

GOKHALE INSTITUTE MIMEOGRAPH SERIES NO. 37

**MAHARASHTRA'S AGRICULTURE : TRENDS IN
THE FOODGRAINS PRODUCTION
(1960-61 to 1988-89)**

M. P. KHARE

 **ECONOMIC RESEARCH CENTRE
GOKHALE INSTITUTE OF POLITICS AND ECONOMICS
(DEEMED TO BE UNIVERSITY)**

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FOREWORD

The present study was undertaken in the Agro-Economic Research Centre of the Institute. As the title suggests, it attempts a review of the growth in foodgrains production in Maharashtra over a period of three decades. Apart from examining growth in individual crops, detailed analysis is also done by seven agro-climatic regions of the State. As growth in foodgrains cannot be studied in isolation, three major non-foodgrain crops are also covered in the analysis so that overall agricultural growth in the State is simultaneously examined. Finally, an analysis of the decomposition of this growth is also carried out.

It is hoped that the study will be found useful by the planners, policy-makers and researchers.

August 18, 1993

D. C. Wadhwa
Director

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August 18, 1993

M.P. Khare

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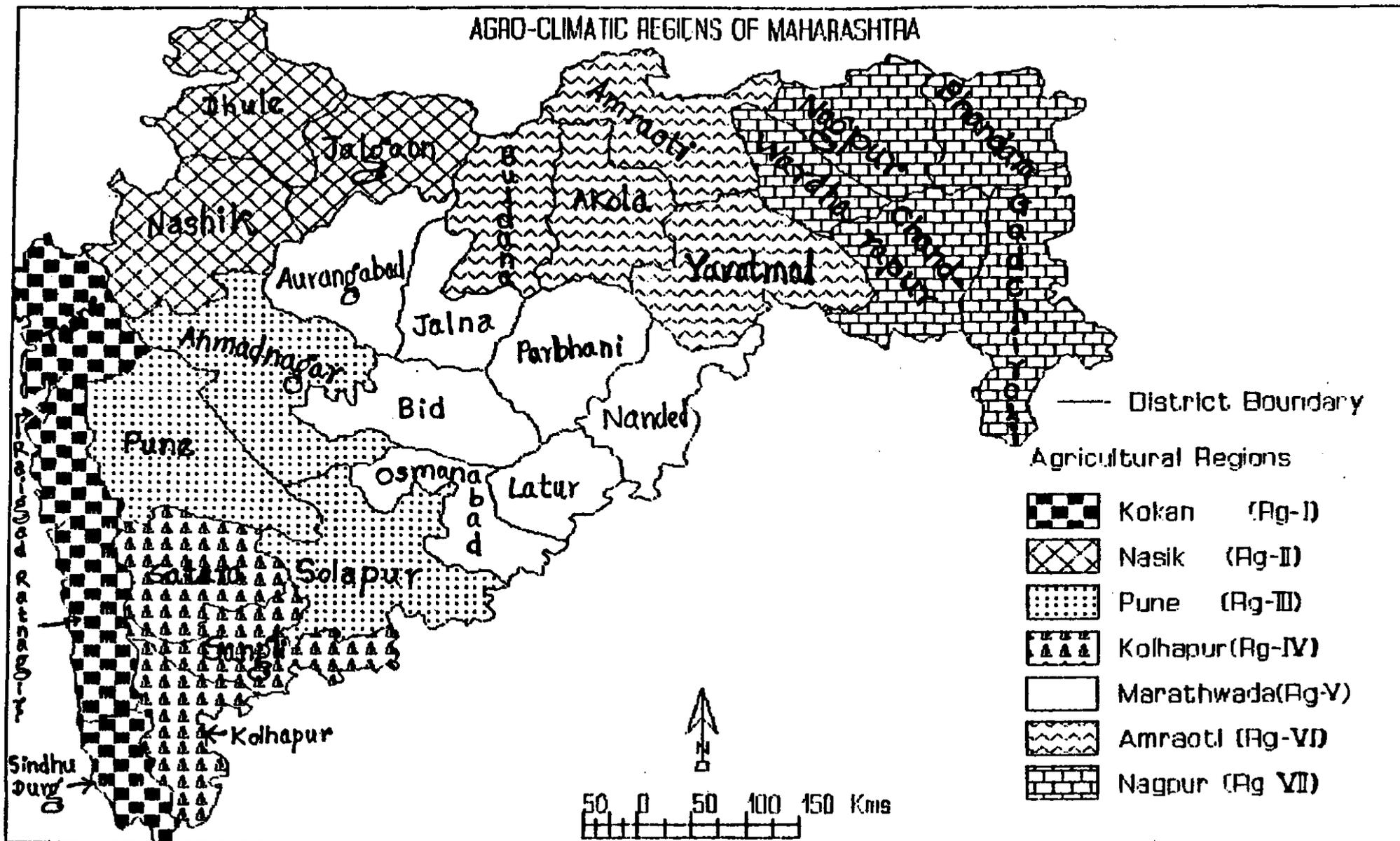
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AGRO-CLIMATIC REGIONS OF MAHARASHTRA



1. PRODUCTION TRENDS IN THE STATE

1.1 The State of Maharashtra came to be formed in 1960 and for a review of its foodgrains production a span of three decades appears adequate. In 1961 Maharashtra had a population of 39.55 million rising to 78.75 million by 1991. This indicates that the population has doubled itself over the years, with an annual compound growth rate of 2.32 per cent per annum. The present study is an attempt to see how the foodgrains production is keeping up with this population increase. We look at various crops and crop-groups in which this growth manifests itself.

To continue with the simple arithmetic of population and foodgrains production, the level of production in the initial period was 6.60 million tonnes and by the end of eighties it has reached to 11.08 million tonnes, somewhat below the doubling mark at an annual compound rate of 2.05 per cent per annum over a period of 25 to 30 years and not exactly thirty years as the production time point taken are averages of two to three years. The fact remains that the foodgrains production growth rate is of 2.05 per cent per annum while the population growth rate is higher at 2.32 per cent per annum. A strict interpretation is that production rate is falling short of population growth rate but a slightly liberal interpretation would be the production is just about keeping up with the population.

But there are other aspects to the problem. In any assessment one has to remember that Maharashtra is a drought-

prone state. The rainfall, in general, is not only low but is uncertain and the production series have various ups and downs and any assessment has to be done with care. To get at the underlying trend, one has to eliminate unusual years from the analysis and sometimes an exceptionally good year has to be eliminated from analysis, being 'unusual'. The resulting trends are likely to be closer to the trends generated by the human effort and would be somewhat dependable indicators of future growth. Although there have been attempts in the literature to develop 'objective' or 'statistical' methods of identifying unusual observations, they have their own limitations.

1.2 For the foodgrains production series of Maharashtra, however, unusual years are rather prominent and after eliminating unusual years it is possible to examine growth during each decade. Our attempt would be first to examine growth over the entire period and then go into the growth over each of the three decades. Thus the production series examined is from 1960-61 to 1988-89 covering twenty-nine years and the method of using triennium averages at suitable time points and examining cropwise growth with the help of per year absolute increases as well as compound growth rates is adopted.

This approach of selected time-points, absolute changes and compound growth rates between these time-points is deliberately adopted in preference to a regression-based growth rate analysis because in the latter one may lose relative importance of crops in providing additions to production as a

crop with impressive growth rate may be contributing relatively unimpressive amounts in absolute terms. Absolute changes together with growth rates on the other hand, give a better perspective and one is also free from statistical requirements of adequacy of observations etc.

1.3 As mentioned in the above section, as a first step, entire period analysis based on initial and end-points of the three decade span is undertaken and then decadewise growth is looked into. The entire period analysis could be gone into without identifying time-points and the discussion of unusual years, but for the fact that even the initial period and terminal periods have unusual years requiring elimination. When we examine the foodgrains production time series from 1960-61 to 1983-89 (original series not reproduced here for brevity), we find that the very first year of 1960-61 has a production of 7.74 million tonnes and this level is not surpassed for the next thirteen years, till the year 1974-75. Inclusion of 1960-61 year with the exceptionally good weather conditions would in general depress the growth rates, being the very first year in the series. This year is then dropped and average of next three years viz. 1961-62, 1962-63, 1963-64 is taken as the starting point of the entire period (and of the sixties). The end of sixties is taken as the average of 1967-68, 1968-69 and 1969-70. These two points neatly bypass 1965-66 and 1966-67 years in which production was again affected, being less than 5 million tonnes. These two triennium averages

are centred on 1962-63 and 1968-69 respectively and will be referred to by these two years or as 1961-64 and 1967-70 time-points respectively. The normality of three years 1967-70 with its 6.63, 6.76 and 6.46 million tonnes production of foodgrains is also reflected in the fact that average of these three years is taken as the 'base' for the official agricultural production index series.

The beginning of the seventies is associated with the above mentioned average centred on 1968-69 and not the actual beginning of the seventies for two reasons. First, this method ensures continuity and secondly, the years 1970-71, 1971-72 and 1972-73 which were progressively bad, are automatically eliminated. The foodgrains production in these three years was 5.41, 4.86 and 3.10 million tonnes respectively and indeed but for these three years production never went down below the 5.5 million mark in the entire series. The end of seventies is identified with triennium average 1977-78, 1978-79 and 1979-80 and the production is somewhat high at 10.35, 9.94 and 10.28 million tonnes but the 9 million mark was already exceeded in 1975-76 and 1976-77 so that these three years production figures are consistent and taken as normal. This 1978-79 centred average is again taken as the beginning point of the eighties.

As mentioned above we have a problem in the terminal period. After the 1977-80 triennium averaging production over 10 million tonnes, production from 1984-85 onwards is as follows.

<u>Year</u>	<u>Foodgrains production (million tonnes)</u>
1984-85	9.74
1985-86	8.78
1986-87	7.14
1987-88	11.06
1988-89	11.07

If we take average of last three years as the end-point, 1986-87 level of 7.14 million tonnes among these years is certainly low. The last year recording production below 8 million mark was 1974-75, nearly 12 years before. So 1986-87 is not included in the end-point average. The end-point, i.e. end of the period average is based on just the last two years viz., 1987-88 and 1988-89. Although an average of 11 million tonnes is somewhat high, between 1977-78 and 1988-89, a period of 12 years, production of foodgrains has exceeded 10 million mark 5 times and an average of 11 million tonnes is not 'unusual'. At the time of writing, provisional estimate of foodgrains production is as high as 13.24 million tonnes for 1989-90 and perhaps reinforces this point.

1.4 With these preliminary observations we go into the 'entire-period' analysis as a first step and assess trends in foodgrains production. This will act as a back-drop to the decadal changes in the foodgrains production, putting the whole scenario in a proper perspective.

The production levels of these time-points along with

absolute changes and compound growth rates are incorporated at the end of the present chapter in Tables I.1, I.2, I.3. These tables will form the basis of analysis although their abridged versions would also appear in the text of this chapter to facilitate discussion. In these basic tables for the state, production of foodgrains is covered in Table I.1 while area under foodgrains is covered in Table I.2. As growth in foodgrains cannot be studied in isolation, some of the other prominent crops like sugarcane, cotton and groundnut are also taken into account in Table I.3.

To consider the three-decade period as a whole, information from Tables I.1 to I.3 is culled. In Table I.1 production details of various foodgrain crops (and crop groups) are presented while in Table I.2 area changes are incorporated. It is already seen that compound growth rate of foodgrains production over the two time-points is 2.05 per cent per annum whereas population growth rate between 1961 and 1991 is higher at 2.32 per cent per annum. For a low rainfall - low irrigation (less than 14 per cent) state this growth is perhaps not very unsatisfactory but let us first examine in which crops this growth manifests itself. Table I.1 reveals that the bulk of increased foodgrains production has come from kharif jowar and the compound growth rate it registers is 2.99 per cent per annum which is quite satisfactory considering the fact that this crop receives hardly any irrigation. The area growth rate of this crop being just 0.52 per cent, it is obvious that

**Table 1.1 : Changes in Agricultural Production of Main Crops
for Maharashtra 1960-61 to 1988-89**

(Production in hundred tonnes)

	Average	Average	Per cent share		Absolute	Growth
	1961-62	1987-88	in foodgrains			
	1962-63	1988-89	-----		change	rate
	1963-64		(1)	(2)		% p.a.
	(1)	(2)	(1)	(2)		
1. Rice	14298	21824	21.66	19.71	7526	1.67
2. Wheat	4055	8383	6.14	7.57	4328	2.89
3. Kharif Jowar	14986	31758	27.71	28.69	16772	2.99
4. Rabi Jowar	16737	19392	25.35	17.52	2657	0.58
5. Bajra	4858	9050	7.36	8.18	4192	2.47
6. Other Cereals	2522	4583	3.97	4.14	1961	2.21
7. All Cereals	57553	94990	37.21	85.80	37437	1.98
8. Tur	3373	5660	5.11	5.11	2287	2.05
9. Gram	1318	3181	2.00	2.87	1863	3.52
10. Other Pulses	3753	6877	5.69	6.21	3124	2.40
11. All Pulses	8444	15718	12.79	14.20	7274	2.47
12. All Food-grains	65997	110708	100.00	100.00	44711	2.05
13. Sugarcane	10909	28029	-	-	17120	3.77
14. Cotton	12105	13482	-	-	1377	0.42
15. Groundnut	7898	8520	-	-	622	0.30

1. Production figures from Epitome of Agriculture, Directorate of Agriculture, Government of Maharashtra and Economic Survey of Maharashtra, Directorate of Economics and Statistics, Government of Maharashtra, for various years.
2. Production of Sugarcane is in terms of gur, of cotton in terms of 100 bales of 180 kg. and of groundnut in pods.
3. Growth rates are annual compound growth rates based on two-time points covering a period of over 25 years.

Table 1.2 : Changes in Area under Main Crops for Maharashtra 1960-61 to 1988-89

(Area in hundred hectares)

	Average	Average	% share in food-		% share in gross		Growth rate % p.a.
	1961-62 1962-63 1963-64 (1)	1987-88 1988-89 (2)	grains area (1)	(2)	cropped area (1)	(2)	
Rice	13369	14574	10.35	10.21	7.01	7.14	0.34
Wheat	8920	8058	6.91	5.65	4.68	3.95	-0.40
Khharif Jowar	25010	28522	19.37	19.98	13.11	13.97	0.52
Rabi Jowar	36441	35718	28.22	25.03	19.10	17.50	-0.08
Bajra	16909	18895	14.00	13.24	8.86	9.26	0.44
Other Cereals	4512	5147	3.57	3.61	2.42	2.52	0.43
All Cereals	105262	110913	81.52	77.71	55.18	54.34	0.21
Tur	5572	8380	4.32	5.87	2.92	4.11	1.61
Gram	3838	6134	2.97	4.30	2.01	3.00	1.86
Other Pulses	14445	17300	11.19	12.12	7.57	8.48	0.71
All Pulses	23855	31813	18.48	17.32	12.50	15.59	1.14
All Foodgrains	129117	142726	100.00	100.00	67.68	69.93	0.39
Sugarcane	1423	3664	-	-	0.75	1.80	3.78
Cotton	27180	25728	-	-	14.25	12.60	-0.21
Groundnut	11327	8132	-	-	5.94	3.98	-1.29
Other Crops	21730	23865	-	-	11.38	11.69	0.37
Gross Cropped Area	190777	204115	-	-	100.00	100.00	0.27

Annual compound growth rate based on the two points of (1) and (2)

productivity increases in this widely grown crop (13 to 14 per cent of gross cropped area) are responsible for this growth. What made this rainfed crop such a success? The answer lies in the development and adoption of hybrid varieties. Rabi jowar, on the other hand, has a production growth rate of just 0.53 per cent and this crop with largest gross cropped area (GCA) coverage of 13 to 19 per cent has made rather meagre additions and has its share of foodgrains production declining from 25 per cent to just 17 per cent by the end of the span of thirty years.

This then, is the contrast that is to be noted in the foodgrains production of the state. While kharif jowar has prospered, rabi jowar has stagnated. Various explanations can be offered for this phenomenon. First of all, the state receives its rainfall mainly in the kharif season and in rabi season there is lack of moisture. Further, hybrid and high-yielding varieties recommended for the rabi season are not comparable to those developed for kharif jowar in their performance. Then again, rabi jowar is an excellent source of fodder and the livestock management requires good fodder yield. This aspect of fodder requirement is taken into account while developing new rabi varieties but these are not quite successful. Grain output of this crop has remained around 4.5 to 5.5 quintals per hectare whereas that of kharif jowar has gone up from 6 to over 11 quintals per hectare. Development and popularization of good grain and fodder yielding varieties

for rabi jowar would be a breakthrough for Maharashtra's agriculture.

Rabi jowar has lost its place as the top contributor of foodgrains production (share reducing from 25 to 17 per cent as mentioned above) while kharif jowar has assumed the top place in the contribution to foodgrains production with its percentage share increasing from 23 per cent (second largest) in the initial period to 29 per cent by the end of the period. The third largest contributor in the initial period was rice (22 per cent) and this crop emerges as the second largest contributor at the end of the period (though its share reduces to 20 per cent) with a compound growth rate of 1.67 per cent per annum, which is somewhat modest considering the fact that next to wheat, this is the crop that ushered in the green revolution in the country. Its productivity level, though, is high being an intensively cultivated crop. Per hectare yield over the years has been risen from 11 to 15 quintals per hectare, and its share in production is thus relatively high. Wheat and bajra crops follow with their 6 to 7 per cent contributions increasing to 7 to 8 per cent over the years with good growth rates of 2.89 and 2.49 per cent per annum and net additions over the period for each crop are of the same order, exceeding that for rabi jowar. But here we should note that while wheat is an irrigated crop (irrigation component increasing from one-third to over one-half) with its productivity rising from 4.5 to 10.4 quintals per hectare, bajra is rainfed kharif

crop and its productivity has increased but at lower levels, from 3 to 5 quintals per hectare. As we shall see later, the bajra crop had a hiccup at the beginning of the seventies and the crop had to recover slowly over the years. Thus although wheat and bajra show growth of the same order between these two time-points, growth in wheat is irrigation based while that of bajra is achieved without irrigation after some initial troubles.

1.5 All cereals together indicate a growth rate of 1.98 per cent while all pulses category shows a growth rate of 2.47 per cent which is somewhat heartening considering the poor growth registered at the all-India level. Cereals together have a productivity level of 5.47 quintals/ha. increasing to 8.90 quintals by the end of the period. Pulses, which are mostly rainfed have the productivities at lower level, increasing from 2.60 to nearly four quintals.

We have also incorporated three major non-foodgrains crops of sugarcane, cotton and groundnut. Table 1.1 reveals that sugarcane has a very good growth rate of 3.77 per cent per annum whereas cotton and groundnut have poor growth rates of 0.42 and 0.30 per cent. Sugarcane has about 2 per cent of gross cropped area (GCA) but it is a prima donna of Maharashtra's agriculture. Cotton and groundnut on the other hand have an area coverage between 10 and 15 per cent of GCA. More about these crops later.

In Table 1.3 we have details of productivity changes

Table 1.3 : Productivities of Important Crops for Maharashtra

Sr. Crops No.	(quintals per hectare)				
	The triennial average centred at			1984-85 and 1987-88	1987-88 and 1988-89
	1962-53	1963-69	1978-79		
1. Rice	10.69	10.27	14.31	12.63	14.98
2. Wheat	4.55	4.60	8.39	8.66	10.40
3. K. Jowar	5.99	6.76	6.18	11.74	11.13
4. R. Jowar	4.59	4.38	5.17	5.28	5.43
5. Bajra	2.87	3.08	3.77	4.13	4.79
6. Other cereals	5.69	5.83	8.18	9.12	8.90
7. Total cereals	5.47	5.53	8.22	8.16	8.56
8. Gram	3.43	2.95	3.47	4.02	5.19
9. Tur	6.05	4.86	5.69	6.63	6.75
10. Mung	2.61	2.48	2.94	-	-
11. Udid	2.76	2.67	3.35	-	-
12. Other pulses	2.60	2.54	3.01	3.31	3.98
13. Total pulses	3.54	3.14	3.66	4.51	4.94
14. Foodgrains	5.11	5.05	7.31	7.36	7.76
15. Sugarcane (tonnes of gur)	7.67	7.33	8.13	8.01	7.65
16. Cotton (lint)	0.80	0.84	0.98	0.96	0.94
17. Groundnut (pods)	6.97	6.86	6.70	9.88	10.48

Table 1.4 : Area, Production and Productivity Compound Growth Rate for Maharashtra (1960-61 to 1988-89)

C r o p	(Growth rate per cent per annum)		
	Area	Production	Productivity
1. Rice	0.34	1.67	1.32
2. Wheat	-0.40	2.89	3.30
3. Kharif Jowar	0.52	2.99	2.46
4. Rabi Jowar	-0.08	0.58	0.66
5. Bajra	0.44	2.47	2.02
6. Other Cereals	0.43	2.21	1.77
7. All Cereals	0.21	1.98	1.77
8. Tur	1.61	2.05	0.43
9. Gram	1.86	3.52	1.63
10. Other Pulses	0.71	2.40	1.68
11. All Pulses	1.14	2.47	1.31
12. All Foodgrains	0.39	2.05	1.65
13. Sugarcane	3.78	3.77	-0.01
14. Cotton	-0.21	0.42	0.63
15. Groundnut	-1.29	0.30	1.61

for these crops and in Table 1.4 area-production-productivity rates are incorporated. We have already used some of the information in Table 1.3 regarding productivity. Here we note again that productivity gains have occurred in kharif jowar, wheat, rice, gram and groundnut and of these, growth in wheat is irrigation-based and to some extent this is true of growth in gram and especially groundnut. In Table 1.4 we see to what extent growth can be attributed to changes in area and changes in production. This table reveals the role productivity has played in increasing production. Rabi jowar is an exception among cereals which is stagnating while among pulses, growth in tur is on account of area and in gram on account of area as well as productivity. Excellent growth rate of sugarcane is wholly on account of area and this hundred per cent irrigated crop carrying the largest weight in the official production index stagnating in productivity should be a cause for concern. Though covering less than 2 per cent of GCA, this crop has a share of 13 to 15 per cent of the state's gross irrigated area. But as is well known, with its very high irrigation requirement, estimates of its irrigation water consumption can be put at a high level of over 50 per cent. It also takes similar proportion of fertilizer consumption.

This is a sort of dilemma for the state. The country needs sugarcane production and Maharashtra has emerged as one of top producers of sugarcane and of sugar. There are other states which with a much better irrigation endowment (compared

to measlly 13 per cent area irrigation for Maharashtra) and perhaps more assured rainfall, are producing foodgrains in abundance. Requirements of commodities like sugar are expected to increase fast due to not only to growth in population but due to growth in incomes as well. But with its paltry area coverage of the cropped area it is obvious that proportion of farmers in Maharashtra growing sugarcane must also be of similar order. The green revolution being irrigation-dependent it is obvious it cannot spread all over the state. Witness the fact that irrigation proportion (gross irrigated area/GCA) has increased from 6 per cent in 1960-61 to 12-13 per cent over the thirty year period. So on the one hand use of irrigation potential for sugarcane production in Maharashtra complements production of foodgrains by other states. On the other the benefit of this lucrative crop goes to only a few farmers leading to inequalities in income distribution.

1.6 Index numbers of agricultural production considers all crops and not just the crops listed above. If we calculate growth using index numbers we have compound growth rates as follows:

	Production growth rate using index numbers (1967-68 to 1969-70 as base)	Area growth rate
Foodgrains	2.12	0.39
Non-foodgrains	2.00	-0.02
All (agricultural) commodities	2.06	0.27

Population growth of 2.32 per cent per annum is noted in Section 1.1 itself.

1.7 Now let us trace the growth decade by decade. In Table 1.5 production changes by decades are presented. The table reveals three phases. Stagnancy in the sixties, considerable growth in the seventies and slowing down of growth in the eighties. Foodgrains have compound growth rate of just 0.07 per cent in the sixties, high growth rate of 4.40 per cent in the seventies and again a modest growth rate of 0.87 per cent in the eighties. The major component of cereals has similar growth rates but pulses show growth in the seventies (2.30 per cent growth rate) and even higher growth in the eighties (4.44 per cent per annum). This is notable as pulses lagged in production in the eighties for the country as a whole. Growth rate of gram in fact is as high as 8.35 and this could be attributed to the increased irrigation for gram (nearly the only pulse receiving some irrigation) with irrigated area increasing to four times the initial level and irrigation proportion increasing from 9 to 15 per cent. Tur has a good growth rate in eighties of 4.44 per cent per annum but this is mainly due to area as we shall see from the next table.

Major growth crop of kharif jowar with impressive growth rate of 6.88 per cent per annum in the seventies (with the largest absolute rate) has a small negative growth rate (-0.47 per cent) or near stagnancy in the eighties. Wheat and rice have excellent growth rates of 9.64 and 4.55 per

Table 1.5 : Rates of Change in Production Over the Three Decades^{*}

(Absolute rate in
hundred tonnes p.a.)

Sr. Crop No.	The Sixties		The Seventies		The Eighties	
	Absolute rate of change	Growth rate % p.a.	Absolute rate of change	Growth rate % p.a.	Absolute rate of change	Growth rate % p.a.
1. Rice	-106.3	-0.76	765.6	4.55	53.4	0.25
2. Wheat	-35.6	-0.90	580.0	9.64	-132.5	-1.45
3. Kharif Jowar	348.7	2.20	1613.4	6.88	-153.2	-0.47
4. Rabi Jowar	-398.8	-2.54	331.1	2.10	183.1	0.99
5. Bajra	249.5	4.58	-40.6	-0.66	326.5	4.52
6. Other cereals	13.9	0.52	105.8	3.36	86.3	2.10
7. All cereals	71.4	0.12	3354.7	4.67	364.3	0.39
8. Tur	-63.4	-1.98	76.8	2.31	200.0	4.40
9. Gram	-43.3	-4.05	45.7	3.75	178.5	8.35
10. Other Pulses	85.4	2.16	89.6	1.92	180.7	3.07
11. All Pulses	-26.3	-0.31	212.0	2.30	559.2	4.44
12. All Foodgrains	45.1	0.07	3555.7	4.40	923.4	0.87
13. Sugarcane (Gur)	549.7	4.50	1092.2	5.87	305.3	1.16
14. Cotton (lint)*	124.7	1.00	42.0	0.32	21.9	0.16
15. Groundnut (Pods)	-269.8	-3.75	-91.2	-1.56	331.7	4.98

* The initial and end points of the sixties, the seventies and the eighties are as follows :

	<u>Initial point</u>	<u>End point</u>
Sixties	Av. 1961-62, 1962-63, 1963-64	Av. 1967-68, 1968-69, 1969-70
Seventies	Av. 1967-68, 1968-69, 1969-70	Av. 1977-78, 1978-79, 1979-80
Eighties	Av. 1977-78, 1978-79, 1979-80	Av. 1987-88 and 1988-89

* Cotton (lint) in terms of 100 bales of 180 kg.

cent per annum and sizeable absolute rates but again show stagnancy-decline in the eighties. Bajra had a good growth in the sixties (whereas all other crops except kharif jowar suffered) but as mentioned earlier in the early seventies its production was severely affected due to 'downy mildew' disease on hybrid crop and faith of bajra growers in the hybrid variety was badly shaken. The good growth rate of 4.52 per cent per annum in the eighties is an exception to other major crops showing down but part of this could be just recovery after the setback in the seventies.

By and large, after promising growth in the seventies, eighties show a slowing down, or reaching a plateau situation. Kharif jowar which is a success in rainfed hybrid cultivation may be slowing down as the process of hybridization is nearly complete for this crop. Growth in wheat is irrigation-based as mentioned earlier and area under unirrigated wheat is fast reducing. The area-production-productivity growth rates for each decade are presented in Table 1.6 for all these crops and this table details this slowing down in the eighties. With limited irrigation potential (maximum of 30 per cent of gross cropped area can be irrigated according to the Irrigation Commission's estimate made in the sixties) and more than half irrigation-water going to irrigation of the intensive crop of sugarcane, development of rainfed high-yielding varieties could be an answer but in spite of research in this direction, no many successful rainfed varieties are emerging, with the exception of kharif jowar.

Table 1.6 : Area Production and Productivity Compound Growth Rates for the Three Decades in Maharashtra (1960-61 to 1988-89)

(Growth Rates per cent per annum)

C r o p	Decade	Area	Production	Productivity
1. Rice	Sixties	-0.08	-0.76	-0.68
	Seventies	1.14	4.55	3.37
	Eighties	-0.23	0.25	0.48
2. Wheat	Sixties	-1.10	-0.90	0.20
	Seventies	3.25	9.64	6.19
	Eighties	-3.67	-1.46	2.29
3. Kharif Jowar	Sixties	0.16	2.20	2.04
	Seventies	1.91	6.83	4.88
	Eighties	-0.70	-0.47	0.24
4. Rabi Jowar	Sixties	-1.77	-2.54	-0.78
	Seventies	0.41	2.10	1.68
	Eighties	0.42	0.99	0.51
5. Bajra	Sixties	3.36	4.58	1.18
	Seventies	-2.63	-0.56	2.02
	Eighties	1.91	4.52	2.56
6. Other Cereals	Sixties	0.09	0.52	0.43
	Seventies	-0.09	3.36	3.45
	Eighties	1.19	2.10	0.90
7. All Cereals	Sixties	-0.06	0.12	0.18
	Seventies	0.05	4.67	4.61
	Eighties	-0.05	0.39	0.44
8. Tur	Sixties	1.68	-1.98	-3.60
	Seventies	0.71	2.31	1.59
	Eighties	2.53	4.40	1.82
9. Gram	Sixties	-1.59	-4.05	-2.50
	Seventies	2.08	3.75	1.64
	Eighties	3.85	8.35	4.33
10. Other Pulses	Sixties	2.52	2.16	-0.35
	Seventies	0.22	1.92	1.70
	Eighties	0.09	3.07	2.98

contd.

Table 1.6 : contd.

C r o p	Decade	Area	Production	Productivity
11. All Pulses	Sixties	1.72	-0.31	-2.00
	Seventies	0.60	2.30	1.69
	Eighties	1.34	4.44	3.06
12. All Food-grains	Sixties	0.23	0.07	-0.21
	Seventies	0.60	4.40	3.78
	Eighties	0.25	0.87	0.62
13. Sugarcane	Sixties	5.29	4.50	-0.75
	Seventies	4.78	5.87	1.04
	Eighties	1.81	1.16	-0.64
14. Cotton	Sixties	0.15	1.00	0.85
	Seventies	-1.21	0.32	1.55
	Eighties	0.61	0.16	-0.45
15. Groundnut	Sixties	-3.49	-3.75	-0.27
	Seventies	-1.32	-1.56	-0.24
	Eighties	0.16	4.98	4.81

Table 1.6 reveals on the other hand, that growth in production of sugarcane is mostly due to increased area and this crop with over 100 inches requirement (4 to 5 times any irrigated cereal) is now an integral part of Maharashtra's agriculture and indeed, many new sugar cooperative factories are slated to come up. It is imperative that good rainfed varieties are developed along with massive adoption of dryland farming techniques to continue the pace of foodgrains production. Progress on this front is however slow perhaps because the effect cannot be very spectacular as in the case of fully irrigated, high fertilizer responsive varieties as was witnessed elsewhere in the country. To indicate place of foodgrains growth in overall agricultural development, in Table 1.7 we present growth rates based on index numbers of agricultural production and slowing down in the eighties is witnessed for the three categories of foodgrains non-foodgrains and all commodities, but for foodgrains the phenomenon really stands out.

1.8 We have already alluded to the irrigation problem. Let us briefly consider which crops are receiving irrigation and the change over years. In Table 1.8 irrigation area details for various time-points and growth rates are presented for 15 crops and crop groups. The last line of the table reveals that the gross irrigated area/gross cropped area percentage has increased from 6.68 per cent in the initial period to 8.02 and 12.05 per cent at the end of sixties and seventies

Table 1.7 : Index Numbers of Agricultural Production and the Growth Rates

Period	(Triennium ending 1969-70 as base)		
	Foodgrains	Non-food grains	All commo- dities
1. Av.1961-62 to 1963-64	100.00	94.13	97.43
2. Av.1967-68 to 1969-70	100.00	100.00	100.00
3. Av.1977-78 to 1979-80	155.40	131.60	144.80
4. Av.1987-88 & 1983-89	170.65	155.85	164.05
<u>Growth Rates</u> (% p.a.)			
Sixties (1 to 2)	0.00	1.01	0.59
Seventies (2 to 3)	4.51	2.78	3.77
Eighties (3 to 4)	0.99	1.80	1.32
Entire period (1 to 4)	2.12	2.00	2.06

Note : In the production index, foodgrains carry a weight of 55.49 and non-foodgrains 44.51. Sugarcane has the highest weight of 21.64 followed by kharif and rabi jowar together with a weight of 21.12 (which we may split as 11.45 and 9.67 respectively). Next in importance are rice (11.52), groundnut (9.25) and cotton (3.43).

Table 1.8 : Changes and Growth Rates of Irrigated Area under Crops of Maharashtra (1960-61 to 1984-85)

Sr. Crops No.	Average area in '00 ha.				Per year rates			
	1961-62 to 1963-64	1967-68 to 1969-70	1977-78 to 1979-80	1983-84 and 1984-85	Sixties	seventies	Eighties	Entire period
1. Rice	2770 (20.72)	3071 (23.08)	3896 (26.15)	3754 (24.69)	50.06	82.53	(-25.82)	(45.75)
2. Wheat	1424 (15.96)	2397 (28.72)	5567 (48.43)	5992 (55.17)	162.28	317.00	77.12	212.46
3. Kharif Jowar	106 (0.42)	207 (0.82)	831 (2.73)	321 (1.10)	16.83	64.43	-92.88	9.98
4. Rabi Jowar	2860 (7.85)	2765 (8.44)	3965 (11.62)	3641 (10.00)	-15.78	120.00	-59.00	36.32
5. Bajra	325 (1.92)	475 (2.30)	646 (4.09)	493 (2.76)	25.00	17.07	-27.85	7.79
6. Other Cereals	141 (3.06)	238 (5.12)	332 (7.22)	410 (8.07)	16.11	9.43	14.18	12.51
7. All Cereals	7626 (7.24)	9153 (8.73)	15237 (13.63)	14611 (12.76)	254.50	608.47	-113.83	324.90

(Figures in brackets indicate proportion of irrigated component of each crop.)

contd.

Table 1.8 : contd.

Sr. Crops No.	Growth rates (% p.a.)			
	1962-63 to 1968-69	1968-69 to 1978-79	1978-79 to Av. 1983-84, 1984-85	1962-63 to Av. 1983-84, 1984-85
1. Rice	1.73	2.41	-0.67	1.423
2. Wheat	9.07	8.79	1.34	6.91
3. Kharif Jowar	11.80	14.92	-15.01	5.28
4. Rabi Jowar	-0.55	3.67	-1.54	1.13
5. Bajra	6.53	3.12	-4.80	1.95
6. Other Cereals	9.09	3.40	3.91	5.09
7. All Cereals	3.09	5.23	-0.76	3.07

contd.

Table 1.8 : contd.

Sr. Crops No.	Average area in '00 ha.				Per year rates			
	1961-62 to 1963-64	1967-68 to 1969-70	1977-78 to 1979-80	1983-84 to 1984-85	Sixties	Seven- ties	Eighties	Entire period
	8. Gram	347 (9.04)	405 (14.45)	735 (17.16)	1159 (23.07)	26.17	23.13	76.94
9. Other pulses	78 (0.39)	110 (0.43)	109 (0.45)	25 (0.10)	5.33	-0.20	-15.03	-2.45
10. All pulses	425 (1.78)	614 (2.32)	843 (3.01)	1184 (4.08)	31.50	22.93	61.91	35.29
11. All Foodgrains	3050 (6.23)	9765 (7.44)	16080 (11.53)	15795 (11.00)	236.00	631.37	-51.91	360.19
12. Sugarcane	1420 (100.00)	1933 (100.00)	3090 (100.00)	3569 (100.00)	86.22	115.27	86.94	99.91
13. Cotton	603 (2.22)	632 (2.30)	887 (3.65)	1021 (3.80)	4.83	25.50	24.27	19.42
14. Groundnut	135 (1.11)	160 (1.75)	378 (4.72)	1797 (23.23)	5.78	21.83	257.94	77.75
15. Gross irrigated area	12749 (6.68)	15521 (8.02)	23979 (12.05)	24524 (12.26)	461.89	845.80	166.61	564.91

(Figures in brackets indicate proportion of irrigated component of each crop.)

contd.

Table 1.8 : contd.

Sr. Crops No.	Growth rates (% p.a.)			
	1962-63 to 1968-69	1968-69 to 1978-79	1978-79 to Av. 1983-84, 1984-85	1962-63 to Av. 1983-84, 1984-85
8. Grain	6.42	3.85	8.62	5.77
9. Other Pulses	5.92	-0.18	-23.32	-5.14
10. All Pulses	6.33	3.23	6.36	4.88
11. All Food grains	3.27	5.11	-0.33	3.18
12. Sugarcane	5.31	4.78	2.65	4.38
13. Cotton	0.79	3.45	2.58	2.43
14. Groundnut	4.15	8.99	32.75	13.19
15. Gross Irrigated Area	3.33	4.45	0.68	3.16

and by mid-eighties (average 1983-84 and 1984-85, year for which detailed irrigation data were available at the time of analysis) it rose to 12.26 per cent. At the time of writing, this proportion is 14.18 per cent for 1987-88 and 1988-89 together. So over thirty years increase is of about 7 percentage points. This progress is rather slow and the percentage is not expected cross thirty as mentioned in the previous section. Foodgrains irrigation proportion is of the same order but in absolute terms rabi jowar, rice and wheat have large areas. Appearance of rabi jowar is rather strange but being a rabi crop this irrigation is likely to be of a protective type and in any case this has not really raised the overall rabi jowar productivity which has remained around 4 to 5 quintals per hectare, half the rainfed kharif jowar productivity. Irrigated rice has a different feature. The crop area irrigated is 20 to 25 per cent but it is almost entirely in the Vidarbha area where late varieties of rice need tank irrigation. Yield in Vidarbha is in fact lower than rainfed rice area of Konkan as we shall see in the next chapter.

It is in wheat that irrigation proportion is fast increasing. Over the years it has increased from 16 per cent in the initial period to 55 per cent by mid-eighties and the growth rate for irrigated wheat area is high at 6.91 per cent whereas gross irrigated area of the state has a growth rate of 3.16 per cent over the entire period. (Good growth rate of over 5 per cent for kharif jowar is deceptive because the

magnitude is quite small. Percentage kharif jowar irrigated has increased and reached just one per cent over the years.) Returning to wheat, one observes that not only irrigated component is fast increasing, unirrigated component is also decreasing in absolute terms. It is clear that farmers are preferring to cultivate this crop under irrigated conditions.

In the Epitome of Agriculture published by the Directorate of Agriculture from the eighties, an item 'proportion of irrigated output to total output of the crop' has started appearing for many crops (an item which was not available in the earlier publications of 'Season and Crop Report'). For foodgrains category irrigated production proportion has increased from 16 to about 20 per cent between 1984-85 and 1988-89. Thus about one-fifth of foodgrains production is 'protected'. This indicates that in a drought year a large proportion of foodgrains production is affected. It is interesting to note that over 70 per cent of wheat production is protected by irrigation. Good production growth rate of this crop is already noted.

Other notable percentage irrigations are in the case of gram where the percentage rises from 9 to 23 and irrigated gram area growth rate is about 6 per cent. Gram production has also increased as witnessed in Table 1. But pulses together have an irrigation proportion of 4 per cent even at the end of the period. Sugarcane is all irrigated while one notes good and somewhat sudden increase in groundnut

(from 1 to 23 per cent) especially in the eighties and this is because of the advent of summer groundnut which is a fully irrigated crop. To encourage oilseeds production, the state government agreed to release canal water in summer for this crop and there is a fast increase in summer groundnut.

1.9 Coming back to the irrigation 'problem' one can say that irrigation proportion for foodgrains is of the same order as the proportion for all crops together and growth rates of irrigated area are very close, 3.18 and 3.15 per cent per annum respectively, so foodgrains are receiving a fair share in irrigation. But as pointed out earlier, irrigation requirement of sugarcane is easily 4 to 5 times that of any cereal crop and the 'fair' share of foodgrains in irrigation appears to be deceptive. An exercise to obtain the shares of 'irrigation water' for foodgrains and sugarcane can be attempted on the following lines.

Considering only foodgrains and sugarcane, one may put irrigation requirements at: rice 32.48 inches, wheat, rabi jowar 20.67 inches, kharif jowar, bajra and 'other cereals' 17.72 inches, gram 13.79 inches and sugarcane 120 inches (taken from various studies and appear reasonable). Using these irrigation requirements, foodgrains: sugarcane ratio can be obtained considering irrigated areas crops. For various time-points this exercise yields ratios as follows :

Average 1961-62 to 1963-64	:	51:49
Average 1983-84 to 1984-85	:	46:54
Average 1987-88 to 1988-89	:	43:57

the last ratio obtained from latest figures available at the time of writing. It may be remembered that share of foodgrains in cropped area is 68 to 70 per cent for all these years whereas sugarcane area share is less than 2 per cent. This contrast brings out sufficiently the disparity in the water use. In the main sugarcane tracts in the western Maharashtra, these ratios are as adverse as 33:62 and 22:78 in the Pune region which is drought-prone and the Kolhapur region (these regions discussed in the next chapter) respectively.

To sum up, while bulk of the irrigated area in absolute terms is engaged in cultivation of rabi jowar, rice and wheat (in that order), for the first two crops it has not really helped in increasing the productivity and perhaps this irrigation has a weak base. This is also reflected in the fact that while rabi jowar receives hardly any chemical fertilizer, for rice the fertilizer application is much higher in rainfed rice of Konkan than better irrigated rice in Vidarbha. Appreciable impact appears to have occurred for wheat. But for foodgrains as a whole, vis-a-vis sugarcane, the latter crop has a large share of irrigation water quite disproportionate to its area coverage.

Table I.1: Changes and Growth Rates of Production of Foodgrains in Maharashtra (1960-61 to 1988-89)

Crops	Average production in '00' tonnes				d=differences and per year rates in '00' tonnes				Growth Rates (% p.a.)			
	61-62 to 63-64	67-68 to 69-70	77-78 to 79-80	87-88 and 88-89	d1	d2	d3	d4	62-63 to 68-69	68-69 to 78-79	78-79 to 87-88 88-89	62-63 to 87-88 88-89
(1) 1	(2) 2	(3) 3	(4) 4	(5) 5	(3)-(2) 6	(4)-(3) 7	(5)-(4) 8	(5)-(2) 9	10	11	12	13
1 Rice	14298 (21.67)	13661 (20.61)	21317 (20.91)	21825 (19.71)	- 637.7 - 106.3	7656.3 765.6	507.5 53.4	7526.2 295.1	-0.76	4.55	0.25	1.67
2 Wheat	4055 (6.14)	3842 (5.80)	9641 (9.46)	8383 (7.57)	- 213.7 - 35.6	5799.7 580.0	-1258.3 -132.5	4327.7 169.7	-0.90	9.64	-1.46	2.89
K.Jowar	14936 (22.71)	17078 (25.77)	33212 (32.58)	31757 (28.69)	2092.3 348.7	16134.0 1613.4	-1455.5 - 153.2	16770.8 657.7	2.20	6.88	-0.47	2.99
4 R.Jowar	16735 (25.36)	14342 (21.16)	17653 (17.32)	19393 (17.52)	-2392.7 - 398.8	3311.3 331.1	1739.2 183.1	2657.8 164.2	-2.54	2.10	0.99	0.58
5 T.Jowar	31720 (48.06)	31420 (47.41)	50859 (49.89)	51149 (46.20)	- 300.3 - 50.1	19438.7 1943.9	290.3 30.6	19428.7 761.9	-0.16	4.93	0.06	1.89
6 Bajra	4858 (7.36)	5355 (9.59)	5949 (5.84)	9051 (8.18)	1497.0 249.5	- 405.7 - 40.6	3101.5 326.5	4192.8 164.4	4.58	-0.66	4.52	2.47
7 O.Cereals	2622 (3.97)	2705 (4.08)	3763 (3.69)	4583 (4.14)	83.3 13.9	1058.0 105.8	819.5 86.3	1960.8 76.9	0.52	3.36	2.10	2.21
3 T.Cereals	57553 (87.21)	57982 (87.50)	91529 (89.79)	94990 (85.80)	428.7 71.4	33547.0 3354.7	3460.5 364.3	37436.2 1458.1	0.12	4.67	0.39	1.98

Table I.3: (Contd.)

	1	2	3	4	5	6	7	8	9	10	11	12	13
9 Gram		1318 (2.0)	1028 (1.55)	1485 (1.46)	3181 (2.87)	-289.7 48.3	457.0 45.7	1696.0 178.5	1863.3 73.1	-4.05	3.75	8.35	3.52
10 Tur		3373 (5.11)	2993 (4.52)	3760 (3.69)	5660 (5.11)	-380.7 63.4	767.7 76.8	1899.7 200.0	2286.7 89.7	-1.98	2.31	4.40	2.05
11 Mung		1092 (1.66)	1283 (1.94)	1563 (1.53)	N.A.	191.7 31.9	279.3 27.9	-	-	2.73	1.99	-	-
12 Udid		1181 (1.79)	1387 (2.09)	1606 (1.58)	N.A.	206.0 34.3	219.3 21.9	-	-	2.72	1.48	-	-
13 O.Pulses (Incl. 11,12)		3753 (5.69)	4265 (6.44)	5151 (5.06)	6878 (6.21)	512.3 85.4	895.7 89.6	1716.5 180.7	3124.5 122.5	2.16	1.92	3.07	2.40
14 T.Pulses		8444 (12.79)	8286 (12.50)	10406 (10.21)	15719 (14.20)	-158.0 26.3	2120.3 212.0	5312.2 559.2	7274.5 285.3	-0.31	2.30	4.44	2.47
15 F.Grains		65997 (100)	66268 (100)	101935 (100)	110708 (100)	270.7 45.4	35667.3 3566.7	8772.7 923.4	44710.7 1753.4	0.07	4.40	0.87	2.05

* This refers to the end period of average of two years 1987-88 and 1988-89.

Table I.2: Changes and Growth Rates of Area Under Various Groups for Maharashtra (1960-61 to 1988-89)

SR. CROPS NO	Average Area in '00' ha.				d=differences & per year in '00' ha.				Growth Rates (% p.a.)			
	61-62 to 63-64	67-68 to 69-90	77-78 to 79-80	87-88 and 88-89	d1	d2	d3	d4	62-63 to 68-69	68-69 to 78-79	78-79 to 87-88	62-63 to 87-88
(1)	(2)	(3)	(4)	(5)	(3)-(2)	(4)-(3)	(5)-(4)	(5)-(2)				
1 RICE	13369 (7.01)	13304 (6.87)	14899 (7.49)	14574 (7.14)	-65.3 -10.9	1595.0 159.5	-325.0 -34.2	1204.7 47.2	-0.08	1.14	-0.23	0.34
2 WHEAT	8920 (4.68)	8347 (4.31)	11495 (5.78)	8059 (3.95)	-573.0 -95.5	3148.3 314.8	-3436.8 -361.8	-861.5 -33.8	-1.10	3.25	-3.67	-0.40
3 K.JOWAR	25010 (13.11)	25249 (13.05)	30495 (15.32)	28522 (13.97)	239.0 39.8	5246.3 524.6	-1973.5 -207.7	3511.8 137.7	0.16	1.91	-0.70	0.52
4 R.JOWAR	36438 (19.10)	32745 (16.92)	34121 (17.14)	35718 (17.50)	-3693.3 -615.6	1376.3 137.6	1596.2 168.0	-720.3 -28.3	-1.77	0.41	0.48	-0.08
5 BAJRA	16909 (8.86)	20613 (10.65)	15790 (7.93)	18895 (9.26)	3703.3 617.2	-4822.3 -482.2	3104.2 326.8	1985.2 77.8	3.36	-2.63	1.91	0.44
6 O.CERE-ALS	4612 (2.42)	4638 (2.40)	4599 (2.31)	5147 (2.52)	25.7 4.3	-39.3 -3.9	548.3 57.7	534.7 21.0	0.09	-0.09	1.19	0.43
7 T.CERE-ALS	105262 (55.18)	104895 (54.20)	111400 (55.97)	110913 (54.34)	-366.4 -61.1	6504.4 650.4	-486.7 -51.2	5651.3 221.6	-0.06	0.06	-0.05	0.21
8 GRAM	3838 (2.01)	3487 (1.80)	4284 (2.15)	6134 (3.00)	-351.0 -58.5	797.0 79.7	1849.5 194.7	2295.5 90.0	-1.59	2.08	3.85	1.86
9 TUR	5572 (2.92)	6157 (3.18)	6608 (3.32)	8380 (4.10)	585.7 97.6	450.7 45.1	1771.5 186.5	2807.8 110.1	1.68	0.71	2.53	1.61
10 MUNG	4183 (2.19)	5183 (2.68)	5325 (2.68)	N.A.	1000.7 166.8	141.7 14.2	-	-	3.64	0.27	-	-

(contd..)

Table I.2 (contd.)

Sr. No.	CROPS (1)	Average Area in '00' hectares				d=differences and per year rates				Growth Rates (% p.a.)			
		61-62 to 63-64 (2)	67-68 to 69-70 (3)	77-78 ^a to 79-80 (4)	87-88 to 88-89 (5)	d1 (3)-(2)	d2 (4)-(3)	d3 (5)-(4)	d4 (5)-(2)	62-63 to 68-69	68-69 to 78-79	78-79 to 87-88 88-89	62-63 to 87-88 88-89
11	UDID	4280 (2.24)	5199 (2.69)	4795 (2.41)	N.A.	919.0 153.2	-404.3 -40.4	-	-	3.29	-0.81	-	-
12	O.PULSES (INCL.10, 11)	14445 (7.57)	16774 (8.67)	17147 (8.62)	17300 (8.48)	2329.0 388.2	372.7 37.3	153.0 16.1	2854.7 111.9	2.52	0.22	0.09	0.71
13	T.PULSES	23855 (12.50)	26419 (13.65)	28039 (14.09)	31813 (15.59)	2563.7 427.3	1620.3 162.0	3774.0 397.3	7958.0 312.1	1.72	0.60	1.34	1.14
14	F.GRAINS	129117 (67.68)	131314 (67.86)	139439 (70.06)	142726 (69.92)	2197.3 366.2	8124.7 812.5	3287.3 346.0	3609.3 533.7	0.28	0.60	0.25	0.39
15	S'CANE	1423 (0.75)	1938 (1.00)	3090 (1.55)	3664 (1.80)	515.7 85.9	1152.0 115.2	573.7 60.4	2241.3 87.9	5.29	4.78	1.81	3.78
16	COTTON	27180 (14.25)	27428 (14.17)	24294 (12.21)	25729 (12.60)	248.3 41.4	-3133.7 -313.4	1434.2 151.0	-1451.2 -56.9	0.51	-1.21	0.61	-0.21
17	G'NUT	11327 (5.94)	9152 (4.73)	8010 (4.02)	8132 (3.98)	-2175.0 -362.5	-1142.0 -114.2	122.3 12.9	-8194.7 -125.3	-3.49	-1.32	0.16	-1.29
18	SAFFLR	3218 (1.69)	3729 (1.93)	4897 (2.46)	6490 (3.18)	511.3 85.2	1167.3 116.7	1593.3 167.7	3272.0 128.3	2.49	2.76	3.01	2.79
19	O.CROPS	21730 (11.39)	23686 (12.24)	24195 (12.16)	23864 (11.69)	1956.0 326.0	509.0 50.9	-331.0 -34.84	2134.0 83.7	1.44	0.21	-0.15	0.37
20	GCA	190777 (100.00)	193518 (100.00)	199028 (100.00)	204115 (100.00)	2741.0 456.8	5510.0 551.0	5086.7 535.4	13337.7 523.0	0.24	0.28	0.27	0.27

Table I.3: Changes and Growth Rates of Important Non-foodgrains Crops in Maharashtra (1960-61 to 1988-89)

Crops	Average production in '00' Tonnes				d=differences and per year rates in '00' tonnes				Growth Rates (% p.a.)			
	61-62 to 63-64	67-68 to 69-70	77-78 to 79-80	87-88 and 88-89	(3)-(2)	(4)-(3)	(5)-(4)	(5)-(2)	62-63 to 68-69	68-69 to 78-79	78-79 to 87-88 and 88-89	62-63 to 87-88 and 88-89**
(1)	(2)	(3)	(4)	(5)	(3)-(2)	(4)-(3)	(5)-(4)	(5)-(2)	68-69	78-79	87-88 and 88-89	87-88 and 88-89**
S. Cane	10909	14207	25129	28030	3298.3 549.7	10921.7 1092.2	2900.5 305.3	17120.5 671.4	4.50	5.87	1.16	3.77
Cotton*	12105	12854	13274	13482	748.3 124.7	420.3 42.0	208.0 21.9	1376.7 54.0	1.00	0.32	0.16	0.42
G. Nut	7898	6280	5368	8520	-1618.7 -269.8	-9111.7 91.2	3151.5 331.7	621.2 24.4	-3.75	-1.56	4.98	0.30
				84-85 and 87-88							to 84-85 and 87-88	to 84-85 and 87-88
S. Cane	-	-	-	28008	-	-	2879.0 383.9	17099.0 727.6	-	-	1.46	4.09
Cotton*	-	-	-	13923	-	-	649.0 86.5	1817.7 77.3	-	-	0.64	0.60
G. Nut	-	-	-	7145	-	-	1777.0 236.9	-753.3 -32.1	-	-	3.89	-0.43

*Cotton production is in '00' bales of 180 kg.

** This refers to the end period of average of two years 1987-88 and 1988-89.

£ This table is presented because the regionwise analysis corresponds to period ending average 1984-85 and 1987-88, referred to as '86.5'.

2. PRODUCTION TRENDS IN THE AGRO-CLIMATIC REGIONS

2.1 In the previous chapter we considered production trends in the state and now we intend to examine trends in the agro-climatic zones. But before we do so, we have to do one modification. As seen in the previous chapter, because production in 1986-87 is unusually low (7.14 million tonnes) we preferred to average foodgrains production for the two years 1987-88 and 1988-89 with their production levels of 11.06 and 11.07 million tonnes. Thus our 'end-point' is based on two years unlike other time-points which are based on three years, in the state-level analysis. In the analysis for agro-climatic regions there is a further difficulty. At the time of analysis, region-wise production details were available only upto 1987-88. So we have to look at the preceding years of which 1986-87 is already ruled out. Production in 1985-86 of 8.78 million tonnes also appears on the lower side as production has not been lower than 9 million tonnes till one goes back to 1974-75. Production in 1984-85 is, however, 9.74 million tonnes and hence average of 1984-85 and 1987-88 is chosen as the 'end-point' for the regionwise analysis. The end-point then centres itself half-way between 1985-86 and 1986-87.

Thus before regionwise analysis could be undertaken, it becomes relevant to see what changes occur in the absolute and compound rates at the state level with this change in the end-point of the entire period (and consequent change in the

end-point of the eighties). The data being related to the agricultural production which is susceptible to weather, it is obvious that the rates would show change but it would be relevant to see if they change radically. In Tables 2.1 to 2.4 rates with end-point changed as described, are presented for the state. Here we see that foodgrains production averages to 10.40 million tonnes as against 11.07 million tonnes (Table 1.1) for the state-level analysis and hence most of the absolute rates and compound growth rates are slightly lower than the rates in the previous chapter. Table 2.1 reveals that growth rate for cereals is unchanged while for foodgrains it is only marginally lower at 1.95 per cent per annum (compared with previous rate of 2.05). But rate for pulses reduces from 2.47 per cent to 1.73 per cent. Tur and mainly gram show reductions. But by and large the production growth rates for individual cereals and pulses as well as for the three non-foodgrain crops of sugarcane, cotton and groundnut are consistent. Table 2.2 shows that pulses area growth rate has reduced from 1.14 to 0.88 and rates for gram and tur have reduced. If we compare Table 2.3 showing changes in area-production-productivity growth rates with similar previous Table 1.4, our conclusions remain unchanged. Additions to foodgrains and cereals are more on account of productivity than area while addition to pulses appear due equally to area and productivity. Kharif jowar continues to show good growth rate (in fact it improves) while rabi jowar remains

Table 2.1 : Changes in Production of Main Crops in Maharashtra
(1960-61 to 1987-88) with Terminating Time Point being
Average of 1984-85 and 1987-88

(Production in hundred tonnes)

Sr. No.	Crop	Average 1961-62	Average 1984-85	% share in Foodgrains		Abso- lute change (62-63 to 1984-85 and 1987-88	Growth Rate (% p.a.)	
		1962-63 1963-64	and 1987-88	(1)	(2)		By	Tabl 1.1
		(1)	(2)	(1)	(2)			
1	Rice	14289	18245	21.66	17.54	3947	1.04	(1.67)
2	Wheat	4055	7450	6.14	7.16	3395	2.62	(2.89)
3	KhariJowar	14936	34290	22.71	32.97	19304	3.59	(2.99)
4	Rabi Jowar	16735	19482	25.36	18.73	2747	0.65	(0.58)
5	Bajra	4858	7379	7.36	7.10	2521	1.79	(2.47)
6	Other Cereals	2622	4515	3.97	4.34	1893	2.34	(2.21)
7	All Cereals	57553	91360	87.21	87.85	33807	1.99	(1.98)
8	Tur	3373	5099	5.11	4.90	1726	1.77	(2.05)
9	Gram	1318	2151	2.00	2.07	833	2.11	(3.52)
10	Other Pulses	3753	5392	5.69	5.19	1639	1.55	(2.40)
11	All Pulses	8444	12642	12.79	12.16	4198	1.73	(2.47)
12	All Foodgrains	65997	104001	100.00	100.00	38004	1.95	(2.05)
13	Sugarcane	10909	28008	-	-	17099	4.09	(3.77)
14	Cotton	12105	13923	-	-	1818	0.60	(0.42)
15	Groundnut	7898	7145	-	-	-753	-0.43	(0.30)

Note: Production of sugarcane is in terms of gur, of cotton in terms of 100 bales of 180 kg. and of groundnut in pods.

Table 2.2 : Changes in Area under Main Crops in Maharashtra (1960-61 to 1987-88) with Terminating Time Point being Average of 1984-85 and 1987-88

(Area in hundred hectares)

Sr. No.	Crop	Average 1961-62 1962-63 1963-64	Average 1984-85 and 1987-88	% share in Foodgrains area		% share in Gross Cropped area		Growth rate % p.a.	(By Table 1.2)
		(1)	(2)	(1)	(2)	(1)	(2)		
1	Rice	13369	14448	10.35	10.22	7.01	7.12	0.33	(0.34)
2	Wheat	8920	8507	6.91	6.09	4.68	4.24	-0.15	(-0.40)
3	Kharif Jowar	25010	29218	19.37	20.07	13.11	14.39	0.66	(0.52)
4	Rabi Jowar	36441	36906	28.22	26.11	19.10	18.18	0.05	(-0.08)
5	Bajra	16909	17881	14.00	12.65	8.86	8.81	0.24	(0.44)
6	Other Cereals	4512	4950	3.57	3.50	2.42	2.44	0.30	(0.43)
7	All Cereals	105262	112008	81.52	79.25	55.18	55.18	0.26	(0.21)
8	Tur	5572	7685	4.32	5.44	2.92	3.79	1.38	(1.61)
9	Gram	3338	5345	2.97	3.78	2.01	2.63	1.42	(1.86)
10	Other Pulses	14445	16300	11.19	11.53	7.57	8.03	0.52	(0.71)
11	All Pulses	23855	29330	18.48	20.75	12.50	14.45	0.88	(1.14)
12	All Foodgrains	129117	141338	100.00	100.00	67.63	69.62	0.39	(0.39)
13	Sugarcane	1423	3496	-	-	0.75	1.72	3.90	(3.73)
14	Cotton	27180	26011	-	-	14.25	12.81	-0.19	(-0.21)
15	Groundnut	11327	7233	-	-	5.94	3.56	-1.89	(-1.29)
16	Other Crops	21730	18334	-	-	11.38	9.03	-0.69	(0.37)
17	Gross Cropped area	190777	203005	-	-	100.00	100.00	0.26	(0.27)

Table 2.3 : Area, Production and Productivity Compound Growth Rates for Maharashtra (1960-61 to 1987-88) with Terminating Time Point being Average of 1984-85 and 1987-88

(Growth rates per cent per annum)

Crop	Area	Production	Productivity
1 Rice	0.33	1.04	0.71
2 Wheat	-0.15	2.62	2.77
3 K.Jowar	0.66	3.59	2.46
4 R.Jowar	0.05	0.65	0.60
5 Bajra	0.24	1.80	1.55
6 Other Cereals	0.30	2.34	2.03
7 All Cereals	0.27	1.99	1.72
8 Tur	1.38	1.77	0.39
9 Gram	1.42	2.11	0.68
10 Other Pulses	0.52	1.55	1.03
11 All Pulses	0.88	1.73	0.84
12 All Foodgrains	0.39	1.95	1.56
13 Sugarcane	3.90	4.09	0.19
14 Cotton	-0.19	0.60	0.79
15 Groundnut	-1.89	-0.43	1.49

Table 2.4 : Absolute Per Year Rates and Growth Rates (Per cent p.a.) for Production in Eighties with Terminating Time Point being Average of 1984-85 and 1987-88

Sr. No.	Crop	The Eighties		The Eighties (By Table 1.5)	
		Per Year Rates (hundred tonnes)	Growth Rates	Per Year Rates (hundred tonnes)	Growth Rates
1	Rice	-409.6	-2.05	(53.4)	(0.25)
2	Wheat	-292.2	-3.38	(-132.5)	(-1.46)
3	Kharif Jowar	143.7	0.43	(-153.2)	(-0.47)
4	Rabi Jowar	243.8	1.32	(183.1)	(0.99)
5	Bajra	190.7	2.91	(326.5)	(4.52)
6	Other Cereals	100.2	2.46	(86.3)	(2.10)
7	All Cereals	-22.6	-0.02	(364.3)	(0.39)
8	Tur	178.5	4.14	(200.0)	(4.40)
9	Gram	88.8	5.06	(178.5)	(8.35)
10	Other Pulses	30.7	0.58	(180.7)	(3.07)
11	All Pulses	298.0	2.63	(559.2)	(4.44)
12	Food Grains	275.4	0.27	(923.4)	(0.87)
13	Sugarcane(Gur)	383.9	1.46	(305.3)	(1.16)
14	Cotton (lint)*	86.5	0.64	(21.9)	(0.16)
15	Groundnut (pods)	236.9	3.89	(331.7)	(4.98)

(The changes for the sixties and seventies remain unaffected, as in Table 1.5)

* Cotton lint in 100 bales of 180 kg.

stagnant. Among non-foodgrains, sugarcane, the little giant of Maharashtra's agriculture continues to show good production rate (in the neighbourhood of 4 per cent) wholly on account of area.

The analysis by decades is affected only for the 'eighties' and the rates for eighties are incorporated in Table 2.4 along with previous rates from Table 1.5. It is here that rates are much lower with cereals stagnating, pulses showing reduction from 4.44 per cent to 2.63 per cent per annum and thus foodgrains showing meagre rate of 0.27 per cent per annum (compared to slightly higher rate of 0.87 previously). Rice, wheat, bajra and gram show appreciable declines in growth rates. Our conclusion in the first chapter of tapering off of foodgrains production is much more evident here.

The detailed information about changes in production and changes in area along with per year absolute rates as well as compound growth rates is presented in Tables II.1 and II.2 at the end of the present chapter for reference. The yield levels per hectare for all crops and production changes for the three non-foodgrain crops with the changed end time-point are to be found incorporated in Tables 1.3 and Table I.3 respectively in the first chapter.

2.2 With this background we first go into the main characteristics of each region and then consider growth of agriculture in general and of foodgrains in particular. As the main source of our information is districtwise data on

agriculture, we have identified seven groups of these districts which broadly agree with the agro-climatic regions. Districts in each region are as follows.

Region I : Konkan Region - Comprising of districts Thane, Raigad, Ratnagiri and Sindhudurg

Region II : Nasik Region - Comprising of districts Nasik, Dhule and Jalgaon

Region III : Pune Region (drought-prone) - Comprising of districts Ahmednagar, Pune, Solapur

Region IV : Kolhapur Region (fertile western Maharashtra) - Comprising of districts Satara, Sangli and Kolhapur.

Region V : Aurangabad Region (Marathwada) - Comprising of districts Aurangabad, Jalna, Parbhani, Bhir, Nanded, Osmanabad and Latur. The assured rainfall zone.

Region VI : Amraoti Region - Comprising of Buldhana, Akola, Amraoti and Ycetmal, the cotton tract

Region VII : Nagpur Region - Containing high rainfall areas - Comprising of Nagpur, Wardha, Bhandara, Chandrapur and Gadchiroli districts.

Some of the agricultural characteristics of these regions are presented in Table 2.5 while cropping patterns for the initial period and the end-periods are presented in Tables II.3 and II.4 at the end of the present chapter. Region I of Konkan is in the high rainfall zone with half of its cropped area under rice. It has also Nachani and horticultural crops. From Table 2.5 we see that it is the

Table 2.5: Some Important Characteristics of Agro-Climatic Regions

Sr. No.	Item	Region	Konkan	Nasik	Pune	Kolha-	Auran-	Amra-	Nagpur	State
			I	II	III	IV	V	VI	VII	
1.	Geographical Area (%)		9.42	13.54	15.49	8.90	20.90	14.97	16.66	100.00
2.	Net Sown Area (%)	Av.1967-70	4.79	12.99	19.06	9.45	26.32	16.35	11.01	100.00
		Av.1980-82	4.35	13.38	18.52	8.98	27.03	16.73	11.00	100.00
3.	Gross Cropped Area (%)	Av.1967-70	4.72	13.20	19.13	9.37	26.38	15.76	11.41	100.00
		Av.1980-82	4.33	13.49	18.63	8.93	27.20	16.30	11.14	100.00
4.	Net Irrigated Area (%)	Av.1967-70	1.74	14.09	27.04	13.57	19.23	3.54	20.78	100.00
		Av.1980-82	1.37	14.30	27.16	13.09	21.78	5.44	16.86	100.00
5.	Gross Irrigated Area (%)	Av.1967-70	1.71	16.17	27.69	14.09	18.72	3.21	18.39	100.00
		Av.1980-82	1.34	15.61	26.81	12.59	22.60	5.72	15.35	100.00
6.	Net Irrigated/ Net Sown (%)	Av.1967-70	2.69	8.03	10.50	10.62	5.41	1.60	13.96	7.40
		Av.1980-82	3.33	11.30	15.50	15.41	8.51	3.44	16.18	10.57
7.	Gross Irrigated/ Gross Cropped (%)	Av.1967-70	2.96	9.82	11.61	12.06	5.69	1.63	12.93	8.02
		Av.1980-82	3.82	14.32	17.81	17.46	10.28	4.34	17.06	12.38
8.	Cropping Intensity (%)	Av.1967-70	3.66	7.04	5.66	4.34	5.12	1.49	9.03	5.27
		Av.1980-82	9.11	10.61	10.39	9.03	10.39	6.85	11.02	9.72
9.	Irr.Cropping Intensity (%)	Av.1967-70	11.81	30.88	16.86	18.54	11.13	3.32	13.03	7.40
		Av.1980-82	25.19	40.22	26.90	23.57	33.34	35.07	17.00	28.53

smallest among the seven regions accounting for five per cent of state gross cropped area. Region II has 13 per cent of state cropped area and has 14 per cent share in state net irrigated area. Apart from widely grown bajra it has kharif jowar, rabi jowar and wheat. Horticultural crops like grapes, bananas are also grown in the area. Region III of Pune is drought-prone but traditionally canal and well irrigated area. Although this region has 19 per cent share in state cropped area, it has 27 per cent share of state irrigated area. One-third of state sugarcane area lies in this region. Rabi jowar (half the region's cropped area) and bajra are the widely grown crops. Region IV of Kolhapur represents a fertile region and again one-third of state sugarcane area is in this region. The region with its 9 per cent share in state cropped area, has a higher, 13 per cent share in the state irrigated area. Regions III and IV together represent the traditional sugar belt. Region V of Marathwada has 26 per cent of state cropped area and is largest in the state but its share in state irrigated area is lower at 20 per cent. Rabi jowar (21 per cent of the region's cropped area) followed by kharif jowar and cotton are widely grown crops but area under cotton has reduced and that under kharif jowar has increased. This is an assured rainfall zone although there are patches where drought does occur. Region VI of Amraoti is cotton-kharif jowar tract and cotton covers 42 per cent of its gross cropped area. The region does not have much

irrigation. Region VII of Nagpur has rice (24 per cent) with cotton, kharif jowar and rabi jowar each covering between 11 and 13 per cent of region's cropped area. It has good irrigated area but as pointed out in the first chapter, most of it is tank irrigation and three-fourth of it goes to irrigate late varieties of rice.

The growth in production of foodgrains for these regions is incorporated in Tables II.5 to II.11 at the end of the chapter where actual production of individual foodgrains is presented at each time-point followed by absolute increases and growth rates for decades as well as for the entire period. Fifteen crop and crop groups are covered. In Table II.12 similar information for three major non-foodgrain crops of sugarcane, cotton and groundnut is set out. These tables are followed by Tables II.13 to II.19 where area changes of crops in terms of absolute increases (total as well as per year) between time-points are presented along with the compound growth rates. Finally, in Table II.20 data on productivities of all these crops for all seven regions is incorporated. These tables cover in great detail growth of foodgrains over the three-decade period.

2.3 The basic tables mentioned above form the background of our discussion with the change that instead of going region by region we go crop by crop and give details of contributions of each region. Among foodgrains we start with the successful crop of kharif jowar and even more widely grown but stagnant rabi jowar.

Kharif jowar covers about 14 per cent of the state gross cropped area and barring Konkan and drought-prone Region III of Pune, is taken everywhere ranging from 12 per cent (Region II) to 28 per cent (Region VI) of the respective region's cropped area. In Table 2.6 we have presented regionwise details for this crop. We cover only the five important regions to facilitate the overall assessment. The lay-out of this table is as follows : The period covered is from the initial time-point of average 1961-62 to 1963-64 and end-point of average 1984-85 and 1987-88. From the second column onwards we give area, production and productivity levels for the two time-points in six columns. Below area and production figures, percentages to the state area and production are written in brackets to bring out importance of each region for the given crop. Below the productivity levels percentage irrigated area of the crop (for that region) is mentioned in brackets. This is not to imply that irrigation is the only factor affecting productivity but the percentage is presented there only to save space. Growth rates for area, production in absolute terms per annum are then displayed and on the line below these compound growth rates per annum are presented with an underline just to distinguish an absolute rate from a growth rate. For productivity, only growth rate is mentioned. Then in the last column information on irrigated area with absolute area increase per annum and compound growth rate (with an underline) is incorporated. Thus in a single table we have

Table 2.6 : Growth of Kharif Jowar for Important Regions over the Entire Period

(Initial Point: Av. 1961-62 to 1963-64, End Point: Av. 1984-85 and 1987-88)

Region	Area ('00 ha.)		Production ('00 tonnes)		Productivity (qtl./ha.)		Absolute change (p.a.) and Growth Rates (% p.a.)			
	Initial Pt.	End Pt.	Initial Pt.	End Pt.	Initial Pt.	End Pt.	Area	Production	Productivity	Irri. area
II	2146 (8.58)	3585 (12.27)	2076 (13.90)	4438 (12.90)	9.67 (0.00)*	12.38 (2.18)*	61 <u>2.21</u>	100 <u>3.29</u>	1.06	4 -
IV	2659 (10.63)	2715 (9.29)	2799 (18.70)	4189 (12.20)	10.52 (2.62)	15.43 (4.41)	2 0.09	59 1.73	1.64	3 3.01
V	7614 (30.45)	10254 (35.09)	4034 (26.90)	11070 (32.20)	5.29 (0.13)	10.79 (2.74)	112 <u>1.27</u>	299 <u>4.39</u>	<u>3.08</u>	15 <u>19.99</u>
VI	9115 (35.45)	9211 (31.53)	4708 (31.40)	11382 (33.20)	5.15 (0.00)	12.29 (0.005)	4 <u>0.04</u>	284 <u>3.83</u>	- <u>3.79</u>	- -
VII	3140 (12.55)	2966 (10.15)	1190 (7.90)	1468 (4.30)	3.79 (0.00)	4.95 (0.02)	-7 <u>-0.24</u>	12 <u>0.90</u>	- <u>1.14</u>	- -
State	25010 (100)	29218 (100)	14986 (100)	34290 (100)	5.99 (0.42)	11.74 (2.46)	179 <u>0.66</u>	821 <u>3.59</u>	- <u>2.90</u>	34 <u>11.06</u>

* These figures in brackets show percentage of crop area irrigated. End point for Irri. data are av. 1980-81 and 1981-82. Absolute average per annum are in '00 ha. for area and '00 tonnes for production. Other details of irrigation given in the last column.

tried to pack nearly all the relevant information. It should also be mentioned that for irrigation data, end-point is average 1980-81 and 1981-82. At the time of analysis though data for 1983-84 and 1984-85 were available for major crops, data for crop groups like 'all cereals', 'all pulses' and 'food-grains' etc., were not available. So we have used the detailed regionwise irrigation data available in the earlier two years. In any case, irrigated area data move rather consistently over the years and the growth rates based on the above-mentioned end-point are not likely to lead us astray.

From Table 2.6 we see that Region V and VI each contributes about one-third of kharif jowar area and production and over the years both the regions show excellent growth rates of 4.39 per cent and 3.83 per cent respectively. It should be emphasized that areas having large shares in production of kharif jowar are showing high growth rates so that in absolute terms also their contributions are large. Another feature is that this crop has hardly any irrigation and yet, these two regions have high productivity growth rates of over 3 per cent per annum. Region V of Marathwada and Region VI of Amraoti have assured rainfall and this factor coupled with hybrid cultivation have achieved this growth. The productivity level has doubled itself from over 5 quintals/ha to around 11 quintals/ha for these regions and naturally productivity for the state has also doubled. For Region II of Nasik, increase in production is more on account of area

than productivity. In Region V of Marathwada, gain in kharif jowar area appears to have occurred at the cost of groundnut and cotton while in Region VI of Amraoti area has not contributed much to the increased production. In Table 2.7 decade-wise area, production and productivity growth rates are presented and one sees rather poor state of affairs in the eighties with these two regions showing production growth rates of zero and 0.78 per cent per annum respectively. But unlike other crops, as observed in Chapter 1, kharif jowar had a good growth rate even in sixties on account of these two regions. Region II of Nasik and IV of Kolhapur on the other hand, had large negative rates in the sixties followed by excellent rates in seventies and good positive growth rates in eighties. Thus there is a difference in the patterns of Regions II and IV compared with the patterns for Regions V, VI and VII of Marathwada and Vidarbha.

Coming to the most widely grown but stagnant crop of rabi jowar we see from Table 2.8 that only two regions are the major ones viz., Region III of Pune (drought-prone) and Region V - Marathwada (assured rainfall) together covering 80 per cent of crop area and production. Over the years Region III has a small positive growth rate of 1.19 per cent per annum on account of productivity whereas Region V has near zero growth rate. Productivity for the former has risen from below 4 to just above 4 quintals/ha while for the latter it has actually fallen from less than 6 to 5.5

Table 2.7 : Area Production and Productivity Compound Growth Rates for the Three Decades for Important Regions in Maharashtra (1960-61 to 1987-88)
Crop : Kharif Jowar

(Growth rates per cent p.a.)				
Region	Decade	Area	Production	Productivity
II	Sixties	-0.87	-2.79	-1.94
	Seventies	5.38	8.94	3.38
	Eighties	0.55	-0.98	0.43
IV	Sixties	-3.13	-5.79	-2.75
	Seventies	2.43	5.30	2.80
	Eighties	-0.39	3.31	3.71
V	Sixties	0.18	2.81	2.63
	Seventies	2.57	8.80	6.07
	Eighties	0.45	0.00	-0.45
VI	Sixties	1.19	5.92	4.67
	Seventies	0.28	4.91	4.62
	Eighties	-1.17	0.78	1.97
VII	Sixties	0.81	8.17	7.30
	Seventies	0.27	3.97	3.69
	Eighties	-1.75	-8.30	-6.67
State	Sixties	0.16	2.20	2.04
	Seventies	1.91	6.88	4.88
	Eighties	-0.57	0.43	-0.14

Table 2.8 : Growth of Kabi Jowar for Important Regions over the Entire Period

(Initial Point: Av. 1961-62 to 1963-64, End Point: Av. 1984-85 and 1987-88)

Region	Area ('00 ha.)		Production ('00 tonnes)		Productivity (Qt./ha.)		Absolute change (p.a.) and Growth Rates (% p.a.)			
	Initial Pt.	End Pt.	Initial Pt.	End Pt.	Initial Pt.	End Pt.	Area	Produc-tion	Produc-tivity	Irri. area
III	18428 (50.57)	18496 (50.12)	7022 (42.00)	9280 (47.60)	3.81 (9.22)*	4.29 (11.56)*	3 <u>0.02</u>	96 <u>1.19</u>	1.17	20 <u>1.08</u>
V	10533 (28.92)	11372 (30.81)	6182 (35.90)	6280 (32.20)	5.86 (6.99)	5.52 (11.95)	35 <u>0.32</u>	4 <u>0.07</u>	-0.25	29 <u>3.01</u>
State	36438 (100)	35906 (100)	16735 (100)	19482 (100)	4.59 (7.85)	5.28 (11.18)	20 <u>0.05</u>	117 <u>0.65</u>	0.60	5 <u>1.76</u>

* These figures in brackets are percentage of crop area under irrigation. End point for Irri. data av. 1980-81 and 1981-82. Other details of irrigation given in the last column. Absolute changes are in '00 ha. for area and '00 tonnes for production.

quintals/ha. Both these regions, especially the latter, have positive area increases in absolute terms but the state level absolute rate is nearly half, indicating loss of rabi jowar areas in other regions. It is remarkable that this crop has 7 to 11 per cent area under irrigation, in absolute terms claiming largest part of irrigated area in the initial period and the third largest at the end of the period. But the unimpressive growth rates indicate absence of good hybrid varieties as well as emphasis on the fodder angle as mentioned in Section 1.4 of the first chapter. From Table 2.9 we further see that although the pattern of stagnancy-decline in the sixties, good growth in seventies and tapering off in the eighties is true for foodgrains in general and many 'growth-crops' in particular, rabi jowar surprisingly shows good growth rate of production in the eighties (2.93 per cent per annum), in Region III on account of productivity while Region V shows small negative growth rate in spite of area increases, on account of loss in productivity. For the state this mixed phenomenon results in production rate of 1.33 per cent per annum on account of area growth rate of 1.05 per cent per annum in the eighties.

2.4 Two growth crops (next to kharif jowar) of rice and wheat are discussed in this section. For rice, entire period production growth rate is 1.67 per cent per annum and with the present end-point of average 1984-85 and 1987-88 for regionwise analysis, the growth rate reduces to 1.04 per cent

Table 2.9 : Area Production and Productivity Compound Growth Rates for the Three Decades for Important Regions in Maharashtra (1960-61 to 1987-88)
Crop : Rabi Jowar

(Growth rates per cent p.a.)				
Region	Decade	Area	Production	Productivity
III	Sixties	-1.40	-1.81	-0.42
	Seventies	0.28	1.73	1.45
	Eighties	0.81	2.93	2.10
V	Sixties	-1.61	-2.93	-1.34
	Seventies	0.51	2.37	1.85
	Eighties	1.64	-0.53	-2.13
State	Sixties	-1.77	-2.54	-0.79
	Seventies	0.41	2.10	1.68
	Eighties	1.05	1.33	0.27

(Table 2.1). This reduction does not appear severe but when we look at Table 2.10, it is seen that this changed end-point is particularly adverse to Region VII of Vidarbha covering 38 per cent of state rice area and about 30 per cent of production. Over the time period under consideration production in this region has actually declined from 4703 hundred metric tonnes to 3858 hundred metric tonnes. When the production series for this region was examined, it was found that but for these two years, production is around 8000 in hundred metric tonnes. In fact if we go back over the years, lower than 5000 (hundred metric tonnes) figure is not encountered till the year 1972-73. So the growth of rice for this region (and its effect on the state as a whole) revealed by the present table are to be interpreted with caution.

Apart from this 'absence of normality', we find that in spite of half the rice area being under irrigation in this region of Vidarbha, productivity is around 10 quintals/ha whereas in Konkan area productivity is higher at 14 quintals in the base year. Productivity in the latter region increases to 19.5 quintals by the end of the period with practically no irrigation. It was pointed out in the last two sections of Chapter 1 that the tank irrigation in Vidarbha enables cultivation of late varieties of rice and this irrigation is more or less supplementary. (In a study entitled 'Levels of Fertilizer Use in Maharashtra' at the Agro-Economic Research Centre of the Institute by the present author it is found

Table 2.10 : Growth of Rice for Important Regions over the Entire Period

(Initial Point: Av.1961-62 to 1963-64, End Point: Av. 1984-85 and 1987-88)

Region	Area ('00,ha.)		Production('00 t.)		Productivity Qt./ha.		Absolute changes (p.a.) and Growth Rates (% p.a.)			
	Initial Pt.	End Pt.	Initial Pt.	End Pt.	Initial Pt.	End Pt.	Area	Produc- tion	Produc- tivity	Irri.Area
I	4158 (31.10)	4627 (32.03)	5740 (40.10)	9035 (49.50)	13.80 (1.51)*	19.52 (2.95)*	20 0.46	140 1.95	- 1.48	4 4.00
IV	1456 (10.89)	1528 (10.57)	1728 (12.10)	3095 (17.00)	11.87 (10.65)	20.25 (17.85)	3 0.20	58 2.51	- 2.31	7 3.29
VII	5076 (37.97)	5522 (38.22)	4708 (32.90)	3858 (21.10)	9.27 (45.45)	6.98 (48.95)	19 0.36	-36 -0.84	- -1.20	31 1.22
State	13369 (100)	14448 (100)	14298 (100)	18245 (100)	10.69 (20.72)	12.63 (27.23)	46 0.33	168 1.04	- 0.71	63 2.03

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* The figures in brackets show percentage of crop area irrigated. End point for Irri.data are av. 1980-81 and 1981-82. Other details of irrigation given in last column. Absolute changes per annum are in '00 ha. for area '00 tonnes for production.

that fertilizer use per hectare is also much higher in Konkan area than in Vidarbha.) If we take average 1985-86 and 1986-87 instead of the present end-point, for this region, we have end-point rice production of 7254 hundred metric tonnes instead of the present average of 3358 hundred metric tonnes appearing in the table. The changed end-point would yield a production growth rate of 1.53 instead of the present -0.84 (per cent per annum) for the major rice region comparable to the growth rate of Konkan of 1.95. The state rate would rise to 1.78 per cent per annum closer to the one in Table 1.1. But we have avoided such crop or region-specific identification of unusual years for obvious reasons. Another feature to note is the increasing production contribution of Region IV of Kolhapur. Table 2.11 with its decadewise growth rates again shows eighties with negative growth rate after high production growth rate of 4.53 in the seventies. But one may also note the fact that for eighties Konkan and Kolhapur regions have good positive growth rates and if we do the adjustment for Vidarbha mentioned above, small positive growth rate of 0.35 per cent per annum results for Vidarbha instead of the present -7.75 per cent per annum. Thus one may note a somewhat different appearance of 'unusual' years in the heavy rainfall region where rice is produced. For the state, with adjustment for Vidarbha, eighties growth rate of rice would be 0.20 per cent instead of the present -2.05 per cent per annum.

2.5 Wheat is a crop covering about 5 per cent of state

Table 2.11 : Area Production and Productivity Compound Growth Rates for the Three Decades for Important Regions in Maharashtra (1960-61 to 1987-88)
Crop : Rice

Region	Decade	(Growth rates per cent p.a.)		
		Area	Production	Productivity
I	Sixties	-0.12	0.01	0.13
	Seventies	0.70	2.89	2.17
	Eighties	0.59	2.26	1.66
IV	Sixties	-1.11	-4.94	-3.87
	Seventies	1.02	7.99	6.90
	Eighties	0.18	1.58	1.40
VII	Sixties	0.93	1.37	0.44
	Seventies	1.15	3.30	2.13
	Eighties	-1.14	-7.75	-6.69
State	Sixties	-0.08	-0.76	-0.68
	Seventies	1.14	4.55	3.73
	Eighties	-0.41	-2.05	-1.65

cropped area and 6 to 7 per cent of foodgrains production, coming out as third largest contributor to the increased production over the years. Barring Konkan and Kolhapur regions (I and IV) it is grown in all zones but Nagpur region has a high percentage (9 per cent of its cropped area) followed by Marathwada and Amraoti regions (V and VI) but in both these area under this crop is fast reducing and percentages to the cropped area of regions have reduced from 5.5 to less than 4 per cent over the years.

In Table 2.12 except for Konkan, details of growth in wheat cultivation are presented for all regions as we have adopted a rule of thumb that if a region contributes more than 10 per cent of either state area or production of a crop, it should feature among 'important regions' covering the crop. Kolhapur (Region IV) gets included because at the end of the period it contributes 10 per cent to production of the state though its area share is lower. From this table it is obvious that in the central and eastern parts covering regions V, VI, VII of Marathwada and Vidarbha, area under the crop is fast decreasing. On the other hand, irrigated area is increasing everywhere, in the traditionally irrigated western regions as well as in the eastern regions with irrigated crop area growth rates ranging from 4 to 13 per cent. Eastern regions show high rates but low absolute additions but increases in irrigated area are unmistakable. Thus farmers are clearly preferring to take this crop under irrigated conditions, a fact

Table 2.12 : Growth of Wheat for Important Regions over the Entire Period

(Initial Point : Av. 1961-62 to 1963-64, End Point : Av. 1984-85 and 1987-88)

Region	Area ('00 ha.)		Production ('00 tonnes)		Productivity (Qt./ha.)		Absolute Change (p.a.) and Growth Rate (% p.a.)			
	Initial Pt.	End Pt.	Initial Pt.	End Pt.	Initial Pt.	End Pt.	Area	Production	Productivity	Irri.Area
II	1512 (16.95)	1656 (19.24)	303 (19.30)	1476 (19.80)	5.31 (27.54)*	8.91 (60.16)*	6 0.39	29 2.62	23 2.23	41 5.78
III	820 (9.20)	1493 (17.34)	382 (9.40)	1616 (21.70)	4.66 (45.02)	10.83 (67.69)	29 2.58	53 6.33	66 3.66	32 5.27
IV	308 (3.45)	707 (8.21)	186 (4.60)	745 (10.00)	6.06 (65.54)	10.53 (64.53)	17 3.60	24 6.07	38 2.38	14 4.61
V	2696 (30.23)	2208 (25.65)	1142 (28.20)	1555 (20.90)	4.23 (11.88)	7.04 (51.00)	-21 -0.85	18 1.32	19 2.19	65 8.81
VI	1605 (17.99)	996 (11.57)	703 (17.30)	841 (11.30)	4.38 (4.11)	8.44 (44.27)	-26 -2.01	6 0.76	83 2.83	33 13.43
VII	1979 (22.19)	1548 (17.98)	340 (20.70)	1083 (14.50)	4.24 (2.51)	6.99 (26.41)	-18 -1.04	10 1.09	15 2.15	22 12.65
State	8920 (100)	8607 (100)	4055 (100)	7450 (100)	4.55 (15.96)	8.66 (50.90)	-13 -0.15	144 2.62	73 2.73	207 7.31

* Those figures in brackets show percentage of crop area irrigated. End point for irri. data are av. 1980-81 and 1981-82. Absolute change per annum are in '00 ha. for area and '00 tonnes for production.

also mentioned previously. So unlike kharif jowar, this crop does not fit in the preferences of cultivators as a rainfed crop. Although rainfed varieties are being identified by research stations and agricultural universities, they have not really caught up. In Region V, obvious beneficiary of the reduced wheat area is gram as it is also a rabi crop but it has also lost areas to rabi jowar, a stagnant crop. In Regions VI and VII of Vidarbha wheat has lost areas to gram but the magnitudes indicate that the beneficiaries are either rabi 'other pulses' or safflower (Region VI) or even some kharif crops like cotton or tur (Region VII).

However, due to increased irrigation, the crop has a good growth rate of 2.62 only on account of productivity as area has actually gone down. Growth rates of production are lower in the eastern regions and high in western regions and so are the absolute changes. Table 2.13 gives decadalwise growth rates and declines in the eighties after high growth in the seventies are unmistakable everywhere. This irrigation-based crop has definitely reached a plateau and it is difficult to see how more growth can be expected from this crop.

2.6 Another crop which appears to contribute to increased foodgrains production a magnitude similar to wheat but is mostly rainfed, is that of bajra. Bajra covers about 9 per cent of cropped area and is taken widely in western parts, consisting of Regions II, III and IV, second of which is the

Table 2.13 : Area Production and Productivity Compound Growth Rates for the Three Decades for Important Regions in Maharashtra (1960-61 to 1987-88)
Crop : Wheat

(Growth rates per cent p.a.)				
Region	Decade	Area	Production	Productivity
II	Sixties	1.35	4.67	3.28
	Seventies	2.78	5.57	2.72
	Eighties	-3.45	-2.73	0.75
III	Sixties	1.75	4.17	2.38
	Seventies	5.63	12.74	6.73
	Eighties	-0.71	-0.02	0.69
IV	Sixties	-0.55	1.21	1.77
	Seventies	8.80	12.04	2.98
	Eighties	0.29	2.37	2.07
V	Sixties	-1.65	-3.40	-1.78
	Seventies	2.99	11.21	7.98
	Eighties	-5.13	-7.03	-2.00
VI	Sixties	-3.29	-4.91	-1.66
	Seventies	2.99	11.11	7.88
	Eighties	7.34	-7.35	-13.69
VII	Sixties	-2.07	-4.20	-2.18
	Seventies	1.51	8.02	6.41
	Eighties	-3.55	-3.41	0.15
State	Sixties	-1.10	-0.90	0.20
	Seventies	3.25	9.64	6.19
	Eighties	-3.79	-3.38	0.42

drought-prone region of Pune and it is only natural that after rabi jowar, this crop should be of importance in that region. From Table 2.14 it can be seen that Regions II and III each contribute one-third of the state area under bajra and these are the major regions but while Region II of Nasik has a good production growth rate of 2.12 per cent per annum mainly on account of productivity along with some area increases also, Region III has lost some area and production is nearly stagnant with growth rate of just 0.46 per cent per annum. Region IV of Kolhapur has large negative area growth rate and in absolute terms absolute area additions of Region II (33 hundred ha per annum) are neatly cancelled by declines in Region IV. But Region V of Marathwada has again good production growth rate of 3.75 per cent on account of area as well as productivity. Bracketed figures below productivity in the table indicate not much irrigation for this crop. All in all, a production growth rate for the state, of 1.80 per cent per annum is due to productivity gains and regionwise, on account of Nasik and Marathwada region whereas in Pune and Kolhapur regions, the crop registers stagnancy or decline. As mentioned in Chapter 1, this crop which showed substantial growth in late sixties on account of hybridization, suffered during seventies because it was affected in the first half of that decade by 'downy mildew' a soil-borne fungus to which hybrid varieties were particularly susceptible. In Table 2.15 these decadewise details are presented. Unlike general stagnancy-decline for other crops

Table 2.14 : Growth of Bajra for Important Regions over the Entire Period

(Initial Point: Av.1961-62 to 1963-64, End Point: Av. 1984-85 and 1987-88)

Region	Area ('00 ha.)		Production ('00 tonnes)		Productivity (Qtl./ha.)		Absolute change (p.a.) and Growth Rates (% p.a.)			
	Initial Pt.	End Pt.	Initial Pt.	End Pt.	Initial Pt.	End Pt.	Area	Production	Productivity	Irrigation area
II	5579 (33.00)	6347 (35.50)	2070 (42.60)	3391 (46.00)	3.71 (0.00)*	5.34 (0.53)*	33 0.55	56 2.12	1.56	3 -
III	5520 (32.60)	5266 (29.40)	1364 (28.10)	1520 (20.60)	2.47 (3.99)	2.89 (4.91)	-11 -0.20	7 0.46	0.66	1 0.61
IV	2843 (16.80)	2070 (11.60)	639 (13.10)	603 (8.20)	2.24 (3.11)	2.91 (7.29)	-33 -1.34	-2 -0.24	1.12	3 2.72
V	2684 (15.90)	3903 (21.80)	733 (15.10)	1734 (23.50)	2.73 (0.62)	4.44 (3.31)	52 1.61	43 3.73	2.09	5 10.95
State	16909 (100)	17881 (100)	4358 (100)	7379 (100)	2.87 (1.92)	4.13 (3.28)	41 0.24	107 1.80	1.55	12 2.75

* Those figures in brackets are percentage of crop area irrigated. End point for Irrigation data are av. 1980-81 and 1981-82. Absolute changes per annum are in '00 ha. for area and '00 tonnes for production. Other details of irrigation given in the last column.

Table 2.15 : Area Production and Productivity Compound Growth Rates for the Three Decades for Important Regions in Maharashtra (1960-61 to 1987-88)
Crop : Bajra

(Growth rates per cent p.a.)

Region	Decade	Area	Production	Productivity
II	Sixties	2.90	3.95	1.02
	Seventies	-2.33	-0.84	1.53
	Eighties	2.62	4.71	2.04
III	Sixties	3.39	4.25	0.83
	Seventies	-3.48	-2.16	1.37
	Eighties	1.44	1.02	-0.41
IV	Sixties	0.63	-0.49	-1.11
	Seventies	-3.83	3.59	0.25
	Eighties	0.47	4.60	4.11
V	Sixties	6.63	9.65	2.83
	Seventies	-1.34	0.85	2.22
	Eighties	1.67	3.03	1.34
State	Sixties	3.36	4.58	1.18
	Seventies	-2.63	-0.66	2.03
	Eighties	1.67	2.91	1.22

in the sixties, this crop has a high production growth rate of 4.58 mainly on account of area, but also on account of productivity and barring Region IV of Kolhapur, good growth was registered in the sixties. In the seventies in the main tract of Region II and III there was negative growth rate and for the state the rate is -0.66 per cent per annum. Eighties show a return of confidence in the crop and unlike other crops, we have a good positive growth rate of 2.91 per cent per annum equally due to area and productivity gains. But the yield of the crop is rather low even at the end of the period, of just over 4 quintals/ha and unless good rainfed varieties keep coming up, given the low level of fertilizer use due to fear of lack of moisture, the crop appears to have a limited prospect of growth.

2.7 The cereals scenario is presented in Table 2.16. The best production growth rate of 3.49 per cent per annum is recorded by Region VI of Amraoti, the cotton-kharif jowar tract. In absolute terms, 297 hundred metric tonnes of cereals were added per year in this region and one may recall that 284 of these were on account of kharif jowar. Thus although this region showed stagnancy in wheat (addition 6 hundred metric tonnes per annum) the kharif jowar 'revolution' has enabled this region to register an excellent growth in cereals as a whole. We should also recall that this is achieved with stagnant area and practically no irrigation. Sheer hybridization appears to have achieved all this growth.

Table 2.16 : Growth of 'All Cereals' over the Entire Period

(Initial Point: Av. 1961-62 to 1963-64, End Point: Av. 1984-85 and 1987-88)

Region	Area ('00 ha.)		Production ('00 tonnes)		Productivity (Ct./ha.)		Absolute change (p.a.) and Growth Rates (% p.a.)			
	Initial Pt.	End Pt.	Initial Pt.	End Pt.	Initial Pt.	End Pt.	Area	Production	Productivity	Irri. area
I	5810 (5.52)	5995 (5.34)	6754 (11.70)	10233 (11.20)	11.62 (1.16)*	17.10 (2.42)*	7 0.13	148 1.78	- 1.65	4 4.22
II	13258 (12.60)	15468 (13.81)	7375 (12.80)	12390 (13.60)	5.56 (3.81)	8.01 (10.56)	94 0.66	213 2.23	- 1.55	59 6.39
III	26293 (24.98)	27108 (24.20)	10064 (17.50)	14582 (15.96)	3.82 (9.29)	5.38 (14.65)	35 0.13	192 1.59	- 1.46	74 2.44
IV	10727 (10.19)	10722 (9.57)	7050 (12.20)	11292 (12.40)	6.57 (9.02)	10.53 (15.04)	Neg. 0.00	180 2.02	- 2.02	32 2.58
V	24870 (23.63)	29308 (25.17)	13757 (22.20)	21682 (23.70)	5.13 (4.86)	7.40 (12.72)	189 0.70	380 2.28	- 1.57	132 6.16
VI	11366 (10.80)	10944 (9.77)	5621 (9.80)	12591 (13.80)	4.94 (0.65)	11.51 (5.82)	-18 -0.16	297 3.49	- 3.66	34 12.90
VII	12913 (12.27)	12474 (11.14)	7907 (13.80)	8536 (9.30)	6.12 (18.26)	6.84 (25.15)	-19 -0.15	27 0.33	- 0.48	54 1.93
State	105262 (100)	112008 (100)	57533 (100)	91360 (100)	5.47 (7.24)	8.56 (13.31)	287 0.26	1433 1.99	- 1.72	388 3.65

* These figures in brackets show percentage of crop area irrigated. End point for irr. data are av. 1980-81 and 1981-82. Other details of irrigation given in the last column. Absolute changes per annum are in '00 ha. for area and '00 tonnes for production.

Region V of Marathwada is the next but with a growth rate of 2.28 per cent per annum and in absolute terms addition of 380 hundred metric tonnes per annum which is even higher than that for the Amraoti region. Again, nearly 300 hundred metric tonnes are on account of kharif jowar chish in turn are due to productivity gains but with some area increases too. (Area growth rate 1.27, production growth rate 4.39 per cent per annum for kharif jowar). Thus kharif jowar without the aid of irrigation has performed a near miracle. Can this trend last? Already general slowing down in the eighties is commented upon. The hybridization is reaching its limits in these areas. So hope lies in constant development of new hybrid varieties with even better yields. But there is another aspect too. The study on fertilizer use in the state by the present author mentioned in Section 2.4 reveals that levels of fertilizer use are lower than the recommended ones and these are nearly the same in drought-prone as well as in assured rainfall areas and the latter covers the two regions of Marathwada (V) and Amraoti (VI) crucial for the crop. So with better fertilizer use also, the upward trend could be maintained. Region II of Nasik has a cereals production growth rate of 2.23 per cent per annum and in absolute terms it is 213 hundred metric tonnes per annum hundred of which are contributed by kharif jowar and 56 by bajra.

Region III of Pune, the drought-prone region, has a production growth rate of 1.59 per cent per annum with

absolute addition of 192 hundred metric tonnes per annum half of which comes from rabi jowar, which is the widely taken crop in the region. But bajra does not contribute much, although the region is a major bajra producer. However there is an addition of 52 hundred metric tonnes per annum on account of wheat which is an irrigation-based crop in the region. Konkan region has mainly rice and nearly all the increase for cereals is on account of this crop while the Vidarbha rice tract (Region VII) does not show good results due to end-point years being particularly bad, as discussed earlier.

All in all kharif jowar has done exceptionally well in the traditionally major kharif jowar areas whereas wheat has done well in minor wheat producing areas with the help of irrigation and bajra has a fair performance in one major area (Region II) but not in the other (Region III).

The decadewise analysis for cereals is presented in Table 2.17. Eighties showing decline in the successful regions (by the entire period analysis) indicate a slowing down of growth. The positive rates in the first four regions for the eighties (but still lower than seventies) improve the state-level growth rate to -0.05 per cent per annum but as pointed out earlier, part of the better growth rates in three out of the first four regions can be attributed to 'recovery' from rather bad sixties. Foodgrains production may continue to increase provided widely grown rainfed crops do well and for this, development of new varieties capable

Table 2.17 : Area Production and Productivity Compound Growth Rates for the Three Decades for Important Regions in Maharashtra (1960-61 to 1987-88)

Crop : All Cereals

(Growth Rates per cent p.a.)

Region		Area	Production	Productivity
I	Sixties	-0.41	0.24	0.65
	Seventies	0.04	2.39	2.35
	Eighties	0.67	2.22	1.54
II	Sixties	0.19	-0.44	-0.63
	Seventies	0.95	4.95	3.96
	Eighties	0.64	0.83	0.19
III	Sixties	-0.25	-1.05	-0.80
	Seventies	-0.06	3.58	3.64
	Eighties	0.69	1.10	0.41
IV	Sixties	-1.55	-4.04	-2.53
	Seventies	0.29	4.92	4.62
	Eighties	0.87	3.23	2.34
V	Sixties	0.07	-0.13	-0.06
	Seventies	1.29	6.37	5.02
	Eighties	0.42	-1.05	-1.46
VI	Sixties	0.74	4.83	4.06
	Seventies	0.70	5.56	4.83
	Eighties	-2.00	-0.24	1.80
VII	Sixties	0.47	1.91	1.43
	Seventies	0.55	3.57	3.00
	Eighties	-1.55	-5.04	-3.54
State	Sixties	-0.06	0.12	0.18
	Seventies	0.60	4.67	4.04
	Eighties	0.07	-0.03	-0.10

of standing moisture-stress and better fertilizer use appear as the prerequisites. For a rainfed crop, fear of lack of moisture restrains farmers from using adequate fertilizers and it is this author's opinion that new methods of fertilizer application which can exploit available moisture need to be developed and perhaps new types of fertilizers could be fabricated that prevent harm in case of moisture-stress. Simultaneously-dry-landfarming techniques need to be adopted vigorously.

2.8 Pulses form about 15 per cent of foodgrains production and about 12 to 14 per cent of the gross cropped area of the state. Major pulses are tur and gram contributing more than half the production and these will be discussed here although information on udid (black gram) and mung (green gram) is also incorporated in the tables at the end of the chapter.

In Tables 2.18 and 2.19 details for tur and gram respectively are presented for important regions. From the table for tur we see that Region V (Marathwada) and Region VI (Amraoti) are major tur areas and Region III and Region VII are minor areas covering around 15 per cent each, of the state tur area. In major areas, area under tur has increased and production growth rates are 3.91 per cent per annum (Marathwada) and 1.75 (Amraoti) with productivity gains helping in the former but not in the latter. With practically no irrigation to tur, the reasons for this difference are not obvious. However area shifts to tur and hence farmers' preferences, are clear. In Region III a minor tur area,

Table 2.13: Growth of Tur for Important Regions over the Entire Period

(Initial Point: Av. 1961-62 to 1963-64, End Point: Av. 1984-85 and 1987-88)

Region	Area ('00 ha.)		Production ('00 tonnes)		Productivity (mtl./ha.)		Absolute Change (p.a.) Growth Rate (% p.a.)			
	Initial Pt.	End Pt.	Initial Pt.	End Pt.	Initial Pt.	End Pt.	Area	Production	Productivity	Irri. Area
III	649 (11.64)	412 (5.37)	344 (10.20)	170 (3.30)	5.30 (N.A.)*	4.12 (4.38)*	-10 <u>-1.91</u>	-7 <u>-2.96</u>	- <u>-1.07</u>	-
V	2070 (37.15)	3045 (39.63)	714 (21.20)	1757 (34.40)	3.45 (N.A.)	5.80 (1.29)	42 <u>1.66</u>	44 <u>3.91</u>	- <u>2.21</u>	-
VI	1364 (24.48)	2493 (32.45)	1233 (33.30)	1946 (38.20)	9.43 (N.A.)	7.80 (0.00)	48 <u>2.60</u>	28 <u>1.75</u>	- <u>-0.83</u>	-
VII	861 (15.46)	1091 (14.06)	616 (18.30)	822 (16.20)	7.16 (N.A.)	7.61 (0.00)	9 <u>0.97</u>	9 <u>1.23</u>	- <u>0.26</u>	-
State	5572 (100)	7685 (100)	3373 (100)	5099 (100)	6.05 (0.63)	6.63 (1.28)	90 <u>1.33</u>	73 <u>1.77</u>	- <u>0.39</u>	4.74

* These figures in brackets are percentage of crop area irrigated. End point for Irr. data are av. 1980-81 and 1981-82. Other details of irrigation given in the last column. Absolute changes per annum are in '00 ha. for area and '00 tonnes for production.

Table 2.19 : Growth of Gram for Important Regions over the Entire Period

(Initial Point : Av. 1961-62 to 1963-64, End Point : Av. 1984-85 and 1987-88)

Region	Area ('00 ha.)		Production ('00 tonnes)		Productivity (ct./ha.)		Absolute change and <u>Growth Rate</u> (% p.a.)			
	Initial Pt.	End Pt.	Initial Pt.	End Pt.	Initial Pt.	End Pt.	Area	Production	Productivity	Irri. Area
II	349 (9.10)	742 (13.89)	118 (9.00)	349 (16.20)	3.38 (12.22)*	4.69 (42.23)*	17 <u>3.26</u>	10 <u>4.72</u>	- <u>1.41</u>	6 <u>2.37</u>
III	659 (17.18)	1025 (19.17)	208 (15.80)	494 (23.00)	3.15 (17.85)	4.82 (21.79)	16 <u>1.89</u>	12 <u>3.76</u>	- <u>1.84</u>	3 <u>2.01</u>
IV	314 (8.17)	550 (10.30)	123 (9.40)	250 (11.60)	3.93 (25.18)	4.54 (21.31)	10 <u>2.42</u>	5 <u>3.05</u>	- <u>0.62</u>	^{Neg.} <u>0.37</u>
V	1775 (46.26)	1884 (35.25)	604 (45.80)	661 (30.70)	3.40 (5.43)	3.51 (16.96)	5 <u>0.25</u>	2 <u>0.38</u>	- <u>0.13</u>	11 <u>6.42</u>
VI	392 (10.21)	607 (11.36)	129 (9.80)	227 (10.50)	3.29 (1.19)	3.73 (12.97)	9 <u>1.88</u>	4 <u>2.41</u>	- <u>0.52</u>	3 <u>14.09</u>
VII	331 (8.62)	497 (9.29)	175 (13.30)	154 (7.10)	5.30 (2.22)	3.09 (7.16)	7 <u>1.74</u>	-1 <u>-0.50</u>	- <u>-2.26</u>	1 <u>7.41</u>
State	3938 (100)	5345 (100)	1318 (100)	2151 (100)	3.43 (9.04)	4.02 (19.27)	64 <u>1.42</u>	35 <u>2.11</u>	- <u>0.68</u>	25 <u>4.63</u>

* These figures in brackets show percentage crop area irrigated. End point for Irri. data are av. 1980-81 and 1981-82. Other details of irrigation given in the last column. Absolute changes per annum are in '00 ha. for area and '00 tonnes for production.

there is a decline in tur production due to decline in area as well as productivity. From the table for gram, we see that gram has gained in area everywhere but the gains in production are marginal in the major gram area of Region V and its share in gram production of the state has declined from 45 to 31 per cent over the years. Other regions have 10 to 16 per cent shares and surprisingly, Region III shows production growth rate of 3.76 per cent per annum equally on account of area as well as productivity. So Region III has shown gains in this rabi pulse along with rabi jowar. For Maharashtra, growth rate of 2.11 per cent per annum and absolute addition of 35 hundred metric tonnes is mainly on account of Region III (12 hundred metric tonnes per annum) and Region II (10 hundred metric tonnes per annum) and the latter has an excellent growth rate of 4.72 per cent per annum. The decadewise growth rates of area, production and productivity details for tur and gram are presented in Tables 2.20 and 2.21 respectively. Notable aspect of these is the fact that barring Region III, growth rates for eighties are even better after good growth in the seventies, quite unlike the behaviour for cereals. This is a rather satisfactory phenomenon because it indicates that farmers in the state are responding positively to the nationwide shortages.

Apart from gram and tur, udid and mung from Marathwada (Region V) and Amraoti (Region VI) are contributing in equal measure so that 'other pulses' have a contribution of the same order as tur. Details of other - . - -

Table 2.20 : Area Production and Productivity Compound Growth Rates for the Three Decades for Important Regions in Maharashtra (1960-61 to 1987-88)

Crop : Tur

(Growth Rates per cent p.a.)

Region	Decade	Area	Production	Productivity
III	Sixties	4.08	0.88	-3.07
	Seventies	0.25	-1.49	-1.74
	Eighties	-9.12	+7.79	-7.79
V	Sixties	2.92	4.04	1.09
	Seventies	1.11	3.37	2.24
	Eighties	1.39	4.51	3.08
VI	Sixties	1.27	-5.31	-6.49
	Seventies	0.97	2.43	1.45
	Eighties	5.91	6.84	0.69
VII	Sixties	-0.71	-5.67	-5.00
	Seventies	-0.26	2.35	2.62
	Eighties	4.02	5.56	1.48
State	Sixties	1.68	-1.98	-3.60
	Seventies	0.71	2.31	1.59
	Eighties	2.03	4.14	2.07

Table 2.31 : Area Production and Productivity Compound Growth Rates for the Three Decades for Important Regions in Maharashtra (1960-61 to 1987-88)

Crop : Gram

(Growth Rates per cent p.a.)

Region	Decade	Area	Production	Productivity
II	Sixties	-0.65	-0.60	0.04
	Seventies	1.49	3.22	1.71
	Eighties	8.98	10.22	1.14
III	Sixties	-1.03	-4.35	-3.35
	Seventies	2.27	5.54	3.20
	Eighties	3.78	8.25	4.31
IV	Sixties	-4.74	-5.95	-1.27
	Seventies	4.44	5.42	1.03
	Eighties	5.76	7.57	1.71
V	Sixties	-0.96	-4.98	-4.06
	Seventies	0.97	3.63	2.63
	Eighties	0.28	0.52	0.24
VI	Sixties	-7.51	-10.53	-3.27
	Seventies	6.45	7.42	0.91
	Eighties	3.82	7.07	3.13
VII	Sixties	1.27	-6.43	-7.60
	Seventies	2.04	0.44	-1.57
	Eighties	1.74	3.00	1.24
State	Sixties	-1.59	-4.05	-2.51
	Seventies	2.08	3.75	1.63
	Eighties	2.99	5.06	2.01

pulses are not presented here for brevity but from the basic tables at the end of the chapter this fact becomes obvious. So that when we come to 'all pulses' together, we see from Table 2.22 that Marathwada and Amraoti regions emerge as main providers of pulses with growth rates of 2.54 and 2.58 per cent per annum respectively, followed by Region II of Nasik with a modest growth rate of 1.15 per cent per annum. Region III with good gains in gram but losses in tur, is nearly stagnant and so is the Nagpur region (Region VII) while Kolhapur (Region IV) has nothing to contribute. Pulses as a whole have less than 5 per cent irrigation barring Region III with nearly 7 per cent irrigation and most of it is accounted by gram whose productivity is lower (3 to 4 quintals/ha) than unirrigated tur (over 6 quintals/ha). At the end of the period we have pulses productivity at 4.31 quintals/ha and this productivity level is higher than all India productivity (A 1985-88 triennium average for pulses is 3.73 quintals/ha for all India against 4.07 quintals for the state). But the productivity can be increased further. The fertilizer study of the Agro-Economic Research Centre by the author mentioned in Section 2.4 reveals that pulses receive practically no fertilizers. As pulses are nitrogen-fixing crops, it is thought that they do not require fertilizers and it is forgotten that for their own growth fertilizers are needed. From the decadalwise growth rates from Table 2.23 we see that what was observed for tur and gram is reinforced for

Table 2.22 : Growth of 'All Pulses' for Important Regions over the Entire Period

(Initial Point: Av. 1961-62 to 1963-64, End Point: Av. 1984-85 and 1987-88)

Region	Area ('00 ha.)		Production ('00 tonnes)		Productivity (mtl./ha.)		Absolute change (p.a.) and Growth Rates (% p.a.)			
	Initial Pt.	End Pt.	Initial Pt.	End Pt.	Initial Pt.	End Pt.	Area	Production	Production	Irr. Area
II	3719 (15.59)	4289 (14.62)	1372 (16.30)	1795 (14.20)	3.69 (1.15)*	4.18 (5.00)*	24 <u>0.61</u>	18 <u>1.15</u>	- <u>0.54</u>	9 <u>8.71</u>
III	2387 (12.10)	2565 (8.74)	826 (9.80)	955 (7.60)	2.86 (5.75)	3.72 (6.74)	-14 <u>-0.50</u>	6 <u>0.62</u>	- <u>1.13</u>	4 <u>1.85</u>
V	8616 (36.12)	10507 (35.82)	2463 (29.20)	4447 (35.20)	2.86 (1.32)	4.23 (3.41)	80 <u>0.85</u>	84 <u>2.54</u>	- <u>1.68</u>	13 <u>6.29</u>
VI	3292 (13.80)	6431 (21.93)	1696 (20.10)	3157 (25.00)	5.15 (0.14)	4.91 (1.35)	134 <u>2.89</u>	62 <u>2.68</u>	- <u>-0.20</u>	3 <u>15.05</u>
VII	3338 (13.99)	3090 (10.54)	1322 (15.70)	1386 (11.00)	3.96 (0.24)	4.49 (1.15)	-11 <u>-0.33</u>	3 <u>0.20</u>	- <u>0.53</u>	1 <u>7.60</u>
State	23855 (100)	29330 (100)	8444 (100)	12641 (100)	3.54 (1.78)	4.31 (3.60)	233 <u>0.88</u>	179 <u>1.73</u>	- <u>0.84</u>	30 <u>4.61</u>

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* These figures in brackets are percentage of crop area irrigated. End point for irri.data are av. 1980-81 and 1981-82. Other details of irrigation given in the last column. Absolute changes per annum are in '00 ha. for area and '00 tonnes for production.

Table 2.23: Area Production and Productivity Compound Growth Rates for the Three Decades for Important Regions in Maharashtra (1960-61 to 1937-88).
Crop : All Pulses

(Growth Rates per cent p.a.)

Region	Decade	Area	Production	Productivity
II	Sixties	2.62	1.08	-1.50
	Seventies	0.27	2.40	2.12
	Eighties	-0.53	-0.44	0.09
III	Sixties	1.81	1.47	-0.33
	Seventies	0.81	1.20	0.39
	Eighties	-4.01	-0.83	3.31
V	Sixties	2.64	2.23	-0.40
	Seventies	0.44	2.65	2.20
	Eighties	-0.03	2.63	2.66
VI	Sixties	1.86	-3.55	-5.31
	Seventies	2.16	3.73	1.54
	Eighties	4.71	6.50	1.71
VII	Sixties	-0.80	-4.55	-3.78
	Seventies	-0.86	0.42	1.29
	Eighties	0.77	3.87	3.08
State	Sixties	1.72	-0.31	-2.00
	Seventies	0.60	2.30	1.70
	Eighties	0.60	2.63	2.02

pulses as a whole viz. pulses have done well not only in seventies but also in the eighties. Regions V and VI of Marathwada and Amraoti have consistently good growth rates. Region II of Nasik with good growth in sixties and seventies appears to stagnate. Thus for the state as a whole, production is not levelling off as in the case of cereals.

2.9 Details of all foodgrains together can be found in Table 2.24 and first aspect to note is that overall growth rate of 1.95 per cent per annum is mainly on account of major foodgrain producer of Marathwada (growth rate 2.32 per cent per annum). In absolute terms, this region is responsible for an addition of 464 hundred metric tonnes per annum followed by Amraoti (Region VI) with even higher growth rate of 3.32 per cent but a somewhat lower absolute addition of 359 hundred metric tonnes per annum. Thus these two regions have provided half the additional production. Productivity appears to be main contributor, especially for Amraoti region where we witnessed tremendous growth in kharif jowar without much area increase. Region II with a growth rate of 2.09 per cent and absolute rate 198 hundred metric tonnes per annum comes next and half of this addition comes from kharif jowar and about one-fourth from bajra. Konkan and sugar tract regions (III and IV) have moderate growth rates.

Looking at the role of irrigation, figures below the productivity levels in the table indicate that as state proportion of irrigated area has increased, so has the

Table 2.24 : Growth of Foodgrains for Different Regions over the Entire Period

(Initial Point : av.1961-62 to 1963-64. End Point: av.1984-85 and 1987-88)

Region	Area ('00 ha.)		Production ('00 tonnes)		Productivity (Mtl./ha.)		Absolute change (p.a.) Growth Rates (% p.a.)			
	Initial Pt.	End Pt.	Initial Pt.	End Pt.	Initial Pt.	End Pt.	Area	Production	Production	Irr. area
I	6220 (4.82)	6504 (4.60)	6357 (10.40)	10407 (10.00)	11.02 (1.16)*	16.00 (2.56)	12 0.19	151 1.79	- 1.50	4 4.11
II	16977 (13.15)	19857 (14.05)	8748 (13.30)	14234 (13.70)	5.15 (3.22)	7.17 (9.39)	123 0.67	234 2.09	- 1.44	67 6.60
III	29130 (22.60)	29673 (20.99)	10881 (16.50)	15537 (14.90)	3.73 (8.94)	5.24 (13.72)	21 0.07	198 1.53	- 1.46	78 2.41
IV	12318 (9.54)	12650 (8.95)	7732 (11.70)	12020 (11.60)	6.28 (8.55)	9.50 (13.59)	14 0.11	183 1.90	- 1.79	32 2.43
V	33486 (25.93)	39814 (23.17)	15225 (23.10)	26129 (25.10)	4.55 (3.95)	6.56 (10.26)	269 0.74	464 2.32	- 1.57	145 6.17
VI	14658 (11.35)	17376 (12.29)	7317 (11.10)	15749 (15.10)	4.99 (0.54)	9.06 (4.58)	116 0.73	359 3.32	- 2.57	37 13.05
VII	16251 (12.59)	15563 (11.01)	9202 (14.00)	9923 (9.50)	5.66 (14.56)	6.38 (21.10)*	-29 -0.18	31 0.32	- 0.50	55 1.96
State	129117 (100)	141333 (100)	65997 (100)	104001 (100)	5.11 (6.23)	7.76 (11.39)	520 0.39	1617 1.95	- 1.56	418 3.71

81

* These figures in brackets show percentage irrigated area under the crop. Other details of irrigation are available in the last column. Absolute changes per annum are '00 ha. for area, '00 tonnes for production.

proportion of irrigated foodgrains. The aspect of inequity between foodgrains and sugarcane is already touched upon at the end of the previous chapter but apart from that, let us, for example see where irrigation for Marathwada has gone within foodgrains. The last column indicates that Marathwada has annual addition of 145 hundred hectares to irrigated area (growth rate 6.17 per cent per annum). The break-up, after looking into the data, is as follows.

(all annual rates in hundred hectares)

Rice	16
Wheat	65
Kharif Jowar	14
Rabi Jowar	29
Bajra	5
Gram	11

Total of these crops	140

And yet, of the 464 hundred metric tonnes annual addition to production for this region major contributors (all hundred metric tonnes) are kharif jowar 299, bajra 42, tur 44, 'other' pulses 37 followed by wheat 18. (It may be added that 'other' pulses have just 2 hundred hectares added annually in irrigation.) Thus although wheat is the main beneficiary of the increased irrigation, this enables the crop to barely cover its loss in production due to losses in unirrigated wheat area. Otherwise irrigation has not played a significant part. This is another aspect of irrigation meriting attention.

For the state, productivity of foodgrains has increased

from 5.11 quintals/ha to 7.76 quintals/ha and compared to all India foodgrains productivity of 11.70 quintals/ha (average of triennium 1985-88) this is certainly low but then all India irrigation percentage is much higher at 30 per cent and not of the protective type as witnessed for the state. In discussion for all cereals together in Section 2.7 certain observations are already made. These need not be repeated here. In Table 2.25 the decadewise growth rates are displayed and one sees some improvement for the eighties in the main growth areas of Marathwada and Amraoti because of good performance of pulses and these regions now show stagnancy instead of negative growth rates for that decade. Ironically, Region IV shows good growth rate for the eighties but it must be remembered that in the sixties it is the worst, with growth rate of production -3.81 per cent per annum so seventies growth rate of 4.68 per cent shows recovery and the impact of new varieties is probably coming out only in the eighties. As commented earlier, Konkan region with its main crop of rice and miscellaneous cereals, appears to go its own way with nominal growth in sixties followed by good growth rates of 2.32 and 2.51 in seventies and even in eighties, a fact noted in the case of cereals.

2.10 To complete the picture, we look at the three major non-foodgrain crops of sugarcane, cotton and groundnut. We already commented upon sugarcane and to some extent on groundnut so the treatment would be brief. In Tables 2.26 and 2.27 details for sugarcane are presented. Here we see that

Table 2.25 : Area Production and Productivity Compound
Growth Rates for the Three Decades for
Various Regions in Maharashtra (1960-61 to
1987-88)
Crop : All Foodgrains

(Growth Rates per cent p.a.)

Region	Decade	Area	Production	Productivity
I	Sixties	-0.42	0.28	0.70
	Seventies	-0.13	2.32	2.45
	Eighties	1.12	2.31	1.13
II	Sixties	0.75	-0.19	-0.94
	Seventies	0.79	4.56	3.74
	Eighties	0.38	0.71	0.33
III	Sixties	-0.09	-0.83	-0.74
	Seventies	0.07	3.39	3.32
	Eighties	0.20	0.98	0.78
IV	Sixties	-1.44	-3.81	-2.40
	Seventies	0.47	4.68	4.19
	Eighties	0.88	2.94	2.04
V	Sixties	0.76	0.27	-0.49
	Seventies	1.06	4.66	4.66
	Eighties	0.30	-0.50	-0.80
VI	Sixties	1.00	3.17	2.15
	Seventies	1.06	5.30	4.20
	Eighties	0.07	0.84	0.73
VII	Sixties	0.21	1.15	0.94
	Seventies	0.29	3.28	2.98
	Eighties	-1.13	-4.13	-3.03
State	Sixties	0.28	0.07	-0.21
	Seventies	0.60	4.40	3.78
	Eighties	0.18	0.27	0.09

Table 2.26 : Growth of Sugarcane for Important Regions over the Entire Period

(Initial Point Av. 1961-62 to 1963-64, End Point: Av. 1984-85 and 1987-88)

Region	Area ('00 ha.)		Production ('00 tonnes of gur)		Productivity (t./ha.)		Absolute change (p.a.) and Growth Rates (% p.a.)			
	Initial Pt.	End Pt.	Initial	End Pt.	Initial Pt.	End Pt.	Area	Production	Production	Irri. Area
II	135 (8.81)	539 (15.42)	770 (7.10)	4266 (15.20)	61.50 (100)*	79.14 (100)*	18 <u>6.40</u>	149 <u>7.55</u>	- <u>1.08</u>	Irrigated area same as the crop is 100 per cent irrigated
III	556 (39.07)	1224 (35.00)	5591 (51.10)	9591 (34.20)	100.56 (100)	78.39 (100)	28 <u>3.41</u>	170 <u>2.32</u>	- <u>-1.05</u>	
IV	496 (34.86)	1109 (31.71)	3597 (33.00)	9771 (34.90)	72.52 (100)	93.14 (100)	26 <u>3.43</u>	263 <u>4.34</u>	- <u>0.83</u>	
V	215 (15.09)	573 (16.39)	863 (7.90)	3526 (12.90)	40.18 (100)	63.27 (100)	15 <u>4.27</u>	118 <u>6.30</u>	- <u>1.95</u>	
State	1423 (100)	3496 (100)	10909 (100)	28003 (100)	76.70 (100)	80.10 (100)	88 <u>3.90</u>	728 <u>4.09</u>	- <u>0.19</u>	

* These figures in brackets show percentage of crop area irrigated. (100 per cent for the present crop of sugarcane). Absolute changes per annum are in '00 ha. and in '00 tonnes of gur for production. / for area

Table 2.27 : Area Production and Productivity Compound Growth Rates for the Three Decades for Important Regions in Maharashtra (1960-61 to 1987-88)

Crop : Sugarcane

(Growth Rates percent p.a.)

Region	Decade	Area	Production	Productivity
II	Sixties	4.55	11.32	6.47
	Seventies	10.30	10.19	-0.11
	Eighties	2.86	1.32	-1.50
III	Sixties	4.77	-1.18	-6.25
	Seventies	3.67	5.11	1.39
	Eighties	2.01	1.51	-0.49
IV	Sixties	5.76	6.15	0.37
	Seventies	3.45	5.51	1.99
	Eighties	1.74	1.41	-0.32
V	Sixties	5.91	15.95	9.48
	Seventies	6.52	5.35	-1.10
	Eighties	0.08	0.36	0.28
State	Sixties	5.29	4.50	-0.75
	Seventies	4.76	5.87	1.04
	Eighties	1.66	1.46	0.20

in the major areas of Region III (Pune) and Region IV (Kolhapur) covering half and one-third sugarcane production respectively in the base year, growth rates are 2.32 and 4.34 per cent per annum respectively all on account of area, and productivity is stagnant or declining. But the productivity level is already very high here. In the relatively 'new' areas of Region II of Nasik and Region V of Marathwada, growth rates are over 6 per cent for production with area accounting for the major part but productivity also registering gains. At the state level production growth rate of 4.09 per cent is on account of area with its growth rate of 3.90 per cent. Inequity in irrigation water use between foodgrains and sugarcane is already commented upon at the end of Chapter 1. Table 2.27 covering decadewise growth rates shows slowing down of growth in production everywhere in the eighties.

In the case of cotton, Table 2.28 indicates that in the major cotton tract of Amraoti covering 40 per cent of production, a modest growth rate of 1.15 per cent per annum is registered. In the other major area of Marathwada (Region V) there is area loss (and our previous analysis indicates this area has gone to kharif jowar) but production growth rate is 2.02 per cent. In Region II there is loss in area as well as production and probably kharif jowar and bajra are the crops preferred. Thus the state growth rate of 0.60 per cent per annum is a result of mixed regional performances. The decadewise growth rates are given in Table 2.29 and

Table 2.38 : Growth of Cotton for Important Regions over the Entire Period

(Initial Point: Av. 1961-62 to 1963-64, End Point: Av. 1984-85 and 1987-88)

Region	Area ('00 ha.)		Production ('00 bales of 180 kg)		Productivity (qtl. of lint/ha.)		Absolute change (p.a.) and Growth Rates (% p.a.)			
	Initial Pt.	End Pt.	Initial Pt.	End Pt.	Initial Pt.	End Pt.	Area	Production	Productivity	Irr. area
II	3699 (13.51)	2360 (9.07)	2755 (22.80)	1452 (10.43)	1.34 (3.49)*	1.11 (12.38)*	-57 <u>-1.90</u>	-55 <u>-2.69</u>	- <u>-0.81</u>	11 <u>5.26</u>
V	7477 (27.51)	6716 (25.82)	2315 (23.20)	4503 (32.30)	0.68 (0.70)	1.21 (3.83)	-32 <u>-0.46</u>	72 <u>2.02</u>	- <u>2.49</u>	11 <u>8.92</u>
VI	12506 (46.01)	14030 (53.94)	4904 (40.50)	6422 (46.10)	0.71 (0.17)	0.82 (1.34)	65 <u>0.43</u>	65 <u>1.15</u>	- <u>0.66</u>	3 <u>11.90</u>
VII	2685 (9.53)	2921 (10.95)	811 (6.70)	1439 (10.30)	0.54 (0.59)	0.92 (0.98)	6 <u>0.21</u>	27 <u>2.47</u>	- <u>2.26</u>	1 <u>3.66</u>
State	27180 (100)	26011 (100)	12105 (100)	13923 (100)	0.80 (2.22)	0.96 (4.44)	-50 <u>-0.19</u>	77 <u>0.60</u>	- <u>0.79</u>	29 <u>3.52</u>

* These figures in brackets show percentage of crop area irrigated. End point for irr. data are, av. 1980-81 and 1981-82. Other details of irrigation given in the last column. Absolute changes per annum are in '00 ha. and '00 tonnes for production.

Table 2.29 : Area Production and Productivity Compound Growth Rates for the Three Decades for Important Regions in Maharashtra (1960-61 to 1987-88)

Crop : Cotton

(Growth Rates per cent p.a.)

Region	Decade	Area	Production	Productivity
II	Sixties	-1.65	-6.90	-5.34
	Seventies	-3.63	-1.12	2.61
	Eighties	0.26	-1.32	-1.57
V	Sixties	0.30	3.44	3.13
	Seventies	-2.12	0.34	2.51
	Eighties	1.20	3.15	1.93
VI	Sixties	0.61	3.18	2.55
	Seventies	-0.41	0.04	0.45
	Eighties	1.61	1.05	-0.55
VII	Sixties	1.50	6.42	4.85
	Seventies	0.04	2.26	2.22
	Eighties	-0.58	-0.32	0.26
State	Sixties	0.15	1.01	0.85
	Seventies	-1.21	0.32	1.55
	Eighties	0.92	0.64	-0.27

barring minor Region II growth rates are positive but of lower magnitudes in the eighties. But our selection of time-points is on the basis of foodgrains production which may not be equally appropriate for cotton. For groundnut there are area declines all over the state, as can be seen from Table 2.30. There are productivity gains in Region III with positive growth rates but in the main areas of Marathwada (Region V) and Nasik (Region II) there are area as well as production losses. From the decadewise growth rates in Table 2.31 one suddenly sees a jump in the eighties in Regions III and IV with growth rates of 9.44 per cent per annum and 8.20 per cent per annum respectively after negative production growth rates of sixties and the seventies. This upsurge is due to summer groundnut which is fully irrigated. This encouragement by the state by offering to irrigate groundnut in summer has made such impressive growth rates possible.

Table 2.30 : Growth of Groundnut for Important Regions Over the Entire Period

(Initial Point: Av. 1961-62 to 1963-64; End Point: Av. 1984-85 and 1987-88)

Region	Area ('00 ha.)		Production ('00 tonnes of pod)		Productivity (qtl. of pods/ha.)		Absolute change (p.a.) and Growth Rates (% p.a.)			
	Initial Pt.	End Pt.	Initial Pt.	End Pt.	Initial Pt.	End Pt.	Area	Production	Productivity	Irri. area
II	3117 (27.52)	2098 (29.00)	2038 (25.80)	1398 (19.60)	6.54 (0.34)*	6.66 (8.19)*	-43 -1.67	-27 -1.59	- 0.08	8 16.29
III	1479 (13.06)	989 (13.63)	1020 (12.90)	1366 (19.10)	6.89 (6.76)	13.80 (32.20)	-21 -1.70	15 1.25	- 3.00	8 4.83
IV	3051 (18.11)	1868 (25.83)	2140 (27.10)	2616 (35.60)	10.43 (0.54)	14.00 (0.89)	-8 -0.40	20 0.86	- 1.27	Neg. 1.11
V	3417 (30.16)	1214 (16.73)	2116 (25.80)	930 (13.00)	6.19 (0.06)	7.66 (0.13)	-94 -4.31	-51 -3.44	- 0.91	8 26.53 ^o
VI	1163 (10.31)	654 (9.04)	535 (6.80)	353 (5.00)	4.58 (0.00)	5.47 (5.75)	-22 -2.44	-8 -1.69	- 0.77	3 -
State	11327 (100)	7233 (100)	7898 (100)	7145 (100)	6.97 (1.11)	10.43 (9.58)	-174 -1.89	-32 -0.43	- 1.49	28 9.35

* These figures in brackets show percentage of crop area irrigated. End point for irr. data are av. 1980-81 and 1981-82. Other details of irrigation given in the last column. Absolute changes per annum are in '00 ha. for area and '00 tonnes (pods) for production.

^o This rate appears too high as the increment in irri. area is from just 2 to 155.5 (in '00 ha.)

Table 2.31 : Area Production and Productivity Compound Growth Rates for the Three Decades for Important Regions in Maharashtra(1960-61 to 1987-88)

Crop : Groundnut

(Growth Rates per cent p.a.)

Region	Decade	Area	Production	Productivity
II	Sixties	-7.17	-7.81	-0.69
	Seventies	1.98	1.79	-0.19
	Eighties	-1.93	-0.88	1.08
III	Sixties	-2.95	-4.94	-2.05
	Seventies	-3.58	-0.80	2.88
	Eighties	1.91	9.44	7.39
IV	Sixties	0.86	-2.02	-2.86
	Seventies	-2.69	-2.64	0.05
	Eighties	1.72	8.20	6.37
V	Sixties	-4.55	-3.99	0.59
	Seventies	-5.05	-6.56	-1.59
	Eighties	-3.12	1.34	4.60
VI	Sixties	-3.48	1.61	5.27
	Seventies	3.03	1.85	-1.15
	Eighties	-3.49	-8.68	-0.21
State	Sixties	-3.49	-3.75	-0.27
	Seventies	-1.32	-1.56	-0.24
	Eighties	-1.35	3.89	5.31

II.1
 Table : Changes and Growth Rate of Foodgrains Production with
 1984-85 and 1987-88 Average as the Final Time Point

S. No.	Crops	Average Production 84-85 and 87-88*	d=differences and per year rates				Growth Rates (% p.a.)	
			d3	d3 p.a.	d4	d4 p.a.	78-79 to 84-85 and 87-88	62-63 to 84-85 and 87-88
1	Rice	18245	-3072.0	-409.6	3946.7	167.9	-2.05	1.04
2	Wheat	7450	-2191.8	-292.2	3394.2	144.4	-3.38	2.62
3	K.Jowar	34290	1078.0	143.7	19304.3	821.5	0.43	3.59
4	R.Jowar	19482	1828.2	243.8	2746.8	116.9	1.32	0.65
5	T.Jowar	53772	2912.8	388.4	22051.2	938.3	0.75	2.27
6	Bajra	7379	1430.0	190.7	2521.3	107.3	2.91	1.79
7	O.Cereals	4515	751.5	100.2	1892.8	80.5	2.46	2.34
8	T.Cereals	91360	-169.5	-22.6	33806.2	1433.6	-0.02	1.99
9	Gram	2151	666.0	88.8	833.3	35.5	5.06	2.11
10	Tur	5099	1338.7	178.5	1725.7	73.4	4.14	1.77
11	Mung	N.A.	-	-	-	-	-	-
12	Udid	N.A.	-	-	-	-	-	-
13	O.Pulses	5392	230.5	30.7	1638.5	69.7	0.58	1.55
14	(Incl. 11, 12)							
14	T.Pulses	12642	2235.2	293.0	4197.5	178.6	2.63	1.73
15	F.Grains	104001	2065.7	275.4	38003.7	1617.2	0.27	1.95

* i) Average production and differences etc. are in '00' tonnes

ii) d3 and d4 cover periods as in the previous tables, with the change in the final time point.

This table is presented because the regionwise analysis corresponds to period ending average 1984-85 and 1987-88, referred to as '86.5'.

II.2
 Table : Changes and Growth Rates of Area Under Crops
 (Maharashtra) with Terminal Point as Average
 of 1984-85 and 1987-88

SR. NO.	CROPS	Area '00' ha. 84-85 and 87-88	Differences & Per+Year rates in '00' ha.				Growth Rates (% p.a.)	
			Differ- ence d3	Rate p.a.	Differ- ence d4	Rate p.a.	78-79 to 84-85 87-88	61-62 to 84-85 87-88
(1)		(5)	(5)-(4)		(5)-(2)			
1	RICE	14448	-451.5	-60.2	1078.2	-0.08	-0.41	0.33
2	WHEAT	8607	-2888.8	-385.2	-313.5	-13.3	-3.75	-0.15
3	K.JOWAR	29218	-1277.5	-170.3	4207.8	179.1	-0.57	0.66
4	R.JOWAR	36906	2784.2	371.2	467.2	19.9	1.05	0.05
5	BAJRA	17881	2090.7	278.8	971.7	41.3	1.67	0.24
6	O.CEREALS	4950	351.3	46.8	337.7	14.4	0.99	0.30
7	T.CEREALS	112008	608.3	81.1	6746.3	287.1	0.07	0.26
8	GRAM	5845	1061.0	141.5	1507.0	64.1	2.99	1.42
9	TUR	7685	1077.0	143.6	2113.3	89.9	2.03	1.38
10	MUNG	N.A.	-	-	-	-	-	-
11	UDID	N.A.	-	-	-	-	-	-
12	O.PULSES (Incl. 10 & 11)	16300	-847.0	-112.9	1854.7	78.9	-0.67	0.52
13	T.PULSES	29330	1291.0	172.1	5475.0	233.0	0.60	0.88
14	F.GRAINS	141338	1899.3	253.2	12221.3	520.1	0.18	0.39
15	SICANE	3496	405.7	54.1	2073.3	88.2	1.66	3.90
16	COTTON	26011	1716.7	228.9	-1168.7	-49.7	0.91	-0.19
17	G'NUT	7233	-777.2	-103.6	-4094.2	174.2	-1.35	-1.89
18	SAFFLR	6593	1695.8	226.1	3374.5	143.6	4.04	3.10
19	O.CROPS	18334	-5861.0	-976.8	-3396.0	-138.6	-4.62	-0.69
20	GCA	203005	3976.7	530.2	12227.7	520.3	0.26	0.26

(This table is incorporated as the Regionwise data have this terminal point)

* Column numbers refer to similar table with different terminal point.

Table II.3 : Cropping Pattern in Various Agro-Climatic Regions of Maharashtra
(Average 1961-62 to 1963-64)

Sr. No.	Crop	Reg I % area	Reg II % area	Reg III % area	Reg IV % area	Reg V % area	Reg VI % area	Reg VII % area	Maha- rash- tra % area
1.	Rice	45.82	2.83	2.00	7.77	1.79	1.02	23.61	7.01
2.	Wheat	-	5.83	2.23	1.64	5.47	5.47	9.21	4.68
3.	K. Jowar	0.04	8.28	0.91	14.19	15.45	31.07	14.61	13.11
4.	R. Jowar	0.003	8.53	50.00	14.19	21.38	0.08	12.01	19.10
5.	Bajra	-	21.53	14.98	15.17	5.45	0.88	0.11	8.86
6.	O. Cereals	18.16	4.16	1.23	4.29	0.93	0.22	0.52	2.42
7.	T. Cereals	64.02	51.17	71.34	57.26	50.46	38.74	60.07	55.18
8.	Gram	0.19	1.35	1.79	1.67	3.60	1.34	1.54	2.01
9.	Tur	0.61	1.04	1.76	1.61	4.20	4.65	4.01	2.92
10.	Mung	0.18	2.71	0.95	0.27	4.53	1.89	1.26	2.19
11.	Udid	1.23	5.24	0.19	0.85	2.83	2.51	2.07	2.24
12.	O. Pulses (incl. 10, 11)	3.72	11.97	4.28	5.20	9.67	5.23	9.98	7.57
13.	All Pulses	4.52	14.35	7.83	8.49	17.48	11.22	15.53	12.50
14.	Foodgrains	68.54	65.52	79.17	65.75	67.94	49.97	75.60	67.68
15.	S'cane	0.01	0.48	1.51	2.65	0.44	0.07	0.04	0.75
16.	Cotton	0.00	14.27	1.91	0.58	15.17	42.63	12.49	14.25
17.	G'nut	0.04	12.03	4.01	10.95	6.93	3.98	0.42	5.94
18.	Safflr	0.00	0.68	3.50	0.69	3.32	0.50	--	1.69
19.	O. Crops	31.41	7.62	9.90	19.38	0.06	2.86	11.45	Neg.
20.	G.C.A.	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table II.4: Cropping Pattern in Various Agro-Climatic Regions of Maharashtra
(Average 1984-85 and 1986-87)

Sr. No.	Crops	Reg.I % area	Reg.II % area	Reg.III % area	Reg.IV % area	Reg.V % area	Reg.VI % area	Reg.VII % area	Maha- rash- tra % area
1.	Rice	48.51	2.54	1.76	7.86	1.91	0.95	26.26	7.12
2.	Wheat	0.00	5.88	3.97	3.64	3.91	2.98	7.36	4.24
3.	K.Jowar	0.00	12.73	1.30	13.96	18.18	27.58	14.10	14.39
4.	R.Jowar	0.00	6.66	49.24	14.51	20.16	0.04	11.06	18.18
5.	Bajra	0.00	22.53	14.02	10.65	6.92	0.85	0.06	8.81
6.	O.Cereals	14.21	4.57	1.88	4.54	0.88	0.37	0.48	2.44
7.	All Cereals	62.27	54.91	72.17	55.16	51.96	32.77	59.31	55.17
8.	Gram	0.42	2.64	2.73	2.83	3.34	1.82	2.36	2.63
9.	Tur	0.67	1.20	1.10	1.29	5.40	7.47	5.14	3.79
10.	Mung	-	-	-	-	-	-	-	-
11.	Udid	-	-	-	-	-	-	-	-
12.	O.Pulses (Incl.10,11)	4.38	11.39	3.00	5.80	9.89	9.97	7.19	8.03
13.	T.Pulses	5.47	15.23	6.83	9.91	18.63	19.26	14.69	14.45
14.	Foodgrains	68.18	70.49	79.00	65.07	70.59	52.02	74.01	69.62
15.	S'eanne	0.00	1.91	3.26	5.70	1.02	0.14	0.02	1.72
16.	Cotton	0.00	8.38	0.15	0.15	11.91	42.00	13.41	12.81
17.	G'nut	0.33	7.45	2.63	9.61	2.15	1.96	1.78	3.56
18.	Safflr	0.00	0.51	5.05	0.91	6.37	2.34	0.00	3.25
19.	O'crops	31.49	11.26	9.91	18.56	7.96	1.54	10.77	Neg.
20.	G.C.A.	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

II.5

Table : Changes and Growth Rates of Production of Foodgrains in Region I (1960-61 to 1987-38)

S. No.	Crops	Average production in '00' Tonnes				d=differences and per year rates '00' tonnes				Growth Rates(% p.a.)			
		61-62 to 63-64	67-68 to 69-70	77-78 to 79-80	84-85 and 87-88	d1	d2	d3	d4	62-63 to 68-69	68-69 to 78-79	78-79 to 84-85 and 87-88	62-63 to 84-85 and 87-88*
(1)	(2)	(3)	(4)	(5)	(3)-(2)	(4)-(3)	(5)-(4)	(5)-(2)	10	11	12	13	
1	2	3	4	5	6	7	8	9	10	11	12	13	
1	Rice	5740.3 (83.72)	5742.7 (82.35)	7638.0 (87.10)	9035.0 (86.82)	2.3 0.4	1895.3 189.5	1397.0 186.3	3294.7 140.2	0.01	2.89	2.26	1.95
2	Wheat	0.0 (0.00)	0.0 (0.00)	2.7 (0.03)	0.0 (0.00)	-	-	-	-	-	-	-	-
3	K.Jowar	1.7 (0.03)	2.3 (0.03)	5.7 (0.07)	0.0 (0.00)	0.7 0.1	3.3 0.3	-	-	5.71	9.30	-	-
4	R.Jowar	0.0 (0.00)	0.0 (0.00)	0.3 (0.003)	0.0 (0.00)	-	-	-	-	0.00	0.00	-	-
5	T.Jowar	1.7 (0.03)	2.3 (0.03)	6.0 (0.07)	0.0 (0.00)	0.7 0.1	3.7 0.4	-	-	5.71	9.92	-	-
6	Bajra	0.0 (0.00)	0.0 (0.00)	0.0 (0.00)	0.0 (0.00)	-	-	-	-	-	-	-	-
7	O.Cereals	4012.0 (14.76)	1106.7 (15.87)	1033.3 (11.78)	1193.0 (11.51)	94.7 15.8	-73.3 -7.3	164.7 22.0	186.0 7.9	1.50	-0.68	1.99	0.72
8	T.Cereals	6754.0 (98.50)	6851.7 (98.26)	8630.0 (98.99)	10233.0 (98.33)	97.7 16.3	1828.3 182.8	1553.0 207.1	3479.0 148.0	0.24	2.39	2.22	1.78

(Contd.)

Table II.5
: (Contd.)

	1	2	3	4	5	6	7	8	9	10	11	12	13
Gram		5.3 (0.08)	5.7 (0.08)	5.7 (0.07)	15.5 (0.15)	0.3 0.1	0.0 0.0	9.8 1.3	10.2 0.4	1.04	0.00	14.35	4.65
0 Tur		15.0 (0.22)	16.7 (0.24)	16.3 (0.19)	25.0 (0.24)	1.7 0.3	-0.3 -0.03	8.7 1.2	10.0 0.4	1.77	-0.21	5.84	2.20
1 Mung		4.0 (0.05)	4.3 (0.06)	3.0 (0.03)	N.A.	0.3 0.1	-1.3 -0.1	- -	- -	1.33	-3.60	-	-
2 Udid		26.3 (0.38)	27.7 (0.40)	20.3 (0.23)	N.A.	1.3 0.2	-7.3 -0.7	- -	- -	0.83	-3.04	-	-
3 O.Pulses (Incl. 11, 12)		82.7 (1.21)	99.3 (1.42)	67.0 (0.07)	133.0 (1.28)	16.7 2.8	-32.3 -3.2	66.0 8.8	50.3 2.1	3.11	-3.86	9.57	2.04
4 T.Pulses		103.0 (1.50)	121.7 (1.75)	89.0 (1.02)	173.5 (1.67)	18.7 3.1	-32.7 -3.3	84.5 11.3	70.5 3.0	2.82	-3.08	9.31	2.24
5 F.Grains		6857.0 (100)	6973.3 (100)	8769.0 (100)	10406.5 (100)	116.3 19.4	1795.7 179.6	1637.5 218.3	3549.5 151.0	0.28	2.32	2.31	1.79

* This refers to the end period of average of 1984-85 and 1987-88.

For items 3 to 6 some of the rates are not calculated because of very small magnitudes.

Table II.6 : Changes and Growth Rates of Production of Foodgrains in Region II (1960-61 to 1987-88)

Crops	Average production in '00' Tonnes				d=differences and per year rates in '00' tonnes				Growth Rates (% p.a.)			
	61-62 to 63-64 (2)	67-68 to 69-70 (3)	77-78 to 79-80 (4)	84-85 and 87-88 (5)	d1 (3)-(2)	d2 (4)-(3)	d3 (5)-(4)	d4 (5)-(2)	62-63 to 63-69	68-69 to 78-79	78-79 to 84-85 and 87-88	62-63 to 84-85 and 87-88 *
(1)	2	3	4	5	6	7	8	9	10	11	12	13
Rice	570.7 (6.52)	431.0 (4.99)	969.0 (5.16)	661.5 (4.65)	-139.7 - 23.3	538.0 53.8	-307.5 -41.0	90.8 3.9	-4.57	8.44	-4.96	0.63
Wheat	803.0 (9.18)	1056.0 (12.21)	1815.3 (13.45)	1475.5 (10.37)	253.0 42.2	759.3 75.9	-339.8 -45.3	672.5 28.6	4.67	5.57	-2.73	2.62
K.Jowar	2076.0 (23.73)	1751.7 (20.26)	4125.0 (30.56)	4438.0 (31.18)	-324.3 -54.1	2373.3 237.3	313.0 41.7	2362.0 100.5	-2.79	8.94	0.98	3.29
R.Jowar	1179.3 (13.48)	726.3 (8.40)	1338.3 (9.91)	1192.5 (8.38)	-453.0 -75.5	612.0 61.2	-145.8 -19.4	13.2 0.6	-7.76	6.30	-1.53	0.05
T.Jowar	3255.3 (37.21)	2478.0 (28.66)	5463.3 (40.47)	5630.5 (39.56)	-777.3 -129.5	2985.3 298.5	167.2 22.3	2375.2 101.1	-4.45	8.23	0.40	2.36
Bajra	2070.3 (23.67)	2612.0 (30.21)	2563.0 (19.02)	3391.0 (23.82)	541.7 90.3	-44.0 -4.4	823.0 109.7	1320.7 56.2	3.95	-0.17	3.78	2.12
O.Cereals	676.0 (7.73)	606.0 (7.01)	829.7 (6.15)	1231.0 (8.65)	-70.0 -11.7	223.7 22.4	401.3 53.5	555.0 23.6	-1.81	3.19	5.40	2.58
T.Cereals	7375.3 (84.31)	7183.0 (83.07)	11645.3 (86.26)	12389.5 (87.04)	-192.3 -32.1	4462.3 446.2	744.2 99.2	5014.2 213.4	-0.44	4.95	00.83	2.23

(Contd.)

Table II.6 : (Contd.)

	1	2	3	4	5	6	7	8	9	10	11	12	13
Gram		118.0 (1.35)	122.3 (1.41)	168.0 (1.24)	348.5 (2.45)	4.3 0.7	45.7 4.6	180.5 24.1	230.5 9.8	0.60	3.22	10.22	4.72
2 Tur		178.3 (2.04)	156.7 (1.81)	213.0 (1.58)	241.5 (1.70)	-21.7 - 3.6	56.3 5.6	28.5 3.8	63.2 2.7	-2.14	3.12	1.69	1.30
1 Mung		240.3 (2.75)	282.3 (3.26)	341.7 (2.53)	N.A.	42.0 7.0	59.3 5.9	- -	- -	2.72	1.93	-	-
2 Udid		522.0 (5.97)	556.3 (6.43)	660.3 (4.89)	N.A.	34.3 5.7	104.0 10.4	- -	- -	1.07	1.73	-	-
3 O.Pulses (Incl. 11,12)		1076.3 (12.30)	1184.3 (13.7)	1473.7 (10.92)	1204.5 (8.46)	108.0 18.0	289.3 28.9	-269.2 -35.9	128.2 5.5	1.61	2.21	-2.65	0.48
4 T.Pulses		1372.3 (15.69)	1463.7 (16.93)	1854.7 (13.74)	1794.5 (12.61)	91.3 15.2	391.0 39.1	-60.2 -8.0	422.2 18.0	1.08	2.40	-0.44	1.15
5 F.Grains		8747.7 (100)	8646.7 (100)	13500.0 (100)	14234.0 (100)	-101.0 -16.8	4853.3 485.3	734.0 97.9	5486.3 233.5	-0.19	4.56	0.71	2.09

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* This refers to the end period of average of 1984-85 and 1987-88.

II.7
e: Changes and Growth Rates of Production of Foodgrains in Region III (1960-61 to 1937-88)

Crops	Average Production in '00' Tonnes				d=differences and per year rates in '00' tonnes				Growth Rates (% p.a.)			
	61-62 to 63-64	67-68 to 69-70	77-78 to 79-80	84-85 and 87-88	d1	d2	d3	d4	62-63 to 68-69	68-69 to 78-79	78-79 to 84-85 and 87-88	62-63 to 84-85*
(1)	(2)	(3)	(4)	(5)	(3)-(2)	(4)-(3)	(5)-(4)	(5)-(2)				
1	2	3	4	5	6	7	8	9	10	11	12	13
Rice	821.7 (7.55)	524.0 (5.06)	1140.7 (7.90)	878.0 (5.65)	-297.7 -49.6	616.7 61.7	-262.7 -35.0	56.3 2.4	-7.22	8.09	-3.43	0.28
Wheat	382.0 (3.51)	488.0 (4.72)	1618.3 (11.20)	1616.0 (10.40)	106.0 17.7	1130.3 113.0	-2.3 -0.3	1234.0 52.5	4.17	12.74	-0.02	6.33
C. Jowar	178.0 (1.64)	51.3 (0.59)	1183.3 (8.19)	607.5 (3.91)	-126.7 -21.1	1132.0 113.2	-575.8 -76.8	429.5 18.3	-18.72	36.86	-8.51	5.36
W. Jowar	7022.3 (64.54)	6294.0 (60.82)	7472.3 (51.73)	9279.5 (59.73)	-728.3 -121.4	1178.3 117.8	1807.2 241.0	2257.2 96.0	-1.81	1.73	2.93	1.19
E. Jowar	7200.3 (66.17)	6345.3 (61.32)	8655.7 (59.92)	9887.0 (63.64)	-855.0 -142.5	2310.3 231.0	1231.3 164.2	2686.7 114.3	-2.08	3.15	1.79	1.36
Bajra	1363.7 (12.53)	1750.7 (16.92)	1407.7 (97.45)	1519.5 (9.78)	387.0 64.5	-343.0 -34.3	111.8 14.9	155.8 6.6	4.25	-2.16	1.02	0.46
N. Cereals	287.3 (2.64)	338.7 (3.27)	606.3 (4.20)	681.5 (4.39)	51.3 8.6	267.7 26.8	75.2 10.0	394.2 16.8	2.78	6.00	1.57	3.34
S. Cereals	10064.0 (92.49)	9446.7 (94.29)	13428.7 (92.96)	14582.0 (93.85)	-617.3 -102.9	3982.0 398.2	1153.3 153.8	4518.0 192.3	-1.05	3.58	1.10	1.59

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(Contd.)

ble II.7 : (Contd.)

	1	2	3	4	5	6	7	8	9	10	11	12	13
Gram		207.7 (1.91)	159.0 (1.54)	272.7 (1.89)	494.0 (3.18)	-48.7 -8.1	113.7 11.4	221.3 29.5	286.3 12.2	-4.35	5.54	8.25	3.76
Tur		344.3 (3.16)	363.0 (3.51)	312.3 (2.16)	170.0 (1.09)	18.7 3.1	-50.7 -5.1	-142.3 -19.0	-174.3 -7.4	0.88	-1.49	-7.79	-2.96
Mung		71.7 (0.66)	65.3 (0.63)	51.7 (0.36)	N.A.	-6.3 -1.1	-13.7 -1.4	-	-	-1.53	-2.32	-	-
Udid		15.7 (0.14)	23.3 (0.23)	18.7 (0.13)	N.A.	7.7 1.3	-4.7 -0.5	-	-	6.86	-2.20	-	-
O.Pulses (Incl. 11, 12)		274.0 (2.52)	353.0 (3.41)	431.3 (2.99)	291.0 (1.37)	-79.0 13.2	78.3 7.8	-140.3 -18.7	17.0 0.7	4.31	2.02	-5.11	0.26
T.Pulses		826.0 (7.92)	901.7 (8.71)	1016.3 (7.04)	955.0 (6.15)	75.7 12.6	114.7 11.5	-61.3 -8.2	129.0 5.5	1.47	1.20	-0.83	0.62
F.Grains		10881.0 (100)	10348.3 (100)	14445.0 (100)	15537.0 (100)	-532.7 -88.8	4096.7 409.7	1092.0 145.6	4656.0 198.1	-0.83	3.39	0.98	1.53

* This refers to the end period of average 1984-85 and 1987.88.

Table II.8 Changes and Growth Rates of Production of Foodgrains in Region IV (1960-61 to 1987-88)

Crops	Average production in '00' tonnes				d=differences and per year rates in '00' tonnes				Growth Rates (% p.a.)			
	61-62 to 63-64	67-68 to 69-70	77-78 to 79-80	84-85 and 87-88	d1	d2	d3	d4	62-63 to 68-69	68-69 to 78-79	78-79 to 84-85 & 87-88	62-63 to 84-85 and 87-88 *
(1)	(2)	(3)	(4)	(5)	(3)-(2)	(4)-(3)	(5)-(4)	(5)-(2)	10	11	12	13
1	2	3	4	5	6	7	8	9				
Rice	1728.3 (22.35)	1275.7 (20.84)	2751.0 (28.44)	3094.5 (25.75)	-452.7 75.4	1475.3 147.5	343.5 45.8	1366.2 58.1	-4.94	7.99	1.58	2.51
Wheat	186.3 (2.41)	200.3 (3.27)	624.7 (6.46)	744.5 (6.20)	14.0 2.3	424.3 42.4	119.8 16.0	558.2 23.8	1.21	12.04	2.37	6.07
K.Jowar	2799.0 (36.20)	1957.3 (31.97)	3282.0 (33.93)	4189.0 (34.85)	-841.7 -140.3	1324.7 132.5	907.0 120.9	1390.0 59.1	-5.79	5.30	3.31	1.73
R.Jowar	1210.0 (15.65)	1015.0 (16.58)	1091.7 (11.29)	1745.0 (14.52)	-195.0 -32.5	76.7 7.7	653.3 87.1	535.0 22.8	-2.89	0.73	6.45	1.57
T.Jowar	4009.0 (51.85)	2972.3 (64.88)	4373.7 (45.21)	5934.0 (49.37)	-1036.7 -172.8	1401.3 140.1	1560.3 208.0	1925.0 81.9	-4.86	3.94	4.15	1.68
Bajra	638.7 (8.26)	620.0 (10.13)	430.3 (4.45)	603.0 (5.02)	-18.7 -3.1	-189.7 -19.0	172.7 23.0	-35.7 1.5	-0.49	-3.59	4.60	-0.24
O.Cereals	487.3 (6.30)	436.3 (7.13)	719.0 (7.43)	916.0 (7.62)	-51.0 -8.5	282.7 28.3	197.0 26.3	428.7 18.2	-1.83	5.12	3.28	2.72
T.Cereals	7049.7 (91.18)	5504.7 (89.90)	8398.7 (91.99)	11292.0 (93.94)	-1545.0 -257.5	3394.0 339.4	2393.3 319.1	4242.3 180.5	-4.04	4.92	3.23	2.02

le II.8: (Contd.)

	1	2	3	4	5	76	7	8	9	10	11	12	13
am	123.3 (1.60)	85.3 (1.39)	144.7 (1.50)	250.0 (2.08)	-38.0 -6.3	59.3 5.9	105.3 14.0	126.7 5.4	-5.95	5.42	7.57	3.05	
ur	215.0 (2.78)	186.0 (8.04)	224.0 (2.32)	137.5 (1.14)	-29.0 -4.8	38.0 3.8	-86.5 -11.5	-77.5 -3.3	-2.39	1.88	-6.30	-1.88	
ung	15.7 (0.20)	13.7 (0.22)	14.3 (0.15)	N.A.	-2.0 -0.3	0.7 0.1	-	-	-2.25	0.47	-	-	
did	52.0 (0.67)	55.0 (0.90)	46.0 (0.48)	N.A.	3.0 0.5	-9.0 -0.9	-	-	0.94	-1.77	-	-	
.Pulses incl. 11, 12)	344.0 (4.45)	347.0 (5.67)	406.0 (4.20)	340.5 (2.83)	3.0 0.5	59.0 3.9	-65.5 -8.7	-63.5 -0.1	0.14	1.58	-2.32	-0.04	104
.Pulses	682.3 (8.82)	618.3 (10.10)	774.7 (8.01)	728.0 (6.06)	-64.0 -10.7	156.3 15.6	-46.7 -6.2	45.7 1.9	-1.63	2.28	-0.83	0.28	
.Grains	7732.0 (100)	6123.0 (100)	9673.3 (100)	12020.0 (100)	-1609.0 -268.2	3550.3 355.0	2346.7 312.9	4288.0 182.5	-3.81	4.68	2.94	1.90	

* This refers to the end period of average of 1984-85 and 1987-88.

Table II.9 : Changes and Growth Rates of Production of Foodgrains in Region V (1960-61 to 1987-88)

Crops	Average production in '00'				d=differences and per year rates				Growth Rates (% p.a.)			
	Tonnes				'00' tonnes				62-63	68-69	78-79	62-63
(1)	61-62	67-68	77-78	84-85	d1	d2	d3	d4	to	to	to	to
1	63-64	69-70	79-80	87-88	(3)-(2)	(4)-(3)	(5)-(4)	(5)-(2)	68-69	78-79	84-85	84-85
	(2)	(3)	(4)	(5)	6	7	8	9	10	11	and	and
	2	3	4	5	6	7	8	9	10	11	87-88	87-88 *
Rice	560.0 (3.68)	399.0 (2.53)	1364.0 (5.03)	558.5 (2.14)	-161.0 -26.8	965.0 96.5	-805.5 -107.4	-1.5 -0.1	-5.49	13.08	-11.22	-0.01
Wheat	1142.0 (7.50)	928.0 (5.89)	2685.7 (9.92)	1555.0 (5.95)	-214.0 -35.7	1757.7 175.8	-1130.7 -150.8	413.0 17.6	-3.40	11.21	-7.02	1.32
K. Jowar	4034.0 (26.50)	4762.7 (30.24)	11066.3 (40.80)	11070.0 (42.37)	728.7 121.4	6303.7 630.4	3.7 0.5	7036.0 299.4	2.81	8.80	0.00	4.39
R. Jowar	6182.3 (40.61)	5170.7 (32.84)	6534.3 (24.09)	6280.0 (24.04)	-1011.7 -168.6	1363.7 136.4	-254.3 -33.9	97.7 4.2	-2.93	2.37	-0.53	0.07
B. Jowar	10216.3 (67.10)	9916.7 (62.97)	17600.7 (64.90)	17350.0 (66.40)	-299.7 -49.9	7684.0 768.4	-250.7 -33.4	7133.7 303.6	-0.49	5.90	-0.19	2.28
Bajra	733.0 (4.82)	1273.7 (8.09)	1386.0 (5.11)	1733.5 (6.63)	540.7 90.1	112.3 11.2	347.5 46.3	1000.5 42.6	9.65	0.85	3.03	3.73
A. Cereals	105.7 (0.69)	140.7 (0.89)	425.3 (1.57)	349.5 (1.34)	35.0 5.8	284.7 28.5	-75.8 -10.1	243.8 10.4	4.88	11.70	-2.58	5.22
B. Cereals	12757.0 (83.79)	12658.0 (80.38)	23461.7 (86.51)	21681.5 (82.98)	-99.0 -16.5	10803.7 1080.4	-1780.2 -237.4	8924.5 379.8	-0.13	6.37	-1.05	2.28

Table II.9 : (Contd.)

1	2	3	4	5	6	7	8	9	10	11	12	
1 Gram	604.0 (3.97)	444.7 (2.83)	635.3 (2.34)	660.5 (2.53)	-159.3 -26.6	190.7 19.1	25.2 3.4	56.5 2.4	-4.98	3.63	0.52	0.38
2 Tur	713.7 (4.69)	905.3 (5.75)	1261.7 (4.65)	1756.5 (6.72)	191.7 31.9	356.3 35.6	498.8 66.0	1042.8 44.4	4.04	3.37	4.51	3.91
3 Mung	587.3 (3.86)	742.0 (4.71)	887.0 (3.27)	N.A.	154.7 25.8	145.0 14.5	-	-	3.97	1.80	-	-
4 Udid	344.3 (2.26)	463.3 (2.94)	510.3 (1.88)	N.A.	119.0 19.8	47.0 4.7	-	-	5.07	0.97	-	-
5 O.Pulses (Incl, 11, 12)	1150.0 (7.55)	1466.3 (9.31)	1763.0 (6.50)	2027.5 (7.76)	316.3 52.7	296.7 29.7	264.5 35.3	877.5 37.3	4.13	1.86	1.88	2.44
6 T.Pulses	2467.7 (16.21)	2816.7 (17.88)	3660.0 (13.50)	4447.0 (17.02)	349.0 58.2	843.3 84.3	787.0 104.9	1979.3 84.2	2.23	2.65	2.63	2.54
7 F.Grains	15224.7 (100)	15474.7 (100)	27121.7 (100)	26128.5 (100)	250.0 41.7	11647.0 1164.7	-993.2 -132.4	10903.8 464.0	0.27	5.77	-0.50	2.32

* This refers to the end period of average of 1984-85 and 1987-88.

Table II.10: Changes and Growth Rates of Production of Foodgrains in Region VI (1960-61 to 1987-88)

Crops	Average Production in '00' Tonnes				d=differences and per year rates in '00' tonnes				Growth Rates (% p.a.)			
	61-62 to 63-64 (2)	67-68 to 69-70 (3)	77-78 to 79-80 (4)	84-85 and 87-88 (5)	d1 (3)-(2)	d2 (4)-(3)	d3 (5)-(4)	d4 (5)-(2)	62-63 to 68-69	68-69 to 78-79	78-79 to 84-85 and 87-88	62-63 to 84-85 and 87-88
(1)	2	3	4	5	6	7	8	9	10	11	12	13
Rice	132.3 (1.81)	159.7 (1.81)	370.7 (2.51)	155.5 (0.99)	27.3 4.6	211.0 21.1	-215.2 -28.7	23.2 1.0	3.18	8.79	-10.94	0.69
Wheat	703.3 (9.61)	520.0 (5.89)	1490.7 (10.08)	841.0 (5.34)	-183.3 -30.6	970.7 977.1	-649.7 -86.6	137.7 5.9	-4.91	11.11	-7.35	0.76
K.Jowar	4708.3 (64.35)	6648.0 (75.33)	10737.3 (72.608)	11382.0 (72.27)	1939.7 323.3	4089.3 408.9	644.7 86.0	6673.7 284.0	5.92	4.91	0.78	3.83
R.Jowar	12.3 (0.17)	3.3 (0.04)	4.0 (0.03)	6.0 (0.04)	-9.0 -1.5	00.7 0.1	2.0 0.3	-6.3 -0.3	-19.60	1.85	5.56	-3.02
T.Jowar	4747.3 (64.88)	6651.3 (75.37)	10741.3 (72.64)	11338.0 (72.31)	1904.0 317.3	4090.0 409.0	646.7 86.2	6640.7 282.6	5.78	4.91	0.78	3.79
Bajra	46.3 (0.63)	94.3 (1.07)	152.3 (1.03)	127.5 (0.81)	48.0 8.0	58.0 5.8	-24.8 -3.3	81.2 3.5	12.58	4.91	-2.34	4.40
O.Cereals	18.3 (0.25)	34.7 (0.39)	64.3 (0.43)	79.5 (0.51)	16.3 2.7	29.7 3.0	15.2 2.0	61.2 2.6	11.21	6.38	2.86	6.44
T.Cereals	5621.0 (76.82)	7460.0 (84.53)	12819.3 (86.69)	12591.5 (79.95)	1839.0 306.5	5359.3 535.9	-227.8 -30.4	6970.5 296.6	4.83	5.56	-0.24	3.49

Contd.

II.10

Table : Contd.

	1	2	3	4	5	6	7	8	9	10	11	12	13
9 Gram	129.3 (1.77)	66.3 (0.75)	135.7 (0.92)	226.5 (1.44)	-63.0 -20.5	69.3 6.9	90.8 12.1	97.2 4.1	-10.53	7.42	7.07	2.41	
10 Tur	1293.3 (17.68)	932.0 (10.56)	1185.3 (8.02)	1946.5 (12.36)	-361.3 - 60.2	253.3 25.3	761.2 101.5	653.2 27.8	-5.31	2.43	6.84	1.75	
11 Mung	104.0 (1.42)	128.0 (1.45)	217.0 (1.46)	N.A.	24.0 4.0	89.0 8.9	-	-	3.52	5.42	-	-	
12 Udid	116.7 (1.59)	156.7 (1.78)	265.3 (1.79)	N.A.	40.0 6.7	108.7 10.9	-	-	5.04	5.41	-	-	
13 O.Pulses	273.3 (3.74)	360.0 (4.08)	647.7 (4.38)	984.0 (6.25)	86.7 14.4	287.7 28.8	336.3 44.8	710.7 30.2	4.70	6.05	5.74	5.60	
14 T.Pulses	1696.0 (23.18)	1365.0 (15.47)	1968.7 (13.31)	3157.0 (20.05)	-331.0 -55.2	603.7 60.4	1188.3 158.4	1461.0 62.2	-3.55	3.73	6.50	2.68	
15 F.Grains	7317.0 (100)	8825.0 (100)	14788.0 (100)	15748.5 (100)	1508.0 251.3	5963.0 596.3	960.5 128.1	8431.5 358.8	3.17	5.30	0.84	3.32	

This refers to the end period of average of 1984-85 and 1987-88.

II.11

Table : Changes and Growth Rates of Production of Foodgrains in Region VII (1960-61 to 1987-88)

Crops	Average Production in '00' Tonnes				d=differences and per year rates in '00' tonnes				Growth Rates (% p.a.)			
	61-62 to 63-64	67-68 to 69-70	77-78 to 79-80	84-85 and 87-88	d1	d2	d3	d4	62-63 to 68-69	68-69 to 78-79	78-79 to 84-85 and 87-88	62-63 to 84-85 and 87-88
(1)	(2)	(3)	(4)	(5)	(3)-(2)	(4)-(3)	(5)-(4)	(5)-(2)				
1	2	3	4	5	6	7	8	9	10	11	12	13
Rice	4708.3 (51.16)	5108.3 (51.82)	7065.0 (51.87)	3858.5 (38.88)	400.0 66.7	1956.7 195.7	-3206.5 -427.5	-849.8 -36.2	1.37	3.30	-7.75	-0.84
Wheat	840.0 (9.13)	649.3 (6.59)	1404.0 (10.31)	1082.5 (10.91)	-190.7 31.8	754.7 75.5	-321.5 -42.9	242.5 10.3	-4.20	8.02	-3.41	1.09
K. Jowar	1190.0 (12.93)	1906.0 (19.33)	2812.3 (20.65)	1468.5 (14.80)	716.0 119.3	906.3 90.6	-1343.8 -179.2	278.5 11.9	8.17	3.97	-8.30	0.90
R. Jowar	1129.0 (12.27)	1149.0 (11.66)	1187.7 (8.72)	928.5 (9.36)	20.0 3.3	38.7 3.9	-259.2 -34.6	-200.5 -8.5	0.29	0.33	-3.23	-0.83
T. Jowar	2319.0 (25.20)	3055.0 (30.99)	4018.0 (29.5)	3532.0 (35.59)	736.0 122.7	963.0 96.3	-486.0 -64.8	1213.0 51.6	4.70	2.78	-1.70	1.81
Bajra	4.3 (0.05)	4.0 (0.04)	4.7 (0.04)	4.5 (0.05)	-0.3 -0.1	0.7 0.1	-0.2 -0.02	0.2 0.02	-1.31	1.56	-0.49	0.16
O. Cereals	35.0 (0.38)	42.0 (0.43)	85.0 (0.62)	59.0 (0.59)	7.0 1.2	43.0 4.3	-26.0 -3.5	24.0 1.0	3.09	7.30	-4.75	2.25
T. Cereals	7907.0 (85.92)	8858.7 (89.86)	12576.7 (92.34)	8536.5 (85.03)	951.7 158.6	3718.0 371.8	-4040.2 -538.7	629.5 26.8	1.91	3.57	-5.04	0.33

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Contd.

II.11
Table : (Contd.)

	1	2	3	4	5	6	7	8	9	10	11	12	13
Gram		175.3 (1.91)	117.7 (1.19)	123.0 (0.90)	153.5 (1.55)	-57.7 -9.6	5.3 0.5	30.5 4.1	-21.8 -0.9	-6.43	0.44	3.00	-0.56
0 Tur		616.3 (6.70)	434.3 (4.41)	547.7 (4.02)	822.0 (8.28)	-182.0 -30.3	113.3 11.3	274.3 36.6	205.7 8.8	-5.67	2.35	5.56	1.23
1 Mung		67.3 (0.73)	47.0 (0.48)	48.0 (0.35)	N.A.	-20.3 -3.4	1.0 0.1	-	-	-5.82	0.21	-	-
2 Udid		103.7 (1.13)	97.3 (0.99)	85.0 (0.62)	N.A.	-6.3 -1.1	-12.3 -1.2	-	-	-1.05	-1.35	-	-
3 O.Pulses (Incl.11,12)		523.7 (5.69)	448.0 (4.54)	372.3 (2.73)	411.0 (4.14)	-75.7 -12.6	-75.7 -7.6	38.7 5.2	-112.7 -4.8	-2.57	-1.83	1.33	-1.03
4 T.Pulses		1322.0 (14.87)	1000.0 (10.14)	1043.0 (7.66)	1386.5 (13.97)	-322.0 -53.7	43.0 4.3	343.5 45.8	64.5 2.7	-4.55	0.42	3.87	0.20
5 F.Grains		9202.3 (100)	9858.7 (100)	13619.7 (100)	9923.0 (100)	656.3 109.4	3761.0 376.1	-3696.7 -492.9	720.7 30.7	1.15	3.28	-4.13	0.32

* This refers to the end period of average of 1984-85 and 1987-88.

II.12
Table : Changes and Growth Rates of Production of Major Non-foodgrains Crops:Regionwise

REGION-I*													
S. No.	CROPS	Average Production in '00' Tonnes				d=differences and per year rates in '00' Tonnes				Growth Rates (% p.a.)			
		61-62 to 63-64	67-68 to 69-70	77-78 to 79-80	84-85 and 87-88	d1	d2	d3	d4	62-63 to 68-69	68-69 to 78-79	78-79 to 84-85	62-63 to 84-85
(1)	(2)	(3)	(4)	(5)	(3)-(2)	(4)-(3)	(3)-(4)	(5)-(2)	68-69	78-79	84-85	84-85	
1	S' CANE (Gur)	5.3	32.3	38.7	0.0	27.0	6.3	0.0	0.0	35.0	1.81	0.00	0.00
						4.5	0.6	0.0	0.0				
2	G' NUT	3.7	4.7	4.3	46.0	1.0	-0.3	41.7	42.3	4.10-0.75	37.04	11.36	
						0.2	-0.0	5.6	1.8				
REGION-II													
1	S' CANE (Gur)	770.3	1465.7	3866.0	4265.5	695.3	2400.3	399.5	3495.2	11.32	10.19	1.32	7.55
						115.9	240.0	53.3	148.7				
2	COTTON**	2755.0	1794.0	1603.7	1452.0	-961.0	-190.3	-151.7	-1303.0	-6.90	-1.12	-1.32	-2.69
						-160.2	-19.0	-20.2	-55.5				
3	G' NUT	2037.7	1250.7	1493.3	1398.0	-787.0	242.7	-95.3	-639.7	-7.81	1.79	-0.88	-1.59
						-131.2	24.3	-12.7	-27.2				
REGION III													
1	S' CANE (Gur)	5591.0	5207.7	8569.7	9590.5	-383.3	3362.0	1020.8	3999.5	-1.18	5.11	1.51	2.32
						-63.9	336.2	136.1	170.2				
2	COTTON**	704.7	404.3	553.3	68.5	-300.3	149.0	-484.8	-636.2	-8.84	3.19	-24.31	-9.44
						-50.1	14.9	-64.6	-27.1				
3	G' NUT	1019.7	752.3	694.0	1365.5	-267.3	-58.3	671.5	345.8	-4.94	-0.80	9.44	1.25
						-44.6	-5.8	89.5	14.7				

(contd.)

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Table II.12 (contd.)

REGION-IV

S. No.	CROPS	Average Production in '00' Tonnes				d=differences and per year rates in '00' Tonnes				Growth Rates (% p.a.)			
		61-62 to 63-64	67-68 to 69-70	77-78 to 79-80	84-85 and 87-88	d1	d2	d3	d4	62-63 to 68-69	68-69 to 78-79	78-79 to 84-85 87-88	62-63 to 84-85 87-88
1	S' CANE (Gur)	3597.0	5145.0	8795.0	9770.5	1548.0	3650.0	975.5	6173.5	6.15	5.51	1.41	4.34
						258.0	365.0	130.1	262.7				
2	COTTON**	117.0	112.3	136.3	39.0	-4.7	24.0	-97.3	-78.0	-0.68	1.96	-15.37	-4.57
						-0.8	2.4	-13.0	-3.3				
3	G' NUT	2140.0	1893.0	1449.0	2616.5	-247.0	-444.0	1167.5	476.5	-2.02	-2.64	8.20	0.86
						-41.2	-44.4	155.7	20.3				

REGION-V

1	S' CANE (Gur)	862.7	2096.0	3528.3	3625.9	1233.3	1432.3	97.2	2762.8	15.95	5.35	0.36	6.30
						205.6	143.2	13.0	117.6				
2	COTTON**	2815.0	3449.3	3569.3	4503.0	634.3	120.0	933.7	1688.0	3.44	0.34	3.15	2.02
						105.7	12.0	124.5	71.8				
3	G' NUT	2116.3	1657.7	841.3	929.5	-458.7	-816.3	88.2	-1186.8	-3.99	-6.56	1.34	-3.44
						-76.4	-81.6	11.8	-50.5				

(contd.)

II.13

Table : (contd.)

REGION-VI

S. No.	CROPS	Average Production in '00' Tonnes				d-differences and per year rates				Growth Rates (% p.a.)			
		61-62 to 63-64	67-68 to 69-70	77-78 to 79-80	84-85 to 87-88	d1	d2	d3	d4	62-63 to 68-69	68-69 to 78-79	78-79 to 84-85 87-88	62-63 to 84-85 87-88
1	SICANE (Gur)	49.3	193.0	256.7	356.5	143.7 23.9	63.7 6.4	99.8 13.3	307.2 13.1	25.53	2.89	4.48	8.78
2	COTTON**	4904.0	5916.0	5939.3	6422.0	1012.0 168.7	23.3 2.3	482.7 64.4	1518.0 64.6	3.18	0.04	1.05	1.15
3	G'NUT	535.0	588.7	707.3	858.0	53.7 8.9	118.7 11.9	-349.3 -46.6	-177.0 -7.5	1.61	1.85	-8.68	-1.69

REGION-VII

1	SICANE (Gur)	32.3	66.0	74.7	49.5	33.7 5.6	8.7 0.9	-25.2 -3.4	17.2 0.7	12.63	1.24	-5.33	1.83
2	COTTON**	811.0	1178.0	1473.7	1439.0	367.0 61.2	295.7 29.6	-34.7 -4.6	628.0 26.7	6.42	2.26	-0.32	2.47
3	G'NUT	53.0	133.7	178.7	267.5	80.7 13.4	45.0 4.5	88.8 11.8	214.5 9.1	16.67	2.94	5.53	7.13

* There is no cotton area in Region-I and hence it is not included.

** Cotton output is in 100 bales of 180 kg. each.

II.13

Table : Changes and Growth Rates of Area Under Crops in Region I (1960-61 to 1987-88)

SR. CROPS NO.	Average Area in '00' ha.				Difference and per year rates in '00' ha.				Growth Rates (% p.a.)				
	61-62	67-68	77-78	84-85	d1	d2	d3	d4	62-63	68-69	78-79	62-63	
	to 63-64	to 69-70	to 79-80	to 87-88	(3)- (2)	(4)- (3)	(5)- (4)	(5)- (2)	to 68-69	to 78-79	to 84-85	to 84-85	
(1)	(2)	(3)	(4)	(5)							87-88	87-88	
1 RICE	4158.0 (45.82)	4128.0 (45.22)	4426.3 (51.73)	4627.0 (48.51)	-30.0 -5.0	298.3 29.8	200.7 26.8	469.0 20.0	-0.12	0.70	0.59	0.46	
2 WHEAT	0 (0.0)	0 (0.0)	1.3 (0.02)	0	-	-	-	-	-	-	-	-	-
3 K.JOWAR	3.7 (0.04)	5.7 (0.06)	4.7 (0.05)	0	2.0 0.3	-1.0 -0.1	-	-	7.52	-1.92	-	-	-
4 R.JOWAR	0.3 (0.003)	0 (0.0)	0.3 (0.003)	0	-	-	-	-	-	-	-	-	-
5 BAJRA	0 (0.00)	0 (0.00)	0 (0.00)	0	-	-	-	-	-	-	-	-	-
6 O.CEREALS	1647.7 (18.16)	1535.0 (16.82)	1288.7 (15.06)	1355.0 (14.21)	-112.7 -18.8	-246.3 -24.6	66.3 8.8	-292.7 -12.5	-1.17	-1.73	0.67	-0.83	
7 T.CEREALS	5809.7 (64.02)	5668.7 (62.10)	5691.3 (66.52)	5984.5 (62.27)	-141.0 -23.5	22.7 2.3	293.2 39.1	174.8 7.4	-0.41	0.04	0.67	0.13	
8 GRAM	17.3 (0.19)	19.0 (0.21)	17.7 (0.21)	40.0 (0.42)	1.7 0.3	-1.3 0.1	22.3 3.0	22.7 1.0	1.55	-0.72	11.51	3.62	
9 TUR	55.0 (0.61)	54.3 (0.59)	53.7 (0.63)	64.0 (0.67)	-0.7 -0.1	-0.7 -0.1	10.3 1.4	9.0 0.4	-0.20	-0.12	2.37	0.65	
10 MUNG	16.3 (0.18)	14.7 (0.16)	11.3 (0.13)	-	-1.7 -0.3	-3.3 -0.3	-	-	-1.77	-2.55	-	-	

II.13

Table : (contd.)

SR. NO.	CROPS	Average area in '00' hectares				Differences and per year rates				Growth Rates (% p.a.)			
		61-62 to 63-64 (1)	67-68 to 69-70 (2)	77-78 to 79-80 (3)	84-85 to 87-88 (4)	d1 (3)- (2)	d2 (4)- (3)	d3 (5)- (4)	d4 (5)- (2)	62-63 to 68-69	68-69 to 78-79	78-79 to 84-85 87-88	62-63 to 84-85 87-88
11	UDID	111.3 (1.23)	96.0 (1.05)	62.0 (0.72)	-	-15.3 -2.6	-34.0 -3.4	-	-	-2.44	-4.28	-	-
12	O.PULSES (Incl. 10 & 11)	337.7 (3.72)	322.3 (3.53)	220.7 (2.58)	417.5 (4.38)	-15.3 -2.6	-101.7 -10.2	196.8 26.2	79.8 3.4	-0.77	-3.72	8.87	0.91
13	T.PULSES	410.3 (4.52)	395.7 (4.33)	292.0 (3.41)	521.5 (5.47)	-14.7 -2.4	-103.7 -10.4	229.5 30.6	111.2 4.7	-0.60	-2.99	8.04	1.03
14	F.GRAINS	6220.0 (68.54)	6064.3 (66.43)	5983.3 (69.93)	6503.5 (68.18)	-155.7 -25.9	-81.0 -8.1	520.2 69.4	283.5 12.1	-0.42	-0.13	1.12	0.19
15	S' CANE	1.3 (0.01)	4.7 (0.05)	4.0 (0.05)	0 (0.00)	3.3 0.6	-0.7 -0.1	-	-	23.29	-1.54	-	-
16	COTTON	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	-	-	-	-	-	-	-	-
17	G' NUT	3.7 (0.04)	5.0 (0.05)	7.0 (0.08)	31.0 (0.33)	1.3 0.2	2.0 0.2	24.0 3.2	27.3 1.2	5.29	3.42	21.95	9.50
18	SAFFLR	0 (0.00)	3.0 (0.03)	0	0	-	-	-	-	-	-	-	-
19	O.CROPS	2850.3 (31.41)	3051.3 (33.43)	2561.7 (29.94)	3003.9* (31.49)	201.0 33.5	-489.6 -49.0	-	-	1.1	-1.8	-	-
20	GCA	9075.3 (100.00)	9128.3 (100.00)	8556.0 (100.00)	9538.4* (100.00)	53.0 8.8	-572.3 -57.2	-	-	0.10	-0.65	-	-

* Estimated.

II.14
 Table : Changes and Growth Rates of Area Under Crops in Region II (1960-61 to 1987-88)

SR. NO.	CROPS (1)	Average area in '00' ha.				Difference & per year rates in '00' ha.				Growth rates (% p.a.)			
		61-62 to 63-64 (2)	67-68 to 69-70 (3)	77-78 to 79-80 (4)	84-85 and 87-88 (5)	d1 (3)- (2)	d2 (4)- (3)	d3 (5)- (4)	d4 (5)- (2)	62-63 to 68-69	68-69 to 78-79	78-79 to 84-85 87-88	62-63 to 84-85 87-88
1	RICE	733.7 (2.83)	605.0 (2.37)	770.3 (2.87)	716.5 (2.54)	-128.7 -21.4	165.3 16.5	-53.8 -7.2	-17.2 -0.7	-3.16	2.45	-0.96	-0.10
2	WHEAT	1512.0 (5.83)	1688.3 (6.41)	2154.7 (8.02)	1656.0 (5.88)	126.3 21.1	516.3 51.6	-498.7 -66.5	144.0 6.1	1.35	2.78	-3.45	0.39
3	K.JOWAR	2146.0 (8.28)	2037.0 (7.97)	3440.0 (12.80)	3584.5 (12.73)	-109.0 -18.2	1403.0 140.3	144.5 19.3	1438.5 61.2	-0.87	5.38	0.55	2.21
4	R.JOWAR	2210.7 (8.53)	1333.0 (5.22)	1916.8 (7.13)	1877.0 (6.66)	-877.9 -146.3	583.3 58.3	-39.3 -5.2	-333.7 -14.2	-8.09	8.70	-0.28	-0.69
5	BAJRA	5579.0 (21.53)	6621.7 (25.91)	5228.7 (19.46)	6346.5 (22.53)	1042.7 173.8	-1393.0 -139.3	1117.8 149.0	767.5 32.7	2.90	-2.33	2.62	0.55
6	O.CEREALS	1077.0 (4.16)	1178.3 (4.61)	1237.0 (4.61)	1287.5 (4.57)	101.3 16.9	58.7 5.9	50.5 6.7	210.5 9.0	1.51	0.49	0.53	0.76
*7	T.CEREALS	13258.3 (51.17)	13413.0 (52.49)	14747.0 (54.89)	15468.0 (54.91)	154.7 25.8	1334.0 133.4	721.0 96.1	2209.7 94.0	0.19	0.95	0.64	0.66
8	GRAM	349.3 (1.35)	336.0 (1.31)	389.7 (1.45)	742.5 (2.64)	-13.3 -2.2	53.7 5.4	352.8 47.0	393.2 16.7	-0.65	1.49	8.98	3.26
9	TUR	268.7 (1.04)	240.7 (0.94)	260.7 (0.97)	339.0 (1.20)	-28.0 -4.7	20.0 2.0	78.3 10.4	70.3 3.0	-1.82	0.80	3.57	0.99
10	MUNG	703.7 (2.72)	941.3 (3.68)	896.0 (3.34)	N.A.	2380 39.7	-45.3 -4.5	-	-	4.98	-0.49	-	-

Table : (contd.)

SR. NO.	CROPS (1)	Average area in '00' ha.				Difference and per year rates in '00' ha.				Growth Rates (% p.a.)			
		61-62 to 63-64 (2)	67-68 to 69-70 (3)	77-78 to 79-80 (4)	84-85 to 87-88 (5)	d1 (3)- (2)	d2 (4)- (3)	d3 (5)- (4)	d4 (5)- (2)	62-63 to 68-69	68-69 to 78-79	78-79 to 84-85 87-88	62-63 to 84-85 87-88
11	UDID	1357.3 (5.24)	1652.3 (6.47)	1570.3 (5.85)	N.A.	295.0 49.2	-82.0 -8.2	-	-	3.33	-0.51	-	-
12	O.PULSES (Incl. 10 & 11)	3101.0 (11.97)	3765.7 (14.74)	3814.0 (14.20)	3207.5 (11.39)	664.7 110.8	48.3 4.8	-606.5 -80.9	106.5 4.5	3.29	0.13	-2.28	0.14
13	T.PULSES	3719.0 (14.35)	4342.0 (16.99)	4461.7 (16.61)	3289.0 (15.23)	623.0 103.8	119.7 12.0	-172.7 -23.0	570.0 24.3	2.61	0.27	-0.52	0.61
14	F.GRAINS	16977.3 (65.52)	17755.0 (69.49)	19208.7 (71.50)	19857.0 (70.49)	777.7 129.6	1453.7 145.4	648.3 86.4	2879.7 122.5	0.75	0.79	0.44	0.67
15	S' CANE	125.3 (0.48)	163.7 (0.64)	436.3 (1.62)	539.0 (1.91)	38.3 6.4	272.7 27.3	102.7 13.7	413.7 17.6	4.55	10.30	2.86	6.40
16	COTTON	3699.0 (14.27)	3348.7 (13.11)	2314.3 (8.62)	2359.5 (8.38)	-350.3 -58.4	-1034.3 -103.4	45.2 6.0	-1339.5 -57.0	-1.64	-3.63	0.26	-1.90
17	G' NUT	3117.3 (12.03)	1994.7 (7.81)	2427.7 (9.04)	2097.5 (7.45)	-1122.7 -187.1	433.0 43.3	-330.2 -44.0	-1019.8 -43.4	-7.17	1.98	-1.93	-1.67
18	SAFFLR	20.3 (0.08)	22.3 (0.09)	77.3 (0.29)	143.5 (0.51)	2.0 0.3	55.0 5.5	66.2 8.8	123.2 5.2	1.58	13.23	8.59	8.67
19	O.CROPS	1973.5 (7.62)	2267.6 (8.88)	2400.4 (8.94)	3172.0 (11.26)	294.1 49.0	132.8 13.3	-	-	2.32	0.57	-	-
20	GCA	25912.7 (100.00)	25552.0 (100)	26864.7 (100)	28168.5 (100)	-360.7 -60.1	1312.7 131.3	-	-	-0.23	0.50	-	-

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*Estimated

II.15

Table : Changes and Growth Rates of Area Under Crops in Region III
(1960-61 to 1987-88)

SR. CROPS (1)	Average area in '00' ha.				Difference and per year rates in '00' ha.				Growth rates (% p.a.)			
	61-62 to 63-64	67-68 to 69-70	77-78 to 79-80	84-85 and 87-88	d1 (3)- (2)	d2 (4)- (3)	d3 (5)- (4)	d4 (5)- (2)	62-63 to 68-69	68-69 to 78-79	78-79 to 84-85 87-88	62-63 to 84-85 87-88
	(2)	(3)	(4)	(5)								
1 RICE	738.7 (2.00)	619.7 (1.67)	642.0 (1.75)	661.5 (1.76)	-119.0 -19.8	22.3 2.2	19.5 2.6	-77.2 -3.3	-2.89	0.35	0.40	-0.47
2 WHEAT	820.3 (2.23)	910.3 (2.46)	1574.0 (4.29)	1492.5 (3.97)	90.0 15.0	663.7 66.4	-81.5 -10.9	672.2 28.6	1.75	5.63	-0.71	2.58
3 K.JOWAR	334.3 (0.91)	230.0 (0.62)	858.7 (2.34)	487.0 (1.30)	-104.3 -17.4	628.7 62.9	-371.7 -49.6	152.7 6.5	-6.04	14.08	-7.28	1.61
4 R.JOWAR	18428.3 (50.00)	16935.0 (45.75)	17413.0 (47.41)	18496.5 (49.24)	-1493.3 -248.9	478.0 47.8	1083.5 144.5	68.2 2.9	-1.4	0.28	0.81	0.02
5 BAJRA	5520.0 (14.98)	6742.7 (18.21)	4731.0 (12.88)	5266.0 (14.02)	1222.7 203.8	-2011.7 -201.2	385.0 71.3	-254.0 -10.8	3.39	-3.48	1.44	-0.20
6 O.CERE-ALS	451.7 (1.23)	462.7 (1.25)	528.7 (1.44)	704.5 (1.88)	11.0 1.8	66.0 6.6	175.8 23.4	252.8 10.8	0.40	1.34	3.90	1.91
7 T.CERE-ALS	26293.3 (71.34)	25900.7 (69.97)	25747.3 (70.10)	27108.0 (72.17)	-392.7 -65.4	-153.3 -15.3	1360.7 181.4	814.7 34.7	-0.25	-0.06	0.69	0.13
8 GRAM	659.3 (1.79)	619.7 (1.67)	775.7 (2.11)	1024.5 (2.73)	-39.7 -6.6	156.0 15.6	248.8 33.2	365.2 15.5	-1.03	2.27	3.78	1.89
9 TUR	648.7 (1.76)	824.7 (2.23)	845.3 (2.30)	412.5 (1.10)	176.0 29.3	20.7 2.1	-432.8 -57.7	-236.2 -10.0	4.08	0.25	-9.12	-1.91
10 MUNG	349.7 (0.95)	320.3 (0.87)	195.0 (0.53)	N.A.	-29.3 -4.9	-125.3 -12.5	-	-	-1.45	-4.84	--	--

(contd.)

Table : (contd.)

SR. CROPS NO. (1)	Average area in '00' ha.				Difference and per year rates in '00' ha.				Growth Rates (% p.a.)			
	61-62 to 63-64 (2)	67-68 to 69-70 (3)	77-78 to 79-80 (4)	84-85 and 87-88 (5)	d1 (3)- (2)	d2 (4)- (3)	d3 (5)- (4)	d4 (5)- (2)	62-63 to 68-69	68-69 to 78-79	78-79 to 84-85 87-88	62-63 to 84-85
11 UDID	71.0 (0.19)	97.0 (0.26)	65.0 (0.18)	N.A.	26.0 4.3	-32.0 -3.2	-	-	5.34	-3.92	-	-
12 P.PULSES	1578.7 (4.28)	1771.3 (4.78)	1864.7 (5.08)	1127.5 (3.00)	192.7 32.1	93.3 9.3	-737.2 -98.3	-451.2 -19.2	1.94	0.51	-6.49	-1.42
13 T.PULSES	2887.0 (7.83)	3215.7 (8.69)	3485.7 (9.49)	2564.5 (6.85)	328.7 54.8	270.0 27.0	-921.2 -122.8	-322.5 -13.7	1.81	0.81	-4.01	-0.50
14 F.GRAINS	29180.3 (79.17)	29026.3 (78.41)	29233.0 (79.59)	29672.5 (79.00)	-154.0 -25.7	206.7 20.7	439.5 58.6	492.2 20.9	-0.09	0.07	0.20	0.07
15 S.CANE	556.0 (1.51)	735.3 (1.99)	1054.0 (2.87)	1223.5 (3.26)	179.3 29.9	318.7 31.9	169.5 22.6	667.5 28.4	4.77	3.67	2.01	3.41
16 COTTON	705.0 (1.91)	467.0 (1.26)	339.7 (0.92)	55.0 (0.15)	-237.3 -39.6	-128.0 -12.8	-284.7 -38.0	-650.0 -27.7	-6.67	-3.15	-21.55	-10.29
17 G.NUT	1479.3 (4.01)	1236.0 (3.34)	858.7 (2.34)	989.5 (2.63)	-243.3 -40.6	-377.3 -37.7	130.8 17.4	-489.8 -20.8	-2.95	-3.58	1.91	-1.70
18 SAFFLR	1288.3 (3.50)	1359.0 (3.67)	1504.0 (4.09)	1897.5 (5.05)	70.7 11.8	145.0 14.5	393.5 52.5	609.2 25.9	0.89	1.02	3.15	1.66
19 O.CROPS	3647.2 (9.90)	4195.1 (11.33)	3741.9 (10.19)	3723.1 (9.91)	547.9 91.3	-453.2 -45.3	-	-	2.33	-1.14	-	-
20 GCA	36855.7 (100.00)	37018.7 (100.00)	36731.3 (100.00)	37561.1 (100)	163.0 27.2	-287.3 -28.7	-	-	0.07	-0.08	-	-

* Estimated

II.16
 Table : Changes and Growth Rates of Area Under Crops in Region IV (1960-61 to 1987-88)

SR. CROPS NO.	Average area in '00' ha.				Difference and per year rates in '00' ha.				Growth rates (% p.a.)			
	61-62	67-68	77-78	84-85	d1	d2	d3	d4	62-63	68-69	78-79	62-63
	to 63-64	to 69-70	to 79-80	to 87-88	(3)- (2)	(4)- (3)	(5)- (4)	(5) - (2)	to 68-69	to 78-79	to 84-85	to 84-85
1 RICE	1456.0 (7.77)	1861.3 (10.27)	1507.0 (8.64)	1527.5 (7.86)	-94.7 -15.8	145.7 14.6	20.5 2.7	71.5 3.0	-1.11	1.02	0.18	0.20
2 WHEAT	307.7 (1.64)	297.7 (1.64)	691.7 (3.96)	707.0 (3.64)	-10.0 -1.7	394.0 39.4	15.3 2.0	399.3 17.0	-0.55	8.80	0.29	3.60
3 K.JOWAR	2658.7 (14.19)	2197.3 (12.12)	2794.7 (16.02)	2714.5 (13.96)	-461.3 -76.9	597.3 59.7	-80.2 -10.7	55.8 2.4	-3.13	2.43	-0.39	0.09
4 R.JOWAR	2658.7 (14.19)	2191.0 (12.08)	2284.7 (13.09)	2821.0 (14.51)	-467.7 -77.9	93.7 9.4	536.3 71.5	162.3 6.9	-3.17	0.42	2.85	0.25
5 BAJRA	2842.7 (15.17)	2952.7 (16.28)	1998.0 (11.45)	2069.5 (10.65)	110.0 18.3	-954.7 -95.5	71.5 9.5	-773.2 -32.9	0.63	-3.83	0.47	-1.34
6 O.CERE- ALS	803.7 (4.29)	765.7 (4.22)	771.7 (4.42)	883.0 (4.54)	-38.0 -6.3	6.0 0.6	111.3 14.8	79.3 3.4	-0.80	0.08	1.81	0.40
7 T.CERE- ALS	10727.3 (57.26)	9765.7 (53.86)	10047.7 (57.58)	10722.5 (55.16)	-961.7 -160.3	282.0 28.2	674.8 90.0	-4.8 -0.2	-1.55	0.29	0.87	0.0
8 GRAM	313.7 (1.67)	234.3 (1.29)	361.7 (2.07)	559.5 (2.83)	-79.3 -13.2	127.8 12.7	188.8 25.2	236.8 10.1	-4.74	4.44	5.76	2.42
9 TUR	302.3 (1.61)	281.0 (1.55)	277.0 (1.59)	250.0 (1.29)	-21.3 -3.6	-4.0 -0.4	-27.0 -3.6	-52.3 -2.2	-1.21	-0.14	-1.36	-0.81
10 MUNG	51.0 (0.27)	44.7 (0.25)	44.0 (0.25)	N.A.	-6.3 -1.1	-0.7 -0.1	-	-	-2.18	-0.15	-	-

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(contd.)

Table : (Contd.)

SR. NO.	CROPS (1)	Average area in '00 ha.				Difference and per year rates in '00 ha.				Growth rates (% p.a.)			
		61-62	67-68	77-78	84-85	d1	d2	d3	d4	62-63	68-69	78-79	82-83
		to 63-64 (2)	to 69-70 (3)	to 79-80 (4)	and 87-88 (5)	(3)- (2)	(4)- (3)	(5)- (4)	(5)- (2)	to 68-69	to 78-79	to 84-85 87-88	to 84-85 87-88
11	UDID	158.7 (0.85)	166.3 (0.92)	138.7 (0.79)	N.A.	7.7 1.3	-27.7 -2.8	-	-	0.79	-1.80	-	-
12	O.PUL- SES (Incl. 10 & 11)	974.7 (5.20)	1012.3 (5.58)	1155.0 (6.62)	1126.5 (5.80)	37.7 6.3	142.7 14.3	-28.5 -3.8	151.8 6.5	0.63	1.33	-0.33	0.62
13	T.PUL- SES	1590.7 (8.49)	1527.7 (8.43)	1793.7 (10.28)	1927.0 (9.91)	-63.0 -10.5	266.0 26.6	133.3 17.8	336.3 14.3	-0.67	1.62	0.96	0.82
14	F. GRAINS	12318.0 (65.75)	11293.3 (62.28)	11841.3 (67.86)	12649.5 (65.07)	-1024.7 -170.8	548.0 54.8	808.2 107.8	331.5 14.1	-1.44	0.47	0.88	0.11
15	SICANE	496.0 (2.65)	694.0 (3.83)	974.3 (5.58)	1108.5 (5.70)	199.00 33.0	280.3 28.0	134.2 17.9	612.5 26.1	5.76	3.45	1.74	3.48
16	COTTON	108.0 (0.58)	89.7 (0.49)	104.0 (0.60)	28.5 (0.15)	-18.3 -3.1	14.3 1.4	-75.5 -10.1	-79.5 -3.4	-3.05	1.49	-15.85	-5.51
17	G'NUT	2051.3 (10.95)	2159.0 (11.91)	1644.3 (9.42)	1868.0 (9.61)	107.7 17.9	-514.7 -51.5	223.7 29.8	-183.3 -7.8	0.86	-2.69	1.72	-0.40
18	SAFFLR	130.0 (0.69)	128.3 (0.71)	156.7 (0.90)	177.5 (0.91)	-1.7 -0.3	28.3 2.8	20.8 2.8	47.5 2.0	-0.22	2.02	1.68	1.33
19	O.CROPS	3630.7 (19.38)	3767.7 (20.78)	2729.7 (15.64)	*3607.7 (18.56)	137.0 22.8	-1038.0 -103.8	-	-	0.62	-3.22	-	-
20	GCA	18734.0 (100.00)	18132.0 (100.00)	17450.3 (100.00)	19439.7 (100)	-602.0 -100.3	-681.7 -68.2	-	-	-0.54	-0.38	-	-

*Estimated

II.17

Table : Changes and Growth Rates of Area Under Crops in Region V (1960-61 to 1987-88)

SR. CROPS No. (1)	Average area in '00' ha.				Differences and per year rates in '00' ha.				Growth rates (% p.a.)			
	61-62 to 63-64 (2)	67-68 to 69-70 (3)	77-78 to 79-80 (4)	84-85 & 87-88 (5)	d1 (3)- (2)	d2 (4)- (3)	d3 (5)- (4)	d4 (5)- (2)	62-63 to 68-69	68-69 to 78-79	78-79 to 84-85 87-88	62-63 to 84-85 87-88
	1 RICE	882.0 (1.79)	856.7 (1.68)	1149.7 (2.14)	1075.0 (1.91)	-25.3 -4.2	293.0 29.3	-74.7 -10.0	193.0 8.2	-0.48	2.99	-0.89
2 WHEAT	2696.3 (5.47)	2440.7 (4.78)	3278.0 (6.11)	2208.0 (3.91)	-255.7 -42.6	837.3 83.7	-1070.0 -142.7	-488.3 -20.8	-1.65	2.99	-5.13	-0.85
3 K.JOWAR	7614.3 (15.45)	7697.0 (15.08)	9917.7 (18.48)	10254.0 (18.18)	82.7 13.8	2220.7 222.1	336.3 44.8	2639.7 112.3	0.18	2.57	0.45	1.27
4 R.JOWAR	10538.3 (21.38)	9561.3 (18.73)	10062.7 (18.75)	11372.0 (20.16)	-977.0 -162.8	501.3 50.1	1309.3 174.6	833.7 35.5	-1.61	0.51	1.64	0.32
5 BAJRA	2684.3 (5.45)	3944.7 (7.73)	3446.3 (6.42)	3903.0 (6.92)	1260.3 210.1	-498.3 -49.8	456.7 60.9	1218.7 51.9	6.63	-1.34	1.67	1.61
6 O.CERE- ALS	456.0 (0.93)	470.0 (0.92)	538.0 (1.00)	495.5 (0.88)	14.0 2.3	68.0 6.8	-42.5 -5.7	39.5 1.7	0.51	1.36	-1.09	0.35
7 T.CERE- ALS	24870.0 (50.46)	24970.3 (48.92)	28382.3 (52.90)	29307.5 (51.96)	100.3 16.7	3422.0 342.2	915.2 122.0	4437.5 188.8	0.07	1.29	0.42	0.70
8 GRAM	1775.3 (3.60)	1675.3 (3.28)	1844.7 (3.44)	1884.0 (3.34)	-100.0 -16.7	169.3 16.9	39.3 5.2	108.7 4.6	-0.96	0.97	0.28	0.25
9 TUR	2070.0 (4.20)	2460.3 (4.82)	2746.7 (5.12)	3045.5 (5.40)	390.3 65.1	286.3 28.6	298.8 39.8	975.5 41.5	2.92	1.11	1.39	1.66
10 MUNG	2233.7 (4.53)	2828.7 (5.54)	2845.0 (5.30)	N.A.	595.0 99.2	16.3 1.6	- -	- -	4.01	0.06	-	-

II.17
Table : (contd.)

SR. CROPS NO. (1)	Average area in '00' ha.				Diff. & per year rates '00' ha				Growth rates (% p.a.)			
	61-62 to 63-64	67-68 to 69-70	77-78 to 79-80	84-85 to 87-88	d1 (3)- (2)	d2 (4)- (3)	d3 (5)- (4)	d4 (5)- (2)	62-63 to 68-69	68-69 to 72-79	78-79 to 84-85	62-63 to 84-85
	(2)	(3)	(4)	(5)								
11 UDID	1397.3 (2.83)	1848.3 (3.62)	1584.0 (2.95)	N.A.	451.0 75.2	-264.3 -26.4	-	-	4.77	-1.53	-	-
12 O.PULSES (Incl. 10 & 11)	4768.3 (9.67)	5941.0 (11.64)	5941.3 (11.07)	5577.0 (9.89)	1172.7 195.4	0.3 0.0	-364.3 -48.6	808.7 34.4	3.73	0.00	-8.84	0.67
13 T.PULSES	8616.3 (17.48)	10076.7 (19.74)	10532.7 (19.62)	10506.5 (18.63)	1460.3 243.4	456.0 45.6	-26.2 -3.2	1890.2 80.4	2.64	0.44	-0.03	0.85
14 F.GRAINS	33486.3 (67.94)	35047.0 (68.66)	38925.0 (72.52)	39814.0 (70.59)	1560.7 260.1	3878.0 -387.8	889.0 118.5	6327.7 269.3	0.76	1.06	0.30	0.74
15 S' CANE	214.7 (0.44)	303.0 (0.59)	569.7 (1.06)	573.0 (1.02)	88.3 14.7	266.7 26.7	3.3 0.4	358.3 15.2	5.91	6.52	0.08	4.27
16 COTTON	7477.3 (15.17)	7612.7 (14.91)	6142.0 (11.44)	6716.5 (11.91)	135.3 22.6	-1470.7 -147.1	574.5 76.6	-760.8 -32.4	0.30	-2.12	1.20	-0.46
17 G' NUT	3416.7 (6.93)	2584.3 (5.06)	1539.0 (2.87)	1213.5 (2.15)	-832.3 -138.7	-1045.3 -104.5	-325.5 -43.4	-2203.2 -93.8	-4.55	-5.05	-3.12	-4.31
18 SAFFLR	1635.0 (3.32)	2028.3 (3.97)	2588.3 (4.82)	3592.0 (6.37)	393.3 65.6	560.0 56.0	1003.7 138.8	1957.0 83.3	3.66	2.47	4.47	3.41
19 O. CROPS	3059.3 (0.06)	3469.7 (6.80)	3909.3 (7.28)	4491.2 (7.96)	410.4 68.4	439.6 44.0	-	-	2.10	-1.19	-	-
20 GCA	49289.3 (100.00)	51045.0 (100.00)	53671.3 (100.00)	56400.2 (100)	1755.7 292.6	2626.3 262.6	-	-	0.59	0.50	-	-

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* Estimated.

II.18

Table : Changes and Growth Rates of Area Under Crops in Region VI (1960-61 to 1987-88)

SR. NO.	Average Area in '00' ha.				d=differences and per year rates in '00' ha.				Growth Rates (% p.a.)				
	61-62	67-68	77-78	84-85	d1	d2	d3	d4	62-63	68-69	78-79	62-63	
	to 63-64	to 69-70	to 79-80	and 87-88	(3)- (2)	(4)- (3)	(5)- (4)	(5)- (2)	to 68-69	to 78-79	to 84-85	to 84-85	
(1)	(2)	(3)	(4)	(5)							87-88	87-88	
1 RICE	298.7 (1.02)	351.3 (1.15)	404.0 (1.24)	315.5 (0.95)	52.7 8.8	52.7 5.3	-88.5 -11.8	16.8 0.7	2.74	1.41	-3.24	0.23	
2 WHEAT	1605.0 (5.47)	1313.3 (4.31)	1763.3 (5.41)	995.5 (2.98)	-291.7 -48.6	450.0 45.0	-767.8 -102.4	-609.5 -25.9	-3.29	2.99	-7.34	-2.01	
3 K.JOWAR	9115.3 (31.07)	9785.7 (32.09)	10059.3 (30.85)	9211.5 (27.58)	670.3 111.7	273.7 27.4	-847.8 -113.0	96.2 4.1	1.19	0.28	-1.17	0.04	
4 R.JOWAR	23.3 (0.08)	8.3 (0.03)	8.3 (0.03)	14.0 (0.04)	-15.0 -2.5	0.0 0.0	5.7 0.8	-9.3 -0.4	15.77	0.00	7.17	-2.15	
5 BAJRA	258.0 (0.88)	335.7 (1.10)	374.0 (1.15)	283.5 (0.85)	77.7 12.9	38.3 3.8	-90.5 -12.1	25.5 1.1	4.48	1.09	-3.63	0.40	
6 O.CEREALS	64.7 (0.22)	87.7 (0.29)	127.0 (0.39)	124.0 (0.37)	23.0 3.8	39.3 3.9	-3.0 -0.4	59.3 2.5	5.20	3.78	-0.32	2.81	
7 T.CEREALS	11336.0 (38.64)	11882.3 (38.96)	12736.0 (39.05)	10944.0 (32.77)	516.3 86.1	853.7 85.4	-1792.0 -238.9	-422.0 -18.0	0.74	0.70	-2.00	-0.16	
8 GRAM	392.0 (1.34)	245.3 (0.80)	458.3 (1.41)	607.0 (1.82)	-146.7 -24.4	213.0 21.3	148.7 19.8	215.0 9.1	-7.51	6.45	3.82	1.88	
9 TUR	1364.0 (4.65)	1471.0 (4.82)	1620.7 (4.97)	2493.5 (7.47)	107.0 17.8	149.7 15.0	872.8 116.4	1129.5 48.1	1.27	0.97	5.91	2.60	
10 MUNG	554.0 (1.89)	725.3 (2.38)	1069.7 (3.28)	N.A.	171.3 28.6	344.3 34.4	-	-	4.59	3.96	-	-	

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contd.

II.18

Table : (contd.)

SR. CROPS No.	Average Area in '00' ha.				d=differences and per year rates in '00' ha.				Growth Rates (% p.a.)			
	61-62 to 63-64 (2)	67-68 to 69-70 (3)	77-78 to 79-80 (4)	84-85 and 87-88 (5)	d1 (3)- (2)	d2 (4)- (3)	d3 (5)- (4)	d4 (5)- (2)	62-63 to 68-69	68-69 to 78-79	78-79 to 84-85 87-88	62-63 to 81-85 87-88
11 UDID	736.3 (2.51)	952.0 (3.12)	1038.7 (3.19)	N.A.	215.7 35.9	86.7 3.7	-	-	4.37	0.88	-	-
12 O.PULSES (Incl.10, 11)	1535.3 (5.23)	1963.7 (6.44)	2476.0 (7.59)	3331.0 (9.97)	428.3 71.4	512.3 51.2	855.0 114.0	1795.7 76.4	4.19	2.35	4.03	3.35
13 T.PULSES	3292.3 (11.22)	3678.0 (12.06)	4555.0 (13.97)	6431.5 (19.26)	385.7 64.3	877.0 87.7	1876.5 250.2	3139.2 133.6	1.86	2.16	4.71	2.89
14 F.GRAMS	14568.3 (49.97)	15560.3 (51.02)	17291.0 (53.02)	17375.5 (52.02)	902.0 150.3	1730.7 173.1	84.5 11.3	2717.2 115.6	1.00	1.06	0.07	0.73
15 S' CANE	19.3 (0.07)	28.3 (0.09)	39.0 (0.12)	47.0 (0.14)	9.0 1.5	10.7 1.1	8.0 1.1	27.7 1.2	6.58	3.25	2.52	3.85
16 COTTON	12506.0 (42.63)	12973.0 (42.54)	12447.3 (38.17)	14029.5 (42.00)	467.0 77.8	-525.7 -52.6	1582.2 211.0	1523.5 64.8	0.61	-0.41	1.61	0.49
17 G'NUT	1167.7 (3.98)	944.0 (3.09)	1272.0 (3.90)	654.0 (1.96)	-223.7 -37.3	328.0 32.8	-618.0 -82.4	-513.7 -21.9	-3.48	3.03	-8.49	-2.44
18 SAFFLR	144.3 (0.50)	188.3 (0.62)	559.3 (1.72)	782.0 (2.34)	44.0 7.3	371.0 37.1	222.7 29.7	637.7 27.1	4.53	11.50	4.57	7.46
19 O.CROPS	838.7 (2.86)	803.1 (2.63)	1003.7 (3.08)	* 512.9 (1.54)	-35.6 -5.9	200.6 20.1	-	-	-0.72	2.22	-	-
20 GCA	29334.3 (100)	30497.0 (100)	32612.3 (100)	* 33400.9 (100)	1162.7 193.8	2115.3 211.5	-	-	0.65	0.67	-	-

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* Estimated

II.19

Table : Changes and Growth Rates of Area Under Crops in Region VII (1960-61 to 1987-88)

SR. NO. CROPS (1)	Average Area in '00' ha.				d=differences and per year rates in '00' ha.				Growth Rates (% p.a.)			
	61-62 to 63-64 (2)	67-68 to 69-70 (3)	77-78 to 79-80 (4)	84-85 and 87-88 (5)	d1 (3)- (2)	d2 (4)- (3)	d3 (5)- (4)	d4 (5)- (2)	62-63 to 68-69	68-69 to 78-79	78-79 to 84-85 87-88	62-63 to 84-85 87-88
1 RICE	5076.0 (23.61)	5367.3 (24.32)	6018.0 (26.08)	5522.0 (26.26)	291.3 48.6	650.7 65.1	-496.0 -66.1	446.0 19.0	0.93	1.15	-1.14	-0.36
2 WHEAT	1979.3 (9.21)	1746.3 (7.91)	2029.7 (8.80)	1547.5 (7.36)	-233.0 -38.8	283.3 28.3	-482.2 -64.3	-431.8 -18.4	-2.07	1.51	-3.55	-1.04
3 K.JOWAR	3139.7 (14.61)	3296.3 (14.93)	3387.0 (14.68)	2966.0 (14.10)	156.7 26.1	90.7 9.1	-421.0 -56.1	-173.7 -7.4	0.81	0.27	-1.75	-0.24
4 R.JOWAR	2581.0 (12.01)	2717.7 (12.31)	2436.0 (10.56)	2325.0 (11.06)	136.7 22.8	-281.7 -28.2	-111.0 -14.8	-256.0 -10.9	0.86	-1.09	-0.62	-0.44
5 BAJRA	24.7 (0.12)	14.7 (0.07)	12.3 (0.05)	12.5 (0.06)	-10.0 -1.7	-2.3 -0.2	0.2 0.0	-12.2 -0.5	-8.30	-1.72	0.18	-2.85
6 O.CERE- ALS	111.3 (0.52)	137.3 (0.62)	144.0 (0.62)	100.5 (0.48)	26.0 4.3	6.7 0.7	-43.5 -5.8	-10.8 -0.5	3.56	0.48	-4.68	-0.43
7 T.CERE- ALS	12912.7 (60.07)	13280.0 (60.16)	14027.0 (60.79)	12473.5 (59.51)	367.3 61.2	747.0 74.7	-1553.5 -207.1	-439.2 -18.7	0.47	0.55	-1.55	-0.15
8 GRAM	330.7 (1.54)	356.7 (1.62)	436.3 (1.89)	496.5 (2.36)	26.0 4.3	79.7 8.0	60.2 8.0	165.8 7.1	1.27	2.04	1.74	1.74
9 TUR	861.3 (4.01)	825.3 (3.74)	804.0 (3.48)	1080.5 (5.14)	-36.0 -6.0	-21.3 -2.1	276.5 36.9	219.2 9.3	-0.71	-0.26	4.02	0.97
10 MUNG	271.7 (1.26)	308.7 (1.40)	264.0 (1.14)	N.A.	27.0 6.2	-44.7 -4.5	0.0 0.0	0.0 0.0	2.15	-1.55	-	-

Table : (contd.)

S. NO.	CROPS (1)	Average Area in '00' ha.				d=differences and per year rates in '00' ha.				Growth Rates (% p.a.)			
		61-62 to 63-64 (2)	67-68 to 69-70 (3)	77-78 to 79-80 (4)	84-85 and 87-88 (5)	d1 (3)- (2)	d2 (4)- (3)	d3 (5)- (4)	d4 (5)- (2)	62-63 to 68-69	68-69 to 78-79	78-79 to	62-63 to
11	UDID	445.0 (2.07)	386.7 (1.75)	336.3 (1.46)	N.A.	-58.3 -9.7	-50.3 -5.0	-	-	-2.31	-1.39	-	-
12	O.PULSES (Incl.10, 11)	2145.7 (9.98)	1999.3 (9.06)	1678.0 (7.27)	1513.0 (7.19)	-146.3 -24.4	-321.3 -32.1	-165.0 -22.0	-632.7 -26.9	-1.17	-1.74	-1.37	-1.48
13	T.PULSES	3338.3 (15.53)	3181.3 (14.41)	2918.3 (12.65)	3090.0 (14.69)	-157.0 -26.2	-263.0 -26.3	171.7 22.9	-248.3 -10.6	-0.80	-0.86	0.77	-0.33
14	F.GRAINS	16251.0 (75.60)	16461.3 (47.58)	16945.3 (73.44)	15563.5 (74.01)	210.3 35.1	484.0 48.4	-1381.8 -184.2	-687.5 -29.3	0.21	0.29	-1.13	-0.18
15	S' CANE	8.7 (0.04)	10.0 (0.05)	13.0 (0.06)	5.0 (0.02)	1.3 0.2	3.0 0.3	-8.0 -1.1	-3.7 -0.2	2.41	2.66	-11.96	-2.32
16	COTTON	2685.3 (12.49)	2936.7 (13.30)	2947.0 (12.77)	2821.0 (13.41)	251.3 41.9	10.3 1.0	-126.0 -16.8	135.7 5.8	1.50	0.04	-0.58	0.21
17	G' NUT	89.7 (0.42)	229.3 (1.04)	261.0 (1.13)	375.0 (1.78)	139.77 23.3	31.7 3.2	114.0 15.2	285.3 12.1	16.94	1.30	4.95	6.28
18	SAFFLR	0.0 (-)	0.0 (-)	0.0 (-)	0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.00	0.00	0.00	0.00
19	O.CROPS	2461.3 (11.45)	2435.7 (11.04)	2909.0 (12.61)	* 2265.6 (10.77)	-25.6 -4.3	473.3 47.3	-	-	-0.17	1.78	-	-
20	GCA	21496.0 (100)	22073.0 (100)	23075.3 (100)	* 21030.1 (100)	577.0 96.2	1002.3 100.2	-	-	0.44	0.45	-	-

* Estimated

Table II. 20 : Yield levels of Crops for Different Regions

(Yield in quintals/ha. for cotton in terms of lint, for groundnut in pods, for sugarcane in tonnes of gur)

Sr. No.	Crops	Region I				Region II			
		Triennium Average at 1962-63	Average 1968-69	Centered 1978-79	Average 1984-85 and 1987-88	Triennium Average at 1962-63	Average 1968-69	Centered 1978-79	Average 1984-85 and 1987-88
1	Rice	13.80	13.91	17.22	19.52	7.77	7.12	12.58	9.23
2	Wheat	-	-	20.76	-	5.31	6.44	8.42	8.91
3	K.Jawar	4.59	4.03	12.12	-	9.67	8.59	11.99	12.38
4	R.Jowar	-	-	10.00	-	5.38	5.44	6.98	6.35
5	Bajra	-	-	-	-	3.71	3.94	4.91	5.34
6	O.Cereals	6.14	7.21	8.01	8.84	6.27	5.14	6.70	9.56
7	T.Cereals	11.62	12.08	15.25	17.09	5.56	5.49	7.89	8.01
8	Gram	3.06	3.00	3.22	3.87	3.37	3.64	4.31	4.69
9	Tur	2.72	3.07	3.03	3.90	6.63	6.51	8.17	7.12
10	Mung	2.45	2.92	2.65	-	3.41	2.99	3.81	-
11	Udid	2.36	2.88	3.27	-	3.84	3.36	4.20	-
12	O.Pulses	2.44	3.08	3.03	3.18	3.47	3.14	3.36	3.75
13	T.Pulses	2.51	3.07	3.04	3.32	3.69	3.37	4.15	4.18
14	F.Grains	11.02	11.49	14.65	16.00	5.15	4.87	7.02	7.16
15	S.Cane (Tonnes of gur)	4.07	6.87	9.57	-	6.14	8.95	8.86	7.91
16	Cotton(Lint)	-	-	-	-	1.34	0.96	1.24	1.10
17	G.Nut(Pods)	10.00	9.40	6.14	14.83	6.53	6.27	6.22	6.66

(Contd.)

Table II.20 : (Contd.)

	Region III				Region IV			
	Triennium Average at 1962-63	Triennium Average 1968-69	Centered 1978-79	Average 1984-85 and 1987-88	Triennium Average at 1962-63	Triennium Average 1963-69	Centered 1978-79	Average 1984-85 and 1987-88
1 Rice	11.12	8.45	17.76	13.27	11.87	9.37	18.25	20.25
2 Wheat	4.65	5.36	10.28	10.82	6.05	6.72	9.03	10.53
3 K.Jawar	5.32	2.23	13.78	12.47	10.52	8.90	11.74	15.43
4 R.Jawar	3.81	3.71	4.29	5.01	4.55	4.63	4.77	6.18
5 Bajra	2.47	2.59	2.97	2.88	2.24	2.10	3.01	2.91
6 O.Cereals	6.36	7.32	11.46	9.67	6.06	5.69	9.31	10.37
7 T.Cereals	3.82	3.64	5.21	5.37	6.57	5.63	8.85	10.53
8 Gram	3.15	3.35	3.51	4.82	3.93	3.64	4.00	4.54
9 Tur	5.30	4.40	3.69	4.12	7.11	6.61	8.08	5.50
10 Mung	2.05	2.03	2.65	-	3.07	3.06	3.25	-
11 Udid	2.21	2.40	2.87	-	3.27	3.30	3.31	1.7
12 O.Fulses	1.73	1.99	2.31	2.58	3.53	3.42	3.51	3.02
13 T.Fulses	2.86	2.80	2.91	3.72	4.28	4.04	4.31	3.77
14 F.Grains	3.72	3.56	4.94	5.23	6.27	5.42	8.16	9.50
15 S.Cane (Tonnes of gur)	10.05	7.08	8.13	7.83	7.25	7.41	9.02	8.81
16 Cotton(Lint)	1.79	1.55	2.93	2.24	1.95	2.25	2.35	2.46
17 G.Nut(Fods)	6.89	6.08	8.08	13.30	10.43	8.76	8.81	14.00

(Contd.)

Table II.20 : (Contd.)

Sr. No.	Crops	Region V				Region VI			
		Triennium at 1962-63	Average 1968-69	Centered 1978-79	Average 1984-85 and 1987-88	Triennium at 1962-63	Average 1968-69	Centered 1978-79	Average 1984-85 and 1987-88
1	Rice	6.34	4.65	11.86	5.19	4.42	4.54	9.17	4.92
2	Wheat	4.23	3.80	8.19	7.04	4.38	3.96	8.45	8.44
3	K.Jawar	5.29	6.18	11.15	10.79	5.16	6.79	10.67	12.29
4	R.Jawar	5.36	5.40	6.49	5.52	5.27	3.97	4.28	4.28
5	Bajra	2.73	3.22	4.02	4.44	1.79	2.80	4.07	4.49
6	O.Cereals	2.31	2.29	7.90	7.05	2.82	3.95	5.06	6.41
7	T.Cereals	5.12	5.06	8.26	7.39	4.94	6.27	10.06	11.50
8	Gram	3.40	2.65	3.44	3.50	3.29	2.70	2.96	3.73
9	Tur	3.44	3.67	4.59	5.79	9.48	6.33	7.31	7.80
10	Mung	2.62	2.62	3.11	-	1.87	1.76	2.02	-
11	Udid	2.46	2.50	3.22	-	1.58	1.64	2.55	-
12	O.Fulses	2.41	2.46	2.96	3.63	1.78	1.83	2.61	2.95
13	T.Fulses	2.86	2.79	3.47	4.23	5.15	3.71	4.32	4.90
14	F.Grains	4.54	4.41	6.96	6.56	4.99	5.67	8.55	9.06
15	S' Cane (tonnes of	4.01	6.91	6.19	6.32	2.55	6.82	6.58	7.58
16	Cotton (Lint) ^{gr}	0.67	0.81	1.04	1.20	0.70	0.82	0.85	0.82
17	G'nut (Pods)	6.19	6.41	5.46	7.66	4.58	6.23	5.56	5.47

(Contd.)

Table II.20 : (Contd.)

Region VII					
Sr. No.	Crop	Triennium Average Centered at			Average 1984-85 and 1987-88
		1962-63	1968-69	1978-79	
1	Rice	9.27	9.51	11.74	*6.98
2	Wheat	4.24	3.71	6.91	6.99
3	K.Jawar	3.79	5.78	8.30	4.95
4	R.Jawar	4.37	4.22	4.87	3.99
5	Bajra	1.74	2.72	3.82	3.60
6	O.Cereals	3.14	3.05	5.90	5.87
7	T.Cereals	6.12	6.67	8.96	6.84
8	Gram	5.30	3.30	2.81	3.09
9	Tur	7.15	5.26	6.81	7.60
10	Mung	2.47	1.52	1.81	-
11	Udid	2.33	2.51	2.52	-
12	O.Fulses	2.44	2.24	2.21	2.71
13	T.Fulses	3.96	3.14	3.57	4.48
14	F.Grains	5.66	5.98	8.03	6.37
15	S.Cane (tonnes of	3.71	6.60	5.74	9.90
16	gur), Cotton(Lint)	0.54	0.72	0.90	0.91
17	G.Nut(Pods)	5.90	5.83	6.84	7.13

* Production of rice was particularly bad(nearly half)in 1984-85 and 1987-88 compared to adjacent years but area was not much different.

3. THE DECOMPOSITION OF GROWTH

3.1 In the discussion so far, we analyzed the growth of food-grain crops and three important non-foodgrain crops by their changing contributions to the total production and from their compound growth rates of area production and productivity.

For a given crop growth in production was attributed to the growth in area and growth in productivity as these two last mentioned growth rates add up to the compound production growth rate but for the interaction term which is small when growth rates are moderate as in the present case. In fact the exact relationship is as follows : for the production in the 'current' i.e. t-th year,

$$C_0(1+r_q)^t = A_0(1+r_a)^t Y_0(1+r_y)^t$$

where C_0 : output of the given crop in the base year

A_0 : area of the given crop in the base year

Y_0 : yield or productivity per hectare for the given crop

r_q , r_a , and r_y are the compound growth rates of production, area and productivity respectively with 'o' representing the base or initial time-point and 't' the current or 'end time-point' respectively.

As $C_0 = A_0 \times Y_0$, the relation in the base year, the above-mentioned equation, after cancelling C_0 , A_0 and Y_0 and taking t-th root of both sides of the equation reduces to

$$1 + r_q = (1+r_a)(1+r_y),$$

giving $r_q = r_a + r_y + r_a \cdot r_y$

when rates are expressed in percentage terms,

$$R_q = R_a + R_y + \frac{R_a \cdot R_y}{100}$$

where R_q , R_a , R_y are our usual compound growth rates in terms of per cent per annum. It is easy to see that the last term representing interaction must be small indeed, for moderate growth rates.

3.2 The decomposition analysis, on the other hand, introduces prices and one can consider any number of crops together and try to find contributions of various components apart from area, production, productivity like the crop-mix, regional shifts etc. The growth in value of agricultural production at constant prices, it is argued, can occur due to area increase alone or yield increase alone or due to change in crop-mix alone with crop-mix changing in favour of high value crops and their various interactions.

This approach to analysis of growth started with the pioneering article by Minhas and Vaidyanathan (1965) followed by Minhas (1966), Dharm Narain (1977) and Vidya Sagar (1977, 1980).

In the present study, we first attempt a multiplicative model, following Minhas (1966).¹ Briefly it can be expressed as follows.

$$\frac{V_t}{V_0} = \frac{A_t \sum_i C_{it} Y_{it} P_{i0}}{A_0 \sum_i C_{i0} Y_{i0} P_{i0}} \quad \dots(1)$$

where the ratio of value of a given set of crops in year 't',

V_t , and year 'o', V_o at constant base year prices P_{io} can be expressed as on the right hand side where in the year 't'

C_{it} = proportion of area under ith crop to total area of the set of crops

Y_{it} = yield per hectare of ith crop.

$\sum_i C_{it} Y_{it} P_{io}$ giving us value per hectare over all crops in the set (at base year prices) for the current year, with similar interpretation for the denominator of the right hand side of (1). This can further be expressed as

$$= \frac{A_t}{A_o} \frac{\sum_i C_{io} Y_{it} P_{io}}{\sum_i C_{io} Y_{io} P_{io}} \times \frac{\sum_i C_{it} Y_{io} P_{io}}{\sum_i C_{io} Y_{io} P_{io}} \times \left(\frac{\sum_i C_{it} Y_{it} P_{io}}{\sum_i C_{io} Y_{it} P_{io}} \frac{\sum_i C_{io} Y_{io} P_{io}}{\sum_i C_{it} Y_{io} P_{io}} \right)$$

Here the first factor gives us the effect of 'pure' area change, the second gives us effect of 'pure' yield change (at base year crop-mix and prices), the third factor gives effect of pure change in crop-mix at base year yields and prices whereas the bracketed factor is a 'product of two elements, i.e. the crop pattern (effect) at final year yields and the inverse of crop pattern (effect) at base year yields' in the words of its proponent (bracketed words not in the original). This interaction term is likely to be close to unity unless changes in yields between crops differ very significantly.

The value ratio is thus resolved into four multiplicative factors depicting effects of area change, yield change, crop-mix change and interaction. Each factor is unity when current year t is same as the base year 'o'. For any

different 't' the value ratio is expressed as multiplication of four ratios each indicating change of 't' years. If one uses the exponential growth rate instead of the compound rate for each ratio, the equation can be expressed as

$$\frac{V_0 e^{rt}}{V_0} = \frac{A_0 e^{r_1 t}}{A_0} \frac{\bar{Y}_0 e^{r_2 t}}{\bar{Y}_0} \frac{\bar{Y}_0 e^{r_3 t}}{\bar{Y}_0} \left(\frac{\bar{Y}_t}{\bar{Y}_t e^{r^* t}} \frac{\bar{Y}_0}{\bar{Y}_0 e^{r_2 t}} \right)$$

hence $e^{rt} = e^{r_1 t} e^{r_2 t} e^{r_3 t} e^{r_4 t}$

where $\bar{Y}_t = \sum_i C_{it} Y_{it} P_{io}$, $\bar{Y}_0 = \sum_i C_{i0} Y_{i0} P_{io}$, the value of yields per hectare, mentioned in (1).

The last term standing for growth rate $r_4 = -(r^* + r_2)$ in which r^* and r_2 are expected to have opposite signs. This further gives us

$$r = r_1 + r_2 + r_3 + r_4$$

The resolution of value growth rate as addition of four rates, representing area effect, yield effect, crop-mix effect and interaction respectively.²

3.3 This model is adopted for the entire period 1960-61 to 1988-89 in the first instance, for Maharashtra and the results are displayed in Table 3.1. The total value growth rates are similar to those obtained in Chapter 1 but are slightly lower, being exponential and not compound growth rates. Further, as the last row of the table indicates, we are able to combine most of the important crops and make an overall

Table 3.1 : Resolution of Value Growth Rate into Various Component Growth Rates for Maharashtra State (Entire Period)
 (Initial time-point : Av. 1961-62 to 1963-64, End time-point; Av. 1987-88, 1988-89, Exponential Growth Rates 'r', per cent per annum)

	Area Effect r_1	Yield Effect r_2	Crop-mix Effect r_3	Interaction r_4	Total value Total r
1. Cereals	0.2051 (10.42)	1.7305 (87.96)	0.0268 (1.35)	0.0049 (0.25)	1.9673 (100.00)
2. Pulses	1.1289 (47.25)	1.0739 (44.96)	0.2287 (9.57)	-0.0427 (-1.79)	2.3888 (100.00)
3. Foodgrains	0.3930 (19.37)	1.6460 (81.15)	0.0151 (0.75)	-0.0258 (-1.27)	2.0283 (100.00)
4. Sugarcane Cotton, Groundnut	-0.2436 (-12.55)	0.7057 (36.35)	1.8039 (92.93)	-0.3247 (-16.73)	1.9412 (100.00)
5. Overall (3 and 4 together)	0.2517 (12.61)	1.3235 (65.30)	0.6233 (31.23)	-0.2023 (-10.13)	1.9962 (100.00)

assessment, as prices of base year are introduced as weights. (It may be mentioned here that the crops covered here have a share of 83 per cent of gross cropped area and 95 per cent of weights in the official agricultural production index number in the triennium 1967-70 and can be taken as a good indicator of the 'overall' agriculture of the state.) Predictably, 81 per cent of growth in foodgrains can be attributed to yield (productivity) and 19 per cent to area with movement in favour of high-value foodgrains having negligible contribution. But for pulses among foodgrains, area effect and yield effect are on par, with 47 and 45 per cent share of growth while crop-mix effect accounts for 9 per cent share.

Non-foodgrains group of sugarcane-cotton-groundnut has a somewhat peculiar behaviour. With the extensively grown crops of cotton and groundnut losing in area as noted in previous chapters, additions to sugarcane area with its negligible share of total area are of no consequence. A negative growth component for 'area effect' contributes '-12.55 per cent' to growth whereas yield effect accounts for 36 per cent and crop-mix effect claims a very high share of 93 per cent. These high percentages are overestimations due to two negative contributions of equal magnitude for area and interaction factors but the prominence of the crop-mix effect unmistakable. While cotton-groundnut dominate area changes, in crop-mix effect with large weightage to sugarcane, consistent additions to sugarcane area dominate and a large positive proportion results.

Thus at the overall level, growth in Maharashtra's agriculture can be attributed to yield effect (65 per cent), crop-mix effect (31 per cent) area effect (13 per cent) and interaction (-10 per cent).

3.4 While covering the entire period of three decades we naturally adopted price weights of triennium 1961-64; the beginning of the sixties. But it appears somewhat inappropriate to use these dated weights. So we pursue this decomposition analysis for a curtailed period of 1967-70 triennium to the end-point of average 1987-88, 1988-89. Triennium 1967-68 to 1969-70 is also the base of official agricultural production index numbers and the 'normality' is more or less assured.

In Table 3.2 decomposition of growth rates is presented for this period of about two decades. Foodgrains total value growth rate improves to 2.71 per cent (from 2 per cent in the previous table) and this is not wholly unexpected. We have already observed that sixties represented stagnation-decline of the state's agriculture and removal of this period from analysis removes the 'low' point at base or initial point and this should result in some reduction in growth rate over the period. On the other hand, whatever growth that has occurred after triennium 1967-70 is now attributed to only two decades rather than three as in the case of 'entire' period and the growth rate moves upwards. The combined effect is that foodgrains and other components now show higher growth rates.

Table 3.2 : Resolution of Value Growth Rate into Various Component Growth Rates for Maharashtra (1967-68 to 1988-89) (Initial time-point av. 1967-68 to 1969-70, End point av. 1987-88 and 1988-89 with exponential growth rates 'r' per cent per annum)

	Area Effect r_1	Yield Effect r_2	Crop-mix Effect r_3	Interaction r_4	Total value Total r
1. Cereals	0.2861 (11.13)	2.2497 (87.50)	0.0599 (2.33)	-0.0246 (-0.96)	2.5711 (100.00)
2. Pulses	0.9528 (23.46)	2.1307 (63.64)	0.2564 (7.66)	0.0125 (0.37)	3.3431 (100.00)
3. Foodgrains	0.4274 (15.74)	2.2934 (82.10)	0.0793 (2.92)	-0.0204 (-0.75)	2.7155 (100.00)
4. Sugarcane, Cotton, Groundnut	-0.1339 (-5.31)	0.3320 (32.60)	2.0571 (81.60)	-0.2242 (-8.89)	2.5211 (100.00)
5. Overall (3 and 4 together)	0.3053 (11.64)	1.7190 (65.53)	0.7914 (30.17)	-0.1926 (-7.34)	2.6231 (100.00)

(Note : Four factor multiplicative model adopted)

But our present purpose is decomposition and the results are similar to those obtained in Table 3.1. At the overall all-crops level they are almost identical while for foodgrains yield effect is again over 80 per cent but area effect is shade lower and crop-mix effect is low at 3 per cent but no longer completely insignificant. It is for pulses that there are some differences with area and yield effects no longer at par, but explaining 28 and 64 per cent variation respectively, yield effect now prominent like cereals but not as much. For this period of 1967-68 to 1988-89 we attempted another exercise in which we changed price weights from 1967-70 average to 1987-88 and 1988-89 (the 'current' year) weights. Results for all the crop groups are nearly identical with factor contributions differing by not more than 2 to 3 per cent in every case (results not presented here for want of space). Apparently this Paasche index approach leads to results no different from Laspeyres approach with base year weight in the assessment of growth of Maharashtra's agriculture.

3.5 The area, yield and crop-mix effects can also be resolved by additive models rather than a multiplicative model presented so far. Among the additive models, seven factor model by Minhas (1966) is attempted in the present study. This model can be described as follows.³

Total value change $V_t - V_0$ can be expressed as

$$V_t - V_0 = A_t \sum_i C_{it} Y_{it} P_{i0} - A_0 \sum_i C_{i0} Y_{i0} P_{i0}$$

where summation is over all crops and other variables are as in Section 3.2.

$$= (A_0 + \Delta A_0) \sum_i (C_{i0} + \Delta C_{i0})(Y_{i0} + \Delta Y_{i0}) P_{i0} - A_0 \sum_i C_{i0} Y_{i0} P_{i0}$$

where $\Delta A_0 = A_t - A_0$, $\Delta Y_{i0} = Y_{it} - Y_{i0}$ etc., showing change over base year.

$$\begin{aligned} &= \Delta A_0 \sum_i C_{i0} Y_{i0} P_{i0} + A_0 \sum_i C_{i0} \Delta Y_{i0} P_{i0} + A_0 \sum_i \Delta C_{i0} Y_{i0} P_{i0} \\ &+ \Delta A_0 \sum_i C_{i0} \Delta Y_{i0} P_{i0} + \Delta A_0 \sum_i \Delta C_{i0} Y_{i0} P_{i0} \\ &+ A_0 \sum_i \Delta C_{i0} \Delta Y_{i0} P_{i0} + \Delta A_0 \sum_i \Delta C_{i0} \Delta Y_{i0} P_{i0} \end{aligned}$$

The three terms in the first line on the right hand side of the equation indicate the area effect, the yield effect and the crop-mix or 'pattern' effect. The remaining four are the interaction terms, last of which considers the interaction between change in area, change in yield and change in crop-mix together. The interaction terms are expected to be small. The percentage shares to changed value $V_t - V_0$ (at constant base year prices) would indicate contributions of these seven factors and some of them can be negative leading to negative percentages, a fact to be remembered in interpretation.

The results of this seven factor additive model are presented in Table 3.3 for period starting with average of triennium 1967-70 and the results can be compared with those of Table 3.2. On the whole we find a good agreement between the two as magnitudes broadly agree. There is some noticeable difference for pulses, but the importance attributed to factors does not differ. Only in the interaction term there is some difference. For example at the overall level, interaction has a negative 'contribution' of 7.34 per cent in

Table 3.3 : Contributions of Various Factors to Growth of Agriculture for the State
(1967-68 to 1988-89)

(Contributions in percentages)

Effect	Cereals (1)	Pulses (2)	Foodgrains (3)	Sugarcane, Cotton, Groundnut (4)	All crops (3) and (4) together
1. Area	8.81	22.13	12.45	-4.06	9.11
2. Yield	84.59	55.83	78.00	27.38	59.15
3. Crop-mix	1.81	5.56	2.23	77.73	25.35
<u>Interactions</u>					
4. Area-Yield	4.35	11.40	6.78	-0.71	3.63
5. Area-Crop-mix	0.10	1.14	0.19	-2.00	1.56
6. Yield-Crop-mix	-0.15	3.29	0.32	1.70	1.13
7. Area-Yield-Crop-mix	-0.01	0.67	0.03	-0.04	0.07
All Interactions (4 to 7)	4.79	16.49	7.33	-1.05	6.39
Total	100	100	100	100	100

(Note : Seven factors additive model adopted)

multiplicative model but a positive contribution of 6.39 per cent in the additive model. This happens because multiplicative model deals with ratios and in fact second factor of the interaction term (at the overall level) has a larger negative growth rate than the positive growth rate in the first factor. But the same data give us all 4 interaction terms as positive in the additive model.

One would prefer the multiplicative model for two reasons. Firstly, there are less number of factors involved and secondly because we also get growth rates for each factor (and for each category). On the other hand, attraction of the additive model is that it is more straightforward and although there are more interaction terms, these are small in magnitude and can be clubbed together into fewer terms. Interpretation of interaction terms is also easier than the one for multiplicative model.

3.6 If one goes to agro-climatic regions and applies the decomposition, what sort of results can be expected? First of all agro-climatic conditions lead to specialization of cultivation of crops and effects of various factors are not likely to be of similar magnitudes. We have used the four factor multiplicative model, for the regions and the results are presented in Tables 3.4 to 3.10. Yield factor does dominate everywhere but in Regions II, III, IV and V where sugarcane cultivation is increasing, crop-mix effect is highly noticeable in the group sugarcane-cotton-groundnut and reflects at the overall

Table 3.4 : Resolution of Value Growth Rate into Various Component Growth Rate for Period 1967-68 to 1987-88 for Region-I.
 (Initial time point : Av. 1967-68 to 1969-70, End time point : Av. 1984-85 and 1987-88)
 (Exponential Growth Rates 'r', per cent per annum)

Sr. Crop No.	Area effect r_1	Yield effect r_2	Crop-mix effect r_3	Interaction r_4	Total value Total r
1. Cereals	0.3098 (12.83)	1.8655 (77.27)	0.2241 (9.28)	0.0151 (0.63)	2.4149 (100.00)
2. Pulses ©	1.5775 (75.77)	0.4375 (33.42)	0.0062 (0.30)	0.0109 (0.52)	2.0820 (100.00)
3. Foodgrains	0.4017 (16.63)	1.8431 (76.52)	0.1533 (6.36)	0.0107 (0.45)	2.4087 (100.00)
4. Sugarcane, Cotton, Groundnut *	=	=	=	=	=
5. Overall (3 and 4 together)	0.4197 (17.47)	1.8085 (75.29)	0.1245 (5.18)	0.0495 (2.07)	2.4022 (100.00)

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© Very small area and production.

* These crops have very small area, giving inordinately large growth rates and percentages and hence not presented.

Table 3.5 : Resolution of Value Growth Rate into Various Component Growth Rate for Period 1967-68 to 1987-88 for Region-II.
 (Initial time point : Av. 1967-68 to 1969-70, and time point : Av. 1984-85 and 1987-88)
 (Exponential Growth Rates 'r', per cent per annum)

Sr. Crop No.	Area effect r_1	Yield effect r_2	Group-mix effect r_3	Interaction r_4	Total value Total r
1. Cereals	0.3146 (28.66)	1.8783 (66.08)	0.1381 (4.86)	0.0116 (0.41)	2.8426 (100.00)
2. Pulses	-0.0702 (-5.29)	0.9916 (74.67)	0.3338 (28.90)	0.0227 (1.71)	1.3279 (100.00)
3. Foodgrains	0.6394 (25.03)	1.7022 (66.63)	0.1842 (7.21)	0.0288 (1.13)	2.5546 (100.00)
4. Sugarcane, Cotton, Groundnut	-0.5565 (-16.67)	0.0292 (0.87)	4.2983 (129.73)	-0.4319 (-12.94)	3.339 (100.00)
5. Overall (3 and 4 together)	0.3780 (13.13)	1.0952 (39.04)	1.7870 (62.07)	-0.3812 (-13.24)	2.8790 (100.00)

Table 3.6 : Resolution of Value Growth Rate into Various Growth Rate for Period 1967-68 to 1987-88 for Region-III
(Initial time point : Av.1967-68 to 1969-70, End time point : Av. 1984-85 and 1987-88)
(Exponential Growth Rates 'r', per cent per annum)

Sr. Crop No.	Area effect r_1	Yield effect r_2	Crop-mix effect r_3	Inter-action r_4	Total value Total r
1. Cereals	0.2603 (9.99)	1.8875 (72.44)	0.2110 (8.10)	0.2470 (9.48)	2.6058 (100.00)
2. Pulses	-1.2930 (-)	0.8676 (-)	0.0363 (-)	0.4505 (-)	0.0614 (-)*
3. Foodgrains	0.1258 (5.44)	1.7551 (75.96)	0.1327 (5.74)	0.2970 (12.85)	2.3106 (100.00)
4. S. Cane, Cotton, Groundnut	-0.4154 (-12.50)	1.2952 (38.96)	2.7921 (83.99)	-0.3474 (-10.45)	3.3245 (100.00)
5. Overall (3 and 4 together)	0.0856 (2.99)	1.5194 (53.08)	1.3765 (48.08)	-0.1188 (-4.15)	2.8627 (100.00)

* With pulse value growth rate near zero, percentages not calculated being inordinately high.

Table 3.7 : Resolution of Value Growth Rate into Various Component Growth Rate for Period 1967-68 to 1987-88 for Region IV
 (Initial time point : Av. 1967-68 to 1969-70,
 End time point : Av. 1984-85 and 1987-88)
 (Exponential Growth Rates 'r', per cent per annum)

Sr. No.	Crop	Area effect r_1	Yield effect r_2	Crop-mix effect r_3	Inter-action r_4	Total value Total r
1.	Cereals	0.5341 (14.75)	3.3942 (93.73)	-0.1523 (-4.21)	-0.1548 (-4.27)	3.6212 (100.00)
2.	Pulses	1.3269 (156.97)	-0.5043 (-59.66)	-0.2375 (-28.10)	0.2602 (30.78)	0.8453 (100.00)
3.	Foodgrains	0.6481 (19.46)	3.0181 (90.61)	-0.1697 (-5.10)	-0.1655 (-4.97)	3.331 (100.00)
4.	S.cane, Cotton, Groundnut	0.1197 (3.73)	1.4758 (46.05)	1.789 (55.82)	-0.1795 (-5.60)	3.205 (100.00)
5.	Overall (3 and 4 together)	0.5428 (16.70)	2.0754 (63.85)	0.8953 (27.55)	-0.2631 (-8.10)	3.2504 (100.00)

Table 3.8 : Resolution of Value Growth Rates into Various Component Growth Rate for Period 1967-68 to 1987-88 for Region-V
 (Initial time point : Av. 1967-68 to 1969-70,
 End time point : Av. 1984-85 and 1987-88)
 (Exponential Growth Rates 'r', per cent per annum)

Sr. No.	Crop	Area effect r_1	Yield effect r_2	Crop-mix effect r_3	Inter-action r_4	Total value Total r
1.	Cereals	0.9152 (23.83)	2.0361 (53.01)	0.8920 (23.22)	-0.0021 (-0.06)	3.8412 (100.00)
2.	Pulses	0.2387 (6.43)	2.2703 (61.07)	1.1907 (32.03)	0.0178 (0.48)	3.7175 (100.00)
3.	Foodgrains	0.7287 (19.28)	2.1001 (55.57)	0.9511 (25.17)	-0.0008 (-0.02)	3.7791 (100.00)
4.	S.cane, Cotton, Groundnut	-1.2055 (-56.14)	0.8646 (40.27)	2.9563 (137.68)	-0.4681 (-21.80)	2.1473 (100.00)
5.	Overall (3 and 4 together)	0.3374 (10.48)	1.6663 (51.77)	1.3693 (42.54)	-0.1541 (-4.79)	3.2189 (100.00)

Table 3.9 : Resolution of Value Growth Rate into Various Component Growth Rate for Period 1967-68 to 1987-88 for Region VI
 (Initial time point : Av. 1967-68 to 1969-70,
 End time point : Av. 1984-85 and 1987-88)
 (Exponential Growth Rates 'r', per cent per annum)

Sr. No.	Crop	Area effect r_1	Yield effect r_2	Crop-mix effect r_3	Inter-action r_4	Total value Total r
1.	Cereals	-0.4700 (-16.14)	3.4191 (117.39)	-0.0151 (-0.52)	-0.0214 (-0.73)	2.9126 (100.00)
2.	Pulses	3.1934 (67.54)	1.5808 (33.43)	-0.0514 (-1.09)	0.0053 (0.11)	4.728 (100.00)
3.	Foodgrains	0.6305 (18.35)	3.0016 (87.38)	0.0537 (1.56)	-0.2505 (-7.29)	3.4353 (100.00)
4.	S. cane, Cotton, Groundnut	0.3130 (113.74)	-0.0681 (-24.75)	-0.0339 (-12.32)	0.0642 (23.33)	0.2752 (100.00)
5.	Overall (3 and 4 together)	0.4826 (20.57)	1.9389 (82.62)	0.0396 (1.69)	-0.1144 (-4.87)	2.3467 (100.00)

Table 3.10 : Resolution of Value Growth Rate into Various Component Growth Rate for Period 1967-68 to 1987-88 for Region VII
(Initial time point : Av. 1967-68 to 1969-70,
End time point : Av. 1984-85 and 1987-86)
(Exponential Growth Rates 'r' per cent per annum)

Sr. No.	Crop	Area effect r_1	Yield effect r_2	Crop-mix effect r_3	Inter-action r_4	Total value Total r
1.	Cereals	-0.3580 (37.70)	-0.3921 (41.29)	0.2517 (-26.51)	-0.4512 (47.51)	-0.9496 (100.00)
2.	Pulses	-0.1664 (-7.80)	1.4878 (69.73)	0.7549 (35.38)	0.0575 (2.69)	2.1338 (100.00)
3.	Foodgrains	-0.3205 (70.02)	-0.1190 (26.00)	0.3063 (-66.92)	-0.3245 (70.90)	-0.4577 (100.00)
4.	S. cane, Cotton, Groundnut	0.0448 (3.02)	1.4381 (97.09)	0.0875 (5.91)	-0.0892 (-6.02)	1.4812 (100.00)
5.	Overall (1 to 4 together)	-0.2598 (107.36)	0.0490 (-20.25)	0.2597 (-107.31)	-0.2909 (120.21)	-0.242 (100.00)

(As the end-point years are particularly adverse for the main rice crop, value growth rates for cereals, foodgrains and overall category are negative, resulting in awkwardly large negative-positive contributions.)

level also. In Regions I and VII where rice crop dominates, the results for the latter region are peculiar as the end period for regionwise analysis of average 1984-85 and 1987-88 is especially bad for this region. Region I on the other hand provides a more or less normal picture but one can sense the problems that may arise due to dominance of one or two crops and its absence for other crops, in a decomposition problem. In Region I of Konkan area sugarcane-cotton-groundnut group being insignificant in area, inordinately high positive and negative percentages result and we have not presented contributions in this group in the table to avoid cluttering the analysis with unnecessary details.

Results for Region VI of Amraoti may also be noted. The relevant table (No. 3.9) reveals that 'total' or value growth rate is 2.91 per cent per annum on account of productivity (growth rate 3.42 per cent) only, all other effects having low negative growth rates. For pulses area growth rate and hence area effect is very large (66 per cent) and yield effect is only half (33 per cent). These results are consistent with what we observed in Chapter 2. Thus one can conclude that the regional analysis is consistent with state results but dominance of some crops in the regions can yield results which appear somewhat peculiar. But then as one goes to disaggregate levels, such results with some peculiarities are expected in any analysis.

3.7 Apart from treating region as a separate entity and

Now

$$Y_{it} = \sum_S d_{ist} Y_{ist}$$

$$\text{Then } V_t - V_0 = A_t \sum_i C_{it} Y_{it} P_{io} - A_0 \sum_i C_{io} Y_{io} P_{io}$$

= seven factors as in Section 3.5.

$$\text{But } \Delta Y_{io} = Y_{it} - Y_{io}$$

$$= \sum_S d_{ist} Y_{ist} - \sum_S d_{iso} Y_{iso}$$

$$= \sum_S (d_{iso} + \Delta d_{iso})(Y_{iso} + \Delta Y_{iso}) - \sum_S d_{iso} Y_{iso}$$

$$= \sum_S d_{iso} \Delta Y_{iso} + \sum_S \Delta d_{iso} Y_{iso} + \sum_S \Delta d_{iso} \Delta Y_{iso}$$

In the seven factors obtained in Section 3.5 if we substitute for ΔY_{io} ^{wherever} ~~where~~ it occurs,

$$\begin{aligned} V_t - V_0 = & \Delta A_0 \sum_i C_{io} Y_{io} P_{io} + A_0 \sum_i \sum_S C_{io} d_{iso} \Delta Y_{iso} \\ & + A_0 \sum_i \sum_S C_{io} \Delta d_{iso} Y_{iso} + A_0 \sum_i \Delta C_{io} Y_{io} P_{io} \\ & + \text{eleven interaction terms.} \end{aligned}$$

The first four terms on the right hand side of the equation are respectively area effect, yield effect, location effect and crop-mix effect respectively, followed by eleven terms. Six of these eleven terms show interaction of two effects, 4 terms show interaction of 3 effects and one term shows interaction of all 4 effects. Here third term in the equation would show effect of changes in regional shares of each crop to state area of that crop and hence bring out the 'location effect'.

Since this involves regions in the analysis, our time-period covered is from triennium 1967-68 to 1969-70 to

applying the decomposition analysis, one can introduce 'location' as an effect and incorporate that into an additive model. Using the basic idea from Dharm Narain (1977) where location effect is introduced in decomposition of productivity of a group of crops into crop-mix effect, yield effect, location effect and interaction, we set up an extension of additive model of Minhas (1965) to decompose change in value into area effect, yield effect, crop-mix effect and 'location' effect and other various interactions (11 in number). This runs into 15 factors but the eleven interactions are expected to be small and can be regrouped to a lesser number. We also use suggestions from Vidya Sagar (1980). We undertake this exercise for foodgrains only for brevity. Using some of the notation from Dharm Narain (1977) as :

A_{ist} : Area under i th crop in s th region (for t -th year)

$d_{ist} = \frac{A_{ist}}{\sum_S A_{ist}}$ Proportion of area under i th crop in s th region to total area under that crop for the State.

Y_{ist} : Yield of i th crop for s th region (for t -th year)

Y_{it} : Yield of i th crop for entire state

P_{it} : Price of i th crop in t -th year

C_{it} : Proportion of i th crop to all crops area of the State

V_t : Value of crops at constant (base year) prices.

Similar notation for base period '0'.

(average of) 1984-85 and 1987-88 as described at the beginning of Chapter 2. The results for foodgrains are presented in Table 3.11. Here we see that yield effect still dominates (66 per cent) followed by area (16 per cent), crop-mix (4 per cent) and finally location (2 per cent). Although location shift does not emerge as a factor of any significance, one can draw an important conclusion that the agro-climatic regions are truly heterogeneous and not much shift occurs between regions for crops.

FOOTNOTES

1 The method of presentation is ours and any shortcomings are also ours.

2 Use of exponential rates results in only one interaction term. If we had used compound growth rates, there would be 11 interaction terms.

3 With same qualification as in 1.

REFERENCES

- Minhas, B.S. and A. Vaidyanathan (1965), 'Growth of Crop Output in India 1951-54 to 1958-61: An Analysis by Component Elements', Journal of the Indian Society of Agricultural Statistics, Vol. 17, No. 2, December, pp. 230-252.

Table 3.11 : Results of the Extended Version of the Seven Factor Model (Section 3.5) to Include Location Effect for the State (1967-68 to 1987-88)
(Initial time point av. 1967-68 to 1969-70, End point Av. 1984-85 and 1987-88)

	Effect	% share
1.	Area	15.69
2.	Yield	65.82
3.	Crop-mix	4.34
4.	Location shift	2.05
5.	Area-Yield	5.02
6.	Area-cropmix	0.33
7.	Area-location	0.16
8.	Yield - crop mix	2.36
9.	Yield - location	3.63
10.	Crop mix - location	-0.004
11.	Area-yield - c.mix	0.18
12.	Area-yield - location	0.28
13.	Area-c.mix - location	-Neg.
14.	Yield-c.mix - location	0.13
15.	Area-yield - c.mix - location	0.01
	All terms	100.00

Minhas, B.J. (1966), 'Rapporteur's Report on Measurement of Agricultural Growth,' Conference Number, Indian Journal of Agricultural Economics, Vol. 21, Oct.-Dec., No. 4.

Narain Dharm (1977), 'Growth of Productivity in Indian Agriculture,' Indian Journal of Agricultural Economics, Vol. 32, No. 2, Jan.-March, pp. 1-52.

Sagar Vidya (1977), 'A Component Analysis of the Growth of Agricultural Productivity in Rajasthan : 1956-71 to 1969-74,' Indian Journal of Agricultural Economics, Vol. 32, No. 1, Jan.-March.

(1980), 'Decomposition of Growth Trends and Certain Related Issues,' Indian Journal of Agricultural Economics, Vol. 35, No. 2, April-June.

4. SUMMARY AND CONCLUSION

4.1 The present study covering a period of 29 years from 1960-61 tries to assess the growth of foodgrains production in the state. Between censuses 1961 and 1991, population has nearly doubled whereas foodgrains production has less than doubled itself with respective compound growth rates of 2.32 and 2.05 per cent per annum. Although growth in foodgrains production is lagging behind the population growth, for drought-prone poorly irrigated state, the foodgrains growth rate is not entirely unsatisfactory. The study looks at crops and regions in which this growth has taken place by selecting time points based on triennium averages identifying the sixties, the seventies and the eighties by avoiding 'unusual' years which are rather prominent so that one can get at the underlying trend which is the result of the human effort. (Section 1.1 to 1.3).

As a first step, entire period analysis based on initial and end time-points is undertaken and with this background, the decadewise details are presented. The entire period analysis reveals that the second largest grown crop of kharif jowar has a good growth rate of about 3 per cent p.a. in spite of being rainfed and this growth is due to productivity increases from hybridization of this crop. But this success is accompanied by the stagnancy in the most widely grown and somewhat better irrigated crop of rabi jowar with its production growth rate of just 0.58 per cent p.a. Rabi jowar is an excellent source of

fodder and hybrid varieties satisfying this need have not been successful and production and productivity of this crop stagnate. Successful development and adoption of hybrid varieties for this widely grown crop would be a breakthrough for Maharashtra's agriculture. Next to kharif jowar, rice followed by wheat and bajra are the major contributors to production increases. While rice has a modest growth rate of 1.67 per cent p.a., wheat and bajra have growth rates of 2.89 and 2.49 per cent respectively. The growth in the former of these two crops is due to constant increases in irrigated area and reductions in rainfed areas, but growth in the latter is practically without irrigation and hence more noteworthy. Cereals together register a growth rate of 1.98 per cent but pulses constituting about 13 per cent of foodgrains production, have a better growth rate of 2.47 per cent which is heartening considering the stagnancy or declines at the all India level. Productivity gains have occurred for kharif jowar, wheat, rice, gram and groundnut with cereals production rising from 5.47 to 8.90 quintals/ha and pulses from 2.60 to nearly 4 quintals. To avoid analysing growth of foodgrains in isolation, three main non-foodgrain crops of sugarcane, cotton and groundnut are also covered. Sugarcane has a good growth rate of 3.77 per cent p.a. but entirely on account of area with cotton and groundnut registering poor growth rates of less than half a per cent. Sugarcane crop with its less than 2 per cent area coverage is the leading crop in the state as it has a huge irrigation requirement of 4 to 5 times any cereal and productivity stagnation for the crop is an unwelcome

feature. Index numbers based analysis also reveals similar results. (Sections 1.4 to 1.6).

4.2 The decadewise growth rates reveal stagnancy in the sixties, excellent growth in the seventies and slowing down of the growth process in the eighties. Major growth crops of kharif jowar, wheat and rice all show this pattern, only exceptions being bajra and pulses. In general, a plateau situation appears to be developing as hybridization of kharif jowar is nearly complete as wheat irrigation component has crossed the 50 per cent mark and as rice has area limitations. Growth of the seventies is not being sustained in the eighties. This slowing down is also true for sugarcane and cotton although groundnut has an upsurge in the eighties due to the advent of fully irrigated summer groundnut. This levelling of foodgrains production trend can be prevented with continuous development of better varieties for kharif jowar and development and adoption of rabi jowar varieties with good fodder yield. Along with this development, massive adoption of dry land farming techniques is urgently needed with the limited irrigation endowment of the state.

Regarding irrigation, it is to be noted that the irrigation proportion (gross irrigated area/gross cropped area) has increased slowly from 6.68 per cent in the initial period to 12.05 by mid-eighties and by the end of eighties it is 14.18 per cent. Further this proportion is not likely to exceed 30 per cent even after all the potential is exploited. The nature

and utilisation of this scarce resource needs to be looked into. In absolute terms wheat, rice, rabi jowar and sugarcane have large irrigated areas in that order. But irrigated rice is really supplementary tank irrigation in Vidarbha where productivity is lower than in rainfed Konkan rice area while irrigated rabi jowar appears to be protective as the 8 to 10 per cent irrigation for that crop has not affected the yield which is between 4 and 5 quintals per hectare. In case of wheat there are clear indications of preference for irrigated wheat. About 20 per cent of foodgrains production is protected by irrigation but for wheat, more than 75 per cent production is protected by irrigation. There is growth of irrigated gram among pulses with some productivity gains but even with irrigated proportion of the crop increasing from 9 to 20 per cent the yield level remains around 4 quintals/ha, below that for rainfed kharif tur. Thus barring wheat, impact of irrigation on foodgrains production is rather weak. On the other hand sugarcane grown on just 2 per cent of cropped area has a highly disproportionate share in irrigation water. Given the irrigated cropping pattern, if we use irrigation requirements of various foodgrains crops and sugarcane, the ratio of foodgrains : sugarcane in terms of estimated irrigation water used increases from 51:49 at the beginning of the period to 43:57 by the end of the period. With foodgrains covering 68 to 70 per cent of cropped area the inequity in water use is clearly brought out. In the two sugarcane tracts one of which is

drought prone, the ratio is as adverse as 38:62 and 22:78. (Sections 1.7 to 1.9).

4.3 For the analysis of growth in the agro-climatic regions of the state, there is a change in the end point of the period because at the time of analysis detailed districtwise data for 1988-89 were not available. We are forced to take average of two years 1984-85 and 1987-88 as the end point because 1985-86 and 1986-87 are again 'unusual' years with lower production of foodgrains. When state level analysis is undertaken with this changed end point, growth rate for cereals remains unchanged but that foodgrains marginally reduces from 2.05 to 1.95 per cent p.a. on account of pulses growth rate reducing from 2.47 to 1.73 per cent. But the pattern and the decadewise trends remain the same.

Seven agro-climatic regions are identified. These are Konkan which covers the coastal area with rice and nachani as the main crops, Nasik region covering north-western parts with bajra, wheat, kharif jowar and fruit crops like banana, grapes etc. Pune region of three districts of Ahmednagar, Pune and Solapur, the drought prone but traditionally irrigated area, with bajra, rabi jowar and sugarcane crops. Fourth region is that of Kolhapur covering three districts representing fertile western Maharashtra with kharif jowar rice, bajra and sugarcane. Marathwada or Aurangabad region is the fifth region with its seven districts representing low but assured rainfall area with kharif jowar, rabi jowar pulses and cotton.

Sixth region is the cotton and kharif jowar tract of west Vidarbha, cotton covering 42 per cent and kharif jowar covering 30 per cent of its cropped area. This region has also good tur area. Seventh region is that of east Vidarbha covering four districts with major rice area, with kharif jowar and pulses. (Sections 2.1 and 2.2).

4.4 Kharif jowar, the 'growth-crop', is mainly in Region V of Marathwada and Region VI of Amraoti and in these major areas the growth rates are excellent, being over 4 per cent p.a. Because these major areas are having high growth rates, the absolute additional contributions are also very large there. In the latter region, the production increase is only on account of productivity and sheer hybridization appears to be responsible for the growth. In other regions, area under kharif jowar has also increased, probably at the cost of groundnut and cotton crops. The decadewise analysis reveals that good growth in seventies and stagnancy in the eighties matches with the general pattern, but the state rate for sixties is also good 2.20 per cent p.a. on account good sixties in the two major regions mentioned above. The more widely grown but stagnant rabi jowar is mainly in two areas viz. drought prone Region III of Pune and that of Marathwada (Region V) with its assured rainfall. In the former there is modest growth of 1.19 per cent p.a. but the latter has almost no growth. Area under the crop has increased in these regions but in other minor regions, rabi jowar has lost area to gram and other rabi pulses. In

decadewise analysis, after heavy losses in sixties we have better growth in the seventies followed by moderate growth in the eighties at the state level on account of Pune Region only, due to area increases.

Other growth crops of rice and what are taken up next. Rice has modest growth rate 1.04 per cent p.a. and the regionwise analysis reveals that while most of the irrigated area is in Nagpur region (Region VII) the productivity there is lower than in the other major region of Konkan (Region I) which is without irrigation. Thus the irrigation in Region VII is supplementary, being tank irrigation. The regionwise analysis also reveals that the selected end point years of 1984-85 and 1987-88 were especially bad for rice in that region and in fact the growth rate can be fairly assessed at 1.53 per cent p.a. instead of -0.84 per cent p.a. obtained for that region. Decadewise analysis follows the general pattern but rather high state level negative growth rate would transform to 0.20 per cent p.a. indicating stagnancy in the eighties if we take more normal years for the last region. Major areas of wheat are Region V of Marathwada and whole of Vidarbha of Regions VI and VII. But here area under rainfed wheat is fast reducing but that under irrigated wheat fast increasing. In minor wheat areas, area is increasing along with productivity and has good production rates so that state level rate of 2.62 per cent p.a. results on account of these minor areas, major areas having less than 1.5 per cent p.a. rate. Decadewise analysis reveals

agreement with the general pattern but ups and downs are more pronounced and eighties show large negative growth rates everywhere. This irrigation based crop seems to have reached limits of its growth. (Sections 2.3 to 2.5).

Bajra has addition of nearly the same order as wheat but the crop is taken without irrigation. In the major areas of Region II of Nasik and Region III of Pune, the former area shows good growth but stagnancy is seen in the latter. In the minor area of Marathwada production has increased due to good area and productivity increases but other minor regions show area losses so that at the state level, growth of 1.80 per cent p.a. appears to be due to productivity alone. In decadewise analysis, unlike other crops there is a decline in seventies after good sixties due to a soil borne disease affecting hybrid bajra. The growth in eighties may be really 'recovery' after the bad seventies. It is somewhat difficult to predict about the growth of this crop. But unlike wheat, this crop is rain-fed and does not have any irrigation constraints and in case of such crops better fertilizer application can always increase production. However, being essentially a crop preferred in the drought prone region, fear of lack of moisture would prevent proper fertilizer application and the productivity is likely to remain low at 4 quintals/ha. Growth prospects thus appear rather uncertain. (Sections 2.3 to 2.5).

4.5 For cereals as a whole, best production growth rate of 3.49 per cent p.a. is in Region VI of Amraoti, the cotton-kharif

jowar tract. Hybridization of kharif jowar has made such a great contribution in this region that out of annual addition of about 30 thousand tonnes for cereals, 28 thousand tonnes are accounted by (rainfed) kharif jowar, overcoming near stagnancy in its wheat production. For Region V of Marathwada, a region that has made largest absolute contributions (with growth rate 3.28 per cent p.a.) to additional production, out of an annual addition of 38 thousand tonnes 30 thousand come from kharif jowar. The fertilizer study at the AER Centre of the Institute by the present author (mentioned in Section 2.4) indicates that levels of fertilizer use are better for kharif jowar in general among rainfed crops but they are still below recommended doses and further, these levels are not much different from those in drought-prone areas. Thus in these two regions of assured rainfall zone, even higher production levels for kharif jowar could be attained, in spite of hybridization reaching its limits. Konkan, drought prone Pune region and Nagpur region make somewhat modest contributions with growth rates less than 2 per cent p.a. Konkan has only rice which is already an intensive crop while Nagpur region has particularly bad end-point years. Pune region has typical drought-prone region crops of bajra and rabi jowar and in the case of bajra it has lost area while in the case of rabi jowar only modest growth is achieved. The decade-wise result show slowing down of growth in the eighties.

Pulses which form about 15 per cent of foodgrains production are mainly tur and gram. For tur major areas of Marathwada

and Amraoti show good growth on account of area and productivity but in minor tur areas there is decline. State level growth rate is 1.77 per cent p.a. with the two major regions having growth rates of 3.91 and 1.75 per cent p.a. respectively. Gram has a growth rate of 2.11 per cent for state and is positive nearly everywhere and irrigated gram is also increasing. For pulses as a whole, (aided by urid and mung in Marathwada and Amraoti) after decline in sixties, growth occurs in seventies as well as in eighties. For foodgrains as a whole, growth rate of 1.95 per cent p.a. is mainly on account of the two regions mentioned above, a fact not very surprising, considering the discussion so far. Irrigation does not appear to play a significant role in the growth of foodgrains as the main growth crop of kharif jowar is rainfed and irrigation to rice is supplementary while that to rabi jowar is protective. Only in case of wheat there is some impact. In the decadewise analysis, there is improvement in the two main growth regions for eighties, due to support of pulses. (Sections 2.6 to 2.9).

4.6 Three major non-foodgrain crops of sugarcane, cotton and groundnut are considered to complete the picture. For sugarcane state level growth rate is over 4 per cent p.a. and in major as well as minor areas growth rates are good but everywhere area is the main factor which is not very desirable given the high irrigation water requirement of the crop. Inequity in irrigation water use between foodgrains and sugarcane is already commented upon. In decadewise analysis there

is distinct slowing down in the eighties but area and production growth rates are positive everywhere. For cotton, poor state level growth rate of 0.60 per cent is a result of modest growth in major cotton tract (Amraoti) of 1.15 per cent p.a. but in the other major region of Marathwada there is production loss due to area loss (areas going to kharif jowar and tur). Decade-wise analysis shows lower but positive growth rates in the eighties. Groundnut has lost area everywhere but there is rise in productivity which is not enough to overcome area losses so that state production growth rate is -0.43 per cent p.a.

Positive production rates of 1.25 and 0.86 per cent p.a. in Regions III and IV, (the main sugarcane tract) are due to the substantial increases in fully irrigated summer groundnut area. The farmers have responded well to the state encouragement for this crop in the form of provision of summer irrigation. The decadal growth rates suddenly show a spurt in the eighties (state growth rate 3.89 per cent p.a.). Thus a major concession has caused substantial growth in this crop against the all India scenario of shortages in oilseeds production. (Section 2.10).

4.7 An overall assessment of growth of a group of crops can be made by using the decomposition analysis. When we are dealing with a single crop, compound growth rate of production is equal to addition of the compound growth rates of area and productivity plus an interaction term which is always small when growth rates are moderate. Thus one can see whether area effect is important or the productivity effect is important. In

dealing with foodgrains, we just added productions of various cereals and pulses without any weighting. In decomposition analysis outputs of rice, wheat, gram, tur, etc. are not just added but (harvest) prices of these crops are used as weights. Taking an initial time point and an end time-point one can then examine to what extent growth in the value of output at constant (base year) prices is due to area effect, yield or productivity effect and also cropping pattern effect. Thus effect of movement to high value crops can also be traced. It is possible to introduce other factors also. With prices in base year acting as weights, one can make assessment of not only foodgrains but foodgrains together with productions of crops like sugarcane, groundnut, cotton etc. Thus an overall assessment of these crops by effects of various factors in growth becomes possible. We have used four factor multiplicative model due to Mihas (1966)* to assess growth decomposition for the state as well as the seven agro-climatic regions. Then a seven factor additive model due to the same author is also used. These decompositions are attempted for crop groups of cereals, pulses, foodgrains, non-foodgrains group of sugarcane-cotton-groundnut separately as well as all these together. This crop coverage accounts for 88 per cent of area and 95 per cent of weights in the index number of agricultural production of the state. Finally to trace shift of crops between agro-climatic regions a model is used on the lines suggested by

* Please refer to 'references' at the end of Chapter 3.

Dharm Narain (1977) incorporating suggestions of Vidya Sagar. (1977, 1980).

Four factor multiplicative model gives 81 per cent of growth in foodgrains as due to productivity about 19 per cent due to area and a negligible proportion due to 'crop-mix' effect for the entire period analysis. This is true of cereals also. In pulses however, area effect is much higher, more than equal to productivity effect of 45 per cent, with crop pattern or crop-mix effect at 9 per cent. Area contribution to pulse growth is already noted in previous chapters. Increasing gram area in 'minor' areas and of 'other pulses' in Amraoti region of cotton probably reflect in 9 per cent crop-mix effect. But in the three crop non-foodgrains group of sugarcane, cotton and groundnut the crop-mix effect is over 80 per cent and yield effect 36 per cent with negative area and interaction effects (negative percentages around 15 per cent each). Increases in sugarcane area are already noted in the analysis but reductions in cotton and groundnut areas swamp out those increases. But in crop-mix effect with prices coming in, sugarcane dominates and the crop-mix effect comes out. So that at the overall all crops level, we have 65 per cent yield effect, 12 per cent area effect and 30 per cent cropmix effect (interaction being negative 7 to 10 per cent). Thus at the overall level sugarcane causes considerable crop-mix effect as it is the highest value crop - a fact reflected in agricultural production index number with highest weight for sugarcane.

The seven factor additive model gives similar results. When we apply four factor model to seven regions various idiosyncrasies of regions come up with differing percentage shares and in extreme cases, high positive-negative shares. In the location effect model, not many crop area shifts between regions appear to occur, thus underlining the fact that our agro-climatic division of the state really gives us agriculturally heterogeneous regions. In the process, one also understands various nuances of the decomposition technique. (Chapter 3).

4.8 What do we conclude from this study? Over the thirty years production of foodgrains has increased at a compound growth rate of 2 per cent p.a. Kharif jowar, a widely grown rainfed crop has made the largest contribution with a growth rate of 3 per cent p.a. This is followed by rice and then wheat-bajra with nearly equal contributions. Apart from the growth in wheat, irrigation is not responsible for this growth (although irrigation may be lending some stability). In the case of irrigated rice (with the second largest irrigated area in absolute terms) its role is supplementary and in irrigated rabi jowar (with third largest irrigated area) its role is protective, as reflected in the productivities of these crops. This comes out from the fact that rice productivity is higher in rainfed Konkan than in Vidarbha where half the rice area is irrigated making late varieties possible. Rabi jowar productivity is stagnant around 4-5 quintals compared with the current productivity of 12 quintals/ha of kharif jowar. The most potent

sources of irrigation appear to go to sugarcane. The foodgrains : sugarcane irrigation water ratio has always been in favour of sugarcane and moves from 51:49 to 43:57 over the thirty years while area ratio is about 68:2, indicating inequitable water use. In sugarcane tracts this ratio is as adverse as 31:69. This creates income disparities but apart from that, it is established by various studies that although per unit of land sugarcane gives higher income, per unit of water other crops can give better income. So on the grounds of equity as well as economic water use, expansion of sugarcane area is undesirable. If additional irrigation is diverted to foodgrains, foodgrains production would receive a boost as well as a degree of stability.

However, sugarcane production and cooperative sugar factories are an integral part of the state and one does not advocate putting back the clock. It must be remembered that in the early days of canal irrigation, farmers had to be persuaded to 'accept' irrigation blocks and cultivate water consuming crops like sugarcane. However, further expansion of sugarcane cultivation appears undesirable.

But the state has limited irrigation. It is estimated that irrigated area cannot exceed 30 per cent of the cropped area even if all sources are exploited. Over thirty years irrigation proportion has increased from 6 to 14 per cent. To reach the thirty per cent level, another forty to fifty years may be needed. Therefore the revolution must occur in the

rained crops. It has occurred in the case of kharif jowar and sheer hybridization has contributed to its spectacular growth. As mentioned at appropriate places, although among rainfed crops kharif jowar has higher fertilizer application, it is still below the recommended doses. In fact level of fertilizer use in assured rainfall areas is same as in drought prone areas. So there is a further scope for this crop with its major areas falling in the assured rainfall regions of Marathwada and cotton tract of Amraoti. For most of the rainfed crops fertilizer is used much below the recommended levels. For rabi jowar it is conspicuous by its absence while pulses are not given fertilizers on the ground that being nitrogen-fixing crops they do not need fertilizers, forgetting the fact that for their own growth fertilizers are needed.

The decadewise analysis has revealed slowing down of the upward trend or even stagnancy-decline for most of the foodgrain crops and this danger signal cannot be ignored. The green revolution which is believed to be irrigation-based, must be made to work for rainfed crops too, if the upward production trend is to be maintained and to cope with the population of the state which is increasing with a growth rate of 2.32 per cent p.a. It has been possible in the case of kharif jowar. It has failed in the case of even more widely grown rabi jowar. Tall varieties with better grain yield need to be developed to tackle the fodder requirement of rabi jowar.

For encouraging proper fertilizer use for all foodgrains, better weather and rainfall forecasting is necessary and in these days of satellite imagery, this is a distinct possibility. In fact, large data should be accumulated and using statistical techniques, appropriate fertilizer doses could be recommended mentioning the risk factor in such calculations. Then only farmers would risk higher and better inputs even for rainfed cultivation. As suggested in another AERC study undertaken by this Institute, different methods of fertilizer application and even different types of fertilizers need to be developed which can exploit available moisture but do no harm in conditions of moisture-stress. In a poorly irrigated state with low and uncertain rainfall these remedies, along with vigorous adoption of dryland farming techniques that preserve moisture, can support a sustained growth in foodgrains production.

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