Occasional Paper—7

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# Problems and Prospects

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**Mumbai** **Authors**
**January 1999**

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## CONTENTS

# CHAPTER 1

## INTRODUCTION

Maharashtra is one of the most industrialised and urbanised states in India. Paradoxically, however, it also enjoys the dubious distinction of a state having highest rural-urban disparity in standard of living of its population.[1]

The share of agriculture in the net state domestic product of Maharashtra declined steeply from 36% in 1961-62 to 18.7% in 1992-93. The comparable shares for Indian agriculture were 47% and 27%. Yet, in terms of the proportion of labour force engaged in agriculture which was 60% in 1991, Maharashtra's economy continues to be predominantly agrarian. Indeed, the share of State's rural labour force employed in agriculture (main workers only) was as high as 83 per cent even in 1991, nearly half of the agricultural workers being labourers. Thus, the crucial dependence of its rural labour force on agriculture is quite evident and is unlikely to diminish drastically in the near future. It is against this scenario, that importance of accelerated growth in Maharashtra's agriculture must be judged.

Apart from the direct impact of agricultural growth on generation of rural employment and incomes its significant secondary linkages with the development of rural non-farm sectors are more crucial. Trade in agriculture's outputs and inputs and services required by it and processing of its products open up additional and more significant avenues for labour absorption. Maharashtra being an important producer of cotton, sugarcane, groundnut and quiet a few horticultural crops, such secondary linkages of agriculture assume added importance to its rural economy, more so now, in the context of new liberalised trade environment for farm products. That is why, careful assessment of agriculture's past performance and based on it, future prospects of growth is needed. The present study undertakes this exercise, focussing on the comparison between the early phase i.e., the years from 1967-68 to 1979-80, vis-a-vis the latter phase i.e., 1980-81 to 1992-93 of the post green revolution period. More specifically, our objectives are :-

(i) To examine trends in and sources of growth in production of major crops and crop groups and changes in them over the two phases of the period under study both at the state and the district level.

(ii) To investigate possible causes responsible for differential performance in growth in the two phases and thereby identify the constraints on

future growth.

(iii) To study the degree of and trends in instability in crop output, analyse the sources of instability and identify the factors associated with changes in degree of instability over the two phases of the study period.

(iv) To analyse the inter-district disparity in output growth and input concentration and further to examine inter-relationship between the output and input concentration for the two phases.

(v) To identify technology and non-technology variables having significant association with productivity growth in agriculture in the two phases of the entire period with the help of regression analysis and comparison of the characteristics of selected districts with distinctly differential inter-temporal patterns of growth performance.

(vi) Finally, to comment on the prospects of growth and emerging constraints on growth in Maharashtra's crop sector.

## 1. Coverage

### Periods :

The analysis undertaken in the present study has been restricted to the post green revolution period (henceforth GR period or the period under study) only, covering the years from 1967-68 to 1992-93 at the state level and from 1967-68 to 1990-91 at the district level. The entire period has been bifurcated into two periods or the two phases, to be referred to as the early and the latter phase/period or periods I and II. Period I covers the years from 1967-68 to 1979-80 and period II from 1980-81 to either 1992-93 or 1990-91. Bifurcation of the period at 1980-81 coincides with the optimal point of break in the time trend for Indian agriculture.[2]

As 1971-72, 1972-73, 1986-87 and 1991-92 were the worst drought years in Maharashtra state the alternative analysis have been attempted mainly at the state level by omitting these four years from the state series and the first three years from the district level series for output instability analysis.

### Districts :

The district level analysis based on comparable crop statistics for the entire period, covers all the twenty five districts excluding the Greater Bombay district and all the seven administrative divisions in the State as

they existed in the year 1981 (Figure 1.1). No attempt has been made to generate the entire data sets separately for the districts formed after 1981 i.e., for Sindhudurg in Konkan division, Jalna and Latur in the erstwhile Aurangabad division and Gadchiroli in the Nagpur division.[3]

**Crops :**

In all 24 major crops and four major crops categories have been included in the state level analysis. The crop categories are: (i) cereals (ii) pulses (iii) oilseeds and (iv) all crops. The district level analysis is, however, restricted to only four major crop categories and in addition, covers two crops, namely, sugarcane and cotton.

The fourth category i.e. of 'all crops' covers 26 major crops, at the State level and only 25, i.e., excluding safflower, at the district level and represents gross value of output of crops covered at 80-81 prices.[4] The series has been specially generated to examine aggregate growth performance of the crop sector at the state and district level, using the recent price base i.e., 1980-81 in place of the old base used in the official crop production index.

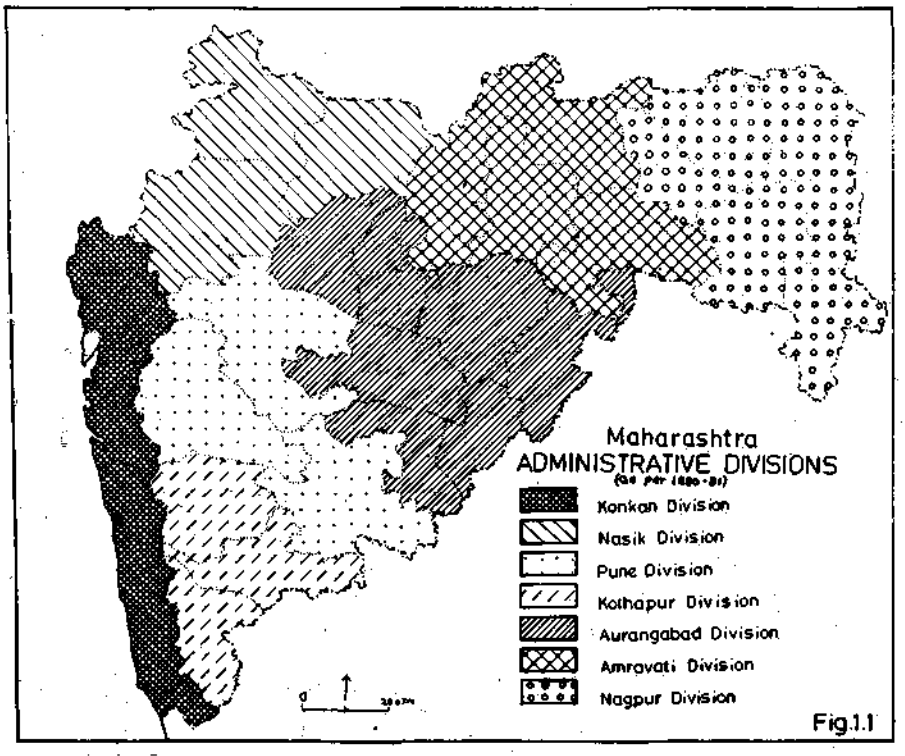
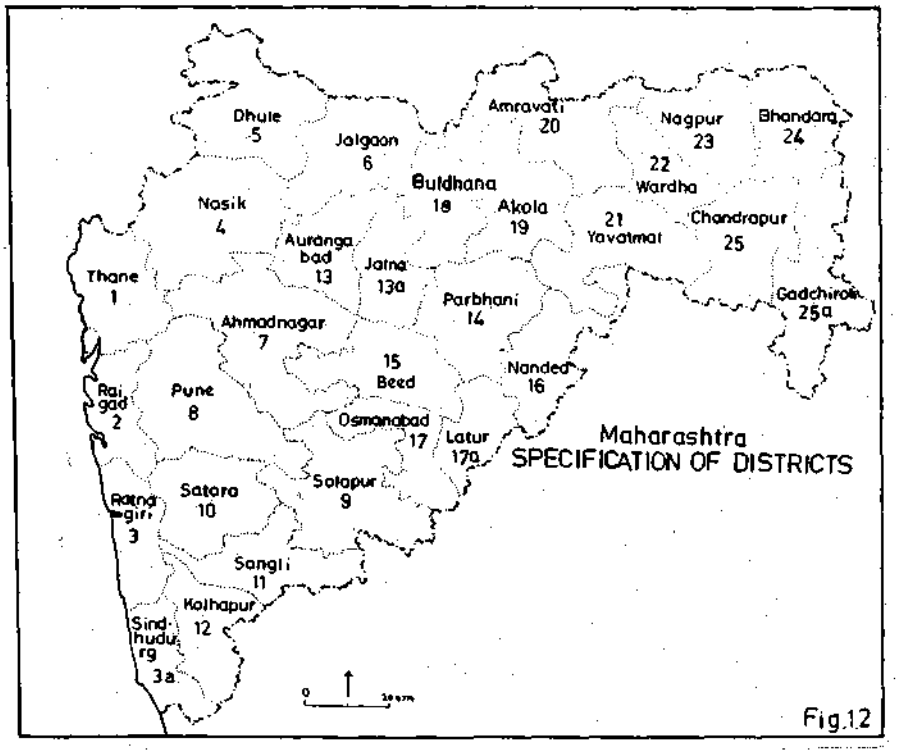


Fig.1.1




**Prices :**

In the exercise of generating gross value of output series farm harvest prices of 13 major crops, as provided in the State's Season and crop Reports are used. For the remaining crops prices prevailing in the major wholesale markets of the relevant commodity in the state are used.[5]

**Rainfall Statistics :**

Monthwise actual and normal rainfall statistics are available for a fairly large number of centres, i.e., both covering observatory and state centres, spread all over the districts and state. The centrewise and yearwise data were collected from the official records and publication of the Maharashtra State's Directorate of Agriculture, Pune.

**2. Data Sources For Crop and Other Statistics :**

State level crop statistics i.e., areas, production and yield per hectare of crops and crop aggregates are drawn from the official publications of the Directorate of Economics and Statistics, Government of India whereas the district level crop statistics from the various issues of Season and Crop

Reports of the Maharashtra State. Additionally, the data relating to land utilisation, crop pattern, irrigation, farm harvest prices, livestock census etc. are also drawn from the Season and Crop Reports.

For the detailed state level analysis of output, aggregated district level production data were not used for two reasons. One, the district level crop statistics were not available, beyond the year 1990-91 while the state level data were available upto 1992-93. Secondly, and more importantly, the production estimates for forecast crops are stated to be more reliable at state level than at the district level.[6]

### 3. Plan of the Study :

Chapter 1 presents an introduction to the study specifying its objectives, scope, coverage and data sources. Chapter 2 covers briefly the analytical and methodological details of the study. Chapter 3 highlights selected aspects of agriculture and major features of its growth in Maharashtra for the period 1967-91. It comments on inter-regional heterogeneity in resource endowments and irrigation development, changes in land use and crop patterns over the period, inter-temporal expansion in the use of inputs, productivity of crops in Maharashtra and India etc.

Chapter 4 undertakes a detailed scrutiny of trends in aggregate growth in agriculture and across the crops in the two phases of the GR period (i.e., 1967-80 and 1980-93) relating them to the character of rainfall variations in the two phases. It analyses further the sources of growth and changes therein. Chapter 5 presents the analysis of crop output growth at the disaggregate level i.e., for districts and administrative divisions in the state. It comments on the inter-regional and inter-crop patterns of trends in growth in the early phase vis-a-vis the latter phase of the period under study.

Keeping in view significant deceleration in productivity growth in agriculture in the latter phase of the GR period, Chapter 6 is devoted to a search for its possible explanations.

In addition to growth in crop output, its instability is an equally crucial aspect for a predominantly rainfed agriculture. Hence, Chapter 7 examines in detail, levels and sources of output instability and inter-regional and inter-temporal changes in it.

Chapter 8 studies concentration in output growth vis-a-vis input expansion by relating incremental growth in output to that in major inputs across the districts for the decades of 1970's and 1980's separately.

Chapter 9 investigates association of productivity growth with technology and non-technology variables by using a framework of regression analysis and alternatively by comparing the agro-climatic, technological and infrastructural characteristics of a few selected districts with distinctly differential degree of growth performance in the period under study. Finally, Chapter 10 summarises conclusions of the study and highlight their implications.

## Notes

1. Human Development Index (HDI) for Maharashtra (rural and urban areas combined) was estimated to be 0.532 with a third rank among all the major Indian states (Kumar Shiva A.K., 1991, 'UNDP's Human Development Index: A computation for Indian States', Economic and Political Weekly, Vol. 26, Number 41). If only rural areas are considered the HDI falls to 0.16 with the state's rank moving down to 16th i.e., just next to Uttar Pradesh (Vyas, V.S. and Vidya Sagar (1993)), 'Alleviation of Rural Poverty in the States: Lessons of 1980's' in Parikh K.S. and Sundaram R. (eds.) 'Human Development And Structural Adjustment', MacMillan India Ltd., Madras.

2. Dholakia R.H. and Dholakia B.H., 'Growth of Total Factor Productivity In Indian Agriculture', Indian Economic Review, vol.. XXVIII, No. 1, 1993, page 25.

3. Refer Appendix A.1

4. Refer Appendix A.2

5. Refer Appendix A.3

6. Bhalla G.S. and Tyagi D.S., 'Indian Agricultural Development', Institute for Studies in Industrial Development, 1989, page 8.

# CHAPTER 2

## DETAILS OF ANALYSIS AND METHODOLOGY

### 1. Construction of Rainfall Index :

The district level rainfall index for a particular crop or a crop group is computed by taking percentage of the average of actual rainfall over the centres within a district to the average of normal rainfall for those centres for a given year. Rainfall in this context refers to total rainfall in the entire growth period specified for a crop/crop group for which rainfall index is to be computed. The state level rainfall index for a crop/crop group is the weighted average of the district level rainfall indices, weights being proportional to the districts' shares in the state level average production of the crop/crops during the triennium ending 1981-82. For the all crop rainfall index districts' shares in the aggregate growth value of output were used for evolving the weights.

### 2. Crop Output Growth: Trends and Sources

All the compound annual growth rates, referred as just 'growth rates' in the text are computed from the time series in various variables, such as the state domestic product or area, production and yield of crops and crop groups, index numbers of crop production etc. They are derived from estimates of a semilog trend function (i.e., log $Y = a + bT$) with intercept and slope dummies introduced to distinguish between the estimates for the two separate periods (refer Section 2 from Chapter 1). The function is either fitted to three year moving averages of the relevant variable or to the original observations, with explicit inclusion of the rainfall index, in the trend function in respect of the latter.

The state level analysis of growth performance is based on four types of growth rates. They are Type A1, A2, B1 and B2. The first two sets i.e. A1 and A2 are estimated by using three year moving average series of areas, production, yield per hectare etc. Type A1 growth rates are based on all 26 years from 1967-68 to 1992-93, while the A2 growth rates cover only 24 years i.e., from 1967-68 to 1990-91. Type B1 and B2 growth rates are estimated by using original observations of the variables such as area, production etc., and introducing explicitly either one rainfall variable (e.g. annual rainfall index) or two rainfall variables namely kharif and rabi rainfall index separately in the trend function. Both the Type B1 and Type B2 growth rates are based on 24 years i.e., 1967-68 to 1990-91 as the detailed centrewise rainfall statistics were not available to us for the years beyond 1990-91. We refer to the first two sets i.e., Type A1 and A2 as

the non-adjusted growth rates and B1 and B2 as rainfall adjusted growth rates.

For the state level aggregate series of gross value of output, state domestic product in agriculture, all crop production index and output of major crop groups and crops, growth rates are estimated alternatively by using either all years i.e., from 1967-68 to 1992-93 or by covering only 22 non-drought years i.e., by eliminating four drought years, namely 1971-72, 1972-73, 1986-87 and 1991-92. However, district level estimation of growth rates is restricted only to Type A2 growth rates i.e., based on three year moving averages and covering all the years from 1967-68 upto 1990-91 only.

Statistical significance of acceleration or deceleration in growth or of existing of structural break between the two period has been judged by using two criteria, namely, CHOW test and significance of the slope dummy for 'time' variable in the state level analysis. But the district level analysis of growth performance uses only the latter criterion i.e., statistical significance of the slope dummy variable in the trend function to indicate acceleration or deceleration in growth rate from the period I to the period II.

For the state level analysis, as mentioned above, the alternative sets of estimates of growth rates i.e., based on all years and non-drought years are worked out to examine whether the omission of drought years would make any significant difference to our conclusions regarding acceleration or deceleration in growth between the two periods.

The state level exercise revealed that the direction of change in growth rates from the period I to the period II, as also many a times their statistical significance/non-significance remained invariant over the two sets of estimates for almost all major crops/crop groups irrespective of inclusions or exclusion of drought years.[1] Hence, the alternative sets of estimates of growth rates based on non-drought years were not worked out at the district level. Again, district level analysis does not cover all the major crops but only two crops, namely cotton and sugarcane individually and four crop categories, namely, (i) cereals, (ii) pulses, (iii) oilseeds and (iv) all crops i.e., gross value of output at 80-81 perices.[2]

As the semi-log trend function is separately fitted to the series of area, production and yield per hectare it is possible to examine broadly relative contributions of area and yield components to the output growth in the two sub-periods and assess changes in their relative importance over the period, if any.

## 3. Instability in crop output: Trends and Sources

We preferred to measure instability in crop output in a specified period by computing standard deviation of annual growth rates in output, rather than using standard error of deviations around the trend line fitted to the output as a measure of instability. This is because the latter measure is highly sensitive to the choice of trend function and its fit to the data.[3]

Further, contributions of area variability, variability in yield and the degree of correlated changes in yield and area are separately computed to examine their relative importance in determining output variability in the period I and II.

The degree of instability in crop output in a specified region may undergo a change over the period due to several reasons. Change may be significant and sustained, leading to either decline or increase in instability over the period. In order to detect existence of such a trend we worked out series of nine-year moving period standard deviations in areas, yield and production for major crops and crop groups at the state level and fitted a semi-log trend function i.e., log Y = a + bT (where Y's are 9-year moving period standard deviations). Further, we also made an attempt to identify the factors responsible for inducing a trend in the degree of output variability at the state level for the output of cereals and all crops combined.

Finally, we examined changes in relative importance of the source of output instability by analysing contributions of yield and area variability and of their correlated changes to the degree of output-instability for the major crops (i.e., sugarcane and cotton) and four major crop groups namely, cereals, pulses, oilseeds and all crops.

## 4. Concentration of output growth and input expansion :

Inter-district pattern of output growth and input expansion has been examined for the decades of 1970's and 1980's. For this purpose shares of different districts in the incremental value/quantities of output of (i) all crops, (ii) cereals, (iii) pulses, (iv) oilseeds, (v) sugarcane and (vi) cotton were computed separately for : (i) the period between the triennia ending 1970-71 (i.e., TE 1970-71) and TE 1980-81 and (ii) the period between TE 1980-81 and TE 1990-91. For assessing the pattern of contribution to the aggregate output growth districts were arranged in the descending order of their contribution and then divided into four groups, each group accounting for 25% or nearly 25% contribution. Additionally, the shares of these groups in (i) total gross cropped area (ii) total male work force in agriculture (iii)

incremental irrigation (iv) incremental fertiliser consumption (v) incremental area under high yielding variety or hybrid seeds were computed to examine the pattern of input concentration as also to compare it with the pattern of output concentration across the groups.

## 5. Association of Output Growth With Technology And Non-Technology Variables: District Level Assessment :

Pragmatic assessment of the prospects of agricultural growth in future calls for a careful scrutiny of the association of the technological and non-technological forces/factors with aggregate productivity growth in agriculture in the past. Such an assessment must cover factors like agro-climatic endowments, quality and extent of infrastructural developments including those of land, irrigation, transport, extension services etc., nature and pace of farmers investment in agriculture, supply of farm labour and its quality, character of rainfall variation etc. Ideally, all the relevant technological and the other variables that matter should be included in the analysis undertaken for evaluating their relative impact on productivity growth. However, in practice coverage of variables is generally restricted by the appropriateness and the length of the data series available for analysis. Therefore, we tried two alternative regression exercises for estimating the relationship of aggregate productivity per hectare with selected technology variables either in presence or absence of the other variables. All the variables including the dependent one were converted into logarithms and the method of estimation was ordinary least squares in both the exercises.

The first one was the state level regression exercise in which four variables namely, annual rainfall index, irrigation, fertiliser use per hectare, percentage of area under HYV and the five dummy variables i.e., the intercept dummy and four slope dummies for the latter part of the period (1980-81 to 1990-91) were included for estimating the relationship for the entire period under study.

The next exercise used district level disaggregated data. Under this exercise the relationship between gross value of output per hectare and several technology and non-technology variables specified below was estimated by pooling the data for all the twenty five districts but separately for the two periods, namely, 1967-80 and 1980-91.

GVPH : f (IRR, FERT, BULL, TRAC, EPUM, HYV, ESUG, RDLG, ILLB, LILB, IRAIN)

GBPH : Gross Value of output per hectare.

IRR : Extent of gross irrigated to gross sown area

FERT : Use of chemical fertilizers (i.e., N+P+K) per hectare of GCA

BULL : Number of work animals per 100 hectares of GCA

TRAC : Number of Tractors per 100 hectares of GCA

EPUM : Number of Electric pumpsets per 100 hectares of GCA

HYV : % of area under high yielding or hybrid varieties total area under five major cereals.

ESUG : % of area under sugarcane

RDLG : Road length per 100 sq.k.m.

ILLB : Illiterate labour (main workers only) per 100 hectares of GCA

LTLB : Literate labour (main workers only) per 100 hectares of GCA

IRAIN : Index of annual rainfall.

In addition, twenty four intercept dummies were introduced to take care of the fixed effects of the districts specific resources endowments.

**Notes**

1. Refer Section 2 from Chapter 4 for details
2. Refer Appendix A.2
3. Better the fit lower will be the degree of instability.

# CHAPTER 3

## AGRICULTURE IN MAHARASHTRA: SELECTED ASPECTS AND SALIENT FEATURES OF GROWTH

### 1. Agriculture in the Economy of Maharashtra :

Share of agriculture in the net state domestic product of Maharashtra declined from 28 per cent in 1967-68 to 25% in 1980-81 and further down to 19% in 1990-91. Thus, not only the absolute magnitude of the share of agriculture in the state's economy in the recent year i.e., 19% was lower than that of Indian agriculture in the national income (i.e., 27%) but the rate of decline in the former during the eighties has been much faster vis-a-vis its own fall in the early phase i.e., 1967-80. It may be the result of either a distinct setback to agricultural growth in Maharashtra in the 1980's or a much greater acceleration in growth in the other sectors of its economy during the same period or the combined result of both. Table 3.1 provides an explanation for this trend.

Agricultural sector's growth record in Maharashtra was highly impressive during the early phase (i.e., 1967-80) of the GR period especially when viewed against its total stagnation prior to 1968 or for that matter through the entire decade of the 1960's.[1] Pace of growth decelerated greatly and significantly in the latter period i.e., 1980-93 (column (4) and (7) in Table 3.1). In contract, there was acceleration in growth in the manufacturing as also in the remaining sectors of the economy.

**Table 3.1**
**Sectorwise Growth Rates in State Domestic Product+**

| Sector | All years included | | | | Drought years excluded | | |
|---|---|---|---|---|---|---|---|
| | I: 1967 to 1980 | II: 1980 to 1993 | Extended period 1980 to 1995 | Acceleration/ Deceleration between I & II | 1967 to 1980 | 1980 to 1993 | Acceleration/ Deceleration between I & II |
| (1) | (2) | (3) | (4)@ | (5) | (6) | (7) | (8) |
| Agriculture | 4.65* (0.79) | 2.84* (0.96) | 3.02* | Deceleration* | 4.94* (0.92) | 3.81* (0.77) | Deceleration* |
| Manufacturing | 5.57* (0.96) | 6.51* (0.97) | 6.60* | Acceleration* | 7.16* (0.99) | 7.41* (0.94)* | Acceleration |
| Total SDP | 4.52* (0.97) | 5.70* (0.97) | 5.88* | Acceleration* | 5.54* (0.99) | 6.54* (0.95) | Acceleration |

+ : Based on semilog trend function fitted to 3-year moving averages of SDP at 1980-81 prices;
@ : Subsequent revision by covering 93-94 and 94-95.
* : Significant at 5 or lower percent level.

Thus, both the deceleration growth in agriculture and acceleration in the other sectors together were responsible for sharp fall in the share of agriculture in the economy of Maharashtra.

It is pertinent to add in this context, that agriculture's growth record in Maharashtra during the eighties was not only disappointing compared to its past record in the early stage of the green revolution but it also represented a contrast to increased pace of growth in the Indian agriculture during the same period.[2]

## 2. Soil and Water Resources : Inter-regional Disparity :

### Soil Fertility :

Range of inter-district variation in soil index has not been very wide (column (3), Table 3.2). The index moves from 54.4 to 72.7. Konkan, Amravati and Nasik divisions, in the descending order, are at the top with relatively better soil index and at the lower end are Kolhapur and Aurangabad divisions. Between them lie Nagpur and Pune divisions with medium soil index (Figure 3.1).

### Average Normal Rainfall :

Maharashtra state is benefited mainly by the rainfall received from southwest monsoon. But the amount of normal rainfall received shows extreme disparity across the districts (column (2). Table 3.2). It varies from the minimum level of 579 m.m. in Ahmednagar district to the maximum of 3306 m.m. in Ratnagiri district (Figure 3.2).

Shares of low, medium and high rainfall districts in the state's geographical area are almost equivalent. But the combined share of the former two i.e., low and medium rainfall regions in the total net shown area is as high as 80%. In other words, only 20% net sown area of the state has the benefit of receiving rainfall higher than 1150 m.m. At the other end, however, a large chunk of the net sown area (37%) receives low i.e., less than 750 m.m. rainfall.

Inequity in extent of irrigation development co-exists with the extreme inequality in the amount of rainfall received.[3] In 1970-71 many districts from the low and medium rainfall groups (i.e., 10 out of 17) had negligible benefits of irrigation. The situation however improved to a much greater extent for the low rainfall group by 1990-91 due to higher benefits of incremental irrigation received by them. But this was not true for the medium rainfall group in which case 8 out of 10 districts continued to have

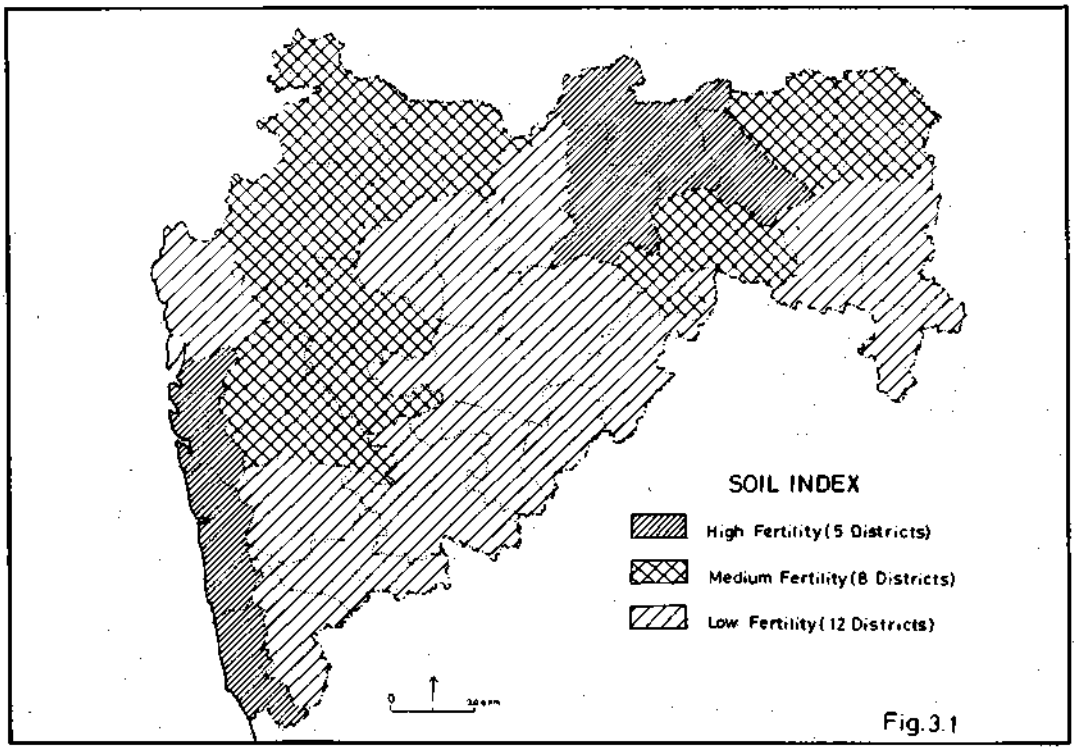

SOIL INDEX
High Fertility (5 Districts)
Medium Fertility (8 Districts)
Low Fertility (12 Districts)

Fig. 3.1

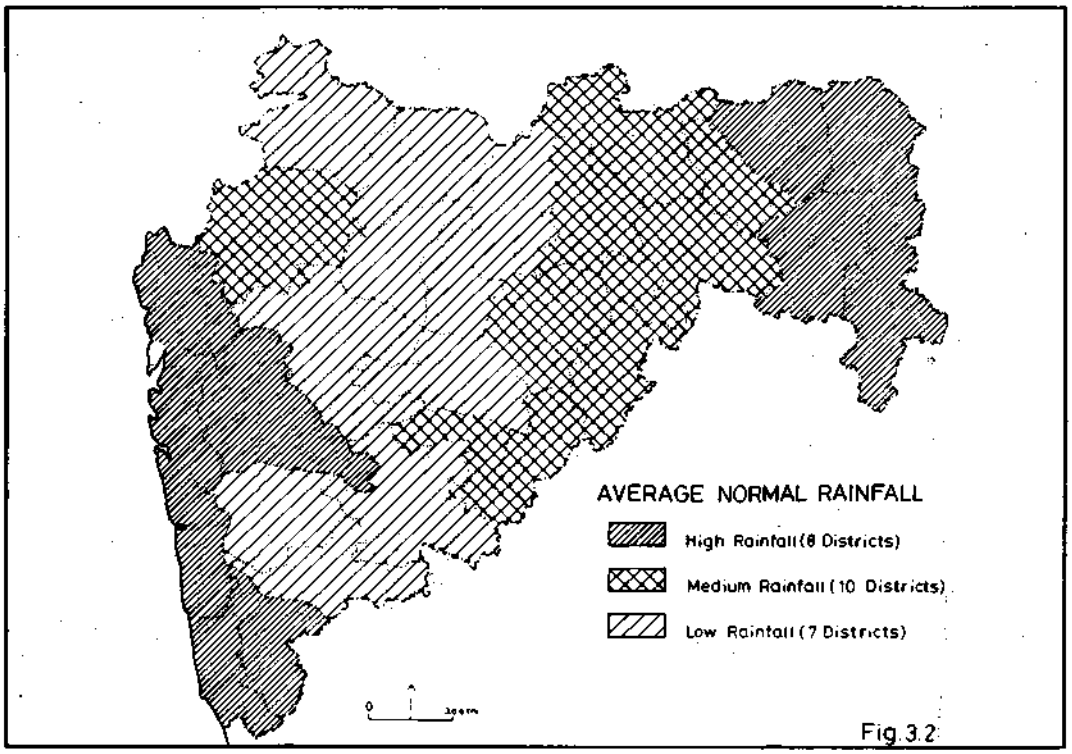

AVERAGE NORMAL RAINFALL
High Rainfall (8 Districts)
Medium Rainfall (10 Districts)
Low Rainfall (7 Districts)

Fig. 3.2

extent of irrigation much below the state average of about 15% in 1990-91. Majority of them belong to the Vidarbha region of the state comprised of Amravati and Nagpur divisions.

**Table 3.2**
**Districtwise Average Normal Rainfall, Soil Index and Percentage of Irrigation**

| District | Average Normal Rainfall (mms) | Soil Index | Percentage of net irrigated area to net sown area | | |
|---|---|---|---|---|---|
| | | | 1970-71 | 1980-81 | 1990-91 |
| **I. Low-rainfall** | | | | | |
| 1. Ahmednagar | 578.8 | 61.2 | 13.1 | 15.6 | 24.5 |
| 2. Solapur | 584.3 | 57.6 | 10.2 | 10.8 | 17.0 |
| 3. Sangli | 624.8 | 54.4 | 9.3 | 11.3 | 15.2 |
| 4. Beed | 668.4 | 54.4 | 5.7 | 11.6 | 21.8 |
| 5. Dhule | 674.0 | 61.2 | 9.7 | 9.7 | 10.6 |
| 6. Aurangabad | 725.8 | 54.4 | 4.8 | 9.0 | 12.9 |
| 7. Jalgaon | 740.7 | 61.2 | 10.1 | 12.2 | 17.0 |
| **II. Medium-rainfall** | | | | | |
| 8. Buldhana | 802.8 | 57.6 | 1.6 | 4.2 | 5.2 |
| 9. Satara | 803.2 | 57.6 | 13.9 | 18.0 | 23.7 |
| 10. Osmanabad | 809.9 | 54.4 | 5.3 | 5.3 | 7.4 |
| 11. Prabhani | 821.0 | 54.4 | 1.7 | 6.2 | 11.8 |
| 12. Akola | 846.5 | 72.7 | 1.0 | 2.5 | 2.4 |
| 13. Amravati | 877.3 | 72.2 | 2.0 | 4.6 | 4.5 |
| 14. Nanded | 901.1 | 54.4 | 2.3 | 5.2 | 8.2 |
| 15. Yavatmal | 991.6 | 64.8 | 0.8 | 2.7 | 4.0 |
| 16. Nasik | 1022.0 | 61.2 | 10.6 | 10.4 | 19.8 |
| 17. Wardha | 1090.3 | 72.7 | 2.1 | 4.2 | 4.6 |
| **III. High-rainfall** | | | | | |
| 18. Pune | 1150.3 | 61.2 | 12.2 | 17.0 | 20.5 |
| 19. Nagpur | 1175.0 | 64.8 | 7.8 | 7.9 | 10.2 |
| 20. Chandrapur | 1397.6 | 56.6 | 16.7 | 17.9 | 18.4 |
| 21. Bhandara | 1446.4 | 64.8 | 34.4 | 38.2 | 43.7 |
| 22. Kolhapur | 1931.5 | 57.6 | 11.9 | 15.0 | 19.4 |
| 23. Thane | 2258.6 | 57.6 | 1.7 | 1.5 | 1.7 |
| 24. Raigad | 2966.3 | 72.7 | 2.6 | 5.1 | 5.1 |
| 25. Ratnagiri | 3305.7 | 72.2 | 3.5 | 2.9 | 6.3 |
| **Maharashtra** | — | — | **7.6** | **10.0** | **14.4** |

Notes : i) The figures are simple averages of the rainfall recorded from all the rainguage stations of the district and are based on 50 years data of 1901-1950.
ii) High Rainfall : 1150 mms. and above. Medium Rainfall : 750 mms. to 1149 mms. Low Rainfall: Upto 749 mms.
iii) Data in respect of soil index are reproduced from Sahasrabudhe, 'Economy of Maharashtra', p. 221.

**Irrigation Development :**

The ultimate irrigation potential is estimated to be around 84 lakh hectares in Maharashtra. That is to say, nearly 60% of area under cultivation would remain dependent totally on rainfall even after exploiting the entire potential. This apart, even the rate of exploitation of the available potential has been very slow. Gross irrigated area in 1990-91 was just 33.2 lakh hectares i.e., only 15% of the total gross cropped area and about 40% of the ultimate irrigation potential in the state. This demonstrates the need for both stepping up investment in irrigation and simultaneously economising the use of water in agriculture by improving on-farm water management so that benefits of irrigation can spread more widely. In addition, there is an urgent need to make the benefits of watershed development available to the bulk of the net sown area dependent totally on rainfed farming.

Two important observations emerge from the scrutiny of the source wise irrigation development statistics provided in Table 3.3.

**Table 3.3**
**Irrigation Development in Maharashtra**

| | Unit | 1970-71 | 1980-81 | 1990-91 |
|---|---|---|---|---|
| I. Irrigation wells | ('000) | 694 | 826 | 1011 |
| Oil engines | ('000) | 143 | 132 | 109 |
| Electric pump sets | ('000) | 108 | 334 | 833 |
| II. A : Surface Irrigation | (Lakh ha.) | 5.8 | 7.8 | 10.0 |
| | | | (34.5) | (28.2) |
| B : Well Irrigation | (Lakh ha.) | 7.7 | 10.6 | 16.7 |
| | | | (37.7) | (59.5) |
| Total net irrigated area | (Lakh ha.) | 13.5 | 18.4 | 26.7 |
| | | | (36.3) | (45.1) |
| Gross irrigated area | (Lakh ha.) | 15.7 | 24.2 | 33.2 |
| | | | (54.1) | (37.2) |
| Intensity of irrigation | | 116 | 132 | 124 |
| III. Net irrigated area as % of net sown area | 7.6 | 10.2 | 14.4 | |
| Gross irrigated area as % of gross cropped area | 8.4 | 12.3 | 15.2 | |

Note : Figures in parentheses refer to percentage change over the year for the preceding column.

Firstly, increase in number of irrigation wells and electric pump sets had been much greater in 1980's when compared to 1970's. That is the rate of extraction of ground water must have gone up steeply in 1980's, probably

reaching the unsustainable levels of use as is being argued by many irrigation experts.[4] That is why, the rate of expansion in well irrigation has also moved up from about 38% between 1970-71 and 80-81 to 60% in the next decade.

Secondly, trend in intensity of irrigation i.e., cropping intensity in irrigated areas, from 1970's to 1980's has not been desirable. Intensity of irrigation moved up from 116 in 1970-71 to 132 in 1980-81 but subsequently declined to 124 in 1990-91.[5]

The next important aspect of irrigation development is the inter-regional inequity in distribution of irrigation benefits. We examined it with reference to the statistics of divisionwise extent of irrigation and shares in incremental irrigation in the three decades since formation of the State in 1960.

A few striking observations emerge from the examination of statistics in Table 3.4.

**Table 3.4**
**Divisionwise Extent of Irrigation and Share in Incremental Irrigation**

| Division | Extent of gross irrigated area to gross cropped area | | | | % Share in increased gross irrigated area between | | | % Share in gross cropped areas |
|---|---|---|---|---|---|---|---|---|
| | 1961-62 | 1970-71 | 1980-81 | 1990-91 | 1960-61 & 1970-71 | 1970-71 & 1980-81 | 1980-81 & 1990-91 | 1978-81 |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Konkan | 2.35 | 2.73 | 3.88 | 4.89 | 0.12 | 1.42 | 1.44 | 4.31 |
| Nasik | 5.73 | 12.44 | 13.96 | 16.97 | 44.91 | 7.74 | 12.07 | 13.54 |
| Pune | 11.42 | 13.52 | 18.04 | 21.16 | 16.30 | 22.26 | 19.29 | 18.38 |
| Kolhapur | 10.16 | 13.01 | 16.97 | 20.60 | 4.14 | 11.27 | 8.76 | 8.84 |
| Aurangabad | 2.65 | 4.38 | 9.97 | 15.22 | 15.51 | 36.03 | 46.84 | 27.05 |
| Amravati | 0.89 | 1.46 | 4.34 | 5.13 | 5.23 | 11.06 | 5.79 | 16.37 |
| Nagpur | 11.70 | 13.50 | 17.42 | 18.75 | 13.79 | 10.22 | 5.80 | 11.51 |
| **Maharashtra** | **4.46** | **8.38** | **12.29** | **15.18** | **100.00 (3599)** | **100.00 (8442)** | **100.00 (9044)** | **100.00** |

Note : Figures in parentheses denote the increased gross irrigated area in hundred hectares.

Aurangabad division's i.e., Maharashtra region's share in the expansion of irrigation at the state level between 1960-61 and 1970-71 i.e., 15.5% was far below its share in the state's gross sown area i.e., 27%. But this division received maximum benefits from incremental irrigation between

1970-71 and 1990-91, much higher than its share in the aggregate cropped area. Indeed, nearly half the benefits of incremental irrigation in 1980's had gone to Aurangabad division. Obviously, by 1990-91 this division reached the state average for irrigation i.e., 15%.

Secondly, Nasik, Pune and Kolhapur divisions, particularly the latter two, had proportion of irrigation much above the state average right from 1960-61 and this superior position of theirs was maintained through 1970's and 1980's due to further additions from the benefits of incremental irrigation. However, it must acknowledged in this context that two districts from each of the Nasik and Pune divisions and one from Kolhapur division fall in the low rainfall tract with its large parts being drought prone and at least the latter i.e., the drought prone regions certainly deserve a special treatment in distribution of irrigation benefits.

What is stated above regarding Nasik, Pune and Kolhapur divisions is also true regarding the average position for Nagpur division. But it conceals extreme inter-division disparity in it. Bhandara and Chandrapur had much higher initial levels of irrigation, namely, 39.4% and 16.7% respectively and they maintained it further while Wardha and Nagpur had negligible and low levels of irrigation i.e., 2.1% and 7.8% respectively in 1970-71 and yet the latter two districts could not improve their position through 1970's and 1980's so as to reach the state average.

Lastly, at the other extreme lie Konkan and Amravati divisions. They not only had initially poor levels of irrigation but received meagre benefits from the expansion of irrigation between 1970-71 and 1990-91. Therefore, they remained at the lower end with hardly 5% of cropped area under irrigation. Thus, Konkan and Amravati divisions have by and large continued to be the most neglected divisions in the state in respect of irrigation development.

### 3. Land Use Pattern :

Pattern of land use as revealed by the state's land records, has been fairly stable since 1961, with marginal downward change in the share of forest area or slightly upward movement in the proportion of area under non-agricultural use (Table 3.5).

## Table 3.5
## Land Utilisation Statistics of Maharashtra State

(Area in '000 hectares)

| Categories | 1970-71 | | 1980-81 | | 1990-91 | |
|---|---|---|---|---|---|---|
| | Area | Percent | Area | Percent | Area | Percent |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Reported area for land utilisation statistics | 30768 | 100.0 | 30758 | 100.0 | 30758 | 100.0 |
| 2. Forest | 5416 | 17.6 | 5309 | 17.3 | 5128 | 16.6 |
| 3. Land under Non-agricultural use | 685 | 2.2 | 993 | 3.2 | 1091 | 3.5 |
| 4. Barren and unculturable land | 1797 | 5.8 | 1733 | 5.6 | 1622 | 5.3 |
| 5. Permanent pastures & other grazing land | 1346 | 4.4 | 1591 | 5.2 | 1125 | 3.7 |
| 6. Land under Misc. trees & Grooves | 196 | 0.7 | 186 | 0.6 | 301 | 1.0 |
| 7. Culturable waste and | 712 | 2.3 | 993 | 3.2 | 966 | 3.1 |
| 8. Total (5+6+7) | 2254 | 7.4 | 2770 | 9.0 | 2392 | 7.8 |
| 9. Fallow land | 1229 | 4.0 | 802 | 2.6 | 1063 | 3.5 |
| 10. Current fallow | 1145 | 3.7 | 852 | 2.8 | 898 | 2.9 |
| 11. Total (9+10) | 2374 | 7.7 | 1654 | 5.4 | 1991 | 6.5 |
| 12. Net area sown | 18242 | 59.3 | 18299 | 59.5 | 18567 | 60.4 |
| 13. Area sown more than once | 1156 | 3.8 | 1834 | 6.0 | 3295 | 10.7 |
| 14. Total cropped area i.e. gross cropped area | 19398 | 63.0 | 20133 | 65.5 | 21860 | 71.1 |
| 15. Cropping Itensity | 106 | | 110 | | 118 | |

The only noticeable change that occurred was with respect to cropping intensity in 1980's. It moved up from 106 to 110 in 1970's but its further rise in 1980's was rapid and it reached the level of 118 by 1990-91. The movement is more remarkable in view of the fact that during the same period cropping intensity on irrigated area moved down i.e., from 132 in 80-81 to 124 in 1990-91. This implies that increase in cropping intensity on unirrigated areas of the state must have been even greater than the rise shown by the overall cropping intensity. It is difficult to attribute this change to distress diversification alone and is likely to be an indication of availability of technological advances promoting double cropping.

Expansion in irrigation need not necessarily lead to higher cropping intensity if the former is accompanied by increasing diversion of lands to annual crops like sugarcane away from the seasonal ones. However, technological advances in the form of either short duration varieties of the existing or newly emerging non-conventional crops and crop sequences or cropping systems superior to the existing ones, if made available to the farmers, generally promote rise in cropping intensity. That is why, for explanation of differential changes in cropping intensity over time we may have to analyse changes in crop pattern along with the nature of technological advances adopted by the farmers. But we leave the scrutiny of this issue to a later section.

A reference to the extent of degraded lands in Maharashtra would be in order in the context of land utilisation. According to the Society of Promotion of Wastelands Development, total estimate of wasteland (1984) in Maharashtra was 144 lakh hectares, out of which 116 lakh hectares were non-forest degraded areas.[6] From this if we exclude (i) all lands under non-agricultural uses i.e., 11 lakh hectares, (ii) barren and unculturable land i.e., 16 lakh hectares and (iii) additionally all grazing lands i.e., 11 lakh hectares (refer column (6) in Table 3.5) then the left out 78 lakh hectares of wastelands are either totally unproductive or their productivity must be much below their optimum capacity. Of them 33 lakh hectares are accounted by (i) land under miscellaneous trees and groves i.e., 3 lakh hectares, culturable waste lands (10 lakh hectares) and (iii) all fallow lands i.e., 20 lakh hectares. Hence remaining 45 lakh hectares of waste lands must be a part of the state's net sown area of 186 lakh hectares. In other words 34% of area under cultivation in Maharashtra is degraded area. This reveals the serious state of neglect of land resource and their under utilisation in the state of Maharashtra.

## 4. Some Aspects of Operational Holdings in Maharashtra :

About 85% of agricultural holdings in Maharashtra were mainly crop production holdings while about 13 per cent were mainly livestock holding in 1981-82. The relative dominance of crop followed by livestock holdings continued till 1991-92 with only a marginal decline in the share of crop holdings to 83%. Poultry, plantation and other holdings together improved their share from 2% in 1981-82 to 4 per cent in 1991-92 (NSSO, Report No. 407, 1996).

Average size of operational holdings declined continuously from 3.83 hectares in 1970-71 to 2.96 hectares and 2.25 hectares in 1981-82 and 1991-92 respectively (Table 3.6). The decline has been more or less comparable to Indian agriculture in which case average size was 2.2 hectares, 1.67 hectares and 1.34 hectares in the respective years.

Though the share of marginal holdings was much lower in Maharashtra initially (i.e. at 24 per cent in 1970-71) than that in Indian agriculture (46%) growth in the number of marginal holdings has been much faster in Maharashtra compared to rise at the national level. Proportion of marginal holdings increased to 44 per cent in 1991-92 for Maharashtra from the initial proportion of 24% in 1970-71. The comparable change for Indian agriculture was from 46% in 1970-71 to 62 per cent in 1991-92.

**Table 3.6**
**Size classwise Percentage Distribution of Number of Operational Holdings and Area Operated in Maharashtra**

| Size Class | Distribution of number of holdings | | | Distribution of area operated | | |
|---|---|---|---|---|---|---|
| | 1970-71 | 1981-82 | 1991-92 | 1970-71 | 1981-82 | 1991-92 |
| Marginal | 23.71 | 35.26 | 43.59 | 3.06 | 3.63 | 6.66 |
| Small | 21.74 | 19.47 | 18.92 | 8.38 | 9.35 | 11.77 |
| Semi-medium | 23.44 | 21.28 | 20.38 | 17.59 | 20.01 | 24.67 |
| Medium | 22.44 | 18.42 | 14.07 | 35.29 | 37.88 | 36.59 |
| Large | 8.67 | 5.57 | 3.04 | 35.68 | 29.13 | 20.31 |
| All holdings | (100.0) | (100.0) | (100.0) | (100.0) | (100.0) | (100.0) |
| Average size | — | — | — | 3.83 | 2.96 | 2.25 |

Source: Land and Livestock Holdings Survey, NSS 48 Round, January-December 92 NSSO, Report No. 407, Report-2 (Mimeo 1996), Some Aspects of Operational Holdings, pages 22-23.

However, the pace of marginalisation was faster for both of them during the decade of the seventies when compared to the eighties. It may further slow down in the nineties. Yet, for a predominantly dry farming and a low productivity state like Maharashtra as large a share as of 44 per cent of marginal holdings alongwith fairly high share of agricultural labourers in the rural work force (i.e., 37% which is above the corresponding national average of 32%) displays improverised character of the agricultural economy of the state.

### 5. Crop Pattern :

In the early phase of the period under study i.e., between 1970-71 and 1980-81, cropping pattern in terms of shares of major categories of crops such as cereals, pulses, oilseeds, sugarcane, cotton and other crops did not undergo a drastic change (refer Table 3.7). Yet, there were, a few noticeable changes such as marginal increase in the shares of the first four crop categories at the cost of decline in the last two i.e., cotton and other crops' by about 1.5% and 1.1% respectively. Another distinct change during the seventies was in the composition of shares of different cereals. Increase

in the share of kharif jowar was highest i.e., 1.6% followed by wheat 1.2% at the cost of decline in the share of bajra by 2.7%. For the other cereals improvement in share was negligible.

**Table 3.7**
**Cropping Pattern for the Triennia Ending 1970-71, 1980-81 and 1990-91 in Maharashtra**

| Crop/Crop Group | Triennia Ending | | |
|---|---|---|---|
| | 1970-71 | 1980-81 | 1990-91 |
| Rice | 7.16 | 7.54 | 7.15 |
| Kh. Jawar | 13.60 | 15.21 | 12.76 |
| Rb. Jowar | 17.97 | 18.05 | 16.37 |
| Jowar | 31.57 | 33.26 | 29.13 |
| Bajra | 10.56 | 7.92 | 8.93 |
| Maize | 0.23 | 0.38 | 0.49 |
| Ragi | 1.16 | 1.12 | 0.95 |
| Small Millets | 1.11 | 1.01 | 0.69 |
| Wheat | 4.55 | 5.77 | 3.99 |
| Other Cereals | 0.00 | 0.05 | 0.02 |
| **Total Cereals** | **56.35** | **57.05** | **51.34** |
| Gram | 1.96 | 2.26 | 3.03 |
| Arhar | 3.31 | 3.44 | 4.39 |
| Other Pulses | 7.49 | 8.21 | 7.77 |
| **Total Pulses** | **12.76** | **13.91** | **15.19** |
| **Kharif Foodgrain** | **43.76** | **43.76** | **42.33** |
| **Rabi Foodgrains** | **25.35** | **27.19** | **24.21** |
| **Total Foodgrains** | **69.11** | **70.95** | **66.54** |
| Groundnuts | 4.89 | 4.03 | 4.08 |
| Sesamum | 0.82 | 0.97 | 1.51 |
| Linseed | 1.00 | 1.33 | 1.02 |
| Safflower | 1.98 | 2.63 | 2.82 |
| Nigerseed | 0.41 | 0.52 | 0.46 |
| Sunflower Seed | 0.00 | 0.19 | 2.10 |
| Soyabean | 0.00 | 0.00 | 0.64 |
| **Total Oilseed** | **9.10** | **9.67** | **12.63** |
| **Sugarcane** | **1.09** | **1.21** | **1.76** |
| **Cotton** | **14.49** | **13.05** | **12.30** |
| Mesta | 0.30 | 0.34 | 0.18 |
| Chillies | 0.81 | 0.76 | 0.58 |
| Potatoes | 0.07 | 0.05 | 0.06 |
| Banana | 0.19 | 0.25 | 0.25 |
| Onions | 0.00 | 0.25 | 0.28 |
| Tobacco | 0.06 | 0.07 | 0.04 |
| Miscellaneous | 4.78 | 3.41 | 5.39 |
| **Total Other Crops*** | **6.21** | **5.11** | **6.78** |
| **All Crops** | **100.00** | **100.00** | **100.00** |

* This category includes all crops other than cereals, pulses, oilseeds, sugarcane and cotton.

The decade of 1980's however, registered more volatile and reverse changes in crop pattern. Oilseeds strengthened their position by moving up from 9.67% in 80-81 to 12.63% in 90-91. 'Other crops' mainly vegetables and fruits were the next important beneficiary class which improved its share by 1.7% (i.e., from 5.1% in 80-81 to 6.8% in 90-91). Pulses and sugarcane followed them. Gains of these four groups of crops were at the cost of mainly the cereals which experienced nearly 6% decline in their share, though cotton too suffered a marginal loss of 0.7%.

Again, composition of both cereals and oilseeds changed significantly. Among the cereals loss of area was highest for kharif jowar (i.e., by 2.5%) followed by wheat (i.e., 1.8%). Between the conventional and non-conventional oilseeds, the latter namely, sunflower and soyabean were the major beneficiaries of gains in area and not the conventional oilseeds.

Thus, with the increased shares of oilseeds, pulses and other crops, but significantly reduced share of cereals, crop pattern moved more towards high value crops produced mainly for market sales by 1990-91 indicating increased commercialisation of the crop pattern in Maharashtra.

**6. Trends in Cropping Intensity :**

Analysis of land use pattern revealed higher rise in cropping intensity during the recent decade of the eighties in comparison with the seventies. The accelerated increase in intensity of land use is quite remarkable for two reasons. One, it occurred in the decade characterised by relatively unfavourable rainfall conditions. Secondly, during the same period intensity of land use on irrigated area declined. The latter implies that the cropping intensity must have accelerated mainly on the unirrigated areas during the eighties. Hence, it would be worthwhile to scrutinise changes in overall cropping intensity in the two decades at a more disaggregate level and to identify regions/districts which are mainly responsible for the emergence of acceleration in the upward movement.

Among all the divisions rise in cropping intensity during the eighties was highest for Aurangabad i.e., by 10 percentage points (columns (3) and (4) in Table 3.8). The index of intensity too was maximum i.e., 119 in TE 1990-91 for Aurangabad division though extent of irrigated area was just equal to the state average of 15% for it. What was much more remarkable about the aforesaid increase in intensity that it could occur despite significant expansion in area under sugarcane in this division. In fact, share of the division in the state's incremental sugarcane production in the eighties was maximum at 38% vs. its own share of 17% in the seventies. Aurangabad district alone accounted for around 15% out of the division's

share of 38%. In other words, in absence of significant diversion of irrigated area to sugarcane, improvement in the index of cropping in Aurangabad division would have been still higher.

Next to Aurangabad were Kolhapur and Pune division in terms of the index of cropping i.e., 115 in TE 1990-91. Nasik, Amravati and Nagpur divisions followed them in that order. Konkan division was at the bottom with its cropping intensity being 106 in TE 1990-91 which remained totally stagnant through the eighties.

**Table 3.8**
**Changes in Cropping Intensity**

| Division | Cropping Intensity for | | | % Gross irrigation to gross cropped area | | |
|---|---|---|---|---|---|---|
| | TE 0-71 | TE 80-81 | TE 90-91 | 70-71 | 80-81 | 90-91 |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Konkan | 103 | 106 | 106 | 2.7 | 3.9 | 4.9 |
| Nasik | 107 | 111 | 114 | 12.4 | 14.0 | 17.0 |
| Pune | 106 | 110 | 115 | 13.5 | 18.0 | 21.2 |
| Kolhapur | 105 | 108 | 115 | 13.0 | 17.0 | 20.6 |
| Aurangabad | 104 | 109 | 119 | 4.4 | 10.0 | 15.2 |
| Amravati | 102 | 106 | 113 | 1.5 | 4.3 | 5.1 |
| Nagpur | 109 | 111 | 113 | 13.5 | 17.4 | 18.8 |
| **Maharashtra** | **105** | **109** | **116** | **8.4** | **12.3** | **15.2** |

Note : TE stands for triennium ending.

Thus, with the highest acceleration (i.e. by 10 per cent point) in the index of intensity Aurangabad division contributed dominantly to the rise in the state level cropping intensity realised in the 80's. Second most important rise occurred in Amravati and Kolhapur divisions i.e., of 7 per cent points. Between the two the performance of the former i.e., Amravati division had been more noteworthy as the extent of irrigation had been one of the lowest in it, i.e., just 5% as it was in the Konkan division in TE 1990-91. Nasik and Nagpur divisions experienced low rise of 3 per cent and 2 percentage points respectively in the eighties. Lastly, as mentioned earlier index of cropping intensity remained invariant for the Konkan division.

At the more disaggregated level, the districts from Aurangabad division were obviously in the fore-front in raising the cropping intensity (Annexure 3.1). All the districts but one (namely Nanded) from Aurangabad registered higher improvement in the degree of multiple cropping than the state level rise i.e. 7 percentage points. Maximum increase occurred in Parbhani district

with its cropping index moving to 138 followed by Aurangabad (128), Osmanabad (126), and Beed district (114). We omit the case of Parbhani district from discussion as its net sown area declined significantly between TE 80-81 and TE 90-91 rendering the inter temporal comparison rather difficult. From the remaining, Aurangabad is the most typical district in which case the index moved up by 16 percentage points in the 80's maximum rise among all the districts of the state. But change in gross irrigated area for this district was marginal (i.e., 12.9% to 13.6%). In other words, entire rise in intensity of land use must be on the rainfed lands. In the other two districts, namely, Osmanabad and Beed cropping index rose by 13 and 8 percentage points respectively. Between the two, Osmanabad resembled the pattern of Aurangabad with significant rise in cropping intensity mainly on rainfed lands. But in Beed district there was simultaneously and significant expansion in irrigated area and its cropping intensity (refer Table 3.2 for details of irrigation).

In addition, there were six districts from the other divisions, namely Pune and Ahmednagar from Pune division, Satara and Kolhapur from Kolhapur division and Jalgaon and Amravati from Nasik and Amravati divisions in which expansion in multiple cropping was above the state average of 7 percent points. Among them Satara revealed the highest expansion i.e., by 12 percentage points and all the rest, eight to ten percentage points in their cropping intensity. In all of them rise in irrigation during the eighties was either low or very low and negligible like that in Amravati district.

Inter-temporal changes in crop pattern analysed at the state level in the preceding section provide a clue for explaining observed acceleration in the upward trend in the intensity of cropping. Field survey undertaken by us specially to examine cropping and fertilization practices in the six districts of the state too support the above mentioned inferences based on macro level crop pattern changes.

Emergence of the non-conventional crops such as soyabean and sunflower which are not only short duration crops but more sturdy and profitable too have picked up in many low to medium rainfall districts particularly in Aurangabad, Amravati and Pune divisions. In addition, summer groundnut, summer sunflower and vegetable crops etc. found to have been preferred by farmers in irrigated areas due to their high productivity and profitability. Similarly, cultivation of short duration varieties of kharif pulses like green gram and black gram have also spread during the eighties in the regions like Amravati divisions.

Hence, we believe that it is the development of the early maturing and

low risk varieties of a few conventional and non-conventional crops suited to multiple cropping in the rainfed areas must be the main guiding force behind the recent spurt in cropping intensity in the state. This transition to new cropping practices must have been certainly facilitated by the significantly improved market support in the eighties for crops like oilseeds and some improvement in the infrastructural facilities for marketing the agricultural produce in the State in general and in Aurangabad division in particular.

**7. Average Productivity of Crops: Maharashtra and India:**

Comparison of the average levels of yields of major crop groups, namely cereals, pulses and oilseeds, in Maharashtra with the averages for Indian agriculture brings out in sharp focus the overall low productivity character of agriculture in Maharashtra (Table 3.9). Nevertheless, the scenario is not pessimistic for all the individual crops. There are exceptions like sugarcane, kharif jowar, groundnut from among the major crops and from the minor ones, like maize, safflower, banana and onions, the conventional crops and sunflower and soyabean the emerging non-conventional crops.

It is pertinent to underscore in this context that the averages of crop yields in Maharashtra must be viewed keeping in background the negligible levels of irrigation for majority of crops grown in the state. Exceptions are only a few, like sugarcane and banana or the minor fruit crops like oranges and grapes which are almost entirely irrigated and a crop like wheat for which irrigation has been above 50 per cent.

A few important observations emerging from the cropwise comparison of the state level average with the national averages for different time periods, are listed below (refer Table 3.9).

(i) State's average yield per hectare for rice was close to all-India average of about 1100 kg. till 1970-71 and moved above it by 1980-81. But with subsequent stagnation throughout the eighties there was significant deterioration in the comparative position of the state by the early nineties. Thus, the state failed to exploit its initial advantage in respect of rice yields in improving further its position vis-a-vis other states.

## Table 3.9
## Average Crop Yields: Maharashtra and India

(Per hectare in kgs.)

| Crops | Maharashtra | | | | India | | | |
|---|---|---|---|---|---|---|---|---|
| | 1967-68 | 1969-72 | 1979-82 | 1990-93 | 1967-70 | 1969-72 | 1979-82 | 1990-93 |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Rice | 1025 | 1094 | 1469 | 1443 | 1060 | 1112 | 1239 | 1745 |
| Jowar (Kh.) | 681 | 498 | 1050 | 1348 | 560 | 545 | 779 | 982 |
| Jowar (Rabi) | 441 | 286 | 485 | 515 | 481 | 386 | 552 | 587 |
| Bajra | 308 | 319 | 439 | 659 | 359 | 500 | 433 | 652 |
| Maize | 1249 | 918 | 1697 | 1339 | 1028 | 1049 | 1100 | 1531 |
| Ragi | 755 | 748 | 959 | 1005 | 772 | 848 | 1044 | 1207 |
| Wheat | 448 | 486 | 869 | 1074 | 1161 | 1238 | 1585 | 2332 |
| Other Cereals | 413 | 385 | 416 | 831 | 379 | 385 | 395 | 443 |
| **Total Cereals** | **559** | **478** | **814** | **957** | **849** | **916** | **1093** | **1598** |
| Gram | 294 | 283 | 372 | 523 | 681 | 673 | 576 | 706 |
| Tur | 519 | 488 | 578 | 450 | 686 | 705 | 692 | 641 |
| Other Pulses | 293 | 255 | 252 | 403 | 371 | 376 | 322 | 471 |
| **Total Pulses** | **357** | **319** | **354** | **437** | **518** | **518** | **447** | **562** |
| **Total Foodgrains** | **522** | **449** | **724** | **836** | **789** | **845** | **977** | **1402** |
| Groundnut | 690 | 640 | 778 | 1014 | 711 | 793 | 837 | 926 |
| Sesamum | 231 | 235 | 200 | 273 | 178 | 204 | 184 | 318 |
| Safflower | 295 | 273 | 477 | 423 | 189 | 241 | 469 | 425 |
| Linseed | 196 | 194 | 223 | 194 | 233 | 255 | 228 | 308 |
| Nigerseed | 170 | 170 | 194 | 193 | 205 | 233 | 230 | 296 |
| Sunflower | NA | NA | 558 | 512 | NA | 656 | 546 | 500 |
| Soyabean | — | — | — | 884 | — | 570 | 682 | 889 |
| **Total Oilseeds** | **473** | **447** | **532** | **623** | **552** | **542** | **562** | **761** |
| Sugarcane | 64908 | 65420 | 92825 | 80920 | 46340 | 48318 | 55187 | 65901 |
| Cotton | 85 | 59 | 94 | 104 | 122 | 126 | 159 | 234 |
| Banana | 26120 | 23848 | 24725 | 27890 | 14461 | 13908 | 15197 | 20250 |
| Chillies | 574 | 528 | 506 | 503 | 606 | 614 | 614 | 819 |
| Potato | 4360 | 4124 | 5096 | 4723 | 8461 | 9224 | 12802 | 15567 |
| Onion | NA | NA | 14479 | 13182 | NA | NA | 10918 | 11006 |
| Tobacco | 420 | 492 | 576 | 1006 | 870 | 831 | 1089 | 1370 |

(ii) Average yield of wheat is hardly half the level of national average despite substantial benefits of irrigation enjoyed by the wheat crop in Maharashtra. In fact, both for irrigated and unirrigated areas under

wheat, yields are significantly lower in Maharashtra than in the states like Rajasthan and Madhya Pradesh. Uncertainty in availability of water whether from rainfall or irrigation appears to be the main reason for the poor performance of this crop for which promising national level HYVs were available during the entire period of the green revolution.

(iii) Among the coarse cereals the state enjoys distinctly superior advantage over the states in respect of kharif jowar. Its average yields for bajra and maize too have been close to the national average.

(iv) Among the conventional oilseeds Maharashtra continues to be competitive in cultivation of groundnut and safflower. Same is also true for the two recently emerged non-conventional oilseeds, namely, sunflower and soyabean. It is also important to note that the yields of the latter are much above the average yields of all the conventional oilseeds other than the groundnut.

(v) Though cotton is one of the most important traditional cash crops of Maharashtra the state continues to be non-competitive in terms of average productivity of cotton. Indeed, its relative position has continuously deteriorated further since the seventies vis-a-vis other states as growth in the all India average yield was faster in the seventies and accelerated further after 1980-81. Almost total absence of irrigation must have been mainly responsible for low and highly variable cotton yields in the state.

(vi) Maharashtra enjoyed highest comparative advantage over all the other states in cultivation of sugarcane til the late seventies. However, sharp decline in its yield during the eighties has not only eroded the State's comparative advantage in this crop but has adversely affected the state's agricultural growth performance by depriving the other crops legitimate benefits of irrigation. Tamil Nadu state has now acquired top position due to remarkable increase in sugarcane yields during the eighties.

A few important lessons follow from the above observations. One, the state has comparative advantage in shifting the low yielding unirrigated wheat areas to non-conventional short duration oilseed like rabi sunflower or even to gram wherever gram is found to be a more sturdy crop than wheat. This is because gram enjoys the advantage of higher prices too over wheat. Similarly, there is an advantage in moving to a crop like soyabean which is an early duration, low risk crop suitable to double cropping particularly in the low yielding kharif jowar areas of the state. The

former enjoys the twin benefits of higher price and better market support too. A shift from conventional oilseeds other than groundnut to either soyabean or sunflower, wherever it is feasible, is also desirable in general due to a distinct yield advantage of the latter i.e., soyabean/sunflower over the former.

Promising hybrid varieties of cotton have been available from the state agricultural university like Punjabrao Krishi Vidyapeeth and also from corporate sector seed company like MAHYCO in Maharashtra. Hence, extension of even minimum life saving irrigation to this crop would go a long way in improving remarkably the cotton economy of the state.

**8. Trends in Absorption of Inputs :**

Sectorwise analysis of SDP growth revealed contrasting trends of significant acceleration and deceleration in the state's agricultural growth in the early and the latter phases of the period respectively. It would therefore, be interesting to compare the pace of input absorption in agriculture in these two phases. Table 3.10 provides comparative statistics for this purpose. From the comparison of changes between the seventies (1970-71 to 1980-81) and the eighties (1980-81 to 1990-91) the following major conclusions emerge :-

(i) Rate of expansion in gross sown area accelerated after 1980-81 though net sown area remained by and large constant since 1970-71. Thus, there was increase in the overall intensity of land use in Maharashtra.

(ii) Net irrigated areas expanded at a faster rate in the eighties (i.e., 4.5 per cent annum) vis-a-vis its lower rate of expansion i.e., 3.6% per annum in the seventies. As observed earlier (Table 3.3) it was the result of rapidly accelerated expansion in area under well irrigation after 1980-81. This implies that private investment in irrigation must have picked up during the eighties while public investment must have slowed down.

(iii) Among all the current inputs the most remarkable expansion occurred in the use of fertilisers during the recent decade of 1980s vis-a-vis the seventies. Consumption of fertilisers moved up from 2 lakh tonnes in 1970-71 to around 4 lakh tonnes in 1980-81 and then jumped to more than 13 lakh tonnes in 1990-91.

(iv) In respect of pesticides almost entire expansion occurred in 1980's from a very negligible use in 1980-81 i.e., almost no use in 1970's.

(v) Unlike fertilisers rate of expansion in area under HYVs was higher in 1970's and not in 80's though expansion in absolute area was around 30 lakh hectares in both the decades.

(vi) Higher annual rate of increase (i.e., 38%) in use of electricity between 70-71 and 80-81 was due to a very low initial base. In fact, much larger expansion was realised between 80-81 and 90-91.

(vii) With regard to investment in capital assets, namely tractors and pumpsets, trends in rates of expansion were opposite. Rate of increase was greater for tractors in 1970's when compared to 1980's where as both relative and absolute expansion in number of pumpsets owned was very high during the five years from 1982 to 1987 vis-a-vis that in the entire decade of 1970's. We believe that this accelerated increase in ownership of pumpsets must have continued beyond 1987 too. Huge expansion in the use of electricity in agriculture as also in area irrigated by wells between 1981 and 1991, mentioned earlier, support our contention.

**Table 3.10**
**Input Expansion in Agriculture in Maharashtra**

| | | 1967-68 | 1970-71 | 1980-81 | 1990-91 |
|---|---|---|---|---|---|
| I. Land | a) Net Sown area (lakh hectares) | 183 | 177 | 180 (0.17) | 179 (0.06) |
| | b) Gross Sown area (lakh hectares) | 193 | 187 | 196 (0.48) | 211 (0.77) |
| II. Irrigation | a) Net irrigated area (lakh hectares) | 12.8 | 13.5 | 18.4 (3.6) | 26.7 (4.5) |
| | b) Gross irrigated area (lakh hectares) | 14.8 | 15.7 | 24.2 (5.4) | 33.2 (3.7) |
| III. Current Inputs | a) Fertiliser (NPK) (lakh tones) | 1.81 | 1.99 | 4.23 (11.3) | 13.2 (21.2) |
| | b) Area under HYVs/Hybrid | 4.7 | 14.1 | 43.5 (20.9) | 76.3 (7.5) |
| | c) Pesticides (Liquid materials only; lakh M. tones) | | | 0.06 — | 4.3 (707) |
| | d) Electricity (GWH) | 155 | 137 | 1723 (38.2) | 6604 (28.3) |
| IV. a) Pump Sets* (000) | | 38 | 251 | 466 (8.6) | 942 (20.4) |
| b) Tractors* (000) | | 3.27 | 6.20 | 21.45 (24.6) | 33.83 (11.5) |

Note : Figures in parentheses denote percentage change per annum (simple average) over the year in the preceding column.
* Relate to 1966, 1972, 1982 and 1987 respectively.

To sum up, two major conclusions emerge from the preceding discussion. One, the pace of absorption of the majority of the key inputs in agriculture had been either maintained or even stepped up as in case of fertilisers, irrigation, electricity, pesticides etc., during the latter part of the green revolution period in Maharashtra. Secondly, the rate of private investment in agriculture too must have been maintained during the eighties at least at its pre - 1981 level.[8]

**9. Inter-Division Disparity in Fertilizer Consumption :**

Spurt in consumption of fertilisers, one of the key inputs in agriculture, was the major distinguishing feature of the expansion of agricultural inputs during the eighties. Inter-regional disparity in its use is therefore likely to have influenced crucially the regional patterns of growth performance in agriculture. That is why, in the present section we examine inter-temporal changes in the per hectare use of fertilizers (N, P and K combined) in different divisions of the state (Table 3.11).

Fertiliser consumption per hectare was highest in Konkan division (i.e., 24 kg.), followed by Kolhapur division (i.e., 19 kg.) in 1970-71. In the remaining divisions it was low, Aurangabad division being at the bottom with the use of fertilisers at just 7 kg. per hectare. Over the seventies situation changed drastically for Nasik and Kolhapur divisions with steep rise in the average use per hectare. It was more so for the former i.e., Nasik as the change in its consumption during the decade was 227 per cent (see column (8) in Table 3.11). Their shares in the state's aggregate consumption, therefore, moved up to 23 per cent and 20 per cent respectively in 1980-81. For all the remaining divisions shares moved down either marginally or steeply (e.g. Konkan). This pattern of changes in divisionwise shares implies increase in the concentration of the use of fertilisers during the 70's.

The decade that followed, experienced tremendous rise in the use of fertilisers when the aggregate consumption moved up to 13 lakh tonnes in 1990-91. More importantly, the rate of increase was highest for Aurangabad division, where the level of consumption was lowest at just 10 kg. per hectare in 1980-81. Again, unlike the seventies, in all the other divisions use of fertilisers moved up significantly, suggesting a decline in the degree of inter-division inequality in their use. Downward movement in inter-district co-efficient of variation in fertilisers use from 84.5 in 1980-81 to 66.7 in 1990-91 vis-a-vis a rise (i.e., from 54.5 in 1970-71 to 84.5 in 1980-81) during the preceding decade of the seventies confirmed our inferences.

Kolhapur division continued to be the high consumption division even in

1990-91 as in the past. Next highest consumption was in Nasik division. In all the remaining use of fertilisers per hectare was below the overall state average of 67 kg. per hectare. Among them Amravati, Aurangabad and Konkan were the low users, with their fertilisers consumption being in the neighborhood of about 40 kg. per hectare.

**Table 3.11**
**Divisionwise Share in Consumption of Fertilisers**

| Division | % share in total fertiliser consumption | | | Fertiliser Consumption Consumption (N.P.&K) per hectare in kg. | | | % change in per hectare consumption of N.P.K. between | | % Share in gross cropped area 1978-81 |
|---|---|---|---|---|---|---|---|---|---|
| | 1970-71 | 1980-81 | 1990-91 | 1970-71 | 1980-81 | 1990-91 | 1970-71 and 1980-81 | 1980-81 and 1990-91 | |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Konkan | 9 | 5 | 3 | 24 | 23 | 42 | -4 | 83 | 4 |
| Nasik | 14 | 23 | 19 | 11 | 36 | 88 | 227 | 144 | 14 |
| Pune | 17 | 15 | 18 | 10 | 18 | 60 | 80 | 233 | 18 |
| Kolhapur | 15 | 20 | 18 | 19 | 49 | 128 | 158 | 161 | 9 |
| Aurangabad | 17 | 13 | 21 | 7 | 10 | 43 | 43 | 330 | 27 |
| Amravati | 14 | 13 | 13 | 9 | 17 | 46 | 89 | 171 | 16 |
| Nagpur | 13 | 10 | 10 | 12 | 18 | 54 | 50 | 200 | 12 |
| Maharashtra (N.P&K in lakh tonnes) | 100 (1.98) | 100 (4.19) | 100 (13.3) | 11 | 21 | 67 | 91 | 219 | 100 |

Finally, in 1990-91 share of Kolhapur division in the state's total fertiliser consumption was double its share in cropped area [Column (4) and (10) in Table 3.11]. Shares of Nasik and Pune divisions were above and equal to their shares in cropped area respectively while for the remaining four, the shares remained below their respective area shares.

## Notes

1. S. Mahendra Dev. 'Agricultural Policy Framework for Maharashtra: Issues and Options', Background Paper Prepared for the World Bank's, Maharashtra Development Project, (Mimeo).
2. Sawant and Achuthan, (1995), 'Agricultural Growth Across Crops and Regions: Emerging Trends and Patterns', Economic and Political Weekly, Vol. XXX, No. 2.
3. It is true that extent of inequity will be crucially influenced by inequity in potential. However, public investment in irrigation projects is expected to be distributed as equitably as possible across the region on the basis of some rational criteria and needs of the region.
4. Gram Vikas Va Jalal Sandharana Vibhag Ani Nagar Vikas Vibhag, Maharashtra Shasan, *Shvetapatrika,* 'Pinyache Panipuravatha Karyakram', *(in Marathi),* 26th July 1995, page. 8.

5. For the limitations of the present irrigation statistics in computation of cropping intensity separately for irrigated and unirrigated areas refer Sawant S.D., Extent of Multiple Cropping In Irrigated and Unirrigated areas of India' *Indian Journal of Agricultural Economics*, April-June 1975, Vol. XXX, No. 2.

6. Government of India, Planning Commission, 'Eighth Five Year Plan (92-97)', Vol. II, page 101.

7. Average irrigated and unirrigated wheat yields per hectare are 1344 kg. and 554 in Maharashtra. The comparable yields for Madhya Pradesh are 2293 kg. and 803 kg. and for Rajasthan 2491 kg. and 1257 kg. respectively (Source: CMIE, India's Agricultural Sector, September, 1995, Table 20).

8. Refer section 2 from Chapter 6 for further evidence in this respect.

## Annexure 3.1
## Districtwise Changes in Cropping Intensity: Maharashtra

| District/Divisions | Net sown area for triennium ending | | | Gross sown area for triennium ending | | | Cropping Intensity | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1970-71 | 1980-81 | 1990-91 | 1970-71 | 1980-81 | 1990-91 | TE 1970-71 | TE 1980-81 | TE 1990-91 |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| 1. Thane | 2755 | 2612 | 2677 | 2815 | 2760 | 2823 | 102 | 106 | 105 |
| 2. Raigad | 2052 | 1895 | 1902 | 2191 | 2143 | 2139 | 107 | 113 | 113 |
| 3. Ratnagiri & Sindhudurg | 3567 | 3487 | 3567 | 3669 | 3648 | 3690 | 103 | 105 | 103 |
| **Konkan Division** | **8394** | **7994** | **8146** | **8675** | **8551** | **8652** | **103** | **106** | **106** |
| 4. Nasik | 8879 | 8983 | 8919 | 9355 | 9825 | 9729 | 106 | 110 | 109 |
| 5. Dhule | 6701 | 7046 | 7297 | 7343 | 7858 | 7955 | 110 | 111 | 109 |
| 6. Jalgaon | 8003 | 8144 | 8306 | 8604 | 9269 | 10281 | 108 | 114 | 124 |
| **Nasik Division** | **23583** | **24173** | **24522** | **25302** | **26952** | **27965** | **107** | **111** | **114** |
| 7. Ahmednagar | 12467 | 11834 | 11600 | 13119 | 12831 | 13520 | 106 | 109 | 117 |
| 8. Pune | 9729 | 10001 | 10144 | 10645 | 11243 | 12370 | 110 | 113 | 122 |
| 9. Solapur | 12127 | 11373 | 11197 | 12510 | 12357 | 11129 | 104 | 109 | 107 |
| **Pune Division** | **34323** | **33208** | **32941** | **36274** | **36431** | **37819** | **106** | **110** | **115** |
| 10. Satara | 5747 | 5814 | 5839 | 6335 | 6567 | 7271 | 110 | 113 | 125 |
| 11. Sangli | 6153 | 6162 | 5894 | 6323 | 6556 | 6486 | 103 | 106 | 110 |
| 12. Kolhapur | 4053 | 4249 | 4122 | 4103 | 4400 | 4607 | 101 | 104 | 112 |
| **Kolhapur Division** | **15953** | **16225** | **15855** | **16761** | **17523** | **18364** | **105** | **108** | **115** |
| 13. Aurangabad & Jalna | 13014 | 12194 | 13258 | 13745 | 13512 | 16132 | 106 | 111 | 128 |
| 14. Parbhani | 9213 | 10153 | 8597 | 10199 | 11398 | 11828 | 109 | 112 | 138 |
| 15. Beed | 8103 | 7930 | 8378 | 8617 | 8403 | 9570 | 106 | 106 | 114 |
| 16. Nanded | 7285 | 7283 | 7276 | 7528 | 7716 | 7937 | 104 | 106 | 109 |
| 17. Osmanabad & Latur | 10910 | 11084 | 11141 | 11332 | 12500 | 14049 | 104 | 113 | 126 |
| **Aurangabad Division** | **48525** | **48644** | **48650** | **51421** | **53529** | **59516** | **106** | **110** | **122** |
| 18. Buldhana | 6916 | 6834 | 6928 | 7186 | 7610 | 8190 | 104 | 112 | 118 |
| 19. Akola | 7942 | 8067 | 8286 | 8061 | 8665 | 9434 | 102 | 108 | 114 |
| 20. Amravati | 7106 | 7224 | 7354 | 7148 | 7580 | 8455 | 101 | 105 | 115 |
| 21. Yavatmal | 8074 | 8417 | 8526 | 8155 | 8588 | 9066 | 101 | 103 | 106 |
| **Amravati Division** | **30038** | **30542** | **31094** | **30550** | **32443** | **35145** | **102** | **106** | **113** |
| 22. Wardha | 4271 | 4340 | 4027 | 4338 | 4607 | 4208 | 101 | 106 | 105 |
| 23. Nagpur | 5457 | 5420 | 5474 | 5576 | 5898 | 5992 | 102 | 108 | 110 |
| 24. Bhandara | 3887 | 3862 | 3637 | 5062 | 4980 | 4736 | 130 | 130 | 130 |
| 25. Chandrapur & Gadchiroli | 6569 | 6907 | 6750 | 7092 | 7330 | 7597 | 107 | 107 | 113 |
| **Nagpur Division** | **20184** | **20529** | **19888** | **22068** | **22815** | **22533** | **109** | **111** | **113** |
| **Maharashtra** | **181659** | **181463** | **181628** | **191796** | **198406** | **210299** | **105** | **109** | **116** |

# CHAPTER 4

## AGRICULTURAL GROWTH ACROSS CROPS: TREND AND SOURCES

### 1. Introduction :

Recent years, particularly the latter part of the eighties and the early nineties experienced significant upsurge in production and productivity growth in the Indian agriculture. It was the result of a much wider and accelerated diffusion of technology across the crops, the regions and the farmers covering the slow growth crops, the lagging regions and the farmers (i.e., the small and marginal farmers) too.[1] However what was observed at the aggregate level was not uniformally true for all the states. There were a few outliers like Gujarat and Maharashtra which indicated significant deceleration in the pace of growth in their agricultural sectors.[2]

Decline in agricultural growth in the eighties for Maharashtra was also noticed by the other researchers and was interpreted as the beginning of a long term trend of diversion of resources away from agriculture.[3] Indeed, the emergence of such a trend appears to be compatible with the low productivity character of agriculture in Maharashtra. Yet, it must be recognised that an accelerated decline in the state's agricultural growth in the near future, *ceteris-pari-bus* would certainly harm the interest of the majority of the rural landless workforce in the short to the medium run.[4] That is why, more indepth and meticulous evaluation of the state's performance in agriculture is called for. The present chapter is devoted to it. The plan of our analysis is as follows :

We would initially focus in section 2 on growth at the aggregate level in the state's crop sector using three macro levels series, namely (i) the net state domestic product in agriculture (SDPA), (ii) All crop production Index (ACPI) and (iii) gross value of output (GVO) in crop sector at 80-81 prices, generated in this study. This would be followed by an assessment of the growth performance of major crop groups and crops covering changes in the trends and sources of output growth in section 3. An elaborate scrutiny of trends in the cropwise output growth and sources of output growth would then be presented in section 4.

The analysis at each level would examine comparative performance of the two phases of the GR period, namely, the early part or the first period covering the years from 1967-68 to 1979-80 and the latter part or the second period which includes the years from 1980-81 to 1992-93 for the state level analysis and upto 1990-91 for the district level analysis.

Two alternative sets, i.e., Type A (either A1 or A2) and Type B (either B1 or B2), of estimates of growth rates are mainly used for scrutinizing the growth performance of the major crops/crop groups at the state level (for details about Type A and Type B growth rates refer Section 2 from Chapter 2). Type A growth rates are not adjusted explicitly to rainfall variations while Type B growth rates are rainfall-adjusted growth rates.[5]

Comparison between Type A and B growth rates for a specified period should help us in identifying the relative character of rainfall variations. For example, higher magnitudes of Type A i.e., non-adjusted growth rates than the Type B i.e., the rainfall adjusted growth rates imply relatively favourable rainfall conditions. It must be recognised in this context that for drawing any inference about the character of weather, Type A2 growth rates need to be compared with Type B as coverage of years is common for them (i.e., upto 90-91).

At the aggregate level all the alternative estimates of growth rates were worked out separately by (i) covering all the years within a specified period and (ii) excluding the drought years i.e., 1971-72, 1972-73, 1986-87 and 1991-92. The exercise was repeated for all the three alternative sets of data namely, (i) GVO at 1980-81 prices (ii) SDPA and (iii) the official ACPI with 1967-70 as the base, though they are not strictly comparable.[6] We expect that they would help us in judging the nature of change in growth performance between the two periods more rigorously.

At the more disaggregate level, i.e., for five major crops/crop groups namely, cereals, pulses, oilseeds, sugarcane and cotton, Type A1 and Type B growth rates only are computed for comparison (Table 4.3). Elaborate assessment of cropwise growth performance is however restricted to the Type A growth rates alone (Table 4.4).

## 2. Aggregate Performance of Agriculture in Maharashtra (1967-93) :

Comparison of various estimates of growth rates based on alternative data series and coverage of years between the early and the latter phase of the GR period (Table 4.1) reveals following important conclusions.

All the period I regressions based on three-year moving averages of observations for all the three data series yield comparatively higher estimates of growth rates i.e., of Type A than the corresponding rainfall adjusted estimates (i.e., of Type B1 and B2). This implies that the performance of monsoon or wether pattern was relatively better in the early part of the GR period in the state.[7] As against this, for period II there is no uniform upward or downward bias in Type A2 growth rates over the Type B i.e., rainfall adjusted growth rates based on all the alternative data sets particularly when all the years, including drought years are covered. For GVO series, difference

between Type A2 and Type B growth rates (for all years) though positive for period II like that for period I it is very negligible (column (3), Table 4.1). For ACPI series too the said difference is positive but not negligible particularly between Type A2 and B2. In contrast, the difference is negative and negligible for growth rates based on SDPA series. In other words estimates based on all years do not consistently indicate unfavourable character of weather in period II. However, estimates of A2 growth rate based on non-drought years (presented on the right side of Table 4.1 are lower than the Type B estimates for all the three data series (refer column (7) from Table 4.1) and thus point at unfavourable character of rainfall variations in period II.[8] Thus our inference of unfavourable rainfall variation in period II has not been as strong as the conclusion of favourable character of rainfall variation for period I.

**Table 4.1**
**Growth Rates is Agriculture: Maharashtra**

| Type of growth rates | All years included | | | | Drought years excluded | | | |
|---|---|---|---|---|---|---|---|---|
| | 1967-80 | 1980-91 | $R^2$ | Deceleration Significant/non-significant | 1967-80 | 1980-91 | $R^2$ | Deceleration Significant/non-significant |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| | I Gross Value of Output (GVO) | | | | | | | |
| $A_1$ | 5.01* | 2.20* | 0.84 | Significant | 5.01* | 3.10* | 0.94 | Significant |
| $A_2$ | 5.07* | 1.73* | 0.81 | Significant | 5.36* | 2.51 | 0.94 | Significant |
| $B_1$ | 3.73* | 1.53@ | 0.84 | Non-significant | 4.56* | 2.98@ | 0.90 | Non-significant |
| $B_2$ | 3.73* | 1.60@ | 0.82 | Non-significant | 4.63* | 3.10@ | 0.89 | Non-significant |
| | II SDP in Agriculture (SDPA) | | | | | | | |
| $A_1$ | 4.65* | 2.84* | 0.89 | Significant | 4.94* | 3.81* | 0.92 | Significant |
| $A_2$ | 4.65* | 2.37* | 0.84 | Significant | 4.94* | 3.14* | 0.92 | Significant |
| $B_1$ | 3.84* | 2.41@ | 0.86 | Non-significant | 4.78* | 3.62@ | 0.90 | Non-significant |
| $B_2$ | 3.79 | 2.45@ | 0.85 | Non-significant | 4.82* | 3.67@ | 0.90 | Non-significant |
| | III All Crop Production Index (ACPI) | | | | | | | |
| $A_1$ | 4.95* | 2.25@ | 0.69 | Non-significant | 5.09* | 3.13* | 0.92 | Significant |
| $A_2$ | 4.95* | 1.69@ | 0.64 | Non-significant | 5.09* | 2.53* | 0.92 | Significant |
| $B_1$ | 4.03* | 1.41@ | 0.81 | Non-significant | 4.85* | 2.96@ | 0.87 | Non-significant |
| $B_2$ | 4.09* | 0.80* | 0.78 | Significant | 4.87* | 2.91@ | 0.87 | Non-significant |

$A_1$ : Based on three-year moving averages, period : 1967-93

$A_2$ : Based on three-year moving averages, period : 1967-91

$B_1$ : Based on original observations but with annual rainfall index in the trend function

$B_2$ : Based on original observations but with two rainfall indices (Kharif & Rabi) in the trend function.

* : Significant at 10% level;

@ : Coefficient of either 'time' or 'slope dummy' variable significant at 10% level.

Secondly, the value of growth rates whether unadjusted or rainfall adjusted and also irrespective of the years covered turn out to the distinctly lower for the period II when compared to period I. In other words, they confirm the emergence of decline in the overall growth rate in the latter phase.

Thirdly, evidence regarding statistical significance of deceleration is mixed. With only one exception i.e., of ACPI with coverage of all years, all the alternative regressions based on moving average series providing type A growth rates indicate significant structural break in period II and significant deceleration in the rate of growth in the agricultural sector and the crop sector. In contrast, statistical significance of deceleration is not supported by Type B estimates i.e., rainfall adjusted estimates of growth rates again, with a singular exception of Type $B_2$ growth rate for ACPI for all years. Besides, magnitude of all in growth rate from the period I to the period II also gets reduced with the Type B estimates for GVO and SDPA but not again for ACPI. In other words, degree of severity in deceleration declines as the impact of rainfall variations on growth rates is taken care of, by the rainfall variables for the first two series but not so for ACPI.

Lastly, it is important to note that the growth rates in period II obtained from the SDPA series are higher than the corresponding other two comparable estimates based on either GVO or ACPI data. This is not so for the growth rates obtained for period I. We believe that the higher growth rates in SDPA for the period II must be the result of continued or slightly accelerated high growth in the livestock production vis-a-vis slowing down of growth in the state's crop production sector in the eighties.[10]

### 3. Sources of Growth in Aggregate Production: Maharashtra

We concluded our discussion on analysis of aggregate growth in agriculture by confirming emergence of deceleration in crop output growth in the latter phase of the period under study. It would be interesting to examine further changes in contribution of area and yield components to the output growth between the two sub-periods. For this purpose we scrutinise the estimates of growth rates in the index numbers of area and yield for all crops for the period from 1967-68 to 1990-91 based on non-drought years.[11]

It is evident from the values of growth rates for area and yield components that the contribution of the latter was overwhelmingly dominant in the early phase while that of area was negligible, though positive and significant. Output growth rate decelerated significantly (i.e., from about 5% to 2.5%) and simultaneously there was significant fall in productivity growth

too from 3.33% in the period I to 1.20% in the period II. The trend was however reverse for aggregate area. Its growth rate, moved up from 0.46% to 0.86%. In other words, though growth in area was low and below 1 per cent in both the periods its relative contribution to output growth improved in the latter phase with drastic decline in aggregate productivity growth.

**Table 4.2**
**Growth Rates in Index Numbers of Area Production and Yield: Maharashtra@**

| Period | Area | Production | Yield |
|---|---|---|---|
| 1967-80 | 0.46* | 5.09* | 3.33* |
| 1980-91 | 0.86* | 2.53* (2.36)+ | 1.20* |
| R-square | 0.80 | 0.92 | 0.85 |
| Significant of acc./dec. | Acceleration in growth significant | Deceleration in growth significant | Deceleration in growth significant |

@ : Type @s growth rates based on non-drought years; + : Period : 1980-1994
* : Statistically significant at 5% level.

## 4. Output Growth for Major Crops/Crop Groups: Trends

The analysis undertaken in this section covers three major crop groups namely, cereals, pulses and oilseeds and the two major cash crops namely sugarcane and cotton grown in the State.

### Inter-temporal Trends in Growth :

Three sets of growth rates, (i) Type A1 with all the years, (ii) Type A1 excluding drought years (both based on three-year moving averages) and (iii) Type B i.e., rainfall adjusted growth rates are used for the scrutiny of trends and sources of growth in output. The following conclusions emerge from the comparison of the magnitudes of these growth rate between the two periods.

(i) Area, production and yield growth rates in the second set are higher for all the crops/crop groups for both the periods when compared to the corresponding estimates of growth rates in the first set based on all the years.

(ii) The pattern of growth rates across the crops as also the direction of change in the growth rate from period I to period II for a specified crop/crop group remain invariant over all the three sets. This is true for all the three variables i.e., area, production and yield per hectare.

(iii) Not only the pattern of acceleration or deceleration in growth between the two periods for a specified crop/crop group remains unaltered over the three sets but conclusions regarding statistical significance of acceleration or deceleration too are unchanged over them. Again, this is true for all the three series of variables i.e., area, production and yield per hectare. Hence, the subsequent detailed discussion regarding trends in output growth rates for all the major crop groups and crops at the State level and the district level growth analysis that follows in chapter 5 is limited mainly to the scrutiny of Type A1 growth rates only.

(iv) Comparison of Type B growth rates i.e. rainfall adjusted growth rates with the Type A1 growth rates, i.e. non-adjusted growth rates, reveals that the former are lower for all the five crop groups than the latter for the period I. This observation is consistent with the similar conclusion drawn earlier in section 2 from the comparison of Type A1 and B growth rates at the aggregate level for all crops and for the agricultural sector as a whole. For the second period, however, the direction of change between the two types of growth rates is not uniform. We treat this as an indication of inadequacy of the aggregate rainfall index to catch the crop-specific influence of the erratic distribution of rainfall in the latter part of the GR period.

**Trends In Growth Across Crops/Crop Groups:**

Comparison of output growth rates (Types A1 for all years) reveal contrasting trends in growth over the crops groups and crops (refer the upper part of Table 4.3). Growth rate declined drastically for cereals output from 6.76% in the early phase to 1.25% in the latter. Similarly, sugarcane an important high value crop too showed a distinct decline in output growth from 6.24% in period I to 2.09% in the period II. In contrast, growth rates in production of pulses and oilseeds registered upward movement between the two sub-periods. Rise in growth rate was from 3.37% to 4.45% for pulses and from 2.18% to 4.12% for oilseeds.[12] Cotton, a major traditional crop of the state, registered sustained growth in output at the rate of about 2% through out the GR period.

Both the CHOW test and significance of the slope dummy indicated structural break between the two periods and significant deceleration in output growth rate for cereals and sugarcane but acceleration for pulses and oilseeds. As indicated earlier this pattern of change in growth rates between the two periods and statistical significance of change remains invariant over the three Types of growth rates.

To sum up, the analysis confirms significant fall in output growth for cereals and sugarcane, continued moderate growth for cotton and acceleration for pulses and oilseeds, in the latter part of the GR period. Moreover, decline in output growth for the most important category of crops like cereals (weight in ACPI 46%) and a major crop like sugarcane (weight in ACPI 21%) was so substantial that it could not be compensated by the rise in output growth for pulses and oilseeds their combined weight in ACPI being only 21%.

## 5. Sources of Output Growth :

Scrutiny of Type A1 growth rates for area and yield per hectare of major crop groups reveal interesting trends (Table 4.3). In the early phase of the GR period high rate of expansion in cereals output was mainly due to expansion in yield per hectare at the rate of 5.92% per annum. It was also accompanied by a small positive growth i.e., 0.92% per annum in area under cereals. The situation changed remarkably in the latter phase with steep fall in productivity growth from 5.92% to 1.75% and replacement of positive area growth (i.e., 0.92%) by the low negative rate of -0.53% in the latter period. The decline in both productivity and area growth was found to be statistically significant too.

**Table 4.3**
**Growth Rates In Area, Production and Yield Per Hectare For Major Crops/Crop Groups In Maharashtra**

| Crop/ Crop group | Period | Area | Production | Yield | Whether acceleration or deceleration in significant (Yes/No) for: | | |
|---|---|---|---|---|---|---|---|
| | | | | | *Area* | *Production* | *Yield* |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| | | Type A, Growth Rate (All years included) | | | | | |
| Cereals (45.05)@ | I | 0.92* | 6.76* | 5.92* | Yes | Yes | Yes |
| | II | -0.53* | 1.25* | 1.75* | (Dec.) | (Dec.) | (Dec.) |
| | ($R^2$) | (0.47) | (0.74) | (0.77) | | | |
| Pulses (10.44)@ | I | 2.15* | 3.37* | 1.27 | No | Yes | Yes |
| | II | 1.86@ | 4.45* | 2.50* | (Dec. | (Acc.) | (Acc.) |
| | ($R^2$) | (0.81) | (0.79) | (0.73) | | | |
| Oilseeds (10.44)@ | I | 1.64* | 2.18 | 0.62 | Yes | Yes | No |
| | II | 2.98* | 4.12* | 1.07 | (Acc.) | (Acc.) | (Acc.) |
| | ($R^2$) | (0.90) | (0.82) | (0.64) | | | |
| Sugarcane (21.64)@ | I | 2.39* | 6.24* | 3.82* | No | Yes | Yes |
| | II | 3.89@ | 2.54* | -1.33* | (Acc.) | (Dec.) | (Dec.) |
| | ($R^2$) | (0.86) | (0.91) | (0.91) | | | |

Contd....

## Table 4.3 (Contd..)

| Crop/ Crop group | Period | Area | Production | Yield | Whether acceleration or deceleration in significant (Yes/No) for: | | |
|---|---|---|---|---|---|---|---|
| | | | | | Area | Production | Yield |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Cotton (8.43)@ | I | -1.76* | 2.08 | 3.77* | No | No | No |
| | II | -0.10 | 2.09* | 2.22@ | (Acc.) | (No change) | (Dec.) |
| | ($R^2$) | (0.45) | (0.62) | (0.58) | | | |
| | | Type $A_1$ growth rate (Drought years excluded) | | | | | |
| Cereals | I | 1.39* | 8.70* | 7.54* | Yes | Yes | Yes |
| | II | -0.35* | 2.21* | 2.58* | (Dec.) | (Dec.) | (Dec.) |
| Pulses | I | 2.33* | 3.94* | 1.81 | No | Yes | Yes |
| | II | 2.48* | 7.01* | 4.50* | (Dec.) | (Acc.) | (Acc.) |
| Oilseeds | I | 2.30* | 3.46* | 1.41 | Yes | Yes | No |
| | II | 3.95* | 6.02* | 2.08* | (Acc.) | (Acc.) | (Acc.) |
| Sugarcane | I | 3.26* | 6.92* | 3.54* | No | Yes | Yes |
| | II | 3.78* | 2.30 | -1.46* | (Acc.) | (Dec.) | (Dec.) |
| Cotton | I | -1.51 | 3.74* | 5.12* | No | No | No |
| | II | -0.24 | 3.81* | 4.03* | (Acc.) | (No change) | (Dec.) |
| | | Type B Growth Rate (Rainfall adjusted) | | | | | |
| Cereals[b] | I | 0.59* | 4.85* | 4.26* | Yes | Yes | Yes |
| | II | -0.59* | -0.12* | 0.47 | (Dec.) | (Dec.) | (Dec.) |
| | ($R^2$) | (0.52) | (0.71) | (0.74) | | | |
| Pulses[b] | I | 1.64* | 2.66* | 1.02 | No | Yes | Yes |
| | II | 1.27@ | 4.67@ | 3.41@ | (Dec.) | (Acc.) | (Acc.) |
| | ($R^2$) | (0.81) | (0.75) | | | | |
| Oilseeds[b] | I | 1.05* | 0.68 | -0.37 | Yes | Yes | No |
| | II | 3.16* | 3.41@ | 0.26 | (Acc.) | (Acc.) | (Acc.) |
| | ($R^2$) | (0.92) | (0.82) | (0.69) | | | |
| Sugarcane[b] | I | 1.87* | 5.66* | 3.79* | No | Yes | Yes |
| | II | 2.88@ | 1.71* | -1.17* | (Acc.) | (Dec.) | (Dec.) |
| | ($R^2$) | (0.85) | (0.89) | (0.84) | | | |
| Cotton[c] | I | -2.03* | 0.97 | 3.01 | No | No | No |
| | II | 0.42@ | 6.44 | 6.03 | (Acc.) | (Acc.) | (Acc.) |
| | ($R^2$) | (0.28) | (0.35) | (0.31) | | | |

* : Statistically significant at 10% or lower level.
@ : Coefficient of either 'time' or slope dummy significant at 10% or lower level
a : Weight in All Crop Production Index (1967-70 = 100)
b : Rainfall variables significant in all the regressions
c : Rainfall variables not significant, R square values for area production and yield regression 0.28, 0.35 and 0.31 respectively.

Similarly, deterioration in yield growth during the second period was equally serious for the sugarcane crop. Growth rate in its yield per hectare declined from 3.82% in the early period to -1.33% in the latter, though the rate of expansion in area accelerated simultaneously from 2.39% to 3.89%. Again, acceleration in area growth and decline in yield growth are statistically significant. Thus, it is the steep fall in productivity growth rate for sugarcane which explains its decelerated output growth in the second period.

Unlike cereals and sugarcane, increased pace of yield growth between the two periods (i.e., from 1.27% to 2.50%) played major role in pushing up output growth rate for pulses though the role of expansion in their area slowed down marginally from 2.15% in period I to 1.86% in period II. In contrast, faster expansion in area under oilseeds i.e., from 1.64% to 2.98% was mainly responsible for their accelerated output growth rate over the period. Rate of growth in their yield per hectare too moved up but the rise was very marginal (i.e., from 0.62% to 1.07) and the trend was weak. However, increase in growth rates obtained both for yield per hectare of pulses and area under oilseeds between the two periods were found to be statistically significant.

Area under cotton showed negative trend at the rate of -1.76% and -0.1% in periods I and II respectively. Thus, the pace of loss of area under cotton slowed down considerably in the second period. But growth in production was at almost constant rate of about 2% throughout the GR period as positive growth rates realised in yield per hectare i.e. 3.77% and 2.22% in the early and the latter part of the GR period more than compensated for the corresponding negative growth rates in area.

Thus, the analysis of sources of growth clearly indicate that barring an exception of rise in productivity of pulses as a group for no other crop or group of crops productivity growth could be stepped up in the second period. On the contrary, it significantly decelerated for cereals and sugarcane and could not be maintained for cotton too. In other words it implies 'non-performance' of Maharashtra in respect of sustaining the level of growth in aggregate productivity achieved in the clearly phase of the GR period. A search for an explanation of this phenomena is, therefore, crucial for pragmatic assessment of the future prospects of growth in the State's crop sector.

### 6. Output Growth Across Major Crops: Trends and Sources:

We now scrutinise trends in and sources of output growth for individual crops in order to identify the crops mainly responsible for depressing overall productivity growth in agriculture after 1980-81 (Table 4.4)

## Table 4.4
## Compound Annual Growth Rates in Area, Production and Yield per Hectare - Maharashtra
(Based on 3 Year Moving Averages, All Years Included)

| Crop/Crop Groups | Period I (1967-80) | | | Period II (1980-81) | | | Whether acceleration or deceleration in significant (Yes/No) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Area | Production | Yield | Area | Production | Yield | Area | Production | Yield |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Rice | 1.06* (0.80) | 5.18 (0.76) | 4.12* (0.71) | 0.26* | 0.24* | -0.03* | Yes (Dec.) | Yes (Dec.) | Yes (Dec.) |
| Kharif Jowar | 2.19* (0.76) | 9.78* (0.76) | 7.63* (0.77) | -0.91* | 1.41* | 2.27 | Yes (Dec.) | Yes (Dec.) | Yes (Dec.) |
| Rabi Jowar | 0.16 (0.36) | 5.06* (0.45) | 4.99* (0.46) | -0.79 | 1.61@ | 2.26@ | No (Dec.) | No (Dec.) | No (Dec.) |
| Jowar | 1.06* (0.63) | 7.87* (0.69) | 6.88* (0.69) | -0.84* | 1.48* | 2.24* | Yes (Dec.) | Yes (Dec.) | Yes (Dec.) |
| Bajra | -1.19 (0.38) | 0.85 (0.56) | 2.49 (0.58) | 1.84@ | 5.77@ | 4.06 | Yes (Acc.) | Yes (Acc.) | Yes (Acc.) |
| Maize | 6.66* (0.88) | 12.53* (0.74) | 5.93* (0.52) | 4.11@ | 0.98* | -3.25* | No (Dec.) | Yes (Dec.) | Yes (Dec.) |
| Ragi | 0.13 (0.47) | 1.93* (0.79) | 1.84* (0.83) | -1.07@ | -0.92* | 0.16* | Yes (Dec.) | Yes (Dec.) | Yes (Dec.) |
| Other Cereals | -0.31 (0.81) | 0.97 (0.56) | 1.30 (0.89) | -3.35@ | 2.97 | 6.52@ | Yes (Dec.) | No (Acc.) | Yes (Acc.) |
| Wheat | 3.52* (0.82) | 10.67* (0.78) | 7.22* (0.85) | -4.07* | -1.61* | 2.46* | Yes (Dec.) | Yes (Dec.) | Yes (Dec.) |
| Total Cereals | 0.92* (0.47) | 6.76* (0.74) | 5.92* (0.77) | -0.52* | 1.25* | 1.75* | Yes (Dec.) | Yes (Dec.) | Yes (Dec.) |
| Gram | 2.31* (0.88) | 4.64* (0.87) | 2.52* (0.77) | 3.15@ | 7.12@ | 4.26@ | No (Acc.) | Yes (Acc.) | No (Acc.) |
| Tur | 1.26* (0.92) | 2.71* (0.82) | 1.42* (0.39) | 3.74* | 2.51@ | -1.19@ | Yes (Acc.) | No (Dec.) | No (Dec.) |
| Other Pulses | 2.48* (0.58) | 3.44* (0.65) | 1.05 (0.73) | 0.48* | 4.96@ | 4.38@ | Yes (Dec.) | Yes (Acc.) | Yes (Acc.) |
| Total Pulses | 2.15* (0.81) | 3.37* (0.79) | 1.27 (0.73) | 1.86@ | 4.45@ | 2.50 | No (Dec.) | Yes (Acc.) | Yes (Acc.) |
| Total Foodgrain | 1.15* (0.57) | 6.37* (0.75) | 5.29* (0.76) | -0.02* | 1.61* | 1.59* | Yes (Dec.) | Yes (Dec.) | Yes (Dec.) |

Contd..

## Table 4.4 (Contd.)

| Crop/Crop Groups | Period I (1967-80) | | | Period II (1980-81) | | | Whether acceleration or deceleration in significant (Yes/No) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Area | Production | Yield | Area | Production | Yield | Area | Production | Yield |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Rice | 1.06* | 5.18 | 4.12* | 0.26* | 0.24* | -0.03* | Yes | Yes | Yes |
| Kharif Foodgrains | 1.10* (0.55) | 6.33* (0.78) | 5.25* (0.81) | 0.63@ | 1.86 | 1.21* | No (Dec.) | Yes (Dec.) | Yes (Dec.) |
| Rabi Foodgrain | 1.24* (0.62) | 6.50* (0.62) | 5.33* (0.59) | -1.16 | 0.95* | 2.00@ | Yes (Dec.) | Yes (Dec.) | Yes (Dec.) |
| Groundnut | -1.02 (0.27) | 0.13 (0.46) | 1.19 (0.77) | 0.34 | 3.03 | 2.64 | No (Acc.) | No (Acc.) | No (Acc.) |
| Sesamum | 2.58* (0.92) | 3.48* (0.91) | 0.95 (0.43) | 5.20* | 6.38* | 1.31 | No (Acc.) | Yes (Acc.) | No (Acc.) |
| Linseed | 3.89* (0.83) | 5.56* (0.73) | 1.72* (0.54) | -3.23* | -3.96* | -0.88* | Yes (Dec.) | Yes (Dec.) | Yes (Dec.) |
| Safflower | 4.20* (0.84) | 8.82* (0.92) | 4.72* (0.85) | 0.13* | -1.44 | -1.68* | Yes (Dec.) | Yes (Dec.) | Yes (Dec.) |
| Nigerseed | 3.56* (0.76) | 2.20* (0.82) | -1.17 (0.71) | 0.92* | 1.06@ | 0.27 | Yes (Dec.) | No (Dec.) | Yes (Acc.) |
| Total Oilseeds | 1.64* (0.90) | 2.18 (0.82) | 0.62 (0.64) | 2.98* | 4.12 | 1.07 | Yes (Acc.) | Yes (Acc.) | No (Acc.) |
| Cotton | -1.76* (0.45) | 2.08 (0.62) | 3.77* (0.58) | -0.10 | 2.08 | 2.22@ | No (Acc.) | No change | No (Dec.) |
| Mesta | 3.65* (0.65) | 3.77* (0.63) | 0.28 (0.18) | -5.24* | -6.02* | -0.78@ | Yes (Dec.) | Yes (Dec.) | No (Dec.) |
| Chillies | -0.39 (0.86) | -1.41* (0.71) | -1.01* (0.47) | -1.60@ | -1.41@ | 0.18* | Yea (Dec.) | No change | Yes (Acc.) |
| Potato | -1.68* (0.70) | -0.41 (0.60) | 1.32* (0.79) | 1.19* | -0.27 | -1.41* | Yes (Acc.) | No (Acc.) | Yes (Dec.) |
| Banana | 3.58* (0.92) | 3.71* (0.86) | 0.10 (0.51) | 1.43* | 2.51@ | 1.07 | Yes (Dec.) | No (Dec.) | No (Acc.) |
| Sugarcane | 2.39* (0.86) | 6.24* (0.91) | 3.82* (0.91) | 3.89@ | 2.54* | -1.33* | No (Acc.) | Yes (Dec.) | Yes (Dec.) |
| Tobacco | -0.14 (0.73) | 2.30* (0.85) | 2.49* (0.97) | 0.04 | 5.01* | 4.94* | No (Acc.) | Yes (Acc.) | Yes (Dec.) |

Figures in parentheses denote value of $R^2$

* : Significant at 5% level

@ : Either of the 'time variable' or slop dummy variable is significant at 5% level.

**Cereals :**

Among the five major cereals grown in the State fall in output growth rate was highest for wheat i.e. from 10.67% in period I to -1.61% in period II. Decline in growth was almost equally severe for kharif jowar (i.e., from 9.78% to 1.4%) the most important cereal crop grown in the State. Rice and rabi jowar followed it with fall in their production growth rates between the two periods being from 5.18% to 0.24% and from 5.06% to 1.62% respectively. But bajra represented the unique exception to the general trend of deceleration. Its output growth rate moved up steeply from 0.85% in the early phase to 5.77% in the latter. From among the remaining minor cereals, maize experienced worst deceleration with fall in output growth rate from 12.53% in the period I to 0.98% in the period II.

In respect of all the above crops except wheat, yield component was mainly responsible for inducing downward (upward in case of bajra) movement in output growth and the role of area component was comparatively less important. But the changes in area growth rates between the two periods were not uniform across the crops. Wheat registered highest negative growth rate of -4.07 in the period II against rapid expansion in its area at the rate of 3.52% in the early period. Rates of growth in area for kharif and rabi jowar in the second period were -0.91% and -0.79% respectively. Area under rice remained almost stagnant in the latter period (growth rate 0.26%) while for maize rate of expansion in area dropped to 4.19% in the period II from its earlier level of 6.66%. At the other extreme, output growth in bajra was supported by increase in its area growth rate to 1.85% per annum in addition to accelerated expansion in productivity at the rate of 4% in the second period.

**Pulses :**

Acceleration in output growth for pulses in the 1980's was more due to increased output growth for gram, i.e., from 4.64% in period I to 7.12% in period II, followed by that of 'other pulses' i.e., from 3.44% to 4.96%. Expansion in production of tur continued at the same moderate rate of growth of about 2.5% through out the GR period.

In the early period the major and significant contributor to growth in output of pulses (3.37%) was the area component which expanded at the rate of 2.15%. But in the second period yield component assumed more important role in inducing acceleration in output growth. This was true for both gram and other pulses as growth in their productivity in the second period was either at the rate of 4% (for gram) or exceeded 4% (for other pulses).

## Oilseeds

Groundnut was the only major oilseeds grown in Maharashtra prior to 1970. From stagnation in its production through out the 1970's, it moved to significant positive growth of the rate of 3.03% in the eighties. For the other minor conventional oilseeds such as safflower and linseed high growth rates (8.8% and 5.6% respectively) in output in the early period were replaced by negative growth rates in period II. Sesamum was the only minor conventional oilseed which picked up very rapidly in the state throughout the GR period. Its production expanded at the rate of about 4% in the early phase and the rate of expansion accelerated further to exceed 6% in the second.

Indeed, apart from the accelerated growth in output of groundnut, it was a very swift spread of the two non-conventional oilseeds, namely sunflower seeds and soyabean, since the mid-eighties which vitalised the oilseed economy of Maharashtra in the latter phase.[13] Obviously, growth in area was the overwhelmingly dominant source of output growth for both of them. Cultivation of sunflower seeds picked up in all the three seasons i.e., kharif, rabi and summer particularly, in Aurangabad and Pune divisions of the State where as soyabean mainly a kharif crop spread in the Amravati division. Area was diverted from kharif jowar or from minor kharif cereals to these two oilseeds due to their higher profitability, better market support and comparatively lower risks in production.14 Expansion in area was also partly due to the increased pace of multiple cropping in 1980's in many districts, particularly from the Marathwada and Vidarbha regions and the parts of Western Maharashtra.[15]

Sources of accelerated expansion in output were differential for the two conventional oilseeds, namely, groundnut and sesamum. For the latter minor oilseed, area component provided major support to output growth, similar to that for sunflower and soyabean. But with regard to the farmer i.e., groundnut, production expanded mainly through growth in its productivity per hectare. It was the result of almost constant area under kharif groundnut but rapid increase in the area under summer groundnut, an irrigated high productivity oilseed crop in the second period.[16]

Lastly, it must be mentioned that the two non-conventional oilseeds, namely sunflower and soyabean which improved their share in crop pattern in the recent years have much higher yield per hectare than the other conventional oilseeds such as nigerseed and linseed which suffered from loss of area. Thus, it is the increased weightage of sunflower, soyabean and summer groundnut in total area under oilseeds which must have pushed up growth in the overall productivity of oilseeds marginally in the

second period (i.e. from 0.62% in period I to 1.06% in period II).

**Cotton and Sugarcane :**

It may be recalled that cotton maintained its output growth at moderate level of about 2% throughout the entire period despite loss of area, especially in the early period due to sustained increase in productivity at about 3.77% in the early phase and 2.2% in the latter one.[17] In contrast, sustained fall in absolute level of yield per hectare resulted into significant deceleration in output growth for sugarcane, accelerated expansion in its area notwithstanding.

**Other Crops :**

Growth performance of the other minor non-foodgrain crops in period II was mixed. Production and productivity growth for tobacco (grown mainly in the Kolhapur division of the State) accelerated and reached the level of 5% in period II vis-a-vis 2.5% in the period I. Growth decelerated for banana while it remained negative in both the periods for chillies and potato.

Thus, if we set aside a few exceptions like bajra, gram other pulses and groundnut, growth rates in yield per hectare declined significantly for all the remaining major crops in the latter part of the GR period. This represents a contract to the impressive record of the State in raising the productivity levels of many crops whether irrigated or not in the early phase. This trend is much more disturbing keeping in view the phenomenal expansion in the use of a key input like fertiliser and continued expansion in irrigation at undiminished pace and in other new inputs like pesticides, electricity etc., at accelerated pace in the second period.

We therefore, discuss this issue of deceleration in productivity growth in detail in chapter 6 to search for its possible explanations.

**Notes**

1. Sawant S.D. and Achuthan C.V., 'Agricultural Growth Across Crops And Regions : Emerging Trends And Patterns', Economic and Political Weekly, Vol. XXX, No. 12, March 25, 1995.
2. *Ibid*, page A-4, Table 3.
3. Ahluwalia Deepak, 'Growth Performance in Indian Agricultural', Journal of Indian School of Political Economy, Vol. 3, No. 4, October-December, 1991.
4. Refer Section 1 from Chapter 1.
5. We computed both Type A and Type B growth rates mainly to examine whether actual growth rates realised (i.e., Type A) in a specified period have consistent upward or downward bias over the Type

B i.e., rainfall adjusted growth rates, due to either favourable or unfavourable pattern of rainfall variations in that period. It was expected that such a comparison, may enable us to differentiate broadly the character of weather pattern in one period vis-a-vis the other, provided difference between the periods is perceptible. Thus, our interest in comparison of Type A with Type B growth rates was mainly analytical. Hence, for assessment of actual growth performance we preferred to rely only on type A growth rates and not the rainfall adjusted growth rates.

6. State domestic product in agriculture (SDPA) represents value of output of crop and livestock production combined which is net of costs while both the official All Crop Production Index (ACPI) and gross value of output of all crops (GVO) generated in this study relate to the state's crop sector alone. Again, the latter two are also not strictly comparable as ACPI has the old base 1967-70 while GVO series is computed by using 1980-81 farm harvest prices.

7. Comparative analysis of rainfall variations in the two periods support this reference. For details refer section 3, from chapter 6.

8. Our analysis of rainfall statistics when carried out by omitting the drought years, shows that the divergence between the rainfall patterns in the two periods increases. This is consistent with relatively higher values of rainfall adjusted growth rates than non-adjusted growth rates obtained with omission of drought years.

9. Comparison of non-adjusted growth rates in GVO with the rainfall adjusted growth rates for different districts yield similar conclusion (refer section 3 from Chapter 6 for detailed discussions).

10. Higher growth in SDPA than in GVO/ACPI, is consistent with the fact that there has been rapid acceleration in growth for milk and poultry production in the State since the mid-80's.

11. As the official series of index numbers of area and yield were available only upto 1991-92. Type A2 growth rates covering the period from 1967-68 to 1990-91, after excluding the drought years were computed for these series. Estimates of Type A1 growth rates are not discussed as they too indicate very marginal acceleration in growth rate for area index and drastic decline in growth of yield index.

12. Alternatively Type A2 growth rates for pulses were 3.94% and 7.01% for the periods I and II respectively and 3.46% and 6.02 for oilseeds.

13. Production of soyabean expanded from 20,000 metric tonnes in 1986-87 to 365,000 metric tonnes in 1992-93 in Maharashtra.

14. Observations based on our field survey.

15. Refer section 6 from Chapter 3 for districtwise cropping intensity changes.

16. Yield per hectare for summer groundnut is nearly double that for kharif groundnut.

17. Corresponding Type A2 growth rates, associated with higher values of $R^2$ are 5.12% and 4.03% respectively for the periods I and II.

# CHAPTER 5

## ANALYSIS OF CROP OUTPUT GROWTH FOR DISTRICTS AND ADMINISTRATIVE DIVISIONS

### 1. Introduction :

We analyse in this chapter growth performance of different districts in Maharashtra with reference to (i) gross value of output of all crops, (ii) cereals (iii) pulses (iv) oilseeds (v) sugarcane and (vi) cotton, in the periods I and II.

Performance of districts in respect of the above mentioned crop groups and crops has been judged on the basis of Type $A_2$ growth rates i.e., growth rates based on three-year moving average computed for the period from 1967-68 to 1990-91.[1] In addition, we also worked out growth rates in gross value of output of all crops and cereals output separately for the different administrative divisions (hence forth divisions only) in Maharashtra in order to identify the broad regional pattern of aggregate performance and trace the intertemporal change in it if any.

For the other four crop groups namely, pulses, oilseeds, sugarcane and cotton, the divisional level performance has been assessed on the basis of performance of districts covered by the division. For this purpose, we classify the districts within a division according to five growth rate classes, namely, (i) negative growth, (ii) low growth (0.01% to 2.0%), (iii) moderate growth (2.01% to 5.0%)., (iv) high growth (5.01% to 10.0%) and very high growth (>10%). Performance ranks are assigned to the divisions by using distribution of districts within a division across the growth classes.

### 2. Growth In Gross Value of Output :

**Districts** :

Aggregate growth in crop sector at the state level though highly impressive in the phase I, inter-district range of growth rates was fairly wide. The lowest growth rate was registered by Raigad district (i.e., 2.69%) from the Konkan division and the highest i.e., 8.92% by Pune district in the Pune division (Table 5.1). With deceleration in overall growth performance in the second period the inter-district range of growth rates not only moved down but widened further. It was -2.15% (for Ahmednagar district) to 6.81% (for Akola district).

## Table 5.1
## Districtwise Growth Rates in Gross Value of Output
(Type A2 Based on 3 Year Moving Average)

| Districts | 1967-80 | 1980-91 | $R^2$ |
|---|---|---|---|
| Thane | 3.14* | 0.37* | 0.57 |
| Raigad | 2.69* | 1.91@ | 0.88 |
| Ratnagiri | 3.27* | 2.84@ | 0.95 |
| Nasik | 6.38* | 0.44* | 0.70 |
| Dhule | 6.20* | 2.70* | 0.74 |
| Jalgaon | 6.66* | 2.91* | 0.78 |
| Ahmednagar | 5.47* | -2.15* | 0.59 |
| Pune | 8.92* | 2.53* | 0.74 |
| Solapur | 4.43* | 3.97@ | 0.73 |
| Satara | 4.47* | 4.41@ | 0.89 |
| Sangli | 7.51 | 0.01* | 0.81 |
| Kolhapur | 3.72* | 2.37* | 0.98 |
| Aurangabad | 7.12* | 2.69@ | 0.77 |
| Parbhani | 6.33* | 3.16@ | 0.72 |
| Beed | 7.04* | 3.37@ | 0.57 |
| Nanded | 5.62* | 1.45@ | 0.53 |
| Osmanabad | 6.65* | 1.52@ | 0.57 |
| Buldhana | 5.06* | 2.33@ | 0.72 |
| Akola | 4.76* | 6.81@ | 0.85 |
| Amravati | 3.91* | 4.01@ | 0.80 |
| Yavatmal | 3.87* | 2.58@ | 0.91 |
| Wardha | 5.40* | 2.97* | 0.91 |
| Nagpur | 5.03* | 4.20@ | 0.86 |
| Bhandara | 2.75* | 0.75@ | 0.40 |
| Chandrapur | 3.33* | 1.85@ | 0.75 |

* : Significant at 10% level
@ : Either of the 'time coefficient' or 'slop dummy' is significant at 10% level.

Cross classification of districts according to growth categories in the two periods revealed that all the districts were concentrated in the moderate growth (2.01% to 5%) and high growth (5.01% to 10%) categories in the first phase but all of them except the two belonged to low and moderate growth classes in the second phase (Table 5.2). One district moved down to negative growth class and the other upwards to high growth class. Of the 25 only 6 districts could maintain their position and continue in moderate growth category. They were Ratnagiri, Solapur, Satara, Kolhapur, Yavatmal and Amravati. Only one district namely Akola could move up from moderate to high growth class and the rest i.e., 18 moved down the growth ladder. Among the latter Ahmednagar represented a unique case of negative growth rate of -2.15% in the gross value of output in the second period as against the high growth rate of 5.47% in the early period. At the other extreme was Akola district which registered acceleration in growth rate from 4.76% in period I to 6.81% in period II.[2]

**Table 5.2**
**Cross Classification of Districts by Levels of Growth Rates in Period - I (1967-80) and Period - II (1980-91) for Gross Value of Output**

| Growth Categories in Period-I (1967-80) | Growth Categories in Period-II (1980-91) | | | | | |
|---|---|---|---|---|---|---|
| | Negative | Low (0.01 to 2.0) | Moderate (2.01 to 5.00) | High (5.01 to 10.00) | Very High (>10.00) | Total |
| Negative | — | — | — | — | — | — |
| Low (0.1 to 2.00) | — | — | — | — | — | — |
| Moderate (2.01 to 5.00) | — | 4 | 6 | 1 | — | 11 |
| High (5.01 to 10.00) | 1 | 4 | 9 | — | — | 14 |
| Very High (>10.00) | — | — | — | — | — | — |
| Total | 1 | 8 | 15 | 1 | — | 25 |

## Divisions :

Aurangabad division representing Marathwada region in the state was the division leading in aggregate growth of all crops (growth rate : 6.57%) in the period I (Table 5.3). It was closely followed by Nasik, Pune and Kolhapur divisions in the descending order with 2nd, 3rd and 4th ranks. Next to them, were Amravati and Nagpur divisions with closely comparable growth rates of 4.08% and 3.65% respectively. Konkan division was at the bottom with hardly 3% growth rate and the last i.e. 7th rank.

**Table 5.3**
**Divisionwise Growth Rates in Gross Vaue of Output**

| Period | | Konkan Division | Nasik Division | Pune Division | Kolhapur Division | Aurangabad Division | Amravati Division | Nagpur Division |
|---|---|---|---|---|---|---|---|---|
| 1967-80 | Growth rate | 2.93* | 5.82* | 5.56* | 4.80* | 6.57* | 4.08* | 3.65* |
| | Rank | R-7 | R-2 | R-3 | R-4 | R-1 | R-5 | R-6 |
| 1980-91 | Growth rate | 1.81@ | 2.24* | 1.02* | 2.31* | 2.91@ | 4.38@ | 2.73@ |
| | Rank | R-6 | R-5 | R-7 | R-4 | R-2 | R-1 | |
| (R-Square) | | (0.87) | (0.74) | (0.68) | (0.93) | (0.67) | (0.84) | (0.82) |

* : Statistically significant at 10% level.
@ : Coefficient of slope dummy variable not significant.

In the latter phase Amravati division remained at the top with further, though marginal, improvement in its growth rate from 4.08% to 4.38%. It was followed by Aurangabad (g.r. 2.91%) and Nagpur divisions (g.r. 2.73%) with second and third ranks. Kolhapur, Nasik and Konkan divisions were at 4th, 5th and 5th position with 2.31%, 2.24% and 1.81% as their growth rates. Finally Pune division was at the other extreme with lowest growth rate 1.02%.

Thus, except Amravati division aggregate growth decelerated in all the other divisions though the extent of deceleration was not uniform over the divisions. Fall was highest for Pune division (i.e., by 4.5% points) and the lowest for Nagpur division i.e. by (1 percentage point). Deceleration in growth was statistically significant for Nasik, Pune and Kolhapur divisions but not for the other three, namely Aurangabad, Nagpur and Konkan. For the remaining namely, Amravati division growth rate moved up just marginally from 4.08% to 4.38%. Obviously, acceleration did not turn out to be statistically significant.

A few important conclusions about the regional growth pattern emerging from the scrutiny of the aggregate growth performance across the divisions are indicated below :

Konkan division remained at or near the bottom of the growth ladder throughout the period from 1967 to 1991. Kolhapur division occupied middle rank with moderate growth in both the sub-periods. Aurangabad division remained at the top or close to it despite significant deceleration in growth in the second period and the more volatile pattern of growth. Amravati division from the Vidarbha region was unique among all the divisions in displaying steady performance throughout the period with growth rate exceeding 4% and in that sense its performance was much better than even the Aurangabad division and the best among all.

Nagpur division though registered consistently moderate performance could not repeat closely the pattern of growth in Amravati division. We believe that it must be due to asymmetric growth behaviour between Wardha and Nagpur districts on the one hand and Chandrapur and Bhandara on the other. The former two resemble closely the growth pattern of districts in Amravati Division while the latter two which belong to essentially different agroclimatic zone display differential growth behaviour.[3]

Nasik and Pune divisions particularly the latter registered more unsteady pattern of growth, their impressive growth record in the early phase notwithstanding.

### 3. Growth in Cereals Output :

**Districts :**

Cereal crops dominated the growth performance of the crop sector in the early phase of the GR period with all the districts falling in the top three classes of growth, namely (i) very high (exceeding 10%), (ii) high (5.01% to 10%) and (iii) moderate (2.01% to 5%). The inter-district range of growth rates (Table 5.4) was from 2.72% (for Raigad district in Konkan division) to 11.3% (for Osmanabad district in Aurangabad division).

**Table 5.4**
**Growth Rates in Output of Major Crops/Crop Groups**
(Type A2 : Based on 3 Year Moving Average)

| Districts | Cereals | | Pulses | | Total Oilseeds | | Cotton | | Sugarcane | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1967-80 | 1980-91 | 1967-80 | 1980-91 | 1967-80 | 1980-91 | 1967-80 | 1980-91 | 1967-80 | 1980-91 |
| Thane | 2.94* | -0.13* | 2.61 | 14.33@ | 3.88 | 24.51 | — | — | — | — |
| Raigad | 2.72* | 1.77@ | -1.83 | 8.30@ | -0.33 | 11.94@ | — | — | — | — |
| Ratnagiri | 3.47* | 2.53@ | -4.03* | 3.97* | -6.19* | 24.34* | — | — | — | — |
| Nasik | 5.69* | -0.22* | 5.45 | -0.04@ | 5.93* | 4.66* | -10.54* | -13.61* | 6.96* | 1.14* |
| Dhule | 6.90* | 1.07 | 4.90* | 8.63* | 0.76 | 6.23 | 0.61 | -0.81 | 15.34* | 2.41* |
| Jalgaon | 10.02* | 3.29* | 6.47* | 2.47@ | 5.25* | 8.19@ | -2.82* | -0.90@ | 22.20* | 5.89* |
| Ahmednagar | 7.16* | 0.51* | 5.72* | 2.65@ | 4.34 | 21.56@ | -1.17 | -32.03@ | 5.07* | -4.57* |
| Pune | 9.55* | 2.04* | 7.83* | 2.45* | 5.19* | 9.15@ | 3.11 | -45.72@ | 8.93* | 2.90* |
| Solapur | 4.86 | 0.85 | 5.36* | -1.20* | -2.97 | 7.73@ | 4.41 | -20.77* | 7.18* | 5.11@ |
| Satara | 5.43* | 3.45@ | 4.64* | 0.26* | -3.23 | 8.69@ | -0.30 | -23.22@ | 8.26* | 4.95@ |
| Sangli | 6.94* | 2.19* | 5.34* | 2.27@ | -5.24 | 19.05@ | 1.93* | -6.29* | 11.19* | -2.48* |
| Kolhapur | 8.39* | 1.91* | 6.12* | 0.54* | 5.59 | 11.62@ | 11.13* | -15.20* | 2.85* | 1.43* |
| Aurangabad | 9.04* | 1.22* | 6.91* | 3.04* | 2.86* | 10.68 | -0.56 | 1.86 | 8.06* | 4.00@ |
| Parbhani | 10.36* | -1.93* | 4.84* | 4.89@ | 4.81@ | 21.04* | 1.33 | 2.99 | 4.94* | 6.08@ |
| Beed | 8.32* | -1.23* | 5.18* | 5.66@ | -2.42 | 16.48@ | 2.07 | 0.47 | 14.27* | 7.74@ |
| Nanded | 10.07* | -1.78* | 4.41 | 4.18@ | -5.43* | 15.48@ | 2.73 | 2.29 | 4.67 | 2.04 |
| Osmanabad | 11.30* | -2.72* | 7.44* | 2.60* | -6.64* | 15.35* | 0.38 | -1.66 | 9.46* | 0.67* |

(Contd.)

**Table 5.4** (Contd..)

| Districts | Cereals | | Pulses | | Total Oilseeds | | Cotton | | Sugarcane | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1967-80 | 1980-91 | 1967-80 | 1980-91 | 1967-80 | 1980-91 | 1967-80 | 1980-91 | 1967-80 | 1980-91 |
| Buldhana | 8.80* | -1.67* | 8.68* | 8.51@ | 3.06 | 12.18@ | -1.29 | 1.74 | — | — |
| Akola | 6.96* | 5.24@ | 5.61* | 13.55* | 0.95 | 8.42 | 2.75* | 4.45@ | — | — |
| Amravati | 10.78* | -0.29* | 3.31* | 12.84* | 4.99* | 11.12@ | -0.57 | 3.47@ | — | — |
| Yavatmal | 7.76* | 0.06* | 2.53* | 6.67* | 0.21 | 5.69 | 1.42 | 1.89 | — | — |
| Wardha | 8.45* | -2.92* | 2.52* | 5.84* | 5.91* | 18.61* | 3.66* | 3.87@ | — | — |
| Nagpur | 8.03* | 0.21* | 2.68 | 8.60@ | 2.82 | 22.26@ | -1.33 | 3.66@ | — | — |
| Bhandara | 3.53* | 0.36@ | 2.28* | 7.14* | 5.05* | 7.40@ | — | — | — | — |
| Chandrapur | 4.31* | 0.06* | -1.81 | 9.14@ | 5.03 | 8.75@ | 0.15 | 10.54@ | — | — |

* : Significant at 10% level
@ : Either coefficient of time or of slope dummy variable is significant at 10% level.

In contrast, output growth for cereals decelerated in all the districts in the second period when compared to the first. Decline was very steep in majority of the districts. The exceptional cases indicating low decline between the two periods were only three, namely, Akola (6.96% to 5.24%), Satara (5.43% to 3.45%) and Ratnagiri (3.47% to 2.52%). Inter-district range obviously slided down greatly for the second period. It was from –2.92% (Wardha district in Nagpur division) to 5.24% (Akola district in Amravati division). Out of 25 districts nine registered negative growth, ten districts low growth (0.01% to 2%), five had moderate growth between 2% to 5% and only one exceeded 5% rate of growth.

**Table 5.5**
**Cross Classification of Districts by Levels of Growth Rates in Period - I (1967-80) and Period - II (1980-91) for Cereals Output**

| Growth Categories in Period-I (1967-80) | Growth Categories in Period-II (1980-91) | | | | | |
|---|---|---|---|---|---|---|
| | Negative | Low (0.01 to 2.0) | Moderate (2.01 to 5.00) | High (5.01 to 10.00) | Very High (>10.00) | Total |
| Negative | — | — | — | — | — | — |
| Low (0.1 to 2.00) | — | — | — | — | — | — |
| Moderate (2.01 to 5.00) | 1 | 4 | 1 | — | — | 6 |
| High (5.01 to 10.00) | 4 | 6 | 3 | 1 | — | 14 |
| Very High (>10.00) | 4 | — | 1 | — | — | 5 |
| Total | 9 | 10 | 5 | 1 | — | 25 |

Cross classification of districts by growth categories in the two periods showed that only two districts could continue in the same growth category i.e., of high and moderate growth in the latter period (Table 5.5). They

were Akola and Ratnagiri districts. All the remaining twenty three experienced deterioration in growth of varying degree. That was why, almost all the districts were concentrated in the lowest three classes of growth in the latter phase vis-a-vis the concentration being in the top three classes in the early phase. Thus, deceleration was almost universal.

**Divisions :**

Among the seven divisions Aurangabad ranked first, with three districts falling in the top most growth class and two in the next class (Table 5.6). Amravati had second position and Nasik followed it with the third rank. Kolhapur ranked fourth with all the three districts experiencing high growth and Pune had fifth position with two and one district belonging to high and moderate growth class respectively. Nagpur occupied sixth position and Konkan division was at the bottom with all three districts falling in the moderate growth class.

**Table 5.6**
**Divisionwise Distribution of Districts by Levels of Growth in Output of Cereals**

| Growth Categories | Konkan Division | Nasik Division | Pune Division | Kolhapur Division | Aurangabad Division | Amravati Division | Nagpur Division | All Divisions |
|---|---|---|---|---|---|---|---|---|
| **Period-I** | | | | | | | | |
| Negative | — | | | | | | | — |
| Low (0.01-2.00) | | | | | | | | |
| Moderate (2.01-5.00) | 3 | | 1 | | | | 2 | 6 |
| High (5.01-10.00) | | 2 | 2 | 3 | 2 | 3 | 2 | 14 |
| Very High (10.01 and above) | | 1 | | | 3 | 1 | | 5 |
| Total No. | 3 | 3 | 3 | 3 | 5 | 4 | 4 | 25 |
| Rank | R-7 | R-3 | R-5 | R-4 | R-1 | R-2 | R-6 | — |
| **Period-II** | | | | | | | | |
| Negative | 1 | 1 | | | 4 | 2 | 1 | 9 |
| Low (0.01-2.00) | 1 | 1 | 2 | 1 | 1 | 1 | 3 | 10 |
| Moderate (2.01-5.00) | 1 | 1 | 1 | 2 | | | | 5 |
| High (5.01-10.00) | | | | | | 1 | | 1 |
| Very High (10.01 and above) | — | — | | | | | | — |
| Total No. | 3 | 3 | 3 | 3 | 5 | 4 | 4 | 25 |
| Rank | R-4 | R-3 | R-2 | R-1 | R-7 | R-5 | R-6 | — |

Between the two period there was substantial reshuffling in the relative positions of the divisions. Aurangabad moved down from the top rank to the lowest of seventh. Nagpur and Amravati were next to Aurangabad in poor performance. At the other end, cereals output growth was much better in Kolhapur division than in any other. Nasik, Pune and Konkan followed it with almost comparable performance.[4]

Finally to sum up, the performance of Marathwada (Aurangabad division) and Vidarbha region (Amravati & Nagpur divisions) in raising the cereal output was very poor in the second phase. It was comparatively better in Western Maharashtra (mainly Kolhapur & Pune divisions) followed by Nasik and Konkan divisions.

**Sources of Growth In Cereals Output :**

Output growth for cereals was overwhelmingly dominated by the growth in yield per hectare in the first period though small positive growth in area also supported it. In Aurangabad and Amravati, the two leading divisions, productivity growth rates registered in the early phase were as high as nearly 10% and 8% (Table 5.7). Kolhapur, Nasik and Pune divisions too registered productivity growth at the rate of about 6%. Nagpur and Konkan divisions were next with 4% and about 3% growth rate in yield per hectare.

**Table 5.7**
**Administrative Divisionwise Growth Rates - Cereals**

| Division | 1967-80 | | | 1980-81 | | |
|---|---|---|---|---|---|---|
| | Area | Production | Yield | Area | Production | Yield |
| Konkan | 0.35* | 2.96* | 2.61* | 0.76* | 1.45* | 0.69* |
| | (0.72) | (0.87) | (0.84) | | | |
| Nasik | 1.56* | 7.25* | 5.69* | 0.31* | 2.05* | 1.75@ |
| | (0.87) | (0.69) | (0.60) | | | |
| Pune | 0.39* | 6.68* | 6.29* | 0.46@ | 1.97* | 1.51* |
| | (0.57) | (0.59) | (0.59) | | | |
| Kolhapur | 0.52* | 6.69* | 6.18* | 0.70@ | 2.61* | 1.92* |
| | (0.83) | (0.89) | (0.88) | | | |
| Aurangabad | 1.47* | 9.75* | 8.27* | 0.17* | -0.64* | -0.82* |
| | (0.88) | (0.66) | (0.60) | | | |
| Amravati | 1.00* | 8.20* | 7.20* | -1.60* | 0.85* | 2.44* |
| | (0.85) | (0.77) | (0.82) | | | |
| Nagpur | 0.62* | 4.88 | 4.26* | -1.21* | -0.09* | 1.11 |
| | (0.88) | (0.69) | (0.73) | | | |

Figures in parentheses denote values for R2
* : Significant at 10% level
@ : Either of the 'time coefficient' or 'slope dummy' is significant at 10% level.

Though the contribution of area component to output growth was by and large very low in all the divisions area under cereals expanded at comparatively higher rate of about 1 to 1.5% in Marathwada and Vidarbha regions (i.e., in Aurangabad, Amravati and Nagpur divisions) as also in the Nasik division, but it was just 0.5% or less in the remaining divisions.

The situation reversed completely for cereals in Aurangabad, Amravati and Nagpur with negligible or negative growth in area, yield per hectare and output in all of them. Exceptions were only of moderate and low growth in yield per hectare in Amravati and Nagpur divisions respectively. Likewise, though output and yield growth rates decelerated steeply for cereals in all the remaining divisions too, moderate growth rates in the range of about 2% to 2.5% could be maintained in at least three of them, namely, Kolhapur, Nasik and Pune divisions. In Konkan division yield growth was below 1%.

Thus, it is evident that the phenomenon of deceleration in output and productivity growth for cereals after 1980-81 had been universal over the regions and the regional pattern of growth underwent a drastic change.

**4. Growth in Pulses Output :**

Though pulses are grown in almost all the districts of Maharashtra, share of Konkan division in the aggregate output has been negligible. Hence, the discussion that follows refers to only 22 districts from the remaining six divisions in the state.

All the 22 districts had moderate to high growth (Table 5.8) in pulses output in period I with an exception of only one, namely, Chandrapur from Nagpur division which registered negative growth rate i.e., -1.81% (Table 5.4). The inter-district range of output growth rates excluding Chandrapur was 2.28% for Bhandara district to 8.68% for Buldhana district (Table 5.4)

Scenario of output growth across the districts changed greatly in the second period with significant acceleration in growth rates in eight districts vis-a-vis deceleration in ten districts. Two each continued growth at the moderate and high levels in the second phase. Consequently, inter-district range of output growth rates widened to -1.20% for Solapur district to 13.55% for Akola district.

In period I, Pune, Aurangabad, Nasik and Kolhapur were the leading divisions with high growth in all or majority of the districts belonging to them (Table 5.9). Amravati division followed them with high growth in 2 out of 4 districts. Nagpur had the lowest rank with moderate growth rate in three districts and negative in one.

## Table 5.8
## Cross Classification of Districts by Levels of Growth Rates in Period - I (1967-80) and Period - II (1980-91) for Pulses Output

| Growth Categories in Period-I (1967-80) | Growth Categories in Period-II (1980-91) | | | | | |
|---|---|---|---|---|---|---|
| | Negative | Low (0.01 to 2.0) | Moderate (2.01 to 5.00) | High (5.01 to 10.00) | Very High (>10.00) | Total |
| Negative | — | — | — | 1 | — | 1 |
| Low | — | — | — | — | — | — |
| Moderate (2.01 to 5.00) | — | 1 | 2 | 5 | 1 | 9 |
| High (5.01 to 10.00) | 2 | 1 | 6 | 2 | 1 | 12 |
| Very High (>10.00) | — | — | — | — | — | — |
| Total | 2 | 2 | 8 | 8 | 2 | 22 |

## Table 5.9
## Divisionwise Distribution of Districts by Levels of Growth in Output of Pulses

| Growth Categories | Nasik Division | Pune Division | Kolhapur Division | Aurangabad Division | Amravati Division | Nagpur Division | All Divisions |
|---|---|---|---|---|---|---|---|
| **Period-I** | | | | | | | |
| Negative | — | | | | | 1 | 1 |
| Low (0.01-2.00) | | | | | | | 1 |
| Moderate (2.01-5.00) | 1 | | 1 | 2 | 2 | 3 | 9 |
| High (5.01-10.00) | 2 | 3 | 2 | 3 | 2 | | 12 |
| Very High (10.01 and above) | — | | | | | | — |
| Total No. | 3 | 3 | 3 | 5 | 4 | 4 | 22 |
| Rank | R-4 | R-1 | R-3 | R-2 | R-5 | R-6 | — |
| **Period-II** | | | | | | | |
| Negative | 1 | 1 | | | | | 2 |
| Low (0.01-2.00) | | | 2 | | | | 2 |
| Moderate (2.01-5.00) | 1 | 2 | 1 | 4 | | | 8 |
| High (5.01-10.00) | 1 | | | 1 | 2 | 4 | 8 |
| Very High (10.01 and above) | — | | | | 2 | | 2 |
| Total No. | 3 | 3 | 3 | 5 | 4 | 4 | 22 |
| Rank | R-4 | R-5 | R-6 | R-3 | R-1 | R-2 | — |

Relative positions of the districts almost reversed in the second phase. Amravati and Nagpur divisions surpassed all other with high and very high growth rates in the districts belonging to them. Aurangabad ranked third with majority of districts falling in moderate growth class. Growth rates for all the districts in Pune and Kolhapur divisions moved downwards significantly but in Nasik division the movement of districts was mixed. Unlike other two districts from Nasik division, Dhule district registered an upward movement in growth rate from 4.9% in 1967-80 to 8.63 in 1980-90. Consequently, Nasik, Pune and Kolhapur divisions occupied 4th, 5th and 6th ranks.

To sum up, there had been remarkable boost to growth in output of pulses in the Vidarbha region (i.e. Amravati and Nagpur divisions) after 1980-81. Growth continued at reduced, yet moderate pace in the Marathwada region (i.e. Aurangabad division). It received significant set back in the remaining three divisions of the Western Maharashtra (with an exception of Dhule district) when compared to their remarkable performance in the early phase of the period under study.

### 5. Growth in Oilseeds Production :

The share of the Konkan division being very negligible i.e. less than 1% in the State's oilseeds output the discussion in this section too covers only 22 districts from the remaining six divisions.

Production of oilseeds declined absolutely in the state between 1970 and 1980. Obviously growth rates remained negative in six districts, were at low and moderate level in four and six districts respectively and high in the remaining six districts (Table 5.10). The inter-district range was -6.6% for Osmanabad district to 5.93% for Nasik district (Table 5.4).

**Table 5.10**
**Cross Classification of Districts by Levels of Growth Rates in Period - I (1967-80) and aPeriod - II (1980-91) for Oilseeds Output**

| Growth Categories in Period-I (1967-80) | Growth Categories in Period-II (1980-91) | | | | | |
|---|---|---|---|---|---|---|
| | Negative | Low (0.01 to 2.0) | Moderate (2.01 to 5.00) | High (5.01 to 10.00) | Very High (>10.00) | Total |
| Negative | — | — | — | 2 | 4 | 6 |
| Low (0.01 to 2.00) | — | — | — | 3 | 1 | 4 |
| Moderate (2.01 to 5.00) | — | — | — | — | 6 | 6 |
| High (5.01 to 10.00) | — | — | 1 | 4 | 1 | 6 |
| Very High (>10.00) | — | — | — | — | — | — |
| Total | — | — | 1 | 9 | 12 | 22 |

The second period, however, experienced dramatic change, in growth environment for oilseeds with across the board acceleration in growth rates. This is evident from the inter district range of growth rates which moved up to 4.66% for Nasik district to 21% for Parbhani district. Out of 22 districts, 12 districts registered growth rates exceeding 10%. For the remaining nine growth rates were between 5% to 10%. Nasik district alone had growth rate slightly lower than 5% (Table 5.10).

Performance of Nagpur division was the best among all the divisions in the period I (Table 5.11). Pune, Nasik and Aurangabad followed it in the descending order of performance. Amravati and Kolhapur divisions were at the bottom of the ladder with low and very low growth performance respectively.

**Table 5.11**
**Divisionwise Distribution of Districts by Levels of Growth in Output of Oilseeds**

| Growth Categories | Nasik Division | Pune Division | Kolhapur Division | Aurangabad Division | Amravati Division | Nagpur Division | All Divisions |
|---|---|---|---|---|---|---|---|
| **Period-I** | | | | | | | |
| Negative | | 1 | 2 | 3 | | | 6 |
| Low (0.01-2.00) | 1 | | 1 | | 2 | | 4 |
| Moderate (2.01-5.00) | | 1 | | 2 | 2 | 1 | 6 |
| High (5.01-10.00) | 2 | 1 | | | | 3 | 6 |
| Very High (10.01 and above) | — | | | | | | — |
| Total No. | 3 | 3 | 3 | 5 | 4 | 4 | 22 |
| Rank | R-3 | R-2 | R-6 | R-4 | R-5 | R-1 | — |
| **Period-II** | | | | | | | |
| Negative | | | | | | | — |
| Low (0.01-2.00) | | | | | | | — |
| Moderate (2.01-5.00) | 1 | | | | | | 1 |
| High (5.01-10.00) | 2 | 2 | 1 | | 2 | 2 | 9 |
| Very High (10.01 and above) | | 1 | 2 | 5 | 2 | 2 | 12 |
| Total No. | 3 | 3 | 3 | 5 | 4 | 4 | 22 |
| Rank | R-6 | R-2 | R-3 | R-1 | R-4 | R-5 | — |

Relative position of the divisions however changed in the next phase with differential degree of acceleration in output growth. Aurangabad division moved up to the top position with growth rates in four districts crossing 10% and for one district lying between 5% to 10%. Pune, Kolhapur, Amravati and Nagpur followed it with successive ranks.

With relatively lower degree of acceleration in output growth compared to the other division, Nasik division slided down to the bottom of the growth ladder with 6th rank though even there oilseeds production increased at the rate which exceeded 6% in two districts.

Finally, to sum up revitalisation of the oilseeds economy was the major achievement of the state's crop sector in 1980's. The lead was provided by the Aurangabad division i.e. Marathwada region followed by the Western Maharashtra (Pune, Kolhapur and Nasik division) and Vidarbha region (Amravati and Nagpur division).

## 6. Growth in Sugarcane Production :

Sugarcane is the most important high value cash crop of Maharashtra. It may be recalled that production of sugarcane is mainly confined to the four divisions, namely, Kolhapur, Nasik, Aurangabad and Pune and growth in sugarcane production decelerated in the state in the latter phase from the high rate of growth achieved in the early phase.

**Table 5.12**
**Cross Classification of Districts by Levels of Growth Rates in Period - I (1967-80) and Period - II (1980-91) for Sugarcane**

| Growth Categories in Period-I (1967-80) | Growth Categories in Period-II (1980-91) | | | | | |
|---|---|---|---|---|---|---|
| | Negative | Low (0.01 to 2.0) | Moderate (2.01 to 5.00) | High (5.01 to 10.00) | Very High (>10.00) | Total |
| Negative | — | — | — | — | — | — |
| Low (0.01 to 2.00) | — | — | — | — | — | — |
| Moderate (2.01 to 5.00) | — | 1 | 1 | 1 | — | 3 |
| High (5.01 to 10.00) | 1 | 2 | 3 | 1 | — | 7 |
| Very High (>10.00) | 1 | — | 1 | 2 | — | 4 |
| Total | 2 | 3 | 5 | 4 | — | 14 |

Out of 14 districts in the above mentioned four divisions leading in sugarcane production eleven had registered high to very high growth rates and only three had moderate i.e., less than 5 per cent but more than 2% growth in output in the period I (Table 5.12). The inter-district range of

growth rates was 2.85% to 22.2% (Table 5.4). With almost universal deceleration in growth, exception being only of Parbhani district, the range of growth rates realised in period II moved downwards to -4.57% in Ahmednagar district to 6.08% in Parbhani district. Two districts registered negative growth, three districts low growth (<2%), five moderate growth (between 2% to 5%) and only four could achieve growth rate higher than 5% in the latter period. Obviously, from among all the fourteen districts, only one district improved rate of output growth, two maintained their growth category over the entire period and the remaining eleven experienced deterioration in growth rates (Table 5.12).

In the early phase, Nasik division surpassed all the other three in raising the output of sugarcane and the latter three had almost equally impressive growth performance (Table 5.13).

**Table 5.13**
**Divisionwise Distribution of Districts by Levels of Growth in Output of Oilseeds**

| Growth Categories | Nasik Division | Pune Division | Kolhapur Division | Aurangabad Division | All Divisions |
|---|---|---|---|---|---|
| **Period-I** | | | | | |
| Negative | | | | | — |
| Low (0.01-2.00) | | | | | — |
| Moderate (2.01-5.00) | | | 1 | 2 | 3 |
| High (5.01-10.00) | 1 | 3 | 1 | 2 | 7 |
| Very High (10.01 and above) | 2 | | 1 | 1 | 4 |
| Total No. | 3 | 3 | 3 | 5 | 14 |
| Rank | R-1 | R-2 | R-2 | R-2 | — |
| **Period-II** | | | | | |
| Negative | | 1 | 1 | — | 2 |
| Low (0.01-2.00) | 1 | | 1 | 1 | 3 |
| Moderate (2.01-5.00) | 1 | 1 | 1 | 2 | 5 |
| High (5.01-10.00) | 1 | 1 | | 2 | 4 |
| Very High (10.01 and above) | — | | | | — |
| Total No. | 3 | 3 | 3 | 5 | 14 |
| Rank | R-2 | R-3 | R-4 | R-1 | — |

Growth performance was more uneven across the districts and the divisions in the second period, in addition to the overall deterioration experienced in them. Between the four divisions performance was best in Aurangabad followed by Nasik, Pune and Kolhapur divisions in the descending order. Obviously, Aurangabad division improved significantly its share in the state's total output of sugarcane in 1980's and it is this along with substantial boost to oilseeds production that it could remain at the second position in raising the gross value of output, despite severe set back to cereal production in 1980's. In contrast, with relatively higher decline in sugarcane output growth, the other three divisions experienced higher erosion in their overall performance in the crop sector vis-a-vis Aurangabad and Amravati divisions.

## 7. Growth in Cotton Production :

Cultivation of cotton is concentrated mainly in the five divisions of the state, namely, Amravati, Aurangabad, Nasik, Nagpur and Pune but more heavily in the first four. It may be recalled that growth in cotton production continued in the state at undiminished rate since 1967-68.

Out of 18 districts leading in cotton production seven registered negative growth in the early phase, five contributed positively but with low growth rate (i.e. < 2%) and the remaining six registered growth in output at the moderate rate i.e., between 2% to 5% (Table 5.14).

**Table 5.14**
**Cross Classification of Districts by Levels of Growth Rates in Period - I (1967-80) and Period - II (1980-91) for Cotton Output**

| Growth Categories in Period-I (1967-80) | Growth Categories in Period-II (1980-91) | | | | | |
|---|---|---|---|---|---|---|
| | Negative | Low (0.01 to 2.0) | Moderate (2.01 to 5.00) | High (5.01 to 10.00) | Very High (>10.00) | Total |
| Negative | 3 | 2 | 2 | — | — | 7 |
| Low (0.01 to 2.00) | 2 | 1 | 1 | — | 1 | 5 |
| Moderate (2.01 to 5.00) | 2 | 1 | 3 | — | — | 6 |
| High (5.01 to 10.00) | — | — | — | — | — | — |
| Very High (>10.00) | — | — | — | — | — | — |
| Total | 7 | 4 | 6 | — | 1 | 18 |

Distribution of districts across the growth categories remained almost invariant in the two sub-periods, despite significant downward and upward movement of the districts over the growth classes. Five districts moved down while seven moved up and twelve maintained their growth category.

Consequently inter-district range of growth rates for districts (showing positive growth) too did not undergo a change between the two sub-periods. It was 0.38% (for Osmanabad district) to 4.41% (for Solapur district) in the early phase and 0.47% (for Beed district) to 4.45% (for Akola district) in the latter phase of the period (Table 5.4). But, the regional pattern of growth performance changed distinctly between the two phases of the GR period (Table 5.15). Pune division which ranged first in the sub-period I performed worst as cotton was almost eliminated from this division in 1980s. At the other end improvement in performance was highest for Nagpur division and it moved to rank one. Amravati and Aurangabad followed it with 2nd and 3rd ranks.

**Table 5.15**
**Divisionwise Distribution of Districts by Levels of Growth in Output of Cotton**

| Growth Categories | Nasik Division | Pune Division | Aurangabad Division | Amravati Division | Nagpur Divisions | All Divisions |
|---|---|---|---|---|---|---|
| **Period-I** | | | | | | |
| Negative | 2 | 1 | 1 | 2 | 1 | 7 |
| Low (0.01-2.00) | 1 | | 2 | 1 | 1 | 5 |
| Moderate (2.01-5.00) | | 2 | 2 | 1 | 1 | 6 |
| High (5.01-10.00) | — | | | | | — |
| Very High (10.01 and above) | — | | | | | — |
| Total No. | 3 | 3 | 5 | 4 | 3 | 18 |
| Rank | R-5 | R-1 | R-2 | R-4 | R-3 | — |
| **Period-II** | | | | | | |
| Negative | 3 | 3 | 1 | | | 7 |
| Low (0.01-2.00) | | | 2 | 2 | | 4 |
| Moderate (2.01-5.00) | — | | 2 | 2 | 2 | 6 |
| High (5.01-10.00) | — | | | | | — |
| Very High (10.01 and above) | — | | | | 1 | 1 |
| Total No. | 3 | 3 | 5 | 4 | 3 | 18 |
| Rank | R-4 | R-5 | R-3 | R-2 | R-1 | — |

In Nasik division the growth performance of cotton remained unsatisfactory and highly unstable though absolute level of production was maintained, despite decline in area under cotton. Obviously, its rank was second from the bottom i.e., 4th.

Finally, we highlight growth performance of different divisions commenting on the contributions of the crop responsible for it, particularly during the recent decade of the eighties.

Aurangabad division played a leading role in the agricultural growth process of the state during the GR period. In the early phase cereals, pulses, cotton and sugarcane were the prominent crops contributing to growth while in the latter phase sugarcane and oilseeds followed by cotton were in the forefront. Thus, the pattern of growth in the recent period reinforced heavy emphasis on the commercial crops like sugarcane, oilseeds and cotton.

Amravati division displayed a unique characteristics of sustained growth across crops in the GR period with acceleration in growth in the later phase. Growth was dominated by cereals, pulses and cotton in the early period and additionally by oilseeds in the second period. Among them growth momentum to output of pulses was highest in the eighties. Thus, even in absence of any emphasis on sugarcane production, Amravati division could achieve highest rate of growth in GVO in the second period.

Growth performance of Nasik division was the second-best in the initial phase of the GR period and deceleration to moderate growth in the latter part. Growth in sugarcane output played the leading role in the entire period while cereals, pulses and oilseeds followed it.

Like Nasik division Pune too performed equally impressively in the early phase of the GR period with emphasis on sugarcane, cereals, pulses and oilseeds too. Pace of growth decelerated for all the crops with the exception being of oilseeds alone, in which case its performance was next to Aurangabad division.

In Kolhapur division, a high and stable productivity region of Maharashtra, sugarcane crop overwhelmingly dominated the growth process in the first period followed by cereals. In the second period though pace of growth decelerated for sugarcane and cereals, it picked up for oilseeds and other commercial crops like tobacco. Yet, the contribution of sugarcane and cereals to growth in the overall crop output continued to be important and it continued its middle position with rank four among all the divisions. Sustained moderate growth with higher stability was the main characteristics of growth in this region.

Overall pace of growth remained at moderate to low level in Nagpur division through the entire GR period. In the early phase cereals and oilseeds followed by cotton played the leading role while main contributors in the second period were cotton, pulses and oilseeds. Similar to Amravati divisions, role of sugarcane crop was negligible in this part of Vidarbha too.

Konkan division remained at the bottom of the growth ladder with relatively moderate growth in cereals output in period I and some deceleration thereafter. Role of all other crops was by and large negligible in it.

## Notes

1. As the district level data available only upto 1990-91, the period of analysis was restricted to 1967-91.

2. For special comments on performance and characteristics of Akola refer section 4 in Chapter 9.

3. Wardha and Nagpur fall in the 'Western Plateau and Hill Region' but Bhandara and Chandrapur belong to 'Eastern Plateau and Hill Region' (Source: Planning Commission, Government of India, 'Agro-Climatic Regional Planning - An Overview', 1989).

4. Thane district in Konkan division, Nasik district in Nasik division and Solapur district in Pune division had -0.13%, -0.22% and 0.85% (not significant) growth rates. For the remaining two districts performance was better in Nasik followed by Konkan and Pune divisions.

# CHAPTER 6

## DECELERATION IN AGGREGATE PRODUCTIVITY GROWTH: A SEARCH FOR EXPLANATION

### 1. Introduction :

The scrutiny of trends in growth in the state's crop sector revealed significant reduction in the aggregate crop output growth rate from abut 5% in the early part of the GR period to 2.5% in the latter. A more disturbing aspect of this phenomenon has been that the deceleration in output growth occurred despite rise in the rate of expansion in the aggregate area under crops. Indeed, it was significant decline in the growth of aggregate yield index (i.e., from 3.3% in period I to 1.2% in period II) which induced fall in growth rate of production index in the crop sector of Maharashtra (refer Table 4.2 from Chapter 4). This is certainly a cause for serious concern in view of the fact that it has not been associated with simultaneous and equivalent slowing down in the expansion of inputs in agriculture. On the contrary, there has been steep acceleration in the use of many key inputs like fertilisers, pesticides, electricity etc. after 1980 (refer section 8 in Chapter 3). It is therefore imperative to search for possible explanations for emergence of this disturbing trend, so that agricultural policies in future can be accordingly reoriented or modified.

Comparative analysis of yield growth rates of major crops for the two periods undertaken earlier (refer section 4 in Chapter 4) revealed that reduced pace of growth in the aggregate yield index was mainly the result of a sharp decline in the growth rates of yield per hectare for cereals and sugarcane but not so far other crops like pulses, oilseeds, cotton, etc. Hence, while exploring possible cause of deceleration in aggregate productivity growth we focus more on deterioration in yield growth for cereals and the sugarcane crop.

Given the institutional structure, productivity growth in agriculture depends on several factors. The most important among them are the advances in production technology and their effective extension. They are expected to lead to distinct improvements in the types of inputs used and their use-efficiency in agriculture over time. Two other factors also influence significantly the growth performance in agriculture particularly in the long run. They are one, investment in agriculture especially in irrigation and land developments and secondly the terms of trade. The latter i.e., the terms of trade, if favourable to agriculture, promotes private investment in agriculture and thereby in turn encourage the former i.e, total agricultural investment and thus reinforce its favourable impact on productivity growth in agriculture.

Variations in rainfall or climatic factors too affect productivity growth in the short to medium run especially when the farming is predominantly rainfed.

The observed trend of deceleration in productivity growth in Maharashtra may, therefore, be attributed to unfavourable changes or deterioration in any one or more of the above mentioned factors.

To explain decline in yield growth for cereals, initially, we used the framework of regression analysis but the results of regressions were not unambiguous particularly regarding the impact of irrigation and HYV variables due to the statistical problem of high multicollinearity between them (refer Annexure 6.1). Hence, in the sections that follow we try to examine separately trends in the aggregate investment in agriculture, changes in rainfall variations, the pattern of expansion in irrigation and adoption of seed-fertilizer technology advances in the early vis-a-vis the latter period in order to judge their influence on the aggregate productivity growth, in general, and yield growth for cereals and sugarcane, in particular.

## 2. Investment in Agriculture :

At the national level a disturbing trend of decline in total gross capital formation in agriculture at constant prices emerged during the eighties. Between the private and public components of investment it was the latter i.e., the public investment in agriculture which suffered serious setback while private investment picked up since 1987-88 (Rao CHH and Gulati, 1995).[1]

Regarding Maharashtra the trends in agricultural investment do not appear to be as pessimistic as they have been found at the national level. Information available for the period 1980-81 to 1990-91 from the State's Directorate of Economics and Statistics suggest that the public sector investment at 1980-81 prices showed high fluctuations during the eighties with no significant downward or upward trend. Bulk of it was for irrigation and its share in total investment fluctuated between 48% to 60%. As against this private sector investment recorded significant growth rate of 4.67% per annum. Due to high growth in private investment, total agricultural investment in Maharashtra increased at an annual rate of 2.81% between 1980 to 1990 (Dev Mahendra, 1995).[2] Similar statistics is not available for the 1970's. However, the alternative source i.e., the R.B.I.'s Debt and Investment Survey for 1971 and 1981 revealed that the gross fixed capital formation (at constant prices) in agriculture of the rural household in Maharashtra increased at a rate close to 4.7% between 1971 and 1981. This proves that atleast the real private investment in agriculture in Maharashtra continued to rise at the undiminished pace through the 70's and 80's.

The above inference is found to be perfectly consistent with the trend in expansion in the term loans disbursed in Maharashtra during the same period (Table 6.1). Annual rate of expansion (simple average) in total disbursement of terms loans in Maharashtra was not only higher during the eighties (40.5%) than that between 1973 to 1980 (15.9%) but it was significantly above the comparable rate for Indian agriculture (18.8%) for the 1980's. Similar trend is revealed by the loans per hectare of net sown area for Maharashtra and all India. This was also reflected in marginal improvement in the State's share in all India disbursement of terms loans for agriculture.

**Table 6.1**
**Expansion in Term Disbursed by Different Agencies***

| | Loans disbursed (Rs. in crore) | | | Rate of expansion (Simple average, per annum %) | |
|---|---|---|---|---|---|
| | 1973-74 | 1980-81 | 1990-91 | 1973-74 & 1980-81 | 1980-81 & 1990-91 |
| Maharashtra | 66.10 (Rs. 37) | 142.68 (Rs. 78) | 731.42 (Rs. 394) | 15.9 | 40.5 |
| All India | 437.77 (Rs. 31) | 1412.66 (Rs. 101) | 4115.20 (Rs. 291) | 18.0 | 18.8 |
| Average share of Maharashtra to All India | 15.1 (TE 1975-76) | 10.1 (TE 1980-81) | 18.0 (TE 1990-91) | | |

* Cooperatives, Land development banks, Commercial banks and Regional rural banks.
Notes : (1) Figures in parentheses represent loans disbursed per hectare of net sown area.
(2) TE stands Triennium ending.

Thus, deterioration in private investment was in no way responsible for declining productivity growth in the agricultural sector of the State.

With regard to public investment in agriculture as no statistics is available for the 1970's we would examine later the extent of irrigation development in 1970s with that in 1980s the former i.e., public investment being mainly accounted by investment in irrigation.

### 3. Role of Weather :

Comparison of non-adjusted growth rates in gross value of output (GVO) with the corresponding rainfall-adjusted growth rates at the state level implied favourable character of rainfall variations for period I but somewhat less favourable weather pattern in the second period (refer section 2 from Chapter 4). To reinforce this conclusion we repeated similar exercise for the district level GVO series (Table 6.2).

## Table 6.2
## Districtwise Growth Rates in Gross Value of Output of all Crops

| Districts | Non-Adjusted (Type A2) growth rates | | | Rainfall-Adjusted (Type B) growth rates | | |
|---|---|---|---|---|---|---|
| | Period-I 1967-80 | Period-II 1980-91 | R-Square | Period-I 1967-80 | Period-II 1980-91 | R-Square |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Thane | 3.14* | 0.37* | 0.57 | 1.51 | 0.68 | 0.44 |
| Raigad | 2.69* | 1.91@ | 0.88 | 1.78* | 0.92@ | 0.60 |
| Ratnagiri | 3.27* | 2.84@ | 0.95 | 2.78* | 3.15@ | 0.87 |
| Nasik | 6.38* | 0.44* | 0.70 | 7.35* | 1.70@ | 0.72 |
| Dhule | 6.20* | 2.70* | 0.74 | 6.11* | 4.07@ | 0.77 |
| Jalgaon | 6.66* | 2.91* | 0.78 | 4.89* | 4.09@ | 0.79 |
| Ahmednagar | 5.47* | -2.15* | 0.59 | 4.05* | -2.71@ | 0.63 |
| Pune | 8.92* | 2.53* | 0.74 | 6.14* | 5.18@ | 0.76 |
| Solapur | 4.43* | 3.97@ | 0.73 | 1.73 | 4.85 | 0.76 |
| Satara | 4.47* | 4.41@ | 0.89 | 3.72* | 3.90@ | 0.79 |
| Sangli | 7.51* | 0.01* | 0.81 | 5.06* | 0.11* | 0.65 |
| Kolhapur | 3.72* | 2.37* | 0.98 | 3.43* | 2.78* | 0.93 |
| Aurangabad | 7.12* | 2.69@ | 0.77 | 5.54* | 2.21@ | 0.73 |
| Parbhani | 6.33* | 3.16@ | 0.72 | 5.12* | 4.63@ | 0.59 |
| Beed | 7.04* | 3.37@ | 0.57 | 6.23* | -1.34@ | 0.63 |
| Nanded | 5.62* | 1.45@ | 0.53 | 4.80* | 2.18@ | 0.30 |
| Osmanabad | 6.65* | 1.52@ | 0.57 | 4.78* | 1.04@ | 0.65 |
| Buldhana | 5.06* | 2.33@ | 0.72 | 3.97* | 2.49@ | 0.63 |
| Akola | 4.76* | 6.81@ | 0.85@ | 4.21* | 9.36* | 0.68 |
| Amravati | 3.91* | 4.01@ | 0.80 | 3.58* | 5.82@ | 0.61 |
| Yavatmal | 3.87* | 2.58@ | 0.91 | 4.01* | 4.43@ | 0.67 |
| Wardha | 5.40* | 2.97* | 0.91 | 5.64* | 4.90@ | 0.68 |
| Nagpur | 5.03* | 4.20@ | 0.86 | 4.65* | 5.83@ | 0.80 |
| Bhandara | 2.75* | 0.75@ | 0.40 | 2.54* | 0.74 | 0.46 |
| Chandrapur | 3.33* | 1.85@ | 0.75 | 2.53* | 1.04@ | 0.59 |

Table 6.2 strongly supports our above stated inference regarding differential character of weather in the periods before and after 1980-81. Type A2 i.e., non-adjusted growth rates are higher than the Type B i.e., the rainfall-adjusted growth rates for all but three districts for the period I. Moreover, from among the three exceptional cases, namely, Nasik, Yavatmal and Wardha, for the latter two Type A2 estimates are just marginally lower than the Type B estimates. Thus, practically for almost all

districts period I represented a favourable phase in terms of performance of monsoon. The situation was reverse in period II with Type A2 growth rates being lower than the Types B growth rates for 18 districts higher for 6 districts and almost the same for one of them. Thus, evidence in favour of weather pattern being unsatisfactory in period II has been strong though not as universal across the districts as the evidence of favourable weather for period I.

In addition direct comparison of weather pattern between the two periods was also made on the basis of nature of rainfall variations across the districts. It indicated that in period I frequency of years, with wider inter-district spread of normal and above normal rainfall conditions (row 1, Table 6.3) or just normal rainfall conditions (row 2, Table 6.3) was greater than that in period II. Period I was also characterised by greater percentage of years with lower inter-district incidence of acute rainfall deficiency than the period II (row 3, Table 6.3)

**Table 6.3**
**Comparative Analysis of District Level Rainfall Variations for 1967-80 and 1980-91**

| Characteristics of rainfall variations | Based on total for June to September | | Based on total for June to May | | Based on total for June to September (for non-drought years only) | |
|---|---|---|---|---|---|---|
| | 1967-80 | 1980-91 | 1967-80 | 1980-91 | 1967-80 | 1980-91 |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1) % of years with majority of districts (i.e., > 50%) having near normal or above normal rainfall (i.e., actual rainfall above 90% of the normal) | 91.31 | 63.64 | 84.61 | 54.55 | 84.61 | 54.55 |
| 2) % of years with majority of districts (i.e. > 50%) having normal rainfall (i.e. actual rainfall between 80% and 120% of normal) | 61.54 | 36.36 | 76.92 | 27.27 | 53.85 | 36.36 |
| 3) % of years with low proportion (i.e., <50% of districts having high rainfall deficiency (i.e., actual rainfall (60% of normal) | 76.92 | 63.64 | 84.62 | 72.73 | 76.92 | 54.55 |

Note : Rainfall variations are based on the analysis of actual and normal rainfall recorded in 125 centres spread over the Maharashtra State.

The above conclusions have been found to be true not only in respect of variations in the south west monsoon but also for annual rainfall

variations. Similarly, they also hold irrespective of the coverage of drought years in the two periods (Columns (6) and (7), Table 6.3). Indeed divergence between the two periods in terms of the third characteristics (row 3, Table 6.3) increase when drought years are omitted from them. Likewise, the graphs of the state level weighted rainfall index for all crops separately for kharif, rabi and annual rainfall reveal not only higher frequency of rainfall deficient years in the post 1980-81 period but their concentration in the mid-eighties in succession (Diagram 6.1). Thus, there is a reason to believe that the unfavourable pattern of rainfall variations must have exerted downward pressure on the growth rates in yield per hectare of crops in the second period.

We therefore try to examine now, the impact of adverse rainfall conditions on yield growth rates separately for cereals as a group and also for rice crop. For this purpose we compare non-adjusted growth rates i.e., estimates of growth rates based on either three-year moving average or the original observations on yield per hectare, with the rainfall adjusted growth rates, which are obtained after introducing one or two rainfall variables in the trend function. In this exercise we include rice crop in addition to cereals because it is one of the major cereal crops in which case yield growth rate dropped to a negative value in the second period.

As mentioned elsewhere we have treated statistical significance of the negative coefficient of the slope dummy variable for the second period and a large gap between the estimates of growth rates for period I and II as an indication of significant deceleration. Hence, if with the inclusion of rainfall variables in the trend function slope dummy for the second period turns out to be statistically non-significant and simultaneously the difference between the growth rates for the two periods narrows down considerably we interpret actual deceleration in growth rate in the second period as mainly the result of unfavourable rainfall conditions.

Scrutiny of alternative growth rates in yield per hectare for cereals and rice (Table 6.4) leads to the following observations :

(i) There is a large gap between the non-adjusted growth rates for period I and period II both for cereals (rows 1 to 3, Table 6.4) and for rice crop (rows 6 & 7, Table 6.4). Besides, slope dummy variable has been statistically significant in all the regression with an exception of only one regression for cereals where R-square value is relatively low (row 3 in Table 6.4).

(ii) Slope dummy variables and rainfall variables included in the trend functions for cereals and rice yield are statistically significant in all the relevant regressions (rows 4, 5 and 8 in Table 6.4).

(iii) Large gap between the growth rates in yield per hectare for period I and II persists even when growth rates are adjusted for rainfall variations (rows 4 and 5 for cereals and row 8 for rice in Table 6.4). Their value are above 3.6% for period I and below 1% for period II in respect of cereals, where as for rice they are 3.04% and -0.63% for periods I and II respectively.

**Table 6.4**
**Rainfall Adjusted And Non-Adjusted Growth Rates in Yield Per Hectare for Cereals and Rice**

| Types of Growth Rates | Period-I 1967-80 | Period-II 1980-91 | R-Square | Statistical Significance of | |
|---|---|---|---|---|---|
| | | | | Slope dummy for period II | Rainfall Variables |
| **I. Cereals Non-adjusted** | | | | | |
| 1. Based on all years (Type A1) | 5.92* | 1.75* | 0.77 | Significant | — |
| 2. Based on non-drought tears (Type A2) | 7.54* | 2.58 | 0.78 | Significant | — |
| 3. Based on all Original Observations | 4.84* | 1.8@ | 0.55 | Non-Significant | — |
| **Rainfall-adjusted** | | | | | |
| 4. With annual rainfall index | 4.26* | 0.47* | 0.74 | Significant | Significant |
| 5. With Kharif and Rabi rainfall index | 3.64* | 0.84* | 0.75 | Significant | Significant |
| **II. Rice Non-adjusted** | | | | | |
| 6. Based on all Years (Type A1) | 4.12* | -0.03* | 0.71 | Significant | — |
| 7. Based on Original Observations | 3.48* | -0.34* | 0.40 | Significant | — |
| 8. **Rainfall Adjusted** | | | | | |
| With Kharif & Rabi rainfall index | 3.04* | -0.63* | 0.75 | Significant | Significant |

* : Statistically significant at 5% level
@ : Coefficient of time variable significant at 5% level but that of slope dummy for period II non-significant.

To sum up, hypothesis of significant deceleration in yield growth is supported even by the rainfall adjusted growth rates. We therefore conclude that deceleration in yield growth for cereals (and for rice too) during the latter part of the GR period cannot be attributed totally to unfavourable weather conditions. Certainly there must be other factors, in addition to weather, contributing to it.

## 4. Role of Irrigation :

The second important factor which is expected to be linked crucially to productivity growth in agriculture is expansion in irrigation alongwith changes in its reliability i.e., dependability of water supply.

To begin with we compare expansion in aggregate irrigated area in 1980's with that in 1970's and then examine further the comparative increase in surface irrigation, which mainly reflects trends in public investment in irrigation in Maharashtra (Table 6.5)

**Table 6.5**
**Irrigation in Maharashtra**

(Area in lakh hectares)

| | 1970-71 | 1980-81 | 1990-91 | Percentage change between 1970-71 and 1980-81 | Percentage change between 1980-81 and 1990-91 |
|---|---|---|---|---|---|
| Area under Surface Irrigation | 5.8 | 7.8 | 10.0 | 34.5 | 28.2 |
| Area under Well Irrigation | 7.7 | 10.6 | 16.7 | 37.7 | 57.6 |
| Total net irrigated area | 13.5 | 18.4 | 26.7 | 36.3 | 45.1 |
| Gross irrigated area | 15.7 | 24.2 | 33.2 | 54.1 | 37.2 |

It is evident that in terms of percentage change in net irrigated area, expansion in irrigation between 1980-1990 was higher (45%) than the 1970's (36%). But higher rate of expansion was mainly due to accelerated increase in well irrigation which more than compensated for fall in growth in the surface irrigation. The latter reflects slowing down of the rate of public investment in agriculture in general and in irrigation in particular.

Trend in expansion in gross irrigated area was however reverse to the changes that occurred in net irrigated area. Pace of expansion in gross irrigated area was higher (54%) in 1970's vis-a-vis the 1980's (37%). One of the main factors responsible for slow expansion in gross irrigated area during the 80's must be an increasingly preferential allotment of irrigated area to sugarcane by farmers. Shares of sugarcane in the total incremental irrigation of the 70's was 13.5% while it moved up to 24% in the 1980's.[3]

Two more factors are also likely to be responsible for fall in rate of expansion in gross irrigated area. One, greater frequency of rainfall deficient years accompanied by higher degree of deficiency in actual rainfall from the normal level must have resulted into a fall in the total volume of water supply available in the state's irrigation reservoirs and possibly from ground water sources like wells too.

Secondly, it was found that the funds allocated for operation and maintenance (O & M) of some of the irrigation systems in Maharashtra were much below the recommended levels and further the analysis of composition of the actual O & M expenses showed a trend of increase in share of expenditure on 'Direction and Administration' and a declining share of expenses on Maintenance and Repairs since the late 1970's (Dev Mahindra, 1995.)[4] It is our contention that the two factors together must have set a trend of increasing deterioration in the operational efficiency of the irrigation systems in Maharashtra and consequently higher underutilisation of irrigation potential in the eighties than the earlier period.

Two important conclusions emerge from the preceding discussion. One, rate of expansion in net irrigated area in the eighties had been marginally higher than that in the seventies. Yet expansion in gross irrigated area slowed down during the eighties due to higher diversion of irrigation water to sugarcane and increased under utilisation of the potential created due to deterioration in the operational efficiency of the irrigation systems in the State. Thus, there are no indications that slowing down of the rate of expansion in irrigation potential by itself was responsible for deceleration in aggregate productivity growth. Nevertheless, pace of increase in gross irrigated area certainly moved down and it must have affected more adversely the cereal crops rather than the non-cereals including sugarcane. Hence, we now try to link up changes in percentage of irrigated area for major cereal crops during 70's and 80's to the growth rates in their yield per hectare in the periods I and II (Table 6.6)

**Table 6.6**
**Growth Rates in Yield and Changes in Irrigation: Maharashtra**

| Crop/Crop Groups | Growth Rates in Yield | | Percent of irrigated area to cropped area | | | |
|---|---|---|---|---|---|---|
| | 1967-80 | 1980-93 | 1968-69 | 1970-71 | 1980-81 | 1990-91 |
| Rice | 4.12 | -0.03* | 23.15 | 23.22 | 27.82 | 26.00 |
| Wheat | 7.22* | 2.46* | 27.98 | 33.87 | 49.86 | 62.66 |
| Jowar (Kharif) | 7.63* | 2.27* | 0.90 | 0.83 | 2.46 | 0.91 |
| Jowar (Rabi) | 4.99* | 2.26@ | 8.27 | 7.58 | 11.29 | 12.01 |
| Bajra | 2.49 | 4.06 | 2.42 | 2.94 | 3.52 | 2.54 |
| Maize | 5.93* | -3.25* | 41.78 | 36.95 | 49.12 | 37.00 |
| **Total Cereals** | **5.92*** | **1.75*** | **8.70** | **9.19** | **13.86** | **13.83** |
| Gram | 2.52* | 3.86@ | 15.10 | 14.84 | 17.80 | 31.50 |
| Total Pulses | 1.27 | 2.50 | 2.46 | 1.99 | 3.24 | 8.11 |
| Groundnut | 1.19 | 2.64 | 1.74 | 2.32 | 7.88 | 31.78 |
| Sugarcane | 3.82* | -1.33* | 100.00 | 100.00 | 100.00 | 100.00 |
| Cotton | 3.77* | 2.22@ | 2.43 | 2.65 | 4.67 | 3.04 |

* : Significant at 5% level
@ : Either time coefficient or slope dummy is significant at 5% level.

The Scrutiny of growth rates realised in yield per hectare of the five major cereals alongwith the changes in the extent of irrigation for them during 1970's and 1980's (Table 6.6) reveals clearly an absence of consistent and strong positive relationship between the productivity growth and expansion in irrigation during the entire period of the two decades.

It is true, that the decade of 1970's i.e., the period of very high growth in yield per hectare of all the major cereals was the period in which percentage of irrigation increased from around 9% in 1968-70 to 14% in 1980-81 for cereals as a group. But the major beneficiaries of this increase were wheat and maize, the relatively minor crops among the cereals and to a much lesser extent two of the major cereals namely rabi jowar and kharif jowar and another major one i.e., bajra had negligible benefits of expanded irrigation. Yet, the highest rate of growth in productivity per hectare was recorded by kharif jowar almost entirely an unirrigated crop. Thus, there is sufficient ground to believe that the other important factors such as extension of new seed technology and favourable weather in addition to expansion of irrigation for the two minor cereals were responsible for inducing high growth in productivity during the early phase, and not irrigation alone.

However, the situation during the decade of 1980's when productivity growth remained greatly depressed was distinctly different. Extent of cereals area under irrigation continued to be around 14 per cent between 1980-81 and 1990-91 with minor inter-year fluctuations. It also continued to be negligible for kharif jowar and bajra like the 1970's. For rabi jowar and rice it remained nearly constant at about 11% and 27% respectively in the entire decade. In contrast, upward change for wheat (i.e., 50% in 1980-81 to 62% in 1990-91) and downward movement for maize (i.e., from 49% in 1980-81 to 37% in 1990-91) was significant.

Simultaneous changes in total area under different cereals that occurred in 1980's were equally important and must have influenced at least partly the course of yield growth particularly for the crops like wheat, and kharif jowar. Though total area under cereals remained constant between 1980-81 and 1990-91 there were conflicting movement in area across the crops.

Area under kharif jowar and wheat declined after 1980-81, the decrease in area being more sharp for wheat. The area withdrawn must obviously be the low yielding area under these crops. For example, irrigated area under wheat remained constant between 1980-81 and 1990-91, when total area decreased by more than 20 percent. It must have been shifted to the relatively more moisture stress resistant crops like rabi sunflower or gram.[5] Thus, significantly increased percentage of irrigation for wheat in the

eighties was the result of steep reduction in low yielding unirrigated area under wheat and not the consequence of increased benefits of irrigation to wheat. Indeed, positive though low growth in yield per hectare registered by wheat can be directly attributed to the shifts of low yielding unirrigated areas under wheat to the other crops.[6] Similarly, part of yield growth realised for kharif jowar during the eighties need to be attributed to withdrawals of low yielding areas from this crop to the other better yielding and low risk crops like kharif sunflower and soyabean.

The case of rice was typical with stagnant total area under it while area under rabi jowar, bajra and maize increased between 1980-81 and 1990-91. Reduction in the extent of irrigation for maize after 1980-81 was due to additions of unirrigated area for its cultivation and not the withdrawal of irrigation benefits. In other words, as withdrawals of unirrigated area from wheat must have pushed up the overall average yield per hectare for it, similarly additions of low-yielding unirrigated area must be partly responsible for depression in yield growth for maize.[7]

Thus, in respect of the two minor crops namely wheat and maize changes in irrigation appear to have played some role in influencing the course of productivity growth. However, it cannot be argued to be so for the four major cereals, namely kharif jowar, rabi jowar, bajra and rice in which case growth in productivity steeply declined with almost no change in the proportion of irrigation. For example on the one hand, with negligible benefits of irrigation yield rate moved up for bajra from 2.5% in period I to 4% in period II while average yields for rice remained stagnant during the eighties with -0.03% growth rate against high positive growth in yield of 4.2% in the early phase.

To sum up, neither high growth rates in yield per hectare registered by cereal crops in the early phase were due to increased benefits of irrigation alone nor a large decline in yield growth in the latter period was associated with equally steep fall in the extent of irrigation for them.

## 5. Role of Seed-fertiliser Technology Development :

There are three possible sources by which growth in crop yields achieved in the past can be sustained or even enhanced in future, given the resource base, institutional and infrastructural set up in agriculture. One is continued extension of the existing seed-fertiliser technology to new area lagging in adoption. Secondly, continuous flow of new HYVs over time with progressively high genetic yield potentials from the agricultural research stations to farmers' fields particularly in the areas where existing technologies have been fully adopted may help in maintaining or even

pushing up growth rates in yield. Improved yield potentials of newly released varieties in this context may enable the farmers to sustain yield growth over time despite absence of any reduction in the extent of gap between the potential and actual yields. A third alternative way by which yield growth can be endured over time is to achieve increasing improvement in farm level efficiency in the use and management of the new crucial inputs like seeds, water and fertilizers so that the gap between the potential and actual yields of the existing HYVs narrows down progressively.

While exploring the causes of deceleration in productivity growth in Maharashtra it would have been worthwhile to examine the differential role played by the above mentioned three sources before and after 1980-81. But the adequate information base is not available for all of them. It is relatively easier to procure and analyse statistical evidence in respect of the first source i.e., extension of seed fertilisers technology. But similar analysis for the other two sources is not possible as direct and inter-temporally comparable evidence regarding flow of new HYVs alongwith their yield performance over time on experimental farms and changes in efficiency in the use of new inputs are difficult to obtain. Therefore, in the analysis that follows we concentrate on the first source and judge the role of the other two by relying more on our inferences based on whatever indirect evidence is available for them.

We examine the scope for and actual role of the extension of seed fertiliser technology by focussing more on its two critical elements, namely, pace of expansion in area under HYVs of cereals and increase in use of fertilisers.

**Use of HYVs :**

It is evident from Table 6.7 that major expansion in HYV area under cereals occurred during the 70's i.e., from 14% in 1970-71 to nearly 50% in 1980-81. But thereafter actual rate of expansion slowed down and coverage moved up to only 70% by 1990-91 though the scope existed for further increase.

Among the major cereals scope for accelerated expansion in the eighties was highest for rabi jowar followed by bajra. For the former area under hybrid seeds must be almost eligible till 1980-81 while with regard to bajra crop coverage was only 41% in 1980-81. For the remaining namely kharif jowar, rice, wheat and maize bulk of the area was already covered by HYVs by 1980-81. In fact coverage was 100% for wheat, about 80% for kharif jowar and maize and 73% for rice.

## Table 6.7
## Expansion in Area Under HYV/Hybrid Seeds in Maharashtra

(Area in 000' hectares)

| Crops | 1970-71 | | | 1980-81 | | | 1990-91 | | |
|---|---|---|---|---|---|---|---|---|---|
| | HYV Area | Total Area | % of HYV to total Area | HYV Area | Total Area | % of HYV to total Area | HYV Area | Total Area | % of HYV to total Area |
| **Rice** | 216 | 1356 | 15.93 | 1102 | 1504 | 73.27 | 1238 | 1581 | 78.30 |
| **Wheat** | 211 | 882 | 23.92 | 1100 | 1100 | 100.00 | 700 | 873 | 80.18 |
| Kharif Jowar | 501 | 2537 | 19.75 | 2366 | 2971 | 79.64 | 2751 | 2751 | 100 00 |
| Rabi Jowar | 0 | 3247 | 0.00 | 0 | 3467 | 0.00 | 1321 | 3580 | 36.90 |
| **Total Jowar*** | 501 | 5784 | 8.66 | 2366 | 6438 | 36.75 | 4072 | 6331 | 64.32 |
| **Bajra** | 481 | 1929 | 24.94 | 700 | 1709 | 40.96 | 1477 | 1927 | 76.76 |
| **Maize** | 6 | 42 | 14.29 | 72 | 86 | 83.72 | 111 | 111 | 100.00 |
| **Total for 5 Crops** | **1415** | **9993** | **14.16** | **5340** | **10837** | **49.28** | **7598** | **10843** | **70.07** |

* : HYV area reported for jowar has been assumed to be entirely under kharif jowar upto 1980-81. for 1990-91, coverage of kharif jowar is treated as 100 percent and the remaining HYV area is attributed to rabi jowar.

During the 80's however, barring the unique exception of bajra crop speed of HYV coverage either slowed down as in case of maize and kharif jowar due to limited scope for further expansion or received a set back as happened particularly with regard to wheat and rice.

Between rabi jowar and bajra, the crops in which case significant expansion was possible, spread of hybrid seeds was very swift for bajra during the eighties, relatively unfavourable weather conditions notwithstanding. It is true that among all the coarse cereals bajra is relatively more drought resistant. But expansion in area under hybrid bajra appear to be more due to availability of promising hybrid varieties with distinctly improved disease/pest resistance in the eighties compared to the pre 1980-81 period (World Bank, 1995).[8] As against this absence of hybrid seeds of jowar suitable for rabi season and with higher degree of tolerance of moisture, stress and a grain quality compatible to cultivators' consumption preferences inevitably led to non-exploitation of the full potential for diffusion of HYV technology for it (Sawant, 1996).[9] Thus, it was the lack of appropriate technology which was equally responsible for restraining the pace of expansion in use of hybrid seeds for rabi jowar as the weather conditions.

To sum up, set back to further progress in HYV coverage of rice and wheat varieties, slow expansion in use of hybrid seeds for rabi jowar and

reduced scope for expanding the HYV coverage for kharif jowar and maize were the three major factors responsible for overall slowing down of the process of diffusion of HYVs in the eighties. So finally we are left with the question which still remains to be resolved: whether the set back or slow expansion of HYVs in the eighties can be attributed entirely to the unfavourable weather conditions?

**Use of Fertilisers :**

Unlike the pattern of spread of HYVs pace of increase in the overall use of fertilisers for all crops combined was much faster during the 80' vis-a-vis slow expansion in their use in the 70's. This is evident from the fact that the consumption of fertilisers per hectare moved up from 11 kg. per hectare in 1970-71 to just 21 kg. in 1980-81 and thereafter it jumped to 67 kg. per hectare in 1990-91. Another distinct characteristics of expansion in fertilisers use in the 80's was reduction in inter-district disparity in their use. Use of fertilisers not only expanded swiftly in all the divisions and districts but the pace of increase was much greater in the regions with low initial levels of consumption like Aurangabad, Pune, Nagpur and Amravati divisions (refer Table 3.11 from Chapter 3). Such extensive special expansion must have certainly benefited all the crops, that is cereals and non-cereals both. The evidence on crop-wise use of fertilisers available from the sample villages covered in our field survey too support this contention. That is why there is no ground to presume that fertiliser use had not expanded for crops like rice and maize which experienced nearly zero or negative growth in yields in the second period.

In fact, there is a reason to believe that the use of fertiliser must be significantly higher for rice, wheat and maize than not only for the coarse cereals like jowar and bajra but the crops like pulses and oilseeds for which fertilisers consumption picked up to only the eighties.

It is true that the yield growth is unlikely to continue at the pace equivalent to that in the initial period of rapid diffusion of HYVs. But the extent of deceleration in growth that occurred despite sharp acceleration in the use of fertilisers is difficult to justify merely in terms of unfavourable rainfall situation.

Let us therefore compare average yields of different cereals in the state in the beginning of the two periods with those at the end of the period by covering only the non-deficient rainfall years so that the comparison is by and large free from the upward or downward bias of weather (Table 6.8).

With the exception of bajra and rabi jowar for all the other major and

minor cereals improvement in the average yields computed for non-deficient rainfall years have been found to be significantly greater for the seventies (column (5), Table 6.8) than the comparable change in the eighties (column (6) Table 6.8). Indeed the change for rice in the seventies was 29.4% as against just 3% change in the eighties when there was sharp upward trend in the overall use of fertilisers in the state.

## Table 6.8
## Yield Average for Cereals Based on Non-deficient Rainfall Years

(Yield in kg. per hectare)

| Crop | Averages for | | | % change between Column (2) & Column (3) | % change between Column (3) & Column (4) |
|---|---|---|---|---|---|
| | 1967-68, 1969-70 & 1970-71 | Triennium ending 1980-81 | Triennium ending 1990-91 | | |
| (1) | (2) | (3) | (4) | (5) | (6) |
| Rice | 1101 | 1425 | 1468 | 29.4 | 3.0 |
| Wheat | 456 | 846 | 1106 | 85.5 | 30.7 |
| Jowar (Kharif) | 681 * | 1034 | 1292 | 51.8 | 24.9 |
| Jowar (Rabi) | 441 * | 488 | 577 | 10.7 | 18.2 |
| Bajra | 341 | 404 | 555 | 18.5 | 37.4 |
| Ragi | 755 | 921 | 1063 | 21.9 | 15.4 |
| Maize | 1118 | 1714 | 1204 | 53.3 | -29.8 |
| Sugarcane | 65733 | 91262 | 85786 | 38.8 | -6.0 |

* : As 1970-71 was relatively an adverse year for jowar crop average has been computed for 1967-68 to 1969-70.

## Table 6.9
## Per Hectare Use of Fertilisers for Districts Leading in Rice and Maize Production

(N, P & K in kg. per hectare)

| Year | Districts leading in rice production | | | | | | Districts leading in maize production | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Thane | Raigad | Ratna-giri | Bhan-dara | Chandra-pur | Kolha-pur | Dhule | Solapur | Auranga-bad | Osma-bad |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| 1970-71 | 23.8 | 35.2 | 17.2 | 12.2 | 9.9 | 28.7 | 12.2 | 7.7 | 6.5 | 5.9 |
| 1980-81 | 22.5 | 35.7 | 14.6 | 15.7 | 9.0 | 109.1 | 36.4 | 15.7 | 16.4 | 6.8 |
| 1990-91 | 42.7 | 66.2 | 37.2 | 55.5 | 28.2 | 259.1 | 63.1 | 50.9 | 41.9 | 35.5 |
| Share in production in TE '80-81 | (14) | (13) | (13) | (18) | (16) | (11) | (12) | (24) | (14) | (12) |

For example, in all the six major rice producing districts which accour for more than 80 per cent of the aggregate rice production in Maharashtra use of fertilisers moved up rapidly during the eighties. In fact, in five of them, namely, Thane, Raigad, Ratnagiri, Chandrapur and Bhandara consumption of fertilisers per hectare remained almost invarient during the seventies and increased only after 1980-81 whereas in the sixth district i.e. in Kolhapur the initial level of consumption per hectare i.e. in 1970-71 was not only high but had sustained expansion thereafter (Table 6.9).

Situation in respect of maize was not very different from that for rice. Increase in average yields realised under normal rainfall conditions was more than 50% for maize in the seventies. But the average yields declined between 80-81 and 90-91 by nearly 30 per cent when coverage of HYVs expanded to 100 per cent and consumption of fertilisers per hectare increased significantly in all the leading maize producing districts of the state (see columns (8) to (11) in Table 6.9). It is true that percentage of irrigation declined for maize crop during the eighties but compared to reduction in irrigation the extent of fall in yield appears to be severe.[10]

Thus, it is evident acute stagnation in rice yields and high absolute decline in maize yields in the eighties cannot be explained merely in terms of rainfall deficiency. Similarly as mentioned earlier slow expansion in use of hybrid seeds for rabi jowar too was not the result of unfavourable weather conditions alone. Absence of enhancement in yield potentials of the existing HYVs of rice and maize and of appropriate seed technology development for rabi jowar in the eighties may be partly responsible for the poor state of their yield growth in addition to the weather.

To sum up, the preceding discussion implies that high growth in productivity of cereals in the early phase was the result of :

(i) rapid expansion in the use of HYV technology for all cereals except bajra and rabi jowar,

(ii) significant increase in proportion of irrigated area for the two minor cereal crops namely wheat and maize and

(iii) comparatively favourable phase of rainfall conditions in the early period than the eighties.

But it was also associated with very low initial level of use of fertilisers for cereals and much smaller subsequent rise in it.

In contrast, overall rate of expansion in area under HYVs slowed down during the second period. There was no change in the aggregate

proportion of irrigated area under cereals as no benefits of expanded irrigation did not accrue to wheat and maize unlike what happened in 1970s. Performance of southwest monsoon too was relatively worse in the eighties when compared to the seventies. Moreover, there are indicating that by and large new technological breakthroughs providing HYVs of cereals with significant increased yield potentials were absent in the eighties. The exception to this was of bajra crop alone. As against these adverse developments the overall use of fertilisers moved up very rapidly in all the area benefiting the cereal crops too.

We therefore conclude that the decline in productivity growth experienced by the cereals in the eighties was only partly weather induced. There were a few other factors which must have hastened and aggravated the process of deceleration. One of them is the likely absence of new technological breakthroughs for the cereals other than bajra ensuring significant enhancement in the yield potentials of the existing HYVs. The other important factor must be a pronounced shift in the farmers' preference in allocation of irrigated area to non-cereals rather than the cereals like wheat and maize in the eighties.

### 6. Deceleration In Yield Growth For Sugarcane :

Sugarcane represents the most typical case of an entirely irrigated high preference crop in Maharashtra which suffered from steep decline in yield growth from 3.82% in the early phase to 1.46% in the latter phase of the GR period.

Emergence of significant negative trend in yield growth for sugarcane in the second period represents a serious cause for concern for more than one reasons. Sugarcane is the most important and profitable cash crop in which Maharashtra till recent years enjoyed comparative advantage overall all the other states in India. Secondly, there has been an accelerated expansion in area under sugarcane in the state i.e., from 56% rise in area between 1970 and 1980 to 68% increase in the 1980 to 1991 period. Thirdly and more importantly, a declining trend in the yield per hectare emerged in the eighties despite a significant proportion i.e., 23% of incremental irrigated area in the eighties being diverted to this crop along vis-a-vis its share of hardly 2% in the state's gross cropped area. Indeed, the amount of water conventionally utilised for sugarcane cultivation being nearly two to three times that for the other crops, 23% share in irrigated area implies that the recent expansion in cultivation of sugarcane in the state must have appropriated nearly 50% to 70% share in the increased volume of irrigation water supply during the eighties, a decade of more unfavourable rainfall conditions.

Thus, on the one hand expanded cultivation of sugarcane deprived even the minimum benefits of life saving irrigation to many other crops particularly the foodgrains in a water-scarce state like Maharashtra and accentuated the degree of inter-crop and inter-farmer inequity in distribution of irrigation benefits while on the other it was accompanied by a significant fall in average yields realised in the state. Depression in yields certainly implies worsening in the state of efficiency in the use and management of the land and water resources locked up in sugarcane cultivation in the state. In addition, there is also a possibility of deterioration in the yield potential of the sugarcane varieties used by the farmers, under the very intensive use of all the new inputs through the 70's and 80's. Gravity of all these problems might have further increased with the higher frequency of rainfall deficient years during the eighties and consequent reduced reliability of the irrigation water supply in the state. That is why, it is necessary to subject the issue of declining sugarcane yields to a more careful scrutiny so as to perceive its implications for changes in policies in future.

No direct evidence representative of the entire state regarding changes in the on-farm resource use efficiency between the 70's and 80's is available in this context for assessment. Hence, in the discussion that follows we rely on a scrutiny of district level patterns of growth in sugarcane yield per hectare, trends in use of fertilisers and the views expressed by the agricultural scientists and irrigation experts on the state of sugarcane cultivation in Maharashtra.

Pune and Kolhapur are the two main divisions which lead in sugarcane production in Maharashtra followed by Aurangabad and Nasik divisions (Table 6.10). To begin with productivity per hectare was highest in Pune division (9850 kg. cane per hectare in 1967-70) and lowest (6884 kg. cane per hectare) in Aurangabad division. In all the regions yield per hectare moved up during the seventies but the rise was more steep in Kolhapur division (particularly in Sangli district, refer Table 6.11). However, the upward movement of the 1970's was replaced by downward trend in yields in the 80's in all the regions with an exception of Aurangabad division. In the latter region too significant positive trend after 1980-81, was registered only by the Aurangabad district (Table 6.11). Estimates of district level growth rates in sugarcane yields per hectare in the first and the second period are thus compatible with the trends in divisionwise average yield per hectare (Table 6.11). The combined share of Pune, Kolhapur and Nasik divisions in the aggregate sugarcane production moved down during the eighties with the emergence of negative growth rates in yield per hectare. Yet, their share continued to be as high as 75% in the triennium ending 1990-91 (Table 6.10). Obviously, it was this trend in the traditional sugarcane belt of Maharashtra which was mainly responsible for steep

deceleration in the state level yield growth during the 80's.

**Table 6.10**
**Divisionwise Average Productivity and Shares in Sugarcane Production**

| Divisions | Average Yield of Sugarcane (Kg/Hectare) (in gur) | | | | % Share in States Production for the period | | |
|---|---|---|---|---|---|---|---|
| | 1967-70 | 1975-80 | 1980-85 | 1986-91 | 1968-71 | 1978-81 | 1988-91 |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Nasik Division | 9618 | 10560 | 10248 | 9460 | 11.49 | 13.92 | 14.44 |
| Pune Division | 9850 | 10039 | 10118 | 9550 | 38.81 | 14.49 | 29.99 |
| Kolhapur Division | 8194 | 12456 | 11362 | 9660 | 34.75 | 35.81 | 31.42 |
| Aurangabad Division | 6884 | 6982 | 7882 | 8220 | 13.04 | 14.33 | 21.18 |

Note : Figures in parentheses represents production of sugarcane in Maharashtra in thousand tonnes.

**Table 6.11**
**Growth Rates in Sugarcane Yield Per Hectare for Leading Sugarcane Growing Districts in Maharashtra**

| Districts | 1967-80 | 1980-91 | $R^2$ |
|---|---|---|---|
| (1) | (2) | (3) | (4) |
| Nasik | 1.16* | -1.28* | 0.45 |
| Dhule | 2.11 | -1.25* | 0.63 |
| Jalgaon | 1.85* | -1.21* | 0.43 |
| Ahmednagar | 0.40 | -1.70@ | 0.70 |
| Pune | 4.80* | -2.97* | 0.44 |
| Solapur | 2.05* | -2.57* | 0.68 |
| Satara | 2.75* | -1.73* | 0.78 |
| Sangli | 4.45* | -1.05* | 0.65 |
| Kolhapur | 0.83* | -0.30* | 0.64 |
| Aurangabad and Jalna | 0.99* | 2.47* | 0.93 |
| Parbhani | 0.00 | 0.36 | 0.01 |
| Beed | 0.92 | 1.91 | 0.36 |
| Nanded | 1.33 | -1.15 | 0.19 |
| Osmanabad and Latur | 0.50 | -1.43 | 0.12 |

* : Significant at 10% level
@ : Coefficient of either time or slope dummy variable significant at 10% level.

It is pertinent to underscore in this context that the decline in average sugarcane yields has been accompanied by a steep rise in the use of fertilisers per hectare over and above the initial high level of use for this crop. According to the cost of cultivating data provided by the Central Agricultural Ministry use of fertilisers per hectare for sugarcane moved up from 226 kg. per hectare in 1972-73 to 479 kg. per hectare in 1980-81 and further to 501 kg. in 1990-91.[11] In contrast aggregate consumption of

fertilisers per hectare for all crops in the state was 11 kg., 21 kg., and 67 kg., in 1970-71, 1980-81 and 1990-91 respectively. That is, sugarcane crop must have appropriated significantly greater share in the incremental fertilisers consumption in the 70's and the 80's, in addition to claiming disproportionately high share in the state's expanded volume of irrigation water supply. Thus, the past trends in yield per hectare, expansion in area and fertiliser consumption per hectare for sugarcane provide sufficient evidence to conclude deterioration in resource use efficiency on the sugarcane farms particularly in the traditional sugarcane growing belt of Maharashtra.

It is true that Aurangabad district represents a unique exception to the general phenomenon of decline in yield growth as its growth rate in sugarcane yield per hectare accelerated 0.9% in period I to 2.47% in period II. But it must be recognised that unlike Pune and Kolhapur divisions, the regions with fairly long history of sugarcane cultivation, major expansion in sugarcane production in Aurangabad division occurred mainly during the 80's Moreover, use of fertilisers per hectare for all crops combined was very low i.e., at 7 kg. per hectare in Aurangabad division (as also in Aurangabad district) in 1970-71 from where it moved to just 16 kg. per hectare in 1980-81 and about 43 kg. in 1990-91 both for the division as a whole as also for Aurangabad district. The use of fertilisers has been, thus, not only lower than the overall state average in the respective years (i.e., 11 kg., 14., and 67 kg. per hectare) but well below the aggregate use per hectare in Kolhapur, Pune and Nasik divisions i.e., 128 kg., 60 kg., and 88 kg., per hectare in 1990-91. Indeed the inter-district range of fertiliser use for these three divisions was 51 kg. (for Solapur) to 259 kg. (for Kolhapur) in 1990-91. In contrast, the use of fertilisers had been about 40 kg., per hectare in all the districts of Aurangabad division with an exception of Nanded district. Hence, it is most likely that as the use of fertilisers accelerates further in Aurangabad region negative trend in yield growth may emerge there too unless there are reasons to believe that on-farm efficiency in use and management of resources is distinctly superior in Aurangabad division and particularly in Aurangabad district compared to many other sugarcane growing districts in Maharashtra.

Understanding the state of technological advances in the form of promising improvements in the sugarcane varieties and their diffusion is equally crucial in the context of declining sugarcane yields. The process of evolving new or improved varieties with higher yield potentials or increased resistance to pests on diseases is not only necessary to push production frontiers of the crop upwards and thereby promote growth in yields but it is also inevitable for maintaining the existing levels of yields. This holds

particularly for a crop like sugarcane which is cultivated under increasingly intensive use of irrigation and fertilisers.

At present, the sugarcane variety CO 740 is being used nearly on 85% area under sugarcane in the state.[12] This variety was developed at Coimbatore sugarcane breeding station in Tamil Nadu and released in 1956. The fact that the variety released in 1956 is still popular and being extensively used even in 1993 by the farmers in Maharashtra represents sufficient evidence to presume that no variety better than CO 740 in terms of average yield per hectare, tolerance towards moisture stress etc. and at the same time suitable to agro-climatic conditions in the sugarcane growth in regions of the state could be developed in Maharashtra either by the regional sugarcane research centres after 1956 or by the state agricultural universities responsible for varietal improvement research for sugarcane since their establishment in the early 1970's. It also implies that the administrators of the public sector agricultural research by and large neglected the technological research by and large neglected the technological research and/or its extension needed for this important cash crop of the state. Alternatively, it may be a reflection of complacency arising out of the most superior position that the state enjoyed initially in terms of maximum average yield per hectare of this crop. What is further deplorable in this respect is the absence of extension efforts to educate the farmers for improving on farm resource use efficiency in sugarcane cultivation since the sixties. Part of the blame in this context must also be shared by the state's flourishing cooperative sugarcane - processing sector which too has not paid adequate attention to this important area of research and extension.

It may be worthwhile to know the perception of the agricultural scientists or administrators of research about the present poor state of sugarcane economy in Maharashtra.

Vice-chancellor, Mahatma Phule Krishi Vidyapeeth, Rahuri, while reflecting on the problems in the growth of sugarcane production in Maharashtra in 1993, pointed at several reasons responsible for deterioration in the state of sugarcane cultivation in the state.[13] Some of the major reasons according to him are :

(i) Excessive and improper use of water on farms

(ii) Low use of organic and green manures

(iii) Imbalances in the use of chemicals fertilisers

(iv) Neglect of ratoon crop and its consequent low productivity

(v) Inadequate availability of good quality and disease free planting material resulting into the use of on-farm planting materials for years by the farmers.

(iv) Absence of proper training and extension programmes for farmers.

Thus, the aforesaid assessment strongly reinforces our inference of deterioration in the resource use efficiency on sugarcane farms in Maharashtra.

To sum up, sugarcane farmers in Maharashtra not only suffered from the poor performance of the state's varietal improvements programme but also from the neglect of research and/or extension needed for improving on-farm water and nutrient management. The state's co-operative sugarcane processing sector was expected to provide a lead in the organizational efforts in this context. The fact that the cooperative sector's role had been by and large ineffective also reflects poorly on the perception and the priorities of the relatively resourceful and progressive sugarcane growers in Maharashtra.

## Notes

1. Rao C.H.H. and Gulati Ashok, 'Indian Agriculture: Emerging Perspectives and Policy Issues', in Uma Rapila (Ed.) India's Economic Reforms, ACADEMIC FOUNDATION, Delhi, 1996.

2. Dev Mahendra 'Public Expenditure Review of Maharashtra Agriculture', Background paper prepared for the World Bank Agriculture Development Project, 1995 (Mimeo) page 60, Table 7.1

3.

| **Area (lakh hectares)** | 1970-71 | 1980-81 | 1990-91 |
|---|---|---|---|
| i) Gross irrigated area | 15.70 | 24.20 | 33.20 |
| ii) Area under sugarcane | 2.04 | 3.19 | 5.36 |
| iii) Share of sugarcane incremental irrigation | — | (13.5%) | (24%) |

4. Dev Mahindra, op.cit., 1995, page 94.

5. This observation has been consistent with the field level evidence reading forces behind changes in crop pattern, revealed by our Field Survey.

6. Average yield of wheat on unirrigated areas is much lower (554 kg. per hectare) vis-a-vis that under irrigated areas (1346 kg. per hectare) in Maharashtra (Source: CMIE, 'India's Agricultural Sector', September, 1995, page 20).

7. Average yield of maize on unirrigated area (i.e., 852 kg. per hectare) is far below that realised on irrigated area (1984 kgs. per hectare) in Maharashtra (Source: CMIE, 1995, Op. cit.)

8. (i) Oblitas Keith, 'Agricultural Technology Review' September 1990, Background Paper prepared for World Bank, 1991, INDIA, Country Economic Memorandum, 1995 (Mimeo).

(ii) Pray C.E., 'High Yielding Varieties And the Indian Seed Industry', Background paper prepared for World Bank 1991 INDIA, Country Economic Memorandum, 1995 (Memo).

9. SAWANT S.D., 'Foodgrains Output Growth In India: Emerging Constraints and Perspective for Technology Development Policies in Desai B.M. (ed.), 'Agricultural Development Paradigm for the Ninth Plan Under New Economic Environment, Oxford IBH Publishing Company Pvt. Ltd., 1997.

10. Exact of irrigation declined for maize from 49% in 1980-81 to 36% in 1990-91. Yields on irrigated and unirrigated areas were 1984 kgs., and 832 kgs., per hectare in 1990-91 in Maharashtra. Weighted average of irrigated and unirrigated yields, therefore work out to be 1396 kgs., and 1246 kgs., per hectare under the assumption of proportion of irrigation being 49% and 36% respectively. This indicates that other things remaining constant yield decline would be 11% if extent of irrigation falls from 49$ to 36%.

11. (i) Directorate of Economic and Statistics, Ministry of Agriculture, Government of India, 1991, Cost of Cultivation of Principal Crops in India.

(ii) Commission of Agricultural Costs And Prices, Ministry of Agriculture, Government of India, Reports of the Commission for Agricultural Costs and Prices on Price Policy for Crops Sown in 1994-95 Season.

12. Jadhav et.al. 'Improved Varieties of Sugarcane', 'Shree Sugi' Special issue on Sugarcane, July 1993, Pages 49-50.

13. Dorge S.K., 'Problems in and Remedies for Sugarcane Production Growth in Maharashtra' Shree Sugi, July 1993, pages 1-5.

## Annexure 6.1
## Impact of Rainfall, Irrigation and HYV Area on Yield Per Hectare of Cereals : Regression Analysis

We examined the role of rainfall variation, percentage of irrigation and HYV area on yield per hectare of cereals within the framework of regression exercise (refer Table 6.1.1). In this context, three alternative combination of explanatory variable were used in addition to the intercept and their slope dummy variables for the second period. In absence of separate statistics of fertiliser use for cereals, fertiliser variables was omitted from the analysis. Estimated relationship was long-linear and method of estimation, ordinary least squares.

**Table 6.1.1.**
**Results of State Level Regression Analysis (1967-91) with Cereal Productivity Per Hectare as Dependent Variable**

| Explanationary variable | Regression I | Regression II | Regression III |
|---|---|---|---|
| Irrigation | 0.882* | — | 1.621 |
| Annual Rainfall | 0.849* | 0.882* | 0.841* |
| HYV | — | 0.181* | -0.176 |
| Intercept Dummy | 6.774 | 2.571 | 9.729 |
| Slope dummy for Irrigation | -1.071 | — | -1.815 |
| Slope dummy for Annual Rainfall | -0.311 | -0.389 | -0.302 |
| Slope dummy for HYV | — | -0.172 | 0.172 |
| Constant | -1.614 | 1.847 | -4.531 |
| K. Statistics | 11.524 | 9.645 | 7.724 |
| Durbin Waston statistics | 1.93 | 1.84 | 2.08 |
| R-square | 0.76 | 0.73 | 0.77 |

* : Indicates statistical significance at 5% or lower percentage level.

All the three regressions indicate significant and consistently positive impact of rainfall variable on yield per hectare for period I with the corresponding elasticities being 0.85, 0.88 and 0.84. Rainfall elasticities obtained for the second period are lower in magnitude. Yet all of them (i.e., 0.54, 0.49 and 0.54) are positive and fairly stable across the three regression irrespective of inclusion or exclusion of other variables.

Irrigation variable too shows positive and highly significant impact on yield per hectare for period I as per regression I. But its significance gets reduced to 15% in the presence of HYV variable in regression III. Moreover, similar to rainfall variable coefficient of its slope dummy for the second period turns out to be negative though nonsignificant. But unlike the

rainfall variable its elasticity for the second period gets reduced to a negative value namely -0.19 in case of regressions I and III both, thus suggesting ineffective role of irrigation in promoting yield growth in the post 1980-81 period.

Regression II indicates positive and highly significant impact of HYV variable in period I on cereals productivity with its elasticity being only 0.18. But in presence of irrigation variable i.e., in regression III it turns out to be non-significant and negative too. Again elasticity estimate of HYV variable provided by regression II and III for the period II are very close to zero, namely 0.01 and -0.04 respectively.

Unstable magnitudes of both irrigation and HYV variables in different regressions is a reflection of high multicollinearity, zero-order correlation between the two being 0.952 vis-a-vis the value of multiple R for regression III being 0.88.

The regression exercise, thus, demonstrates clearly positive and significant impact of rainfall index on yield growth for cereals in period I and its reduced yet significant influence during the second period. Role of HYVs and irrigation, however, does not get established unambiguously. Nevertheless the evidence further indicates erosion in their influence on productivity growth after 1980-81.

## CHAPTER 7

## INSTABILITY IN CROP INTRODUCTION IN MAHARASHTRA: ANALYSIS OF SOURCES AND INTERTEMPORAL TRENDS

### 1. Introduction :

Another important issue related to the process of agricultural growth is the year to year instability in output growth for different crops and crop groups and the trends in the indices of instability over the period. A number of earlier research studies on Indian agriculture have analysed this aspect both at the state and the country level for the period before and after 1967-68. Majority of them report rise in output instability in the post-1967 period and its further aggravation since 1975 mainly in unirrigated regions and the regions where available of irrigation water too is crucially dependent on performance of monsoon.[1]

Analysis of output instability assumes special significance for a state like Maharashtra due to more than one reasons. Farming in Maharashtra is predominantly rainfed. Extent of cropped area benefiting from irrigation is not only very low at present (i.e., just 15 per cent) but the ultimate potential of irrigation too is unlikely to exceed 40 per cent of gross cropped area. Nearly 31 percent of geographical area (with its share in net sown area being 36 percent) receives low rainfall i.e., less than 750 m.m. Consequently, as many as 88 talukas out of a total number of 303 talukas in the state have been identified as drought prone.[2] Obviously, the productivity levels of the majority of crops are not only below the corresponding national averages but their output is subjected to a comparatively higher degree of instability. In fact, the level of instability in foodgrain production in Maharashtra during the period from 1970 to 1984-85 was found to be the highest among all the states in India.[3]

High level of instability in crop output affects adversely not only the income and investment in agriculture of the majority of farmers but also the incomes of agricultural labourers through short run volatility in agricultural employment and the real wages. It is pertinent to note in this context that the proportion of agricultural labourers in the state's total work face is fairly high and above the national average. Therefore, we intend to study the issue of instability in crop production in detail at the state and the district level for the early vs. latter phase of the GR period.

We preferred to measure instability or variability in production of a crop by computing standard deviation of annual percentage changes in production in the two periods separately. Further, in order to examine

whether the degree of output variability has significantly increased or declined over the entire GR period we fitted a semilog trend function to the values of 9-year moving period standard deviations, computed for the series of annual percentage changes in production. Analysis of sources of variability in crop output has also been attempted by computing sandard deviations of annual growth rates in area and yield per hectare and by examining the nature of correlated changes between the annual growth rates in area and yield component of output.

## 2. Sources of Output Instability in Agriculture :

Change in the degree of weather induced fluctuations in crop output in any period in a given region may be the result of either a change in the sensitivity of output to rainfall variations or in the pattern of weather variability itself or a combined result of both the changes. The former i.e., change in sensitivity of output to weather or rainfall may occur due to changes in technology and inputs used.[4] For examble, in a dry farming region advances in yield raising seed-based technology may lead to enhancement in the use of new inputs such as fertilisers in a normal and above-normal rainfall years and consequently higher rise in yields but to a much greater depression in yields in a below-normal rainfall year with the reduced use of new inputs. On the contrary, wide spread adoption of new crop varieties resistant to moisture stress or the use of more effective new pesticides may lead to reduction in crop output instability.

Sensitivity of output to rainfall may decline with the effective and wide spread implementation of land development and water conservation measures or significant improvement in the quality of agricultural infrastructure such as irrigation particularly in a low rainfall region due to improved on-farm water management. It may also decrease with the development and diffusion of moisture stress resistant varieties.

Alternatively, as mentioned above the pattern of rainfall may itself undergo a change leading to a change in crop output instability in a specified region. However, in reality such changes are likely to occur in the short or medium run but not in the long run so as to induce a sustained change in the degree of output variability.[5]

Between the two components of production area component is more stable than the yield component. The extent to which relative contribution of the two components to output growth undergoes a change, the degree of output instability too may change. Additionally, with the change in the covariance between the two components of output over time, level of variability in crop output may get altered. For example, extensive adoption

of the new seed fertiliser technology in the rainfed farming area may lead to increasingly sympathetic movements in area and yield thereby aggravating the output instability.

Besides, increased share of rabi season crops in the aggregate output may also lead to a fall in the overall output instability. This may be due to, one, less volatile changes in climatic factors during the rabi season vis-a-vis the kharif season and, two, higher percentage of irrigated area for rabi crops than for the kharif crops or both. In respect of Indian agriculture at least, the aggregate level of output instability for kharif foodgrains has been observed to be distinctly higher than that for rabi foodgrains.

Similarly, increased incidence of multiple cropping, i.e., rise in cropping intensity, is expected to have stabilising impact on the aggregate output of all crops due to a possibility of mutually offsetting changes in output of crops grown in different seasons. The latter is more likely to occur when multiple cropping leads to a higher degree of crop-diversification.

Again, a change in the output instability at the regional or aggregate level may be due to changes in the output shares over time of different sub-regions with markedly varying levels of instability. For example, increased shares in the state's output of districts with fairly low level of output instability would lead to a reduction in the overall index of instability at the state level. Similarly, a change in the output composition of all crops or a group of crops, in favour of crops with distinctly low/high instability levels may induce consequent decline/increase in the degree of instability in the aggregate output of the corresponding crop group.

In other words, analysis and interpretation of the state level changes in output variability calls for an examination of their relationship with the changes in one or more of the following variables or aspects between the two periods under study.

(i) Pattern of rainfall variations

(ii) Degree of sensitivity of output to rainfall variations.

(iii) Nature of new agricultural technology provided to the farmers, particularly w.r.t. its implications for stabilisation of output.

(iv) Relative contribution of area and yield components to output growth

(v) Nature of correlation between area and yield variations

(vi) Shares of different crops in the aggregate output

(vii) Changes in irrigation and cropping intensity

(viii) Shares of different districts/regions in the state's aggregate output.

In the section that follows we present the cropwise estimates of the index of instability at the state and the district level for the two period under study. Subsequently, we analyse the sources of and trends in output instability and examine the relationship between growth and instability over the crops and finally, search for an explanation for the changes in output instability at the state level with reference to some of the explanatory factors mentioned above.

### 3. State Level Output Instability for Major Crops and Crop Groups : 1967-80 :

Among the major crops and crop groups output instability (Table 7.1) was high for cotton (50.5) moderate for cereals (13.2) sugarcane (14.2) and foodgrains as a whole (12.5) but low for pulses (11.4) and oilseeds (9.3) in the period I. Again, between the kharif and the rabi foodgrains instability turned out to be higher for the latter i.e., rabi foodgrains (28.1) when compared to that for the former (10.6). Finally, at the aggregate level for all crops index of instability was very low at 10.0, significantly lower than that for the individual crops and crop groups except that of oilseeds.

Among the cereals rabi jowar had highest instability (44.7) followed by maize (38.0) and kharif jowar (32.2). All the other kharif cereals, as also wheat had much lower instability than rabi jowar. It is pertinent to note in this context that though rabi jowar enjoyed higher benefits of irrigation (11.3%) than the kharif jowar (2.5%) in 1980-81 (Table 7.2) degree of fluctuations was higher for the former. Same is true in the case of rice and wheat. The latter had nearly 50 per cent of area under irrigation in 1980-81, vis-a-vis 28% for rice. Yet the output variability remained marginally higher for wheat than for rice.

The explanation of the above mentioned behaviour of instability index across the cereal crops may lie in the fact aht the degree of uncertainty regarding the availability of water for crops is, in general, higher for rabi season than that for kharif season in the state. This is not only true for unirrigated crops but also for irrigated crops in rabi season as availability of the benefits of irrigation too in many part of the state is linked crucially to performance of the southwest monsoon in any given year. These

observations also explain why output instability is higher for gram (23.2) than that for kharif pulses including tur (13.6). They are also consistent with the moderate rather than low level of output variability for sugarcane, an entirely irrigated crop in Maharashtra.

**Table 7.1**
**Instability in Crop Production: Maharashtra**

| Crop/Crop group | | Weight in All Crop Production Index (Base: 1967-70) | Index of Output Instability (Standard deviation of annual percentage changes in output) | |
|---|---|---|---|---|
| | | | 1967-80 | 1980-93 |
| (1) | | (2) | (3) | (4) |
| Rice | | 11.52 | 23.0 | 24.4 |
| Jowar (kharif) | | N.A. | 32.2 | 33.8 |
| Jowar (Rabi) | | N.A. | 44.7 | 27.9 |
| Jowar (Total) | | 21.12 | 33.7 | 27.1 |
| Bajra | | 5.80 | 18.0 | 53.9 |
| Maize | | 0.24 | 38.0 | 37.3 |
| Ragi | | 1.19 | 20.4 | 9.2 |
| Wheat | | 4.81 | 26.3 | 28.3 |
| Other Cereals | | 0.27 | 9.2 | 26.3 |
| **Total Cereals** | | **45.05** | **13.2** | **14.8** |
| Gram | | 1.32 | 23.2 | 31.1 |
| Arhar | | 4.46 | 13.6 | 21.9 |
| Other Pulses | | 4.66 | 11.3 | 24.2 |
| **Total Pulses** | | **10.44** | **11.4** | **19.0** |
| **Total Foodgrain** | | **55.49** | **12.5** | **14.3** |
| **Foodgrains (Kharif)** | | **N.A.** | **10.6** | **16.3** |
| **Foodgrains (Rabi)** | | **N.A.** | **28.1** | **19.6** |
| Groundnut | | 9.25 | 12.9 | 30.5 |
| Sesamum | | 0.70 | 9.8 | 22.7 |
| Linseed | | 0.58 | 15.9 | 15.7 |
| Safflower | | N.A. | 25.6 | 24.1 |
| Nigerseed | | N.A. | 18.9 | 26.7 |
| Sunflower seed | | N.A. | N.A. | 77.2 |
| **Total Oilseeds** | | **10.54** | **9.3** | **20.8** |
| **Sugarcane** | | **21.64** | **14.2** | **16.3** |
| **Cotton** | | **8.43** | **50.5** | **39.1** |
| **All Crops** | GVO | — | 8.3 | 8.6 |
| | SDPA | — | 17.6 | 18.3 |
| | ACPI | — | 10.0 | 8.5 |

## Table 7.2
## Crop Output and Yield Instability Index and Extent of Irrigation: Maharashtra

| Crop | | Index Instability | | Extent of Irrigation | |
|---|---|---|---|---|---|
| | | 1967-80 | 1980-93 | 1980-81 | 1990-91 |
| Rice | Output | 23.0 | 24.4 | 27.8 | 25.7 |
| | Yield p.h. | 19.9 | 19.4 | | |
| Jowar (Kharif) | Output | 32.2 | 33.8 | 2.5 | 0.5 |
| | Yield p.h. | 31.0 | 30.9 | | |
| Jowar (Rabi) | Output | 44.7 | 27.9 | 11.3 | 14.7 |
| | Yield p.h. | 43.3 | 27.0 | | |
| Jowar (Total) | Output | 33.7 | 27.1 | 7.2 | 8.5 |
| | Yield p.h. | 30.5 | 25.1 | | |
| Bajra | Output | 18.0 | 53.9 | 3.5 | 2.5 |
| | Yield p.h. | 15.1 | 44.1 | | |
| Wheat | Output | 26.3 | 28.3 | 49.9 | 63.1 |
| | Yield p.h. | 20.4 | 16.6 | | |
| Gram | Output | 23.2 | 31.1 | 17.8 | 29.9 |
| | Yield p.h. | 19.2 | 20.9 | | |
| Groundnut | Output | 12.9 | 30.5 | 7.9 | 14.8 |
| | Yield p.h. | 11.6 | 17.7 | | |
| Cotton | Output | 50.5 | 39.1 | 4.7 | 2.5 |
| | Yield p.h. | 57.8 | 38.7 | | |

Note : Instability is measured by standard deviation of annual growth rates (i.e., percentage changes) in Output/Yield per hectare.

Groundnut, which has highest weight in total oilseeds production during the early period registered very moderate degree of variation in output i.e., 12.9. This alognwith mutually compensating output fluctuations among all the oilseeds must have resulted into low degree of output instability (9.3) in the early period for the oilseeds as a group.

To sum up, three observation clearly emerge from the inter-crop pattern of output instability index obtained for the early stage of the GR period. One, the amplitude of fluctuations in output was lower for pulses and oilseeds at the group level vis-a-vis the cereals. Two, in general, output variability was higher for rabi foodgrains vis-a-vis kharif foodgrains. Thirdly, the index of output instability for all crops as also for each of the major crop groups was fairly lower than the magnitude of index for individual crops.

As expected mutually off setting output fluctuations of individual crops in any given year must be responsible for a much lower degree of output instability for the group of crops combined or for all crop production index at the aggregate level.

Low degree of output instability for pulses and oilseeds vis-a-vis cereals in Maharashtra may be explained with reference to non-avai-labilty of the new seed-fertiliser technology to these crops coupled with almost total absence of use of fertilisers for them particularly during the early phase of the GR period. It is necessary to recall in this context that the use of high yielding varieties and the hybrid seeds for the major cereals spread fairly rapidly in the state in 1970's. Two other factors may additionally explain low output variability of pulses vis-a-vis cereals in Maharashtra. One, the pulses are more drought resistant than the cereal crops in general. Secondly, until 70's pulses were being grown mainly for subsistence consumption in many part of the state particularly as inter-crops and not the sole crops.

**4. Analysis of Output Instability : 1980-93 :**

The inter-crop pattern of output instability underwent a distinct change between the two periods (Table 7.1). Output variability for pulses increased remarkably during the second period (19.0) and exceeded the output variability for cereals (i.e., 14.8). Likewise output fluctuactions aggravated for oilseeds too reaching the level of 20.8. However, cereals experienced only marginal rise, i.e., from 13.2 to 14.8 in output instability. Similarly, moderate level of variability continued for surgarcane during the second period too (16.3). In constrast, index of output variability declined significantly for cotton from 50.5 in period I to 39.1 in part II. Yet, cotton continued to be one of the high-variability crops after 1980-81.

Another noticeable change occurred during the latter period. Large gap in output instability for kharif and rabi foodrains narrowed down considerably in the second period with the instability index for the former moving up from 10.6 to 16.3 and for the latter i.e., rabi foodgrains falling from 28.1 to 19.6. This must be due to large reduction in output instability of rabi jowar (i.e., from 44.7 to 27.8) but significant rise in fluctuations for bajra, a kharif cereal in the second period. The former can be attributed to a significant fall in the share of Aurangabad division in the output of rabi jowar during the 1980's vis-a-vis its increased share in the Pune and Kolhapur division in 1980's. This is because, Aurangabad division is characterised by high degree of output instability in crop sector while the latter two display moderate and low instability respectively in crop output (refer Table 7.6).

Steep rise in output instability for bajra must be the result of more swift expansion in the area under hybrid seeds for bajra in 1980's vis-a-vis 1970's,[6] and consequent increase in correlated change between the area and yield components of the bajra production (column 7, Table 7.3). Moderate rise in the degree of output fluctuations in sugarcane is, also consistent with the changes in shares in the state's sugarcane production of

different divisions from period I to period II. Rise in the share of Aurangabad division, a high instability division vis-a-vis the reduced shares of Kolhapur and Pune divisions characterised by very low and moderate levels of instability respectively in the crop sector, may be partly responsible for rise in output instability for sugarcane. This together with increased vulnerability of irrigation systems in 1980's to adverse rainfall variations might have aggravated output fluctuations for sugarcane.

Jump in output instability of pulses and oilseeds is the combined effect of increased adoption in new technology practices like use of improved varieties and fertilisers for these higherto neglected crops and pronounced shifts in crop pattern in favour of high output instability pulses or oilseeds during the second period. The former aggravated output instability for almost all pulses and oilseeds and the latter i.e., the crop pattern shifts more in favour of high instability crops reinforced the effect of the former. For example, increased weightage of sunflower seeds and groundnut with maximum (77.2) and next to maximum (30.5) instability index, pushed up aggregate output instability of oilseeds as a group (column (4) in Table 7.1).

An additional factor responsible for increase in output instability of pulses and oilseeds is significant locational shifts of these crops from low to moderate instability regions to high cutout instability regions in the eighties. For example, share of Amravati division, a high instability region, in the aggregate output of pulses rose sharply in 1980's vis-a-vis decline in the shares of low to moderate instability divisions like Kolhapur, Nasik and Pune (refer Annexure 7.1). Similarly, in respect of oilseeds too Aurangabad division increased its share remarkably at the cost of reduced shares of Kolhapur and Nasik divisions.

Finally, as the decline in variability of cotton was substantial and variability did not rise significantly for a major crop group like cereals and a major cash crop such as sugarcane, instability index for all crops registered marginal fall from 10.0 to 8.5, increased degree of fluctuations in the output of pulses and oilseeds, notwithstanding. Indeed, the marginal decline in the aggregate output instability, is consistent with the high weightage (75%) of cereals, sugarcane and cotton combined in the State's ACPI.

**5. Sources of Output Instability : 1967-80 :**

Output variability in a specified period can be decomposed into variability in area, variability in yield and third component representing contribution of correlated changes between the two. Hence, in order to identify the sources of output instability in the two period we examined the

contribution of (i) variance in area growth rates (ii) Variance in yield growth rates and the correlated changes, between area and yield growth rates for major crop groups and crops (refer section 3 in chapter 2 for methodological details).

**Table 7.3**
**Sources of Output Instability for Major Crops/Crop Groups: Maharashtra**

| | Percentage of Variation in annual output growth rates due to | | | | | |
|---|---|---|---|---|---|---|
| | Variance in Area growth rates | Variance in Yield growth rates | Correlated Changes between area and Yield growth rates | Variance in Area growth rates | Variance in Yield growth rates | Correlated Changes between area and Yield growth rates |
| | 1967-80 | | | 1980-93 | | |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Rice | 2.32 | 74.86 | 22.82 | 5.46 | 63.22 | 31.32 |
| Jowar (Kharif) | 5.00 | 92.68 | 2.32 | 0.95 | 83.58 | 15.47 |
| Jowar (Rabi) | 0.84 | 93.83 | 5.33 | 4.32 | 93.65 | 2.03 |
| Jowar (Total) | 1.14 | 81.94 | 16.95 | 1.86 | 85.78 | 12.36 |
| Bajra | 43.71 | 70.37 | -14.08 | 6.00 | 66.94 | 27.06 |
| Maize | 22.69 | 50.86 | 26.45 | 40.71 | 10.00 | 49.29 |
| Ragi | 5.31 | 105.97 | -11.28 | 7.99 | 95.70 | -3.69 |
| Wheat | 9.96 | 60.17 | 29.87 | 22.76 | 34.41 | 42.83 |
| Other Cereals | 17.97 | 81.39 | 0.64 | 55.54 | 64.98 | -20.52 |
| **Total Cereals** | **7.86** | **60.89** | **31.25** | **3.58** | **93.96** | **3.06** |
| Gram | 6.91 | 68.49 | 24.60 | 8.94 | 45.60 | 45.46 |
| Arhar | 31.23 | 129.89 | -61.12 | 5.21 | 97.28 | -2.49 |
| Other Pulses | 35.16 | 41.73 | 23.11 | 14.45 | 75.30 | 10.25 |
| **Total Pulses** | **19.24** | **58.24** | **22.52** | **11.35** | **69.15** | **19.50** |
| **Total Foodgrains** | **8.29** | **61.47** | **30.24** | **4.70** | **86.50** | **8.80** |
| **Foodgrains (Kharif)** | **25.00** | **72.09** | **2.91** | **8.31** | **79.13** | **12.56** |
| **Foodgrains (Rabi)** | **0.46** | **90.93** | **8.61** | **7.02** | **91.20** | **1.78** |
| Groundnut | 68.13 | 77.61 | -45.74 | 32.17 | 33.68 | 34.15 |
| Sesamum | 100.00 | 78.81 | -78.81 | 88.76 | 79.19 | -37.95 |
| Linseed | 26.60 | 34.21 | 39.19 | 69.62 | 43.38 | -13.50 |
| Safflowera | 6.45 | 117.93 | -24.38 | 14.26 | 93.47 | -7.73 |
| Niger seed | 10.08 | 130.61 | -40.69 | 43.45 | 56.11 | 0.44 |
| Sunflower seed | — | — | — | 34.89 | 25.00 | 40.11 |
| **Total Oilseed** | **56.65** | **59.94** | **-16.59** | **13.00** | **52.00** | **35.00** |
| **Sugarcane** | **87.73** | **30.17** | **-70.90** | **50.65** | **12.66** | **36.69** |
| **Cotton** | **29.44** | **131.00** | **-60.44** | **1.38** | **97.96** | **0.66** |

Analysis of decomposition of output variability clearly brings out dominant contribution of yield variability for all the crop groups and crops in period I and its increased importance further in period II with an exception of only sugarcane. Yield variability accounted for about 60% of variability in output growth rates for cereals, pulses and foodgrains as a whole and about 20 to 30% of output variability was explained by the correlated changes (Table 7.3). Contribution of area variability was relatively insignificant. However, in respect of rabi foodgrains contribution of yield variability to output variability exceeded 90 per cent. Similarly, the role of yield fluctuations was overwhelmingly dominant for the output variability in cotton (131% contribution). But its effect has been moderated somewhat by the inverse relationship between area and yield growth rates. The latter i.e., negatively correlated changes between area and yield helped to reduce output variability significantly. In absence of its dampening impact output instability could have been further higher for cotton in the early period.

Unlike cereals both area and yield variability had almost equivalent impact on output instability of oilseeds while area variability component remained dominant for sugarcane (88% contribution).

## 6. Sources of Output Instability : 1980-93 :

Relative importance of different sources underwent a distinct changes in the second period particularly for oilseeds, sugarcane and cotton. For the other groups importance of yield variability was reinforced and contribution of area variability reduced further.

Contribution of area variability continued to be dominant for sugarcane in the second period too, though it reduced from around 88% to 51%. Low importance of the contribution of yield variability for sugarcane is not surprising keeping in view that it is totally an irrigated crop in Maharashtra. Emergence of positively correlated changes between area and yield variability was the second most important factor after area variability in influencing output instability in the second period. It is consistent with the behaviour pattern of weather in the latter period. It may be recalled that the second period was found to be the peirod with higher frequency of below-normal rainfall years. Crucial dependence of the availability of irrigation water on the amount of rainfall received in the state, must have induced positive correlation between area and yield variability, replacing the inverse relationship obtained in the early period.[7]

Increased importance (35%) of correlated changes between area and yield growth rates in output instability of oilseeds as a group was due to their higher contribution to output instability of groundnut and sunflower

seeds (column 7, Table 7.3). The weightage of the latter two crops improved significantly in the group of oilseeds crops in the second period. Moreover, rise in importance of corrleated changes is also linked to emergence of summer groundnut and summer sunflower as important contributors to the aggregate oilseeds production. Both of them being irrigated crops have higher yields per hectare than the kharif season groundnut or sunflower. Changes in their area were obviously linked to the state of rainfall conditions in the second period. That was why the changes in the area and yield were positively correlated for groundnut and sunflower crops and consequently positive linkage between area under oilseeds and their overall productivity per hectare must have been strengthened in the latter part of GR period.

**7. Trends in Instability :**

The analysis of instability undertaken so far was based on the comparison of output instability and its sources between the two fixed periods for a specified crop. Though it revealed direction of change from period I to perio II it did not establish unambiguously the presence or absence of any trend in the entire period. Therefore, in order to examine this issue an alternative exercise was carried out. Under this exercise nine-year moving period standard deviations (SDs) of annual growth rates in area, production and yield per hectare of a crop/crop group were computed and a semilog trend function was fitted to them.

While interpreting the results of the above exercise we also verify whether the trends revealed are in conformity with the changes in the output instability index and in the sources of instability between the two periods as revealed by the earlier analysis and discussed in the preceding sections.

The alternative exercise confirmed significant rising trend in output instability for pulses, kharif foodgrains and oilseeds but the emergence of declining trend in output instability for cotton and absence of significant trend in the amplitude of output fluctuations for cereals, foodgrains as a group and sugarcane (part I Table 7.4).

Area variability registered significant declining trend for cotton (time coefficient : (-0.22), cereals (-0.03), kharif foodgrains (-0.01) and foodgrains as a whole (-0.01). In contrast, rabi foodgrains and pulses indicated positive trend in area variability.

## Table 7.4
## Trends in and Sources of Instability in Crop Production (1967-93) : Maharashtra

| Crop/Crop groups | I. Estimates of trend function for 9-year moving period standard deviations for | | | | | |
|---|---|---|---|---|---|---|
| | Area | | Production | | Yield | |
| | Time Coefficient | R Square | Time Coefficient | R Square | Time Coefficient | R Square |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Cereals | -0.03* | 0.75 | 0.02 | 0.17 | 0.04* | 0.31 |
| Pulses | 0.04* | 0.69 | 0.03* | 0.76 | 0.02* | 0.28 |
| Foodgrains | -0.01* | 0.25 | 0.02 | 0.21 | 0.04* | 0.30 |
| Foodgrains (Kharif) | -0.01* | 0.36 | 0.04* | 0.67 | 0.04* | 0.49 |
| Foodgrains (Rabi) | 0.04* | 0.27 | -0.03 | 0.08 | -0.02 | 0.02 |
| Oilseeds | -0.00 | 0.00 | 0.09* | 0.92 | 0.09* | 0.91 |
| Sugarcane | -0.01 | 0.18 | 0.01 | 0.13 | -0.05* | 0.43 |
| Cotton | -0.22* | 0.77 | -0.02 | 0.34 | -0.03* | 0.26 |

| | II. Percentage of variation in annual growth rates due to | | | | | |
|---|---|---|---|---|---|---|
| | Variability in area g.r. | Variability in yield g.r. | Correlated changes in area and yield g.r. | Variability in area g.r. | Variability in yield g.r. | Correlated changes in area and yield g.r. |
| | (Period : 1967-80) | | | (Period : 1980-93) | | |
| Cereals | 7.86 | 60.89 | 31.25 | 3.58 | 93.36 | 3.06 |
| Pulses | 19.24 | 58.24 | 22.52 | 11.35 | 69.15 | 19.50 |
| Foodgrains | 8.29 | 61.47 | 30.24 | 4.70 | 86.50 | 8.80 |
| Foodgrains (kharif) | 25.00 | 72.09 | 2.91 | 8.31 | 79.13 | 12.56 |
| Foodgrains (Rabi) | 0.46 | 90.03 | 9.51 | 7.02 | 91.20 | 1.78 |
| Oilseeds | 56.65 | 59.94 | -16.59 | 13.0 | 52.0 | 35.0 |
| Sugarcane | 87.77 | 30.17 | -17.40 | 50.65 | 12.66 | 36.69 |
| Cotton | 29.44 | 131.0 | -60.44 | 1.38 | 97.96 | 0.66 |

* : Significant at 5% level.

The former is compatible with the fact that in the second period which was characterised by greater frequency of rainfall deficient years cultivation of cereals particularly kharif jowar, rice and other minor cereals and also of cotton must have remained confined to the areas relatively better suited for

their cultivation. The low yielding marginal areas must have gone to crops like pulses depending upon the charater of weather, thus explaining higher area variability of pulses in the second period.

Rise in variability of area under rabi foodgrains must be linked to more erratic fluctuations in annual rainfall, particularly, the rabi season rainfall and in addition, to their destabilising impact on irrigation area under foodgrains.

Yield variability aggravated for all the three major crop groups namely, cereals, pulses and oilseeds with the exceptions of sugarcane and cotton (Table 7.4). More universal trend of rise in yield variability is a reflection of wider spread of new seed-fertiliser technology across the crops under rainfed conditions. Positive trend was much stronger for oilseeds (time coefficient is 0.09) followed by cereals (time coeff: 0.04) and pulses (time coeff: 0.02).

The trend mentioned above have been found to be consistent with the changes in the value and the relative importance of sources of output instability for the major crops. For example, with significant decline in area variability and rise in the degree of yield variability over the period (Part I Table 7.4), contribution of yield variability was almost total (i.e., 93%, column 6 in Table 7.3) in respect of cereals. However, significant but opposite trends in area and yield variability, of cereals were responsible for only marginal rise in their output instability index from period I to period II i.e., from 13.2 to 14.8 (Table 7.1).

In contrast, significant positive trends in areas and yield variability led to aggravation in output instability for pulses and thereby rise in the value of output instability index from the early period (11.4) to the latter (19.0).

Foodgrains as a combined category revealed the same pattern of trends and sources of instability as that of cereals, the latter being the dominant constitutent of the former i.e., foodgrains. But kharif and rabi goodgrains displayed contrasting pattern of trends in area, yield and output instability.

Both area and yield variability contributed almost equally to the low level of output instability of oilseeds in the early period (Part I Table 7.4) But with strong positive trend (time coefficient 0.09 with $R^2 = 0.91$) in their yield variability contribution of area variability reduced to insignificant level in period II (i.e., from 57% in period I to 13% in period II). Moreover, we believe that it was an extension of cultivation of oilseeds to all the three seasons namely kharif, rabi and summer which must have depressed aggregate output instability for all oilseeds combined than that for individual oilseeds, with mutually off setting changes in their output.

In respect of sugarcane as expected the contribution of yield variability to output variability was low (30%) in the initial period and it declined further to insignificant level of 12.7% with significant negative trend in yield variability over the period (time coefficient: -0.05). Instead, positively correlated changes between area and yield assumed importance in influencing output instability. This caused marginal rise in output instability for sugarcane i.e., (from 14.2 to 16.3).

Substantial and significant fall in area variability of cotton (time coefficient: -0.22) rendered its impact on output instability to a negligible level of 1% in the second period. Yield variability too declined significantly but at a comparatively lower rate (time coefficient: -0.03) over the entire period. But due to very high decline in the area variability, yield variability continued to be the major determinant of output variability for cotton in the second period.

**8. Instability in Crop Production: Disaggregate Level Analysis:**

Maharashtra State represents an extremely heterogeneous pattern of the agro-climatic and infrastructural development across the administrative divisions (henceforth divisions only) and even the districts within a division. Obviously, the inter-district variability in the degree of output fluctuations is expected to be high. This implies that ther sensitivity of instability in crop output at the state level to the spatial shifts of crops across the divisions must also be higher. Hence, for explaining the state level changes in output instability it would be imperative to know the levels of crop output instability for different districts and divisions and identify the high vs. low output instability districts/divisions among them.

Cursory glance at Table 7.5 reveals that inter-district disparity in the degree of instability in crop output is quite significant. Index was lowest for Kolhapur district in both the periods i.e., 8.15 and 5.09 respectively; but the highest for Amravati and Bhandara i.e., 38.63 and 82.14 in periods I and II respectively.

Between the two periods output instability changed differentially across the districts. It declined, in ten districts, remained by and large at the same level in six districts and increased in the remaining nine districts. That was why, for the state as a whole instability index did not change significantly.

## Table 7.5
## Districtwise Irrigation and Instability Index for Gross Value of Output

| District | Period I 1967-80 | Period II 1980-90 | % of gross irrigated area to gross sown area | |
|---|---|---|---|---|
| | | | 1980-81 | 1990-91 |
| Thane | 18.74 | 10.28 | 1.6 | 1.8 |
| Raigad | 17.37 | 12.67 | 5.0 | 5.6 |
| Ratnagiri | 10.18 | 9.45 | 4.8 | 7.4 |
| Nasik | 9.91 | 13.56 | 15.2 | 20.3 |
| Dhule | 11.18 | 21.10 | 12.6 | 13.4 |
| Jalgaon | 18.62 | 15.77 | 13.9 | 16.6 |
| Ahmednagar | 13.29 | 16.09 | 21.0 | 25.1 |
| Pune | 32.65 | 13.17 | 17.6 | 19.1 |
| Solapur | 13.45 | 21.99 | 14.6 | 18.9 |
| Satara | 9.34 | 19.21 | 20.3 | 23.8 |
| Sangli | 19.36 | 12.31 | 15.3 | 17.1 |
| Kolhapur | 8.15 | 5.09 | 15.6 | 20.6 |
| Aurangabad | 19.03 | 21.00 | 12.9 | 13.6 |
| Parbhani | 25.35 | 21.31 | 7.4 | 11.9 |
| Beed | 17.63 | 13.80 | 13.5 | 22.0 |
| Nanded | 36.15 | 56.29 | 6.1 | 11.0 |
| Osmanabad | 19.91 | 31.16 | 7.7 | 15.4 |
| Buldhana | 29.44 | 25.98 | 5.1 | 5.2 |
| Akola | 35.05 | 23.56 | 2.9 | 8.0 |
| Amravati | 28.63 | 15.47 | 5.7 | 6.6 |
| Yavatmal | 27.22 | 26.16 | 3.3 | 5.9 |
| Wardha | 30.72 | 29.92 | 5.3 | 6.0 |
| Nagpur | 19.67 | 20.49 | 9.4 | 12.4 |
| Bhandara | 24.94 | 82.14 | 37.2 | 38.9 |
| Chandrapur | 19.30 | 30.35 | 17.6 | 17.8 |
| **Maharashtra** | **8.3** | **8.6** | **12.0** | **15.2** |

It is pertinent to note that there is no consistent relationship between the degree of output fluctuations and extent of irrigation across the districts. For example index of instability was very high i.e., 25 and 82 in the early and the latter phase for Bhandara, a district with highest i.e., nearly 40 per cent of irrigation while it was much lower than Bhandara in many districts with negligible and low levels of irrigation like Thane, Raigad, Nagpur etc. Similarly, with about 11% of irrigated area instability index was 36 and 56 for Nanded district in the periods I and II respectively while the index was 25 and 21 for Parbhani district in the respective periods with equivalent level of irrigation. High degree of output instability in a district like Bhandara demonstrates not only the poor state of reliability of irrigation systems in the state but their vulnerability to rainfall variations.

Among the seven administrative divisions those in the Marathwada and

Vidarbha regions i.e., Aurangabad, Amravati and Nagpur had comparatively higher degree of output instability than the others either in period I or in II or both (Table 7.6). Konkan, Nasik and Pune divisions revealed moderate degree of instability (their index being in the range of about 9 to 15) while Kolhapur divisions was unique in maintaining lowest level (i.e., 8.0) of instability throughout the GR period.

**Table 7.6**
**Divisionwise Irrigation and Instability Index for Gross Value of Output**

| Period | Konkan Division | Nasik Division | Pune Division | Kolhapur Division | Aurangabad Division | Amravati Division | Nagpur Division |
|---|---|---|---|---|---|---|---|
| I : 1967-1980 | 14.7 | 10.7 | 13.6 | 8.0 | 21.0 | 32.0 | 13.7 |
| II : 1980-90 | 8.7 | 14.6 | 13.2 | 8.0 | 22.9 | 19.5 | 33.3 |
| | | | **Percentage of Irrigation** | | | | |
| 1980-1981 | 3.7 | 13.8 | 17.8 | 17.8 | 6 | 4.1 | 16.7 |
| 1990-1991 | 4.9 | 16.9 | 21.2 | 20.6 | 15.2 | 5.1 | 19.8 |

Again, the comparison between the instability index and the extent of irrigation across the divisions reveals absence of any consistent relationship between the two (Table 7.6). It must be noted in this context that the Aurangabad division which maintained high level of instability throughout the GR period was the recipient of the maximum benefits of irrigation during 1970's and 1980's.[8] Its share in the incremental irrigation between 1970-71 and 1990-91 was as high as 42%.

Thus, once again, the pattern of instability across the districts and divisions demonstrate that the irrigation development in Maharashtra has, by and large, failed to impart stability to the crop output. Yet, it is true that the degree of instability did not rise significantly either for all crop output or for cereals in the latter phase of the period, though the expansion of the seed-fertiliser technology continued unabeted across the cross and the districts after 1980-81. In fact, rise in fertiliser consumption was unprecedentally high in the state between 1980-81 and 1990-91. In the section that follows we, therefore, try to search an explanation for this phenomenon.

## 9. Why Absence of Significant Rise in Output Instability for All Crop and Cereals ?:

### Instability in Cereals Output :

It may be recalled that Aurangabad division, a region with high output instability (refer Table 7.6) registered maximum growth rate in cereal output

and was the leading division in the state in contributing to expanded cereal production in the early phase i.e. 31.5% (refer column (2) in Annexure 7.2). As against this its contribution declined to just 2% (Annexure 7.2) in the latter phase when its growth rate reduced to a negative value (Table 5.7 from chapter 5). The situation was exactly reverse in respect of Kolhapur, Pune and Nasik divisions which are characterised by low to moderate output instability. They increased their contribution from 38% in period I to 58% in period II. Among them Kolhapur a division with the lowest output instability recorded maximum growth rate in cereal output in period II and was followed by the Nasik and Pune divisions with the next to maximum growth rates. Thus, the major centres of cereals output growth, which were in the high instability region in period I shifted to low or moderate instability regions in period II. This must have prevented aggregation in the degree of instability in cereals output in the latter phase, continued adoption of seed-fertiliser technology, notwithstanding.

In addition, we examined change in sensitivity of cereals output to rainfall variations between the two periods, by regressing output of cereals on (i) time variable and (ii) annual rainfall index for cereals alongwith intercept and slope dummies for the second period. Estimates of the regression indicated strong positive and significant impact of rainfall on cereals output with elasticity of rainfall index being 1.17 for period I but decline in elasticity to 0.47 in period II as the coefficient of slope dummy for rainfall was negative (i.e., -0.70) though significant only at 12% level.[9] Thus, the results of regression confirm absence of any rise and indeed decline in sensitivity of cereals output to rainfall variations in the second period.

Thus, the above two factors together provide a reasonable justification for absence of significant increase in the instability index for cereals output. This conclusion of ours is also consistent with the results of one of the recent studies.[10]

**Instability In Output of All Crops:**

It may be recalled that at the aggregate level the index of output instability increased only marginally from 14.2 to 16.3 for sugarcane and declined significantly for cotton from 50.5 to 39.1 from the periods I to II respectively.

Absence of significant rise in the amplitude of output fluctuations for sugarcane, an entirely irrigated crop in Maharashtra is not surprising but decline in output instability index for a highly weather sensitivity and mainly rainfed crop like cotton needs an explanation. We believe that the latter

can be explained mainly with reference to the benefits of technological advances received by the cotton crop during the eighties. The most important among them are, one, expansion in the use of pesticides and the other promising varietal improvements for cotton. In Maharashtra, use of pesticides material shoot up from 0.06 lakh tonnes in 1980-81 to 4.3 lakh tonnes in 1990-91. Cotton must be the major beneficiary of this expansion. Secondly, many improved varieties and a number of early maturing hybrids moderately resistant to pests and tolerant to drought conditions were released since 1975 by the Cotton Research Centre of the State Agricultural University located at Akola.[11] A prominent private sector seed company namely Maharashtra Hybrid Seeds Company Ltd. (MAHYCO) has also played a very crucial role in evolving good quality hybrids and improved varieties suitable for agroclimatic conditions in Maharashtra.[12] Distinctly positive contribution of these developments in moderating the degree of yield and output instability for cotton in the recent years must be recognised.

In addition, two more factors might have helped to some extent at least in containing the aggregate level output instability in the crop sector of Maharashtra in the second period. They are one, marginal rise in contribution of area component to output growth and second, increased degree of crop diversification associated with it.

It may be recalled that with significant depression in aggregate productivity growth and simultaneous rise in growth rate of area in the second period relative contribution of area to output growth improved in the second period. The latter being more stable component of output growth, must have had moderating impact on output instability.

More importantly, increased contribution of area was mainly the result of faster ties in multiple cropping during the eighties vis-a-vis its very slow expansion in the early period (refer section 5 from chapter 3 for detailed discussion). In other words, output growth in the second period was characterised by simultaneous through very moderate improvement in cropping intensity and crop diversification. Mutually reinforcing impact of these two factors in controlling the rise in overall output instability cannot be ignored.

Lastly, we also examined the issue of change in sensitivity of all crop output to rainfall variations between the two phases of the entire period by estimating a regression awith gross value of output as dependent variable and time and rainfall index all crops as independent variables alongwith intercept and slope dummies for the second period. The results of regression indicated strong positive and highly significant impact of rainfall

on gross value of output for the period I with its regression coefficient being 0.77 and decline in its value to 0.39 for the period II. However, the latter was significant only at 20% level[13], suggesting weak evidence for decline in sensitivity of the aggregate output to rainfall variations. In any case, there was no evidence of rise in sensitivity of the aggregate output to the pattern of rainfall variations in the second period.

The preceding discussion leads to the following two major conclusions :

(i) With no significant rise in output instability index for the major crops like cereals and sugarcane together with significant fall in the degree of output fluctuations for cotton, all crop output instability did not register rise in the post-1980-81 period.

(ii) A possible upward push in output instability due to extensive diffusion of new technology across crops and regions, particularly in the form of sharp rise in use of fertilisers was almost neutralised by the dampening impact of pest or disease resistant variates/hybrids and large expansion in the use of pesticides.

## Notes

1. i) Rao, C.H.H., Ray S.K. and Subbarao K. (1988), 'Unstable Agriculture And Droughts', Chapter 4.

   ii) Mahendradev S. (1987), 'Growth and Instability in Indian Agriculture', Economic and Political Weekly, Vol. XXII, No. 39, September 26, 1987.

   iii) Mitra Ashok (1990), 'Agricultural Production In Maharashtra: Growth and Instability', Economic and Political Weekly, Vol. XXV, No. 52, December 29, 1990.

2. Dandekar, V.M. 'A Report of Fact Finding Committee on Regional Imbalance in Maharashtra', 1984.

3. Mahendradev S. (1995), 'Agricultural Policy Framework for Maharashtra: Issues And Options', Background Paper prepared for the World Bank's Maharashtra Agricultural Development Project, 1995, (Mimeographed), page 8.

4. Rao C.H.H. et. al. op. cit.

5. Rao C.H.H. et. al. op. cit.

6. Refer Table 6.7 in Chapter 6.

7. In the interviews of the farmers conducted under the Project's Field Survey they invariably pointed out adverse impact of reduced water availability as the major constraint on area and yield of sugarcane.

8. Refer Table 3.4 in Chapter 3.

9. Log (Cereal Output = 3.07 + 0.046 (Time) + 1.17 (Rainfall Index) + 3.79 (ID - 0.039 (SDT) -0.7 (SDR) where $R^2$ was 0.75 and two-tailed significance levels for the independent variables were 0.5%, 0.1%, 6%, 11.6% and 11.8% for Time, Rainfall index, Intercept Dummy (ID), Stope Dummy for Time (SDT), Slope Dummy for Rainfall for the second period respectively.

10. The study of Rao C.H.H. ('Agricultural Growth Rural Poverty and Environmental Degradation' 1994 page 23, Table 2.1) revealed that the index of instability for the output of coarse cereals at the all India level declined from 14.2 for the period 1967-78 to 13.1 for 1978-89 while the index increased between these two period for pulses and oilseeds.

11. Refer Annexure 7.4.1. and 7.4.2. from the Draft-Report of the present study for the list of hybrid and improved varieties of cotton released by Dr. Punjabrao Deshmukh Krishi Vidyapeeth, Akola, and MAHYCO respectively.

12. The share of private sector in total distribution of cotton seeds was 44% in 1987 and it exceeded 60% in 990-91.

13. Log (GVO) = 8.75 + 0.036 (Time + 0.77 (Rainfall Index) + 2.05 (ID) -0.017 (SDT -0.38 (SDR) where $R^2$ was 0.85 and two-tailed significance levels for the independent variables were 0.2%, 0.1%, 12%, 30%, 19.6% for Time, Rainfall index, Intercept Dummy (ID), Slope Dummy for Time (SDT), Slope Dummy for Rainfall (STDR) for the second period respectively.

## Annexure 7.1
## Divisionwise Shares in Production of Major Crops and Crop Groups: Maharashtra

| Division | Cereals | | | Pulses | | | Oilseeds | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1968-69 to 1970-71 | 1978-79 to 1980-81 | 1988-89 to 1990-91 | 1968-69 to 1970-71 | 1978-79 to 1980-81 | 1988-89 to 1990-91 | 1968-69 to 1970-71 | 1978-79 to 1980-81 | 1988-89 to 1990-91 |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Konkan Divn. | 12.69 | 9.75 | 9.95 | 1.34 | 0.85 | 1.18 | 0.31 | 0.29 | 0.69 |
| Nasik Divn. | 13.15 | 13.12 | 14.70 | 18.07 | 17.24 | 15.80 | 20.63 | 21.24 | 15.39 |
| Pune Divn. | 15.26 | 14.75 | 15.07 | 10.28 | 10.18 | 8.18 | 11.84 | 15.13 | 21.50 |
| Kolhapur Divn. | 10.05 | 10.66 | 11.98 | 7.17 | 7.57 | 5.23 | 25.03 | 22.66 | 16.70 |
| Aurangabad Divn. | 20.15 | 24.58 | 21.09 | 32.37 | 34.61 | 28.31 | 25.14 | 21.53 | 33.27 |
| Amravati Divn. | 12.18 | 13.50 | 14.29 | 17.23 | 19.17 | 29.19 | 10.96 | 10.82 | 8.21 |
| Nagpur Divn. | 16.52 | 13.76 | 12.89 | 13.54 | 10.39 | 12.10 | 6.09 | 8.10 | 4.24 |
| **Maharashtra** | **100.00** | **100.00** | **100.00** | **100.00** | **100.00** | **100.00** | **100.00** | **100.00** | **100.00** |

## Annexure 7.1 (Contd.)

| Division | Sugarcane | | | Cotton | | | All Crops: Gross Value | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1968-69 to 1970-71 | 1978-79 to 1980-81 | 1988-89 to 1990-91 | 1968-69 to 1970-71 | 1978-79 to 1980-81 | 1988-89 to 1990-91 | 1968-69 to 1970-71 | 1978-79 to 1980-81 | 1988-89 to 1990-91 |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Konkan Divn. | 0.02 | 0.13 | 0.03 | 0.00 | 0.00 | 0.00 | 5.78 | 5.02 | 4.42 |
| Nasik Divn. | 11.49 | 13.92 | 14.44 | 14.60 | 13.50 | 12.57 | 14.04 | 14.12 | 14.23 |
| Pune Divn. | 38.81 | 34.49 | 29.99 | 3.42 | 4.75 | 0.31 | 18.61 | 18.41 | 17.36 |
| Kolhapur Divn. | 34.75 | 35.81 | 31.42 | 1.22 | 1.29 | 0.25 | 16.69 | 17.18 | 16.17 |
| Aurangabad Divn. | 13.04 | 14.33 | 21.18 | 22.85 | 27.38 | 25.74 | 20.44 | 22.27 | 23.43 |
| Amravati Divn. | 1.27 | 1.01 | 2.43 | 44.97 | 41.75 | 46.24 | 13.43 | 13.13 | 14.85 |
| Nagpur Divn. | 0.46 | 0.29 | 0.53 | 9.91 | 11.34 | 14.91 | 10.99 | 9.88 | 9.53 |
| **Maharashtra** | **100.00** | **100.00** | **100.00** | **100.00** | **100.00** | **100.00** | **100.00** | **100.00** | **100.00** |

## Annexure 7.2
## Divisionwise Shares in Incremental Prodcution of Major Crops and Crop Groups: Maharashtra

| Divisions | % Share in the incremental production for | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cereals | | Pulses | | Oilseeds | | Sugarcane | | Cotton | | Gross Value | |
| | 1967-70 & 1978-80 | 1978-80 & 1988-90 | 1967-70 & 1978-80 | 1978-80 & 1988-90 | 1967-70 & 1978-80 | 1978-80 & 1988-90 | 1967-70 & 1978-80 | 1978-80 & 1988-90 | 1967-70 & 1978-80 | 1978-80 & 1988-90 | 1967-70 & 1978-80 | 1978-80 & 1988-90 |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) |
| Konkan Division | 5.14 | 11.06 | -1.13 | 1.66 | -1.83 | 0.95 | 0.00 | 0.20 | 0.00 | 0.00 | 3.31 | 2.97 |
| Nasik Division | 13.08 | 23.36 | 13.86 | 13.61 | 19.53 | 11.52 | 18.36 | 15.69 | 9.91 | 9.45 | 14.30 | 14.51 |
| Pune Division | 13.95 | 16.82 | 9.75 | 5.12 | 157.54 | 25.58 | 26.67 | 19.12 | 9.04 | -14.42 | 17.96 | 14.81 |
| Kolhapur Division | 11.31 | 17.85 | 9.16 | 1.69 | -146.87 | 12.88 | 37.72 | 20.84 | 1.49 | -3.33 | 18.31 | 13.67 |
| Aurangabad Division | 31.51 | 2.11 | 43.66 | 18.68 | -207.81 | 40.78 | 16.74 | 37.67 | 32.37 | 20.24 | 26.33 | 26.29 |
| Amravati Division | 15.58 | 18.56 | 27.02 | 44.47 | -18.49 | 6.53 | 0.54 | 5.83 | 31.19 | 61.16 | 12.45 | 19.05 |
| Nagpur Division | 9.44 | 8.24 | -2.34 | 14.75 | 97.91 | 1.77 | -0.03 | 1.06 | 16.00 | 26.78 | 7.34 | 8.70 |
| **Maharashtra** | **100.00** | **100.00** | **100.00** | **100.00** | **100.00** | **100.00** | **100.00** | **100.00** | **100.00** | **100.00** | **100.00** | **100.00** |

# CHAPTER 8

## OUTPUT GROWTH AND INPUT EXPANSION: INTER-DISTRICT DISPARITY

### 1. Introduction :

Agricultural economy of the state witnessed dramatic and contrasting changes in growth pattern across the crops and the districts in the two phases of the green revolution period. It would be worthwhile to examine inter-district pattern of contributions to these changes in the early phase versus the latter phase of the period under study. Hence, we analyse and compare contributions of various districts to the state level change in gross value of output of 26 major crops at constant prices during 1970's and 1980's.[1] For this purpose, incremental outputs (value/quantity) were computed for the two periods : (i) between the triennia ending (henceforth TE) 1970-71 and TE 1980-81, and (ii) TE 1980-81 and TE 1990-91.

Contributions to gross value of output are more influenced by changes in production of high value crops such as sugarcane, oilseeds etc. Therefore, we scrutinised the shares of different districts in the incremental quantities of outputs of cereals, pulses, oilseeds, cotton and sugarcane separately too (Annexure 8.1). It was expected to help us in identifying the crops which might have played a crucial role in enhancing gross incomes of the farmers in various districts in the two periods.

For assessing the degree of concentration in output growth districts were first arranged in descending order of their percentage contribution to the aggregate incremental value of output and then divided into four groups each group accounting for successive 25% or nearly 25% share in the total. Thus, Group I accounted for top 25% share, Groups II and III for the middle two 25% shares respectively and Group IV the bottom 25% share of the incremental value of output. They are referred as quartiles I, II, III and IV in the discussion.

Further, shares of the above mentioned four groups of districts in the state's gross cropped area and total male workforce in agriculture were computed for comparison with their shares in the incremental output. In addition, their shares in the incremental use of three other inputs namely, (i) irrigation (ii) fertilisers and (iii) area under high yielding varieties or hybrid seeds (henceforth to be referred as HYVs) were worked out to judge the concentration in input use across the groups.

Groupwise shares in the expanded output and inputs were compared mainly to examine whether the pattern of output growth was related to the

pattern of expansion in use of any one or more than one of the three inputs simultaneously.

## 2. Analysis of Incremental Output in 1970's and 1980's:

During the decade of 1970's the gross value of output at constant prices of all the 26 crops in the state increased by Rs. 1059 crores while the increase was Rs. 1403 crores in the 1980's (refer Annexure 8.1). Extent of growth in real output in the two decades was, however, differential across the major crops and crop groups. Rise in cereal output in 1970's was 34.7 lakh m. tonnes and declined to just 16.3 lakh m. tonnes in the next decade. Output increases were 8.75 lakh m.t. and 10.2 lakh m.t. for sugarcane, 0.56 lakh m. tonnes and 0,72 lakh mt. for cotton in the seventies and eighties respectively. Thus incremental outputs marginally increased in 1980's for both of them. In contrast to cereals, incremental output shoot up dramatically for pulses and oilseeds in the latter decade. It decreased from 1.95 lakh m.t. to 6.4 lakh m.t. for the former and from -0.13 lakh m.t. (i.e. from absolute decline) to 10.25 lakh m.t. for the latter, i.e, oilseeds, between the two consecutive decades.

In other words, cereals contributed dominantly to the real crop output growth in 1970's whereas pulses and oilseeds together played a leading role in the next decade. Both sugarcane and cotton continued their contribution with marginal improvement in their contribution to the real output growth during the 1980's over that in 1970's.

In terms of shares in incremental gross value of output, cereals dominated during the 70's with 65% share but their contribution declined to just 19% in the eighties (Table 8.1) combined contribution of pulses and oilseeds, as expected, moved up sharply from 6% in the seventies to 40 per cent in the next decade while contribution of sugarcane and cotton experienced marginal increase and decline respectively. Nevertheless, sugarcane being the high productivity and high value crop its share in the incremental gross value of output was fairly large at about 30% in both the decades.

**Table 8.1**
**Cropwise Contributions to Incremental Gross Value of Output**

| Period | Cereals | Pulses | Oilseeds | Sugarcane | Cotton | Others | All crops |
|---|---|---|---|---|---|---|---|
| TE 1970-71 & TE 1980-81 | 65 | 4 | 2 | 29 | 9 | -9 | 100 |
| TE 1980-81 & TE 1990-91 | 19 | 17 | 23 | 33 | 7 | 1 | 100 |

An examination of the shares of different districts in the incremental gross value of output in the two decades of 1970's and 1980's revealed considerable inter-district disparity (Table 8.2). In the former decade maximum contribution (i.e. 7.83%) was made by Aurangabad district while the minimum (i.e., 0.76%) was contributed by Bhandara district in Nagpur division. In general, districts belonging to Nasik, Kolhapur and Aurangabad divisions had higher contributions than those from the remaining three divisions. The latter three, namely, Amravati, Nagpur and Konkan divisions were at the lower end in the descending order.

Relative position of many districts changed significantly in the second decade though Aurangabad district retained its leading position by improving its contribution further to 9.55%. Shares of eleven districts declined while for the remaining 14, contribution improved.

All the districts from Amravati division and all but one from Nagpur and Nasik divisions increased their contribution further. In the other divisions larger number of districts experienced deterioration rather than improvement. Again, Konkan and Nagpur divisions remained at the bottom of the ladder in 1980's too, with very low levels of contributions of districts from the Konkan division i.e., ranging from 0.59% to 1.67% and the range being relatively higher for Nagpur division i.e., 1.69% to 2.62%.

It would be more useful and instructive to scrutinise the shares of groups of districts rather than of individual districts after arranging them in the descending order of their contributions and then compare the contributions of the groups with their shares in the total gross cropped area.

Shares of the first two quartiles in the gross cropped area i.e., 19.5% and 16.1% as also in the male work force i.e., 15.2% and 19.9% respectively were much lower than their shares of 25% each in the incremental value of output (Column 3, Table 8.3). Share of the third quartile, however, in the cropped area and work force had been fairly close to its share of 25% in the incremental output. As against this, shares of the last quartile in the area and the male work force namely 36.6% and 41.5% respectively were disproportionately higher than its share of 25% in the incremental value of output. This pattern of share across the quartiles remains more or less undisturbed in both the decades. Therefore, in the discussion that follows we refer to the last i.e., the forth group as the group of low growth or lagging districts while the first two as of comparatively high growth districts and the third of moderate growth districts.

## Table 8.2
## Districtwise Shares in Incremental Gross Value of Output

| Districts/Region | | % shares in incremental gross value of output between | | % share in gross cropped area for TE 1980-81 |
|---|---|---|---|---|
| | | TE 1970-71 and 1980-81 | TE 1980-81 and 1990-91 | |
| | (1) | (2) | (3) | (4) |
| 1) | Thane | 0.90 | 0.59 | 1.39 |
| 2) | Raigad | 0.95 | 0.71 | 1.08 |
| 3) | Ratnagiri (& Sindhudurg) | 1.46 | 1.67 | 1.84 |
| | **Konkan Div.** | **3.31** | **2.97** | **4.31** |
| 4) | Nasik | 5.75 | 3.84 | 4.96 |
| 5) | Dhule | 2.91 | 4.42 | 3.96 |
| 6) | Jalgaon | 5.64 | 6.25 | 4.62 |
| | **Nasik Div.** | **14.30** | **14.51** | **13.54** |
| 7) | Ahmednagar | 7.08 | 1.81 | 6.47 |
| 8) | Pune | 7.34 | 5.66 | 5.67 |
| 9) | Solapur | 3.54 | 7.34 | 6.23 |
| | **Pune Div.** | **17.96** | **14.81** | **18.37** |
| 10) | Satara | 4.63 | 6.39 | 3.31 |
| 11) | Sangli | 6.90 | 1.53 | 3.31 |
| 12) | Kolhapur | 6.78 | 5.75 | 2.22 |
| | **Kolhapur Div.** | **18.31** | **13.67** | **8.84** |
| 13) | Aurangabad (& Jania) | 7.83 | 9.55 | 6.82 |
| 14) | Parbhani | 5.50 | 4.87 | 5.75 |
| 15) | Beed | 3.52 | 4.03 | 4.24 |
| 16) | Nanded | 3.29 | 2.53 | 3.94 |
| 17) | Osmanabad (& Latur) | 6.19 | 5.31 | 6.31 |
| | **Aurangabad Div.** | **26.33** | **26.29** | **27.06** |
| 18) | Buldhana | 3.73 | 4.24 | 3.84 |
| 19) | Akola | 2.19 | 6.84 | 4.37 |
| 20) | Amravati | 2.98 | 4.50 | 3.82 |
| 21) | Yavatmal | 3.55 | 3.47 | 4.33 |
| | **Amravati Div.** | **12.45** | **19.05** | **16.36** |
| 22) | Wardha | 2.59 | 2.15 | 2.32 |
| 23) | Nagpur | 2.17 | 2.62 | 2.98 |
| 24) | Bhandara | 0.17 | 1.69 | 2.51 |
| 25) | Chandrapur (& Gadchiroli) | 1.82 | 2.24 | 3.70 |
| | **Nagpur Div.** | **7.34** | **8.70** | **11.51** |
| | **Maharashtra** | **100.00** | **100.00** | **100.00** |

Scrutiny of the share of different quartiles in the incremental output of major crops or crop groups reveals a few important observations. They are elaborated below.

The first two quartiles has higher than proportionate share in the incremental sugarcane output in 1970s (Column (10), in Table 8.3). This was more so for the second quartile, the share of which in the increased sugarcane output was double (i.e., 32%) its share in the cropped area (i.e., 16%). In contrast, the group of lagging districts i.e., those in the last quartile had lowest share in the incremental sugarcane output. The third group had medium but slightly less than proportionate share in increased sugarcane output. This pattern of inter-group shares for sugarcane gets further reinforced in the next decade of 1980's with rise in the shares of the first three quartiles but more so for the first two high growth quartiles and significant decline in the share the last quartile. To sum up, high growth quartiles were leading in sugarcane cultivation while the lagging group continued to have very low share in the incremental sugarcane production.

High growth districts though leading in sugarcane production in both the decades, had also almost equivalent (for quartile I) or more than proportionate (for quartile II) share in increased cereals and pulses production in 1970's and in cereals and oilseeds production in 1980's.

Lagging districts in quartile four were the cereal and cotton growing but mainly the cereals growing districts with maximum share in the incremental cereals output in both the decades.

The third quartile was the group of districts with proportionate share in the incremental cereal output, more than proportionate shares i.e., 39% and 44% respectively in the incremental pulses and cotton output and slightly less than proportionate share in the sugarcane output in 1970's. But for this group, incremental cereal output was almost totally replaced by oilseeds in 1980's with its share in the incremental oilseed output (i.e., 38%) being much higher than its share in gross cropped area (i.e., 28%). Indeed, the former was maximum among all the four groups during the eighties. However, its higher than proportionate shares in the increased pulses and cotton output continued in the latter decade too at almost the same level i.e., at around 40%.

## Table 8.3
## Shares of Districts In Gross Cropped Area Male Work Force And Incremental Output

| Percentage share in incremental output | No. of districts | % share in gross cropped area for TE 1970-71 or 1980-81 | % share in male work force for 1971 or 1981 | Average productivity TE 1970-71/ 1980-81 Rs./ha. | Percentage share in incremental output for | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Cereals | Pulses | Oilseeds | Cotton | Sugarcane |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| **Between the Triennia ending 1970-71 and 1980-81** | | | | | | | | | |
| Quarter I (upto 25) | 3 | 19.50 | 15.21 | 1171 | 16.83 | 20.53 | @ | 14.27 | 26.19 |
| Quarter II (25-50) | 4 | 16.14 | 19.89 | 1769 | 21.07 | 27.63 | @ | 10.43 | 32.41 |
| Quarter III (50-75) | 6 | 27.81 | 23.38 | 1104 | 27.61 | 38.53 | @ | 44.17 | 22.94 |
| Quarter IV (75-100) | 12 | 36.55 | 41.52 | 1155 | 34.49 | 13.31 | @ | 31.13 | 18.46 |
| All Groups (1058.95) | 25 | 100.00 | 100.00 | 1243 | 100.00 (34.73) | 100.00 (1.95) | 100.00 (-0.13) | 100.00 (0.56) | 100.00 (8.75) |
| **Between the Triennia ending 1980-81 and 1990-91** | | | | | | | | | |
| Quarter I (upto 25) | 3 | 17.42 | 12.53 | 1326 | 23.38 | 23.18 | 20.69 | 25.05 | 30.32 |
| Quarter II (25-50) | 4 | 15.83 | 17.84 | 2472 | 34.00 | 7.38 | 22.22 | 1.22 | 35.94 |
| Quarter III (50-75) | 6 | 27.92 | 24.83 | 1458 | 3.60 | 39.73 | 38.04 | 39.16 | 23.25 |
| Quarter IV (75-100) | 12 | 38.83 | 44.80 | 1837 | 39.02 | 29.71 | 19.05 | 34.57 | 10.49 |
| All Crops (1402.66) | 25 | 100.00 | 100.00 | 1743 | 100.00 (16.31) | 100.00 (6.43) | 100.00 (10.25) | 100.00 (0.72) | 100.00 (10.21) |

@ : Figures have not been given as the total incremental output is negative.

Note : i) Figures in parentheses under column (i) for the category of 'All Groups' represent value of total incremental output in Rs. crores.

ii) Figures in parentheses under column (6-10) represent quantity of total incremental output in lakhs tonnes.

### 3. Concentration In Output Growth :

The distribution of districts across the quartiles remained unaltered for both the decades. Their numbers were 3, 4, 6 and 12 respectively in the top, the middle two and the lowest quartile. Thus, the distribution by itself does not indicate any change in the level of concentration of output growth between the two decades. But the two high growth quartiles, accounting for 50 per cent rise in the incremental value of output had 36% and 35% shares in the state's cropped area and male work force in 1970-71 (Columns (3) and (4) in Table 8.3). These shares further declined to 32% and 30% in the second decade of 1980's. In contrast, the last quartile which had 37% and 42% share in the aggregate cropped area and male work force in 1970-71, accounted for 39% and 45% shares in 1980-81 as against its share of 25% in the incremental output. The resulting reinforcement of the superior position of the first two quartiles vis-a-vis worsening of the position of the last quartile implies accentuation in inequality in per hectare and per worker income growth during eighties.

### 4. Inter-decadal Movement of Districts :

Though the frequency distribution of districts remained unaltered for both the decades there had been considerable downward and upward movements of districts across the quartiles from 1970's and 1980's. In all 12 districts maintained their relative position by continuing in the same quartile in both the decades while seven moved up and six moved down (refer Table 8.4).

It is pertinent to note that all the seven districts belonging to Nagpur and Konkan divisions continued to be in the forth i.e., the lagging growth quartile in both the decades. Apart from these seven, Nanded was the only district from Aurangabad which was in the forth quartile both in 1970's and in 1980's. Continuation of these eight districts at the lower end of the growth ladder during the eighties i.e., the decade of decelerated growth has serious implication for their relative growth performance in the entire period. Certainly, the disparity between them as a group and the other districts particularly those with comparatively better and sustained growth performance must have further widened during the eighties in terms of per hectare and per worker income growth.[2]

At the other extreme was the Amravati division in which case three districts out of four either improved their position (namely Akola and Amravati) of maintained it (Buldhana district). Amravati division was followed by Nasik division where two districts (Jalgaon and Dhule) improved their position. In each of the Aurangabad and Kolhapur divisions, only one

district out of four and three respectively experienced deterioration. Deterioration was however wortst in Pune division with two districts out of three, namely Pune and Ahmednagar, moving down to the lower quartiles from the top one. Thus, there was considerable reshuffling in the relative positions of districts, with seven improving their position considerably and the remaining six experiencing erosion. The following important conclusions emerge from the inter-decadal movements of districts:

**Table 8.4**
**Gross Classification of Districts by the Quarters of Shares in Incremental Output for 1970-80 and 1980-90**

| Groups for share in incremental output between triennia ending 1970-71 and 1980-81 | Groups for share in incremental output between triennia ending 1980-81 and 1990-91 | | | | |
|---|---|---|---|---|---|
| | Quarter-I | Quarter-II | Quarter-III | Quarter-IV | Total |
| Quarter-I | Aurangabad(ARD)<br>1 | Pune (PD)<br>1 | | Ahmednagar (PD)<br>1 | 3 |
| Quarter-II | | Kolhapur (KLD)<br>1 | Osmanabad (ARD)<br>1 | Sangli (KLD)<br>Nasik (NSD)<br>2 | 4 |
| Quarter-III | Solapur (PD)<br>1 | Jalgaon (NSD)<br>Satara (KLD<br>2 | Parbhani (ARD)<br>Buldhana (AMD)<br>2 | Yavatmal (AMD)<br>1 | 6 |
| Quarter-IV | Akola (AMD)<br>1 | | Beed (ARD)<br>Amravati (AMD)<br>Dhule (NDS)<br>3 | Nanded (ARD)<br>Wardha (NCD)<br>Nagpur (NGD)<br>Chandrapur<br>Ratnagiri (KND)<br>Raigad (KND)<br>Thane (KND)<br>Bhandara (NGD)<br>8 | 12 |
| Total | 3 | 4 | 6 | 12 | 25 |

Note : KND: Konkan Division, NSD: Nasik Division, PD: Pune Division, KLD: Kolhapur Division, ARD: Aurangabad Division, AMD: Amravati Division, NCD: Nagpur Division.

(i) Centres of high and moderate growth did not remain constant over the two decades though there were a few exceptions like Aurangabad district which continued its top position in both the decades. In contrast, districts from the low growth category did not improve their positions significantly vis-a-vis the other districts and remained at the lower end.

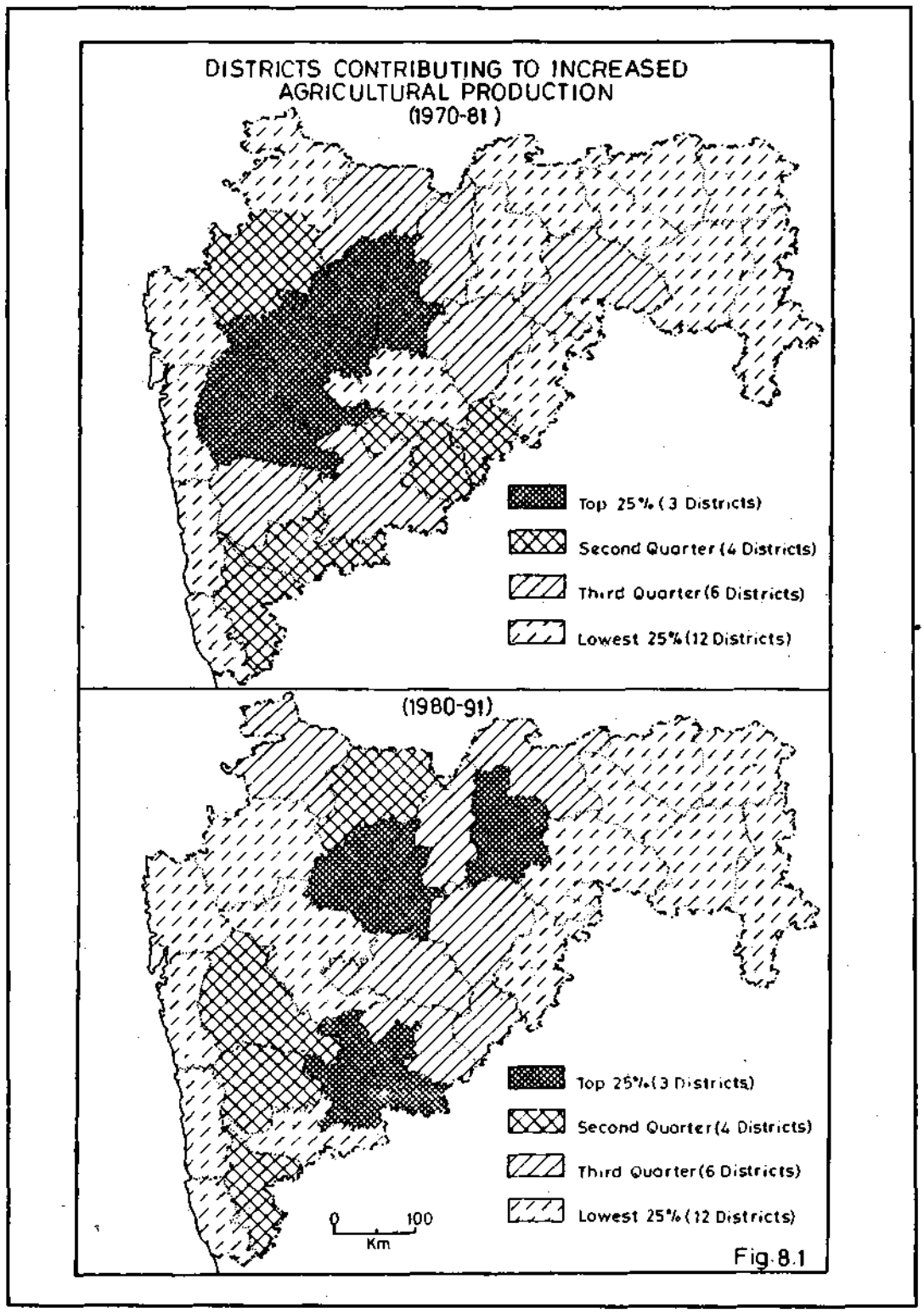

DISTRICTS CONTRIBUTING TO INCREASED AGRICULTURAL PRODUCTION
(1970-81)
Top 25% (3 Districts)
Second Quarter (4 Districts)
Third Quarter (6 Districts)
Lowest 25% (12 Districts)
(1980-91)
Top 25% (3 Districts)
Second Quarter (4 Districts)
Third Quarter (6 Districts)
Lowest 25% (12 Districts)
0
100
Km

Fig.8.1

(ii) Among all the divisions Konkan division continued to be at the bottom of the growth ladder with neither improvement nor significant deceleration in growth. Nagpur division too maintained its growth momentum through 1970's and 1980's at the low level but remained above Konkan division in terms of growth performance in both the decades.

At the other end, was Amravati division which not only sustained its growth performance through both the decades but improved it further in the latter. Its achievement was unique in that sense. Worst deceleration in income growth was registered by the districts in Pune division. Remaining three divisions, namely, Aurangabad, Kolhapur and Nasik had mixed performance, though among them Aurangabad was above the remaining two.

Among all the districts Aurangabad continued to be the leading district in contributing to the incremental income growth in the state's crop sector, with sustained growth performance throughout the green revolution period. Again, among all the districts Akola represents a unique case of the highest improvement in growth performance in 1980's, the decade of relatively unfavourable weather for the state. Solapur's achievement was next to Akola in enhancing its contribution to growth. Finally, Ahmednagar district represents the other extreme with its downward movement from the quartile I to quartile IV between the two decades. Sangli and Nasik districts followed Ahmednagar in this process of deterioration by moving to quartile IV in 1980's from the quartile II in 1970's.

**5. Inequality In the Input Use And Output Growth:**

Concentration in output growth across the districts may be related to concentration in input growth. In order to examine whether such a link exists we compared shares of different groups in gross cropped area with their shares in the incremental irrigation, fertilisers and area covered by HYV seeds (Table 8.5). The scrutiny reveals following observations :-

For none of the three inputs group-wise shares in three inputs were close to area shares, indicating, inequality in sharing the incremental inputs among the groups for both the decades.

Secondly, and most importantly different inputs were concentrated in different groups and no group indicated concentrated use of all the three inputs simultaneously. Even the top two groups of high growth districts were no exception to this observation. For example, benefits of incremental irrigation in 1970s were concentrated in group I with its share of 31% vis-

a-vis its share in gross cropped area of 19% only. Incremental fertiliser consumption was concentrated in group II, its share being 28% against a share in gross cropped area of 16%. The last group of low growth districts, surprisingly has disproportionality high share in expanded HYV area.

In 1980's too, the situation was no different. The third group of moderate growth districts had disproportionately high benefits of increased irrigation (i.e., 41% vis-a-vis its area share of 28%). Concentration of fertiliser use was in the second group i.e., 28% vs. its area share of 16%, followed by the share of the forth group (40%) which was almost equivalent to its share in area i.e., 39%.

Again unlike the 1970's, in 1980's it was the first group of high growth districts which has higher than proportionate share in increased HYV area i.e., 23% vis-a-vis its area share of 17%. Indeed, it is surprising that the share of this group in the incremental irrigation and fertilisers (namely 14% for each of them) are below its share in area (i.e., 17%).

To sum up, there was no concentration of all the three incremental inputs or even two of them simultaneously in any of the four groups either in 1970s or in 1980s.

**Table 8.5**
**Percentage Share of Districts in Incremental Inputs**

| Groups for share in incremental output between triennia ending 1970-71 and 1980-81 or 1980-81 | Incremental Irrigated area | | Incremental fertiliser consumption | | Incremental HYV area | | Gross cropped area | |
|---|---|---|---|---|---|---|---|---|
| | TE ending 1970-71 and 1980-81 | TE ending 1980-81 and 1990-91 | 1970-71 and 1980-81 | 1980-81 and 1990-91 | 1970-71 and 1980-81 | 1980-81 and 1990-91 | 1970-71 and 1980-81 | 1980-81 and 1990-91 |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Quarter-I | 31 | 14 | 16 | 14 | 8 | 23 | 19 (3) | 17 (4) |
| Quarter-II | 19 | 17 | 28 | 27 | 18 | 16 | 16 (4) | 16 (4) |
| Quarter-III | 22 | 41 | 30 | 19 | 27 | 21 | 28 (6) | 28 (6) |
| Quarter-IV | 28 | 28 | 26 | 40 | 48 | 40 | 37 (12) | 39 (12) |
| All Groups | 100 | 100 | 100 | 100 | — | 100 | 100 | 100 |

Note : Figures in parentheses in Columns (8) and (9) represent total number of districts falling in the respective quarters.

The third observation that emerges from the comparison between the two decades for a specified input is that no group continues to have concentration of the same input in the entire period.[3] The only exception to this statement is of concentration of fertilisers in group II in both 1970s and 1980s. It may be recalled in this context that the second group has been observed to have maximum share, i.e., more than double its share in cropped area, in the incremental sugarcane production in both the decades and thus is a group of districts leading in sugarcane cultivation.

Absence of simultaneous concentration of more than one inputs for any groups suggests that the three inputs have not been used synergistically in the State's crop sector.[4] This was not so only for the early stage of the green revolution but also holds for the latter period. In other words, farmers might have used HYV seeds without the other two inputs or with their low levels of use, wherever HYVs have been found to yield more than the existing varieties, even in absence of the other two inputs. Similarly, they might have used fertilisers with or without the other two inputs namely irrigation and HYVs if the response to fertilisers under the local agroclimatic conditions had been found to be promising.[5] Thus, high growth has occurred with or without the concentration of irrigation or HYVs or without even the concentrated use of fertilisers (as in case of group I in the 80's), moderate growth could be realised with less than proportionate share in fertilisers (as for group III in 1980s) and low growth has also resulted despite the share in inputs like fertilisers and HYVs being almost proportionate to area (e.g. group IV in the second decade). This implies that there may be significant inter-group differences in productivity of inputs arising out of either differences in crop pattern or differential stages of technology adoption for the same crops or varying levels of efficiency in use of inputs across the groups or due to a combined impact of more than one of them.

What is equally important to note in this context is that in addition to the above mentioned inter-group differences, there are significant intra-group differences among the districts with respect to production environment in which growth has taken place. this holds particularly for the upper three groups registering high and moderate growth. Characteristics of the three districts falling in quartile I for the 1980's, listed in Table 8.6 illustrate our point. The districts are Aurangabad, Solapur and Akola which hold first three ranks in the descending order in terms of their share in gross incremental value of output.

Finally, we reiterate a few major conclusions emerging from the preceding analysis and indicate their implications.

One, there is no evidence of raise in over-all inter-district disparity in output growth over the two decades. However, this in no way represents a reason for complacency as there has been a deterioration in the relative positions of the districts belonging to the Konkan and Nagpur divisions which continued at the lower end of the growth ladder in both the decades. Disparity between these lagging districts and the other districts with comparatively better and sustained growth performance must have widened in terms of per hectare and per worker income growth. The situation therefore implies continued neglect in the sate's agricultural policies and programmes, of the major constraints holding the growth momentum in these two relatively backward regions of the state.

**Table 8.6**

| District | Soil Index | Average normal rainfall (mm) | % of irrigation (90-91) | Cropping intensity TE 90-91 | % of area under Sugarcane | Road Length per 1000 sq. km. 90-91 | Railway route length 1987 (in kms) |
|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Aurangabad | 54.4 | 726 | 13.6 | 122 | 2 | 44 | 173 |
| Solapur | 57.6 | 584 | 18.9 | 107 | 3 | 61 | 448 |
| Akola | 72.7 | 847 | 3.0 | 114 | Neg. | 37 | 355 |

Secondly, inter district disparity regarding benefits of irrigation, fertiliser consumption and use of HYV seeds decreased particularly during the eighties. However, the decline was found to be significant only in respect of HYVs and not for the former two. Hence, efforts need to be concentrated in future to extend irrigation benefits and improve water management and fertilization practices in the lagging areas on a priority basis.

Lastly, the preceding analysis also demonstrates absence of distinctly identifiable patterns of input use across the better performing groups of the districts either for 70's and 80's even for a specified group across the two decades. In other words, the analysis does not highlight unambiguously the role of technology variables in influencing the past agricultural growth. Hence it may be worthwhile to explore impact of various technology variables in the presence of a few important non-technology variables on output growth in an alternative framework of analysis. The next chapter represents an attempt towards this direction.

## Notes

1. Refer Annexure-3 for crops covered and prices used in computing gross value of output.

2. Combined share of the eight lagging districts in the aggregate gross cropped area was 20% in TE 1980-81 and in state's labour force in agriculture was nearly 26% both in 1981 and 1991 (population census 1981 & 1991). As against this their share in the aggregate incremental gross value of output during the decades of 1970's and 1980's continued to be around 14% (based on Table 8.2).

3. This is also indicated by reduction in inter-district coefficient of variation in the extent of irrigation, area under HYVs and fertiliser use per hectare from 1970-71 to 1990-91 though at differential rates.

| | Coefficient of variation for | | |
|---|---|---|---|
| Year | % of irrigation | Fertiliser use per hectare | % of area under HYVs |
| 1970-71 | 78.2 | 54.4 | 113.9 |
| 1980-81 | 63.9 | 84.5 | 39.1 |
| 1990-91 | 59.2 | 66.7 | 21.5 |

4. For more convincing demonstration of this point refer Parikh K.S., 'HYV Fertilisers: synergy or Substitution', Economic And Political Weekly, March 25, 1978, Review of Agriculture.

5. This is not to deny that there might be other factors like inadequate availability of organic manures, convenience with which chemical fertilisers can be used on farms etc., which too must have played a positive role in promoting rapid use of fertilisers under unirrigated conditions particularly in the latter period.

## Annexure 8.1
## District-wise Shares in Average Incremental Products

| District | Cereals | | Pulses | | Sugarcane | |
|---|---|---|---|---|---|---|
| | I & II | II & III | I & II | II & III | I & II | II & III |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Thane | 1.29 | 1.93 | –0.19 | 0.93 | 0.09 | –0.10 |
| 2. Raigad | 1.40 | 2.77 | –0.22 | 0.51 | 0.00 | 0.00 |
| 3. Ratnagiri (incl. Sindhudurg) | 2.45 | 6.36 | –0.72 | 0.22 | –0.09 | –0.10 |
| 4. Nasik | 3.63 | 5.11 | 6.08 | 1.08 | 9.21 | 9.67 |
| 5. Dhule | 3.23 | 6.94 | 2.66 | 7.76 | 4.75 | 2.19 |
| 6. Jalgaon | 6.22 | 11.31 | 5.12 | 4.77 | 4.40 | 3.83 |
| 7. Ahmednagar | 3.99 | 6.09 | 1.11 | 2.14 | 11.87 | –4.42 |
| 8. Pune | 6.50 | 8.38 | 5.09 | 2.37 | 7.65 | 9.42 |
| 9. Solapur | 3.46 | 2.35 | 3.55 | 0.61 | 7.15 | 14.12 |
| 10. Satara | 3.43 | 8.92 | 3.91 | 0.20 | 9.94 | 12.01 |
| 11. Sangli | 3.17 | 5.54 | 1.90 | 1.45 | 16.89 | –1.85 |
| 12. Kolhapur | 4.71 | 5.39 | 3.35 | 0.04 | 10.89 | 10.68 |
| 13. Aurangabad (incl. Jalna) | 6.34 | 9.51 | 14.33 | 7.13 | 6.67 | 14.91 |
| 14. Parbhani | 5.98 | –0.58 | 7.74 | 2.15 | 0.86 | 3.91 |
| 15. Beed | 4.82 | –1.60 | 3.31 | 3.23 | 2.64 | 8.18 |
| 16. Nanded | 4.81 | –1.08 | 1.98 | 1.16 | 0.31 | 3.55 |
| 17. Osmanabad (incl. Latur) | 9.56 | –4.14 | 16.30 | 5.01 | 6.24 | 7.12 |
| 18. Buldhana | 5.01 | 1.51 | 12.90 | 9.81 | –0.24 | 1.32 |
| 19. Akola | 2.25 | 11.52 | 4.95 | 15.44 | –0.12 | 1.29 |
| 20. Amravati | 4.81 | 1.47 | 3.86 | 11.77 | 0.07 | 0.53 |
| 21. Yavatmal | 3.51 | 4.06 | 5.31 | 7.45 | 0.83 | 2.69 |
| 22. Wardha | 2.10 | –01.11 | 2.34 | 3.36 | 0.05 | 0.61 |
| 23. Nagpur | 3.03 | 0.75 | 2.44 | 4.74 | 0.13 | 0.15 |
| 24. Bhandara | 1.50 | 5.77 | –4.54 | 1.74 | –0.08 | 0.32 |
| 25. Chandrapur (incl. Gadchiroli | 2.81 | 2.83 | –2.58 | 4.91 | –0.10 | –0.02 |
| **Total** | **100.00** | **100.00** | **100.00** | **100.00** | **100.00** | **100.00** |
| **Absolute value (quantity in '00MT and value in Rs. million)** | **(34743.00)** | **(16305.00)** | **(1951.33)** | **(6425.33)** | **(8748.00)** | **(10212.58)** |

## Annexure 8.1 (Contd.)

| District | Cotton | | Oilseeds | | All Crops Gross Value of Output (at 1980-81 prices) | | | |
|---|---|---|---|---|---|---|---|---|
| | I & II | II & III | I & II | II & III | I & II | Rank | II & III | Rank |
| (1) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) |
| 1. Thane | 0.00 | 0.00 | -1.56 | 0.12 | 0.90 | 24.00 | 0.59 | 25.00 |
| 2. Raigad | 0.00 | 0.00 | 0.00 | 0.05 | 0.95 | 23.00 | 0.71 | 24.00 |
| 3. Ratnagiri (incl. Sindhudurg) | 0.00 | 0.00 | 3.39 | 0.78 | 1.46 | 22.00 | 1.67 | 22.00 |
| 4. Nasik | -0.54 | -0.85 | -84.63 | 0.92 | 5.75 | 7.00 | 3.84 | 14.00 |
| 5. Dhule | 2.93 | 2.55 | 119.26 | 4.36 | 2.91 | 17.00 | 4.42 | 11.00 |
| 6. Jalgaon | 7.52 | 7.75 | -54.16 | 6.24 | 5.64 | 8.00 | 6.25 | 5.00 |
| 7. Ahmednagar | 3.72 | -6.05 | -190.35 | 7.96 | 7.08 | 3.00 | 1.81 | 20.00 |
| 8. Pune | 2.04 | -3.70 | -116.92 | 6.01 | 7.34 | 2.00 | 5.66 | 7.00 |
| 9. Solapur | 3.28 | -4.67 | 149.73 | 11.61 | 3.54 | 13.00 | 7.34 | 2.00 |
| 10. Satara | 0.90 | -2.77 | 121.35 | 5.04 | 4.63 | 10.00 | 6.39 | 4.00 |
| 11. Sangli | 0.52 | -0.37 | 79.68 | 2.91 | 6.90 | 4.00 | 1.53 | 23.00 |
| 12. Kolhapur | 0.07 | -0.06 | -54.16 | 4.93 | 6.78 | 5.00 | 5.75 | 6.00 |
| 13. Aurangabad (incl. Jalna) | 8.51 | 9.42 | -137.23 | 7.65 | 7.83 | 1.00 | 9.55 | 1.00 |
| 14. Parbhani | 14.08 | 3.51 | -79.94 | 12.40 | 5.50 | 9.00 | 4.87 | 9.00 |
| 15. Beed | 1.65 | -0.32 | 37.76 | 5.39 | 3.52 | 14.00 | 4.03 | 13.00 |
| 16. Nanded | 8.36 | 8.56 | 47.39 | 3.83 | 3.29 | 15.00 | 2.53 | 17.00 |
| 17. Osmanabad (incl. Latur) | -0.23 | -0.93 | 339.83 | 11.51 | 6.19 | 6.00 | 5.31 | 8.00 |
| 18. Buldhana | 1.86 | 12.32 | -43.49 | 3.91 | 3.73 | 11.00 | 4.24 | 12.00 |
| 19. Akola | 11.36 | 20.30 | 32.03 | 1.43 | 2.19 | 19.00 | 6.84 | 3.00 |
| 20. Amravati | 1.44 | 22.03 | -14.84 | 0.47 | 2.98 | 16.00 | 4.50 | 10.00 |
| 21. Yavatmal | 16.53 | 6.51 | 44.79 | 0.72 | 3.55 | 12.00 | 3.47 | 15.00 |
| 22. Wardha | 14.95 | 15.63 | -20.05 | 1.14 | 2.59 | 18.00 | 2.15 | 19.00 |
| 23. Nagpur | 0.04 | 4.06 | -18.49 | 1.16 | 2.17 | 20.00 | 2.62 | 16.00 |
| 24. Bhandara | 0.00 | 0.00 | -19.01 | -0.31 | 0.76 | 25.00 | 1.69 | 21.00 |
| 25. Chandrapur (incl. Gadchiroli) | 1.01 | 7.09 | -40.36 | -0.22 | 1.82 | 21.00 | 2.24 | 18.00 |
| **Total** | **100.00** | **100.00** | **100.00** | **100.00** | **100.00** | — | **100.00** | — |
| **Absolute value (quantity in '00MT and value in Rs. Million)** | **(557.84)** | **(716.21)** | **(-128.01)** | **(10248.01)** | **(10590)** | | **(14027)** | |

Note : i) Period I : Triennium ending 1970-71, Period II: Triennium ending 1980-81 and Period III: Triennium ending 1990-91.
ii) Ranks in descending order of contribution as per percentage share in incremental value.

# CHAPTER 9

## AGRICULTURAL PRODUCTIVITY GROWTH: ROLE OF TECHNOLOGY

### 1. Introduction :

Technological advances available in the form of new inputs and methods of production constitute an important source of productivity growth in agriculture. However, the pace of adoption of new technology and the efficiency of its use which determine productivity of new inputs such as fertilisers, high yielding variety seeds etc., are crucially influenced by agro-climatic, institutional and infrastructural environment in which growth occurs.

Our main objective in this chapter is to examine the association of productivity growth in Maharashtra with the technology and non-technology variables and highlight the role played by them in the two phases of the GR period under study. For this purpose we use the framework of regression analysis and apply it to the state level aggregate data initially and then the disaggregated district level data.

### 2. Productivity Growth: State Level Analysis:

In the state level analysis, we regress gross value of output per hectare mainly on four variables, namely, (i) extent of irrigation, (ii) fertilisers (i.e., N + P + K) per hectare, (iii) annual rainfall and (iv) percentage of area under HYVs of cereals to gross cropped area, alongwith the intercept and slope dummies for the second period. The method of estimation is ordinary least squares and all the four main variables are converted into logarithms. Results of regressions with alternative combinations of variables are reproduced in Table 9.1

Main observations emerging from these results are summarised below :

(i) In all the four regressions, rainfall variable, as expected, turns out to be consistently and highly significant. However, its slope dummy variable has been negative though non-significant in all of them. Negative sign in any case implies decline in sensitivity of output per hectare to rainfall variations in the second period. Rapid expansion in the use of pesticides that occurred after 1980-81 in the state must be partly responsible for it.

**Table 9.1**
**Results of State Level Regression Analysis (1967-91) with Gross Value of Output Per hectare as Dependent Variable**

| Explanatory Variable | Regression-I | Regression-II | Regression-III | Regression-IV |
|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) |
| Irrigation | — | — | 1.297* | 0.817 |
| | | | (3.44) | (1.52) |
| NPK per hectare | — | -0.046 | -0.235 | -0.194 |
| | | (-0.197) | (-1.40) | (-1.10) |
| % of HYV area | 0.133* | 0.165 | — | 0.0780 |
| | (3.16) | (1.51) | | (0.66) |
| Annual rainfall Index | 0.598* | 0.584* | 0.452* | 0.499* |
| | (3.26) | (3.28) | (2.82) | (2.78) |
| Slope dummy for Irrigation | — | — | -0.789 | -1.172 |
| | | | (-0.76) | (-0.90) |
| Slope dummy for NPK per hectare | — | -0.502 | 0.009 | 0.611 |
| | | (-1.69) | (1.22) | (1.75) |
| Slope dummy for HYV area | 0.133 | 0.376 | — | -0.467 |
| | (0.97) | (1.29) | | (-1.51) |
| Slope dummy for annual rainfall | -0.291 | -0.498 | -0.373 | -0.343 |
| | (-1.05) | (-1.71) | (-1.21) | (-1.02) |
| Intercept dummy | 1.043 | 2.873 | 3.611 | 4.246 |
| | (0.86) | (1.76) | (1.96) | (1.91) |
| Constant | 4.238* | 4.352* | 2.849* | 3.478* |
| F. Statistics | 15.89 | 12.74 | 18.51 | 13.43 |
| D.W. Statistics | 1.72[a] | 1.73[a] | 2.07[b] | 2.03[b] |
| R-Square | 0.82 | 0.85 | 0.89 | 0.90 |

Notes : (i) * indicates statistical significance at 5% levels of probability
(ii) Figures in parentheses refer to the corresponding "t" values
a : Test is inconclusive
b : No serial correlation

(ii) While irrigation is positive and highly significant in regression III, it is significant only at 15% level of probability in regression IV in the presence of HYV variable. But its slope dummy, though non-significant, is negative in both the regressions. It we leave aside its statistical significance and compute the irrigation elasticity for the second period, it continues to be positive even for the second period i.e., 1.297 - 0.788 = 0.509, as per regression III. But, when obtained from regression IV, it works out to be negative (0.817 - 1.17 = -0.353). In other words, irrigation had positive impact on productivity growth in period I but its role diminished significantly in the second period.

It appears that quite a few rainfall deficient years in succession during the mid-eighties not only reduced the quantum of total water supply

available from irrigation but also its reliability, ultimately affecting its effectiveness in influencing productivity per hectare. In addition, as mentioned elsewhere (section 4, Chapter 6) there has been on evidence suggesting deterioration in operational efficiency of the public irrigation systems in the state during the eighties.

(iii) The coefficient of fertiliser variable is negative and non-significant in all the three regressions but the coefficient of its slope dummy for the second period is positive in two of them i.e., in regressions III & IV and statistically significant at 12% level in the latter only i.e., regression IV. Likewise, elasticity of fertiliser variable for the second period works out to be positive i.e., 0.417 (-0.194 + 0.611) only for regression IV and not for the other two (i.e., II & III). The results thus imply that at best fertilisers had no significant positive impact or weak negative impact at worst on productivity growth at the aggregate level during period I when the quantum of use of fertilisers per hectare was not only low for many districts but did not expand significantly in majority of them. In contrast, fertilisers might have played positive role in influencing productivity per hectare in the second period when increase in their use was phenomenal at the aggregate level and almost universal across the districts. This differential behaviour of fertiliser variable is rather confusing, as the response to fertilisers is expected to be much greater at the low levels of use rather than the high. Therefore, its renewed assessment on the basis of careful scrutiny of the disaggregate level data is called for.

(iv) Regression I, II and IV reveal positive impact of HYV area on productivity though it has been highly significant only in regression I where irrigation variable is absent. Coefficient of its slope dummy i.e., of HYV variable too turns out to be positive in absence of irrigation variable but negative though non-significant when irrigation variable is included (i.e. for regression IV). Strong positive trend in both irrigation and HYV variables alongwith high multicollinearity between them especially for period I appear to be responsible for instability in the coefficient of HYV variable and its significance in different regressions.[1]

Lastly, a reference must be made to the problems associated with the aggregation at the state level, arising out of non-compatible patterns of input use across the districts. There is reason to believe that the use of HYVs on the one hand and fertilisers and irrigation on the other, was non-synergistic in quiet a few major jowar and rice producing districts of the state during the 70's, while it was highly synergistic for all the three inputs in many districts growing sugarcane and wheat under irrigation. But the situation underwent a significant change during the 80's when the quantum

of fertiliser use shot up and its use spread to all the crops including coarse cereals, pulses and oilseeds and in almost all the districts either in presence or absence of HYVs or irrigation. In other words, the degree of non-complementarity of fertiliser use with the other inputs might have strengthened further in the second period though at differential rate in different districts. Hence, reassessment of the role of technology variables at the district levels was carried out on the basis of two more alternative exercises.

In the first exercise, we estimated the relationship of productivity per hectare with the technology variables in the presence of a couple of non-technology variables like literacy of labour, road length etc. within the framework of regression analysis but separately for periods I and II. The analysis was based on a pooled sample of time series data for 25 districts of the state, the assumption being that the elasticities of different variables are constant across the districts for a specified period.

Secondly, as it was difficult to obtain appropriate time series data for several relevant non-technology variables, at the district level we preferred to compare the characteristics of production technology, organisation of production and of infrastructural environment in the framework of case studies for a few districts. For this purpose we selected six districts which had distinctly divergent growth performance in the periods I and II.

### 3. Productivity Growth: District Level Analysis :

The following regression was estimated by using time series data pooled for all 25 districts, separately for period I (1967-80) and period II (1980-91).[2]

Gross value of output per hectare = f (Irrigation, Fertilisers, Tractors, Electric pump-sets, Literate labour, Illiterate labour, Work animals, Road length, Annual rainfall index)

All the variables except rainfall index were normalised by gross cropped area and all of them were converted into logarithms. Methods of estimation was ordinary least squares. In addition, to the above mentioned variables intercept dummies were introduced to take care of the district-specific fixed effects. The variables 'work animals per 100 hectares' was excluded from the final regression as it was found to be highly correlated with the other variable like illiterate labour. Similarly, one more variable namely % of HYV area too was highly multicolinear with irrigation for period I and its coefficient non-significant in all the regressions for both the periods. Hence, it too was omitted from final regressions. From the scrutiny of the two final regressions presented in Table 9.2 the following conclusions emerge:

i) Out of 24 district level dummies, 14 turn out to be highly significant and thus establish significance of district specific fixed effects on gross value of output per hectare.

ii) Rainfall variable turns out to be highly significant and positive for both the periods but its coefficient declines from 0.27 for period I to 0.15 for period II. This is consistent with our earlier conclusions of decline in sensitivity of output to rainfall variations in the second period.

**Table 9.2**
**Results of District Level Regression Analysis**
(Gross Value of Output Per Hectare As Dependent Variable)

| Explanatory Variable | 1967-80 Regression Coefficient & t - value | 1980-91 Regression Co-efficient & t - value |
|---|---|---|
| Irrigation | 0.3071* | 0.1381* |
| | (5.04) | (1.77) |
| NPK per hectare | 0.0287 | 0.1367* |
| | (0.83) | (3.67) |
| Tractors | 0.2870* | 0.0114 |
| | (5.38) | (0.23) |
| Electric Pump Sets | –0.0505 | 0.1026 |
| | (–1.50) | (1.36) |
| Literate Labour | 0.2088 | –0.2245 |
| | (0.83) | (–1.06) |
| Illiterate Labour | –0.4486+ | –0.1634 |
| | (–1.71) | (–0.68) |
| Road Length | –0.0403 | 0.1917+ |
| | (–0.48) | (1.60) |
| Annual Rainfall | 0.2731* | 0.1474* |
| | (5.46) | (3.04) |
| Constant | 7.2074* | 6.6162* |
| F. Statistics | 35.7020 | 33.7383 |
| R-Square | 0.80 | 0.82 |
| Number of Observations | 325 | 275 |

Notes : i) * indicates significance at 5% or lower level and
+ denotes significance at 10%
ii) Figure in parentheses refer to 't' values.

iii) Coefficient of irrigation is positive for both the periods but it is highly significant only for the first period (i.e., 0.31 which is significant at 0.01% level of probability). For the second period, elasticity of irrigation not only gets reduced to 0.14 but turns out to be significant at 7.6% level. State level regression analysis too displays similarly reduced impact of irrigation on productivity per hectare in the second period. We interpreted it as the partial consequence of increased vulnerability

of irrigation water supply to rainfall variations during the eighties. Reduced effectiveness of irrigation is also compatible with our inference of deterioration in the operational efficiency of the public irrigation systems in Maharashtra.

iv) Like irrigation, tractor variable too shows highly significant impact on the aggregate productivity for the early period but its reduced and non-significant impact for the latter period.

v) Signs of the two labour variables are right for period I i.e., positive for literate labour and negative for illiterate labour. Non-significance of the literate labour for period II may be treated as an indication of mere literacy of agricultural labour being no longer decisive in the changed context of relatively advanced technology development for agriculture during the eighties.

   Consequently negative coefficient of illiterate labour though significant only for period I can be interpreted as illiteracy being a continuing constraint to productivity growth in agriculture.

vi) Unlike the state level analysis, the district level regression exercise yields positive coefficient of fertiliser variable for both the periods. Nevertheless, it too reinforces our earlier conclusion of differential impact of fertilisers on productivity growth during the 70's vis-a-vis the 80's. This is because the elasticity estimate for the early period is not only statistically non-significant but it is close to zero i.e., 0.028. In contrast, its value (i.e., 0.137) for period II, is significant at 0.01% level of probability.

One of the hypotheses forwarded to explain the differential response to fertiliser use before and after 1980-81 in the context of Indian agriculture is that of improvement in fertiliser use efficiency in the latter period of the eighties. We hesitate to accept this hypothesis in absence of any conclusive research evidence establishing it in respect of agriculture in Maharashtra. On the contrary, reverse may be true for Maharashtra, as growth in physical productivity not only experienced significant deceleration during the 80's for the majority of the cereal crops but also for a nigh fertiliser consuming crop like sugarcane. We believe that unlike the seventies when increase in fertiliser use was concentrated in a few sugarcane-growing districts, it is the more extensive use of fertilisers across crops and regions during the eighties which must have been responsible for their positive and significant influence on productivity per hectare in agriculture.

Finally, to sum up, though variables like irrigation, tractors, fertilisers, road length, literacy of labour etc., indicate significant positive impact either in period I or in period II on productivity per hectare, they do not reveal sustained and equally significant impact in the two periods, as the rainfall index does.

Possibly, omission of certain non-technology factors like the spread and efficiency of extension, level and quality of infrastructural development including transport, communication, storage etc., farmers' entrepreneurial abilities and progressiveness rather than mere literacy etc. may be responsible for less than satisfactory results of the regression analysis. Moreover, the nature of technology adoption was not as simple as the spread of use of HYVs and/or fertilisers for the period II. Similarly, inter-district degree of divergence in the forces behind productivity growth too appeared to have increased significantly during the second period. Hence, we thought that it would be worthwhile to identify the factors responsible for differential growth performance at the district level by describing and comparing characteristics of the agro-climatic, technological and institutional environment in which growth has taken place in a few selected districts. The section that follows is devoted to these case studies.

## 4. Case Studies of Selected Districts:

### Selection of Districts :

We selected six districts for special study on the basis of their distinctly differential pattern of contribution to the state level incremental gross value of output (henceforth IGVO) in the seventies and the eighties (refer to columns (3) and (6) of Table 9.3). They are (i) Aurangabad, (ii) Akola, (iii) Solapur, (iv) Ahmednagar, (v) Sangli and (vi) Kolhapur. Inter-period changes in their growth performance were also found to be remarkably divergent (refer to columns (4) and (7) in Table 9.3).

Aurangabad has been selected as it continued to be the leading district in terms of its share in the state's IGVO both in the 70's and 80's, substantial fall in its growth rate between the two periods notwithstanding (i.e., from 7.12% in period I to 2.69% in period II).

Akola and Solapur have been selected as they were at the top in enhancing their contribution during the eighties over their own shares in the seventies, while contribution of the majority of the districts in the state declined during the same period. Obviously, unlike many other districts Akola improved its growth performance significantly after 1980-81 and Solapur district maintained it at almost the pre-1980-81 level of about 4% in period II.

## Table 9.3
## Growth Performance of Selected Districts

| District | Period: TE 1970-71 to TE 1980-81 | | Growth rate in gross value of output for 1967-80 | Period: TE 1980-81 to 1990-91 | | Growth rate in gross value of output for 1980-81 |
|---|---|---|---|---|---|---|
| | Growth Category in which district falls[a] | Share in state level IGVO | | Growth Category in which district falls[a] | Share in state level IGVO | |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Aurangabad | I: High Growth | 7.83 | 7.12* | I: High Growth | 9.55 | 2.69@ |
| Akola | IV: Low Growth | 2.19 | 4.76* | I: High Growth | 6.84 | 6.81@ |
| Solapur | III: Moderate Growth | 3.54 | 4.45* | I: High Growth | 7.34 | 3.97@ |
| Ahmednagar | I: High Growth | 7.08 | 5.47* | IV: Low Growth | 1.81 | -2.15* |
| Sangli | II: High Growth | 6.90 | 7.51* | IV: Low Growth | 1.53 | 0.01* |
| Kolhapur | II: High Growth | 6.78 | 3.72* | II: High Growth | 5.75 | 2.37* |

a : Growth categories as per Table 8.3 from Chapter 8
* : Indicates significance at 10% or lower percentage level
@ : Either coefficient of time or of slope dummy variable statistically significant.

In contrast to Akola and Solapur districts, Ahmednagar and Sangli were at the bottom with maximum and next-to-maximum decline in their contribution to the aggregate IGVO from the seventies to the eighties. They experienced, obviously, high deterioration in growth performance with their growth rates moving down from 5.47% and 7.51% respectively in period I to -2.15% and 0.01% in period II.

Lastly, Kolhapur district had very marginal erosion in its contribution to the state's IGVO from the seventies to the eighties and continued to be in the third i.e., moderate growth category of the districts in both the decades. Similarly, though its growth rate declined between the two periods, growth continued at the moderate pace even during the eighties at a rate which exceeded 2%. Another special feature of Kolhapur district because of which it was in the present exercise was its unique position with the maximum value of aggregate land productivity among all the districts of the state. Total value of output per hectare of net sown area at 1980-81 prices was Rs. 4711, Rs. 6182 and Rs. 8158 for Kolhapur vis-a-vis the state averages of Rs. 1319, Rs. 1904 and Rs. 2633 for the triennia ending 70-71, 80-81 and 90-91 respectively. On the contrary, the comparable values were minimum for Akola district i.e., Rs. 970, Rs. 1243 and Rs. 2241 respectively.

As, unlike all the other districts, Akola represents a unique case of high and accelerated growth performance of the rainfed agriculture, the

discussion that follows focusses mainly on its comparison with the other districts, in addition to commenting on typical factors or features of other districts responsible for their better/worse or special character of growth performance. Tables 9.4 to 9.8 provide statistical basis for this comparison.

**Comparison of Selected Districts:**

Akola district represents a contrasting situation vis-a-vis the other selected districts not only in terms of its distinctly differential inter-temporal pattern of growth but also with reference to many of its other features such as agro-climatic conditions, resource endowments, crop pattern, the state of infrastructural developments etc.

Akola registered a maximum rate of growth (6.81%) in gross value of output in period II, among all the districts of the state, over and above its high growth performance (4.76%) in the early phase (Table 9.4). Sustained high growth that occurred in Akola is particularly noteworthy because unlike the other five selected districts as also many other districts in the state, expansion in the output of sugarcane, a high productivity and high value crop, did not play any role in it (Table 9.4). In fact, growth rates in real output of the major crops and crop groups in Akola ranged from 4.45% for cotton to 13.55% for pulses. Moreover, it was the growth in yield per hectare which alone contributed to output growth in respect of cotton and cereals the crops together accounting for more than 75% share in area, while for pulses and oilseeds contribution of yield growth was significant though not dominant (Table 9.8). In other words, sustained high growth in GVO, reflects real sector expansion in Akola in the last two and half decades.

In a remarkable contrast to its growth performance, Akola is either average or much below the average with reference to many other characteristics vis-a-vis the remaining five selected districts. For instance, average normal rainfall in Akola is 875 m.m., a level close to the lower limit of the medium rainfall range i.e., 750 m.m., while irrigation is almost non-existent (i.e., 3% in 1990-91, Table 9.5). The other adverse features of resource and infrastructural developments are (i) poor state of road transport development and (ii) grossly inadequate supply of bank credit and lowest level of non-farm employment (Table 9.7).

Likewise, decisively superior performance of Akola cannot be explained in terms of a more rapid and sustained spread of new technologies like use of HYVs, fertilisers and tractors etc., than the other districts (Table 9.6). In fact, the use of fertilisers and tractors had been much below the state average for Akola district throughout the GR period and it was one of the

lowest among the selected districts too. There were only two characteristics in which Akola enjoyed distinct advantage over the others. One was the relatively abundant supply of agricultural labours as the proportion of the latter in total agricultural workers continued to be above 60% for it. The other was highest proportion of cultivators' literacy i.e., 60% in 1981, which further increased to 68% in 19901 (Table 9.5).

**Table 9.4**
**Crop Pattern, Growth And Instability in Crop Output is Selected Districts**

| | Year/Period | Akola | Solapur | Amhed-nagar | Sangli | Auran-gabad | Kolhapur |
|---|---|---|---|---|---|---|---|
| **I. Crop Patterns** (% of share in gross cropped area) | | | | | | | |
| i) Cereals | TE 1980-81 | 38 | 73 | 73 | 60 | 53 | 48 |
| | TE 1990-91 | 32 | 69 | 73 | 64 | 52 | 44 |
| ii) Pulses | TE 1980-81 | 17 | 14 | 7 | 13 | 21 | 6 |
| | TE 1990-91 | 25 | 10 | 7 | 13 | 18 | 6 |
| iii) Oilseeds | TE 1980-81 | 5 | 8 | 6 | 8 | 11 | 12 |
| | TE 1990-91 | 7 | 15 | 10 | 12 | 14 | 18 |
| iv) Sugarcane | TE 1980-81 | 0.06 | 2 | 5 | 5 | 1.5 | 12 |
| | TE 1990-91 | 0.29 | 3 | 3 | 4 | 2.4 | 13 |
| v) Cotton | TE 1980-81 | 40 | 1 | 1 | — | 11 | — |
| | TE 1990-91 | 35 | 0 | — | — | 10 | — |
| vi) Fruits & Vegetables | TE 1980-81 | 0.5 | 0.6 | 0.8 | 0.6 | 0.4 | 0.7 |
| | TE 1990-91 | 0.6 | 1.4 | 1.6 | 1.3 | 0.8 | 1.7 |
| **II. Growth Rates For** | | | | | | | |
| i) Gross Value of Output | | | | | | | |
| a) Non-adjusted | 1967-80 | 4.76* | 4.43* | 5.47* | 7.51* | 7.12* | 3.72* |
| | 1990-91 | 6.81@ | 3.97@ | -2.15* | 0.01* | 2.69@ | 2.37* |
| b) Rainfall-adjusted | 1967-80 | 4.21* | 1.73* | 4.05* | 5.05* | 5.54* | 3.43* |
| | 1980-91 | 9.36* | 4.85* | -2.71@ | 0.11* | 2.21@ | 2.78* |
| ii) Gross Value of Output per hectare | 1967-80 | 3.23* | 1.85 | 4.46* | 9.03* | 7.27* | 2.89* |
| | 1980-91 | 5.40* | 5.17* | -3.39 | -0.58 | 0.75 | 1.57* |
| III. Instability index for Gross Value of Output | 1967-80 | 35.1 | 13.5 | 13.3 | 28.2 | 19.0 | 8.2 |
| | 1980-91 | 23.6 | 22.0 | 16.1 | 30.6 | 21.0 | 5.1 |
| IV. Gross Value of Output per hectare of net sown area (Rs.) | TE 1990-71 | 970.21 | 1015.35 | 1724.72 | 1646.01 | 889.30 | 4711.39 |
| | TE 1980-81 | 1243.18 | 1391.68 | 2450.95 | 2829.29 | 1628.78 | 6182.38 |
| | TE 1990-91 | 2241.11 | 2398.84 | 2664.17 | 3309.17 | 2436.18 | 8157.57 |

* : Significant at 10% or lower level of possibility, TE : Triennium ending.
@ : Coefficient of either time or slope dummy variable significant at 10% level.

## Table 9.5
## Agro-Climatic Characteristics And Resources is Selected Districts

| Characteristic | Year/Period | Akola | Solapur | Amhed-nagar | Sangli | Auran-gabad | Kolhapur |
|---|---|---|---|---|---|---|---|
| 1. Soil Index | — | 72.7 | 57.6 | 61.2 | 54.4 | 54.4 | 57.6 |
| 2. Average normal rain fall (mm) | — | 846.5 | 584.3 | 578.8 | 624.8 | 725.8 | 1931.5 |
| 3. Net Sown Area (00' hect.) | TE 1980-81 | 8067 | 11373 | 11834 | 6162 | 12194 | 4249 |
| 4. Irrigation (% to GCA) | TE 1970-71 | 1.0 | 12.3 | 14.4 | 10.0 | 5.4 | 12.4 |
| | TE 1980-81 | 3.1 | 13.7 | 22.1 | 15.3 | 12.9 | 15.6 |
| | TE 1990-91 | 3.0 | 18.9 | 25.1 | 17.1 | 13.6 | 20.6 |
| 5. Cropping Intensity | TE 1970-71 | 102 | 104 | 106 | 103 | 106 | 101 |
| | TE 1980-81 | 108 | 109 | 109 | 106 | 111 | 104 |
| | TE 1990-91 | 114 | 107 | 117 | 110 | 122 | 112 |
| 6. Percentage of agricultural labourers to agriclutural workers | 1981 | 64 | 46 | 37 | 32 | 41 | 22 |
| | 1991 | 66 | 48 | 36 | 36 | 46 | 28 |
| 7. percentage of literate cultivators | 1981 | 60.1 | 45.3 | 42.9 | 51.9 | 39.5 | 40.9 |
| | 1991 | 67.9 | 53.9 | 50.4 | 59.8 | 55.3 | 54.2 |

## Table 9.6
## Indicators of Technology Development in Selected Districts

| Characteristic | Year/Period | Akola | Solapur | Amhed-nagar | Sangli | Auran-gabad | Kolhapur |
|---|---|---|---|---|---|---|---|
| 1. Use of fertiliser per hectare (N, P & K in kg.) | 1970-71 | 8.4 | 7.7 | 8.3 | 15.0 | 6.5 | 28.7 |
| | 1980-81 | 13.0 | 15.7 | 13.3 | 30.7 | 16.4 | 109.1 |
| | 1990-91 | 50.1 | 50.9 | 74.8 | 120.7 | 41.9 | 259.1 |
| 2. Percentage of area uunder HYVs | 1980-81 | 52.2 | 11.0 | 15.4 | 40.5 | 48.1 | 69.6 |
| | 1990-91 | 85.8 | 45.3 | 49.6 | 100.00 | 72.5 | 98.9 |
| 3. Tractors per 100 hectares of gross cropped area (No.) | 1980-81 | 0.07 | 0.05 | 0.20 | 0.15 | 0.06 | 0.40 |
| | 1990-91 | 0.10 | 0.11 | 0.21 | 0.33 | 0.12 | 0.75 |
| 4. Consumption of electricity for agriculture per 100 hectares of net sown area | 1990-91 | 199 | 391 | 632 | 504 | 432 | 478 |

## Table 9.7
## Infrastructural Development Indicators for Selected Districts

| Indicators | Year/Period | Akola | Solapur | Amhed-nagar | Sangli | Auran-gabd | Kolhapur |
|---|---|---|---|---|---|---|---|
| 1. Road length (Per 100 sq. km. If area in (kms.)) | 1980-81 | 23.6 | 40.4 | 37.5 | 44.2 | 31.9 | 51.4 |
| | 1990-91 | 36.9 | 61.4 | 42.1 | 89.2 | 44.5 | 65.8 |
| 2. Bank Credit (Per hectare of gross cropped area) (Rs.) | 1986 | 270.8 | 361.6 | 526.6 | 491.8 | 433.7 | 882.8 |
| 3. Bank Officers (per 10,100 population, No.) | 1986 | 65 | 67 | 61 | 81 | 67 | 75 |
| 4. Members of marketing cooperative societies per 100 hectares of net sown area | 1987-88 | 3.5 | 1.1 | 2.8 | 2.0 | 3.1 | 24.7 |
| 5. Percentage of Urban Population | 1991 | 27.0 | 29.1 | 14.7 | 22.2 | 30.5 | 25.7 |
| 6. Percentage of non-farm workers to total main workers (Rural + Urban) | 1981 | 21 | 36 | 24 | 30 | 26 | 33 |
| | 1991 | 23 | 34 | 26 | 32 | 30 | 37 |

In yet another respect Akola distinguishes itself from other districts. A crop pattern in Akola district has not been dominated by the cereals like that in Ahmednagar and in many other districts of the state, so as to induce high growth through unhindered spread of new seed-fertiliser technologies. Share of cereals in crop pattern has been one of the lowest in Akola. It was 38% in 1980-81 and declined further to 32% in 1990-91 (Table 9.4). Cotton had been, traditionally, the most important crop in Akola followed by cereals, pulses and oilseeds. Importance of oilseeds however, improved significantly during the eighties depressing the relative importance of pulses. Nevertheless, growth has not been restricted only to the non-cereal commercial crops and was also high (5.24%) for cereals in the second period too. Infact, both output and yield growth for cereals in the second period was maximum in Akola among all the districts of the state. Thus, neither the spread of routinely identified new technologies nor the decisively higher level of irrigation or other infrastructural developments etc., could explain Akola district's success in achieving sustained high growth in agriculture over the last two and half decades. A clue to explain this puzzling situation in respect of Akola was provided by our Field Survey. Agricultural growth strategy which appeared to have yielded better results in Akola involved relatively successful development and extension of dry farming technologies well integrated with the new seed fertiliser technologies

and the watershed development approach suited to the agro-ecological conditions in the district (refer Annexe 9.1 for detailed discussion of this issue). It helped in pushing up croping intensity from 108 in 1980-81 to 114 in 1990-91 with no change in irrigation.

A fact that sustained high growth could be achieved in a relatively backward rainfed farming area with underdeveloped infrastructural network is of paramount importance to agricultural policies to be followed in a predominantly dry farming state like Maharashtra. That is why, we shall discuss in detail its implications after commenting on the major forces behind accelerated or decelerated agricultural growth in the other selected districts.

**Solapur District :**

Solapur was next to Akola in enhancing further its share in the state level IGVO in the eighties. Yet, its pattern of output growth and characteristics of the resource endowments were not similar to those of Akola. Unlike Akola, it is a district with low soil fertility and receives very low, in fact minimum (578.8 m.m) rainfall similar to Ahmednagar. But percentage of irrigation has been above the state average in Solapur right from 1970-71 and remained so with further expansion in 70's and 80's at undiminished pace (Table 9.5).

Though infrastructural development is slightly better for Solapur than that for Akola, the state of technology adoption is either comparable to Akola in some respects like use of fertilisers per hectare or poor in terms of some other indicators such as spread of HYVs. Negligible proportion of area under HYVs of cereals in Solapur in 1980-81 and subsequent rise to only 45% (Table 9.6) was mainly due to domination of rabi jowar. A low productivity cereal for which seed technology development had not been very promising in Maharashtra.

Crop pattern in Solapur represents an extreme contrast to that of Akola (Table 9.4). The share of cereals has been maximum i.e., nearly three-fourth in Solapur and continues to be so even in recent years. During the eighties, however, the share of cereals declined marginally, relative importance of pulses too declined significantly i.e., from 14% in 1980-81 to 10% in 1990-91 and cotton was almost wiped out from the district. As against this, the share of oilseeds particularly of high value oilseeds like groundnut and sunflower expanded rapidly. Unlike Akola, again share of sugarcane expanded continuously from 1% in 1970-71 to 3% in 1990-91 in Solapur. Similarly, the share of vegetables and fruits too moved up during the eighties. Thus, the crop pattern moved more towards high value oilseed

crops, sugarcane and fruits and vegetables at the cost of decline in the share of cereals, pulses and cotton. That was why, Solapur could sustain growth in GVO at the rate of 4% even in the second period. Moreover, decline in the share of cereals and pulses too was due to reduced shares of relatively low productivity crops among them like bajra among the cereals but not of wheat and maize. Similarly the share of tur and other pulses declined but not of gram. In addition, extension of seed-fertiliser technology too made further headway during the eighties particularly for wheat and maize among the cereals and further for gram, groudnut, sunflower etc. Therefore yield growth rates for cereals could be maintained in the second period at about 2% and stepped upto 4% for pulses and oilseeds (Table 9.8).

Thus, the major forces behind Solapur's sustained performance during the entire GR period were expansion in irrigation coupled with crop pattern changes favouring high value and high productivity crops.

**Aurangabad District :**

Aurangabad district contributed the maximum share to the State's IGVO in both the decades despite absence of distinctly higher benefits of favourable agro-climatic conditions. Like the other selected districts, with an exception of Akola, soil fertility index and the level of normal rainfall is low for Aurangabad, though the latter is close to the upper limit of the low rainfall range i.e., 750 m.m. More importantly, expansion in gross irrigated area was very rapid in the district during the 70's and crossed the state average proportion of around 12% in 1980-81, rising from the low initial level. But thereafter further increase in the percentage of gross irrigated area was apparently negligible, though expansion in absolute level of gross irrigated area continued more or less at an undiminished pace even after 1980-81.

As such, the percentage of gross irrigated area to gross cropped area moved up marginally from 12.9% in 1980-81 to 13.6% in 1990-91. However, this holds only for the proportion of gross irrigated area in gross cropped area and not so for net irrigated area.[3] Percentage of net irrigated area to net sown area moved up continuously from 4.6% in 1970-71 to 9.5% in 1980-81 and then to 13.7 in 1990-91 and facilitated expansion in area under sugarcane and other irrigated crops like rabi jowar, gram, sunflower, summer groundnut etc. Absence of rise in percentage of gross irrigated area to gross cropped area was partly due to substantial fall in the intensity of irrigation (an indicator of irrigation water being available for crops in more than one season) during the eighties and significant increase in gross cropped area itself due to greater rise in multiple cropping under

## Annexure 9.8
## Growth Rates in Area, Production and Yield per hectare for Major Crops and Crop-groups

| | | Akola | | Solapur | | Ahmednagar | | Sangli | | Aurangabad | | Kolhapur | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 67-80 | 80-91 | 67-80 | 80-91 | 67-80 | 80-91 | 67-80 | 80-91 | 67-80 | 80-91 | 67-80 | 80-91 |
| **Cereals** | | | | | | | | | | | | | |
| | Area | 1.39* | 0.23* | -0.26 | -1.13 | 0.30 | 0.63 | 0.44 | 0.59 | 0.61* | 1.85* | 0.59* | -0.11* |
| | Production | 6.96* | 5.24@ | 4.86 | 0.85 | 7.16* | 0.51* | 6.94* | 2.19* | 9.04* | 1.22* | 8.39* | 1.91@ |
| | Yield | 5.58* | 5.03@ | 5.12* | 1.98* | 6.87* | -0.11* | 6.50* | 1.60* | 8.43* | -0.63* | 7.79* | 2.01* |
| **Pulses** | | | | | | | | | | | | | |
| | Area | 2.76* | 6.38* | 3.91* | -5.06* | 1.41 | 1.24 | 2.97* | 0.91* | 1.40* | 0.31@ | 5.34* | 2.37* |
| | Production | 5.61* | 13.55* | 5.36* | -1.20* | 5.72* | 2.65@ | 5.34* | 2.27@ | 6.91* | 3.04@ | 6.12* | 0.54* |
| | Yield | 2.85* | 7.17* | 1.46* | 3.87@ | 4.31* | 1.41@ | 2.38 | 1.37 | 5.51* | 2.73@ | 0.78 | -1.83 |
| **Oilseeds** | | | | | | | | | | | | | |
| | Area | 1.82 | 6.32@ | -0.64 | 4.08@ | -0.44 | 16.60@ | -7.16* | 12.63* | 0.73 | 7.47@ | -1.42* | 7.26* |
| | Production | 0.95 | 8.42 | -2.97 | 7.73@ | 4.34 | 21.56@ | -5.24 | 19.05@ | 2.86 | 10.68 | 0.59 | 11.62@ |
| | Yield | -0.87 | 2.10 | -2.33 | 3.65 | 4.78* | 4.96@ | 1.91 | 6.41 | 2.13 | 3.21 | 2.01 | 4.36 |
| **Sugarcane** | | | | | | | | | | | | | |
| | Area | -3.87* | 12.62* | 5.13* | 7.68* | 4.67* | -2.86* | 6.74* | -1.44* | 7.06* | 1.53* | 2.02 | 1.74@ |
| | Production | -1.51 | 12.66@ | 7.18* | 5.11@ | 5.07* | -4.57* | 11.19* | -2.48* | 8.06* | 4.00@ | 2.85* | 1.43* |
| | Yield | 2.35* | 0.03* | 2.05* | -2.57* | 0.40 | -1.70@ | 4.45* | -1.05* | 0.99* | 2.47* | 0.83* | -0.30* |
| **Cottons** | | | | | | | | | | | | | |
| | Area | -0.37* | 0.60* | -1.97 | -20.51@ | 11.99* | -30.70* | -1.90* | -9.63@ | -5.44* | 1.78* | 6.64 | -17.54* |
| | Production | 2.75* | 4.45@ | 4.41* | -20.77* | -1.17 | -32.03@ | 1.93* | -6.29@ | -0.56* | 1.86* | 11.13* | -15.20* |
| | Yield | 3.13* | 3.86@ | 6.38* | -0.26* | 10.82* | -1.33* | 3.83* | 3.34@ | 4.88* | 0.68* | 4.49* | 2.33@ |

Notes : (1) Growth rates are derived from semilog trend function with intercept and slope dummies for period II
* (2) Significant at 10% level
@ (3) Coefficient of either time or slope dummy variable significant at 10% level.

rainfed conditions in Aurangabad after 1980-81 i.e., from III in TE 1980-81 to 122 in TE 1990-91 (Table 9.5). The former i.e., fall in intensity of irrigation was the result of continued expansion in area under sugarcane, a heavy water consuming annual crop during the eighties when the overall volume of irrigation water supply was reduced due to more widespread and higher rainfall deficiency in the state. The latter i.e., increase in multiple cropping under rainfed farming must have been technology-induced.[4] Development of early maturing HYVs or hybrids of crops like sunflower, black gram, green gram etc., alongwith evolution of new crop sequences suitable to multiple cropping by the Marathwada Agricultural University and their effective diffusion to farmers' fields must have facilitated accelerated rise in cropping intensity on rainfed areas in Aurangabad district despite relatively higher incidence of rainfall deficiency in the second period.

Large expansion in both net and gross irrigated area during the seventies must have benefitted crops like sugarcane, wheat, rabi jowar, safflower etc. Use of HYVs too expanded both on irrigated and unirrigated areas during this period though growth in fertiliser consumption remained much more depressed (6.5 kgs and 16.4 kgs., p.h. in 70-71 and 80-81 respectively. (Table 9.6). Use of fertilisers was particularly very low or negligible for jowar and bajra. Yet, in the absence of fertilisers output and yield growth for cereals and thereby in all crops was very high and exceeded 7% in the early phase. Pulses and cotton too contributed significantly to the overall productivity growth in this period. Swift expansion in HYVs/hybrids and irrigated area accompanied by more favourable rainfall conditions were mainly responsible for it.

The second period experienced significant depression in crop output growth in Aurangabad as in many other districts. The fall was more severe in respect of an important crop group like cereals. Output and yield growth rates moved down from about 9% and 8.4% respectively in period I to 1.22% and -0.63% in period II. It must have been the combined result of the reduced shares of high productivity cereals like wheat, kharif jowar etc., and increased share of a low productivity bajra crop slowing down of expansion in use of HYVs and in general unfavourable rainfall conditions in the eighties. Yet, growth in GVO could be maintained at least to a moderate level of 2.7% in the second period. This was possible mainly due to three factors.

One, in addition to a marginal expansion in the share of area under sugarcane (i.e., from 1.5% to 2.4%. Table 9.4), growth in its yield per hectare was positive and significant in Aurangabad district (i.e., 2.5%, Table 9.8). This has been the most unique and exceptional trend in the second period, for Aurangabad district alone.[5]

Secondly, there was an unprecedented expansion in the overall cropping intensity from 111 in 1980-81 to 122 in 1990-91 in Aurangabad (Table 9.5). It facilitated expansion in area under many oilseeds like sunflower, safflower, sesamum without equivalent reduction in area under other crops. Indeed, the major crops like cereals and pulses, though suffered from a relative loss of shares in crop pattern, absolute area under many of them expanded during the eighties as a result of expansion in gross cropped area. Rates of area growth therefore were positive for both of them i.e., 1.85% and 0.31% for cereals and pulses respectively (Table 9.8).

*Thirdly, in general, crop composition in the eighties shifted more in favour* of high productivity and high value crops excluding the group of cereals. For example, among the pulses relative shares of irrigated gram and tur increased but low productivity 'other pulses' experienced significant erosion in their share in crop pattern (from 14% in 1980-81 to 10% in 1990-91). Similarly, high productivity and high value oilseeds like summer groundnut, safflower, kharif and rabi sunflower gained in importance. These shifts certainly helped in inducing positive growth in GVO in the second period.

**Ahmednagar And Sangli :**

Ahmednagar and Sangli districts experienced sharp deceleration in agricultural growth with growth rates in all crop output dropping to negative (-2.15%) and almost zero (0.01%) value in the second period vis-a-vis their high growth rates i.e., 5.47% and 7.51% respectively in period I. Deterioration in growth was also in contrast to the better performance of Solapur which is broadly comparable to the former two in terms of index of soil fertility, level of normal rainfall received and dominance of cereals in crop pattern etc. (Table 9.4 and 9.5). Again, proportion of irrigated area in Sangli district had been close to the state average in the past like that in Solapur district but it was significantly above the state average in Ahmednagar right from the 70's.

Against this background, changes in crop pattern were reverse in Ahmednagar and Sangli vis-a-vis Solapur (Table 9.4). For instance, cereals and pulses maintained or further strengthened their shares in cropped area in the former two in the second period despite expansion in gross cropped area, consequent to rise in cropping intensity while share of cereals and pulses declined in Solapur. Moreover, in contrast to a general trend of increase in the share of sugarcane in majority of districts of the State, including Solapur, sugarcane crop suffered from the loss of share in area in both Ahmednagar and Sangli. The rates of area decline were -2.86% and -1.14% respectively for the two (Table 9.8).

Our field survey revealed that continuous cultivation of sugarcane, under excessive use of water and chemical fertilisers in total absence of adequate drainage and crop rotation practices had resulted into salinisation of lands in many irrigated areas in the Sangli district. During the eighties, therefore, small and marginal farmers shifted more to grain crops like jowar, bajra, gram and the oilseeds like groundnut, safflower and soyabean and to fodder crops, while the more resource-rich farmers moved towards cultivation of grapes and vegetables.

Situation in Ahmednagar district was however reported to be different from that in Sangli. Significant reduction in area under sugarcane and a shift towards irrigated rabi jowar, irrigated gram, summer groundnut, fodder crops, grapes, as also to livestock production in Ahmednagar was more a response to the reduced availability of water from irrigation systems due to widespread and higher deficiency of rainfall in the eighties. Many resource-rich farmers shifted to well or lift irrigation and drip irrigation method due to inadequate availability of water from the public irrigation systems since the mid-eighties. Much larger consumption of electricity for agriculture (item 4 in Table 9.6) in Ahmednagar is consistent with this trend.

In both the districts livestock production has also picked up very rapidly in the eighties. Ahmednagar tops in cross-bred cow population in the state and at present also leads in milk production alongwith Pune district. Each of them i.e., Ahmednagar and Pune had 8.3% share in the state's aggregate milk production in 1993-94. Though Sangli has also been a major producer of milk with 6.6 per cent share and a fourth rank among all the districts, it has been the second most important district after Pune in production of eggs in 1993-94.[6] Thus, with a distinct set back to sugarcane cultivation during the 80's, agricultural economy in Ahmednagar and Sangli is getting rapidly diversified with expansion of allied activities. The rate of diversification, however, must be much higher for the resourceful farmers than for the small and marginal farmers.

Recent trends in livestock production in Ahmednagar and Sangli demonstrate that the assessment of deceleration in agriculture is incomplete if livestock production is not covered along with crop production at the district level. However, as the series of SDP generated in agriculture were not available for districts, growth rates for the entire agricultural sector could not be computed. But we modified the GVO series marginally for these two districts by covering two more crops, namely, safflower and grapes for the second period. Though the modification led to improvement in growth rate for the second period it did not reduce degree of deceleration in growth significantly.[7]

Micro level investigation would therefore, be worth undertaking for Ahmednagar and Sangli to examine the pace and inter-farmer spread of agricultural diversification beyond 1990-91.

**Kolhapur District :**

Kolhapur district is unique in the state with productivity per hectare of its land being maximum and nearly 3.5 times the state average during the entire GR period. Another most distinct feature of agriculture in Kolhapur has been the lowest level of output instability in its crop sector among all the districts of the state (Table 9.4).

It is true that growth in all crop output and productivity had not been very high in this district in the last two and half decades. Nevertheless, the district has maintained its top position over time through moderate but steady growth performance, and further increase in area under sugarcane starting from the most superior initial position. Growth rates in all crop output and overall productivity in Kolhapur were 3.72% and 2.89% for period I and 2.37% and 1.57% for period II respectively.

Kolhapur district is endowed with the most favourable water resource availability among all the districts of the state as it combines high and assured rainfall with the above average irrigation development (Table 9.5). Similarly, it enjoys the benefits of distinctly higher infrastructural development i.e., of roads, rail transport, banking infrastructure etc. (Table 9.7). But more importantly it has exploited its favourable water-resource endowments through maximum level of adoption of both bio-chemical and mechanical technologies. Almost the entire area under cereals (rice, wheat and kharif jowar) was covered by HYVs/hybrids by the end of 80's. It uses the highest quantity of fertilisers per hectare (260 kg. in 1990-91), four times the state average, thus overcoming the constraint imposed by the initial low level of overall fertility index. Use of tractors in Kolhapur is maximum among all the districts and consumption of electricity in agriculture has also been fairly high (Table 9.6). Finally, another most unique feature of the district has been its superior and wide spread net-work of cooperative marketing societies (Table 9.7).

Yet another important feature of the agricultural economy of Kolhapur has been the domination of its crop sector by all the high productivity and/ or high value crops and progress in livestock production. Kolhapur grows mainly high productivity cereals like rice, wheat, kharif jowar, ragi and maize. Share of sugarcane has been maximum in Kolhapur among all the districts i.e., 13% of cropped area vis-a-vis the state average of 2% in TE 1990-91. Groundnut too (mainly summer groundnut) occupied a leading

position (16% cropped area) in the crop pattern of the district. It is followed by soyabean (2% area), another high productivity oilseed. The district also grows other high value commercial crops like chillies, tobacco, fodder crops etc.

In other words, behind the high value of land productivity in Kolhapur lie the factors such as :

(i) relative abundance of water resources,

(ii) a crop pattern dominated by high productivity and high value crops,

(iii) full exploitation of the available technological advances,

(iv) decisively better infrastructural development supported by a superior net work of cooperative marketing societies.

Thus, Kolhapur district has internalised in the most unique way benefits of new technologies through optimum exploitation of its favourable natural resources and superior infrastructural net work.

It is pertinent to note that composition of agricultural workers in Kolhapur is typical and represents a contrast to the situation in Akola, the best growth performance district of the state Akola. As against the domination of agricultural labourers (66%) in Akola, agricultural sector in Kolhapur is heavily dominated by the peasant cultivators, their percentage being 72% among the agricultural workers in 1991. Certainly, the distinctly superior entrepreneurship of the peasant cultivators and their spirit of cooperation must be a major force behind Kolhapur's unique success in agricultural growth.

Progress made by Kolhapur in livestock production is not less important. Though, Kolhapur district is smallest in size among the selected districts, nearly one-third of Ahmednagar in terms of land under cultivation it was the third most important district in milk production in 1993-94. Its share was 7.3% just next to Ahmednagar and Pune, each one of them accounting for 8.3% share in the aggregate milk production. Similarly, its share in the aggregate production of eggs in the state too was significant i.e., 4.5% with seventh rank among all the other districts. Thus, in addition to highly commercial character of its crop sector, the district has made rapid strides in diversification of its agricultural economy.

Yet, everything has not been all well in its agricultural economy. Yield per hectare of sugarcane crop, output of which accounts for nearly 60 per

cents of its GVO has shown declining trend in the eighties (Table 9.8). In spite of being the agriculturally most progressive and the major sugarcane growing district of the state, the district has not provided the kind of leadership it was expected to provide in the use and management of inputs, to the sugarcane producers of the state. Hence, the overall productivity growth in the crop sector of this district which reached a low level of 1.57% in the eighties is unlikely to improve significantly in future at least in real terms unless input efficiency in sugarcane cultivation increases in future.

## 5. Comparison of Akola and Kolhapur Districts and Its Policy Implications :

Agricultural economies of Kolhapur and Akola represent two distinctly different patterns of the agro-ecological and resource development conditions in the State. That is why, past experience of agricultural growth in these two districts would provide important lessons for the state's future agricultural policies.

Though dominance of commercial crops is the common characteristics of both Akola and Kolhapur crop pattern in Akola is dominated by cotton, cereals and pulses while in Kolhapur relative importance of sugarcane, oilseeds and high productivity cereals is overwhelming. But their crop patterns are compatible with their natural resource endowments and the state of resource development.

Kolhapur district is a region endowed with relative abundance of water resources and above average irrigation development and its agriculture is dominated by peasant cultivators. It has exploited to a maximum level the new seed fertiliser technologies as also the mechanical advances like the use of tractors and overcome the constraints of low natural soil fertility and availability of labour right from the initial stage of the GR period. It was also able to maintain low to moderate growth over and above its high level of land productivity per hectare by relaying more on intensive use of the new bio-chemical and mechanical inputs.

In contrast, Akola is predominantly a dry farming district with domination of agricultural labourers in its rural work force. The strategy of agricultural development in Akola appears to be more labour intensive and less intensive in terms of use of fertilisers and tractors (Table 9.6) and thus more appropriate for its predominantly dry farming character.

In both the districts technological advances played a key role in agricultural growth, though the character of technological advances and

mechanism of their spread were obviously different. In Akola the public sector research institutes mainly the. Dr. Punjabrao Deshmukh Krishi Vidyapeeth, Akola, alongwith the Centres for Dry Land Agriculture Technology of Indian Council of Agriculture Research, in coordination with the a state's extension sector played a leading role in providing and diffusing appropriate dry farming technologies combined with new seed-fertiliser technologies. Besides, World Bank aided Rainfed Farming Project, a project for watershed development in dry farming areas (1983-93) which was implemented in a few villages of Akola district must have complemented the efforts of the former institutes observation based on Appendix B.3 from the Draft Report of the Study). In fact, the training and research component of the world Bank's project was assigned to the Punjabrao Deshmukh Krishi Vidyapeeth.

Thus, the coordinated research and extension activities of the public sector institutes promoted high real growth in agricultural sector of Akola. It must have helped not only agricultural cultivators of the district in augmenting their incomes but the agricultural labourers too who represent a dominant component (66%) of the rural agricultural workers in Akola. This represents a contrast to the situation in Kolhapur district. We believe that it is the active role of the agricultural entrepreneurs, i.e., of the peasant cultivators which must have facilitated rapid and uninterrupted spread of new bio-chemical and mechanical technologies, more than the state's public sector extension institutes.

The lessons of these experiences are also evident. The development strategy which could work successfully, in the relatively backward rainfed farming region like Akola needs to be extended to the other dry farming areas of the Vidarbha and Marathwada regions after making it suitable to their local agro-ecological conditions. This will be in addition to the development of irrigation compatible with it. Both together would help in sustaining the process of high growth and imparting stability to it in future.

Experience of agricultural growth in Kolhapur district demonstrates clearly that in absence of continued and significant enhancement in the yield potentials of the existing HYVs/hybrids of crops, all crop output growth relying on merely intensification of new inputs like fertilisers in unlikely to lead to high growth, even in irrigated and assured rainfall areas. Hence, we may have to contend with moderate growth in the neighborhood of about 2% in many districts of the state in the absence of further expansion in irrigation coupled with improvement in the input use efficiency. More problematic areas in this context would be the conventional rice and rabi jowar growing area of the state if their crop pattern remain invariant. Setback to yield growth in the presently sugarcane growing areas is also

likely to continue in the absence of a more positive emphasis on achieving improvements in the efficiency of using water and fertilisers.

In other words, for sustaining even modest growth in the state's crop sector, there are no soft options like target oriented expansion in irrigation, fertilisers and other new inputs. Agricultural development strategies to be pursued in future need to be based on a positive emphasis on integration of seed-fertiliser technologies with appropriate cropping sequences and practices and watershed development techniques suited to various rainfed farming areas. Expansion in irrigation would certainly play a crucial role in future. But keeping in view the declining influence of irrigation on productivity of land, much more than mere expansion needs to be done to achieve sustained gains in productivity from it. Lessons of the past cannot be neglected if agricultural growth in Maharashtra is expected to lead to sustained growth in rural incomes.

## Notes

1. There has been high degree of multicollinearity between irrigation, HYV and fertiliser variable at the aggregate level especially for period I as is evident from the zero-order correlations given below :

| | Zero Order Correlating | | |
|---|---|---|---|
| Period | Irrigation & fertilisers | Irrigation & HYV use | HYV use & fertilisers |
| I. | 0.898 | 0.955 | 0.900 |
| II. | 0.866 | -0.017 | 0.356 |

Nevertheless, the degree of multicollinearity is more serious for irrigation and HYV (with r = 0.955) for period I as the correlation coefficient between them exceeds values of multiple R of the relevant regressions.

2. Refer section 5 from Chapter 2 for details about methodology and specification of variables.

3. Details of changes in irrigation for Aurangabad district are as follows :

| | 1970-71 | 1980-81 | 1990-91 |
|---|---|---|---|
| i) Net sown area (00' hectares) | 13014 | 12194 | 13258 |
| ii) Net irrigated area (00 hectares) | 596 | 1160 | 1817 |
| iii) % of net irrigated to net sown area | 4.6 | 9.5 | 13.7 |
| iv) Gross irrigated area | 714 | 1755 | 2339 |
| v) Cropping intensity on irrigated area (%) | 120 | 151 | 129 |

4. For detailed discussion of this issues refer to Section 6 from Chapter 3.

5. Either improved management of water and fertilisers on the sugarcane farms or extension of sugarcane cultivation to relatively high productivity areas may be responsible for positive trend in yield growth in Aurangabad district. The issue certainly deserves detailed investigation at the disaggregate level.

6. Source: Statistical Bulletin on Animal Husbandry, 1993-94, Office of the Commissioner of Animal Husbandry, Pune, 411001, Table 26 and 27.

7. Growth rates in gross value of output after adjusting the series for coverage of grapes for Sangli district and grapes and safflower for Ahmednagar district for the period from 1981-82 to 1990-91 are :

| | **Sangli** | **Ahmednagar** |
|---|---|---|
| Without coverage of additional crops | -1.21 ($R^2$ = 0.20) | -3.53 ($R^2$ = 0.29) |
| With coverage of additional crops | -0.24 ($R^2$ = 0.20) | -3.31 ($R^2$ = 0.26) |

## Annexure 9.1
## DRY FARMING TECHNOLOGY STRATEGY IN AKOLA

Four major and mutually complementary elements of the dry farming technology strategy, and their beneficial impact on crop productivity growth in Akola are described below :

(i) **Vegetable Bunds for Soil and Moisture Conservation:** Emphasis on vegetative bunds (particularly of khus grass on the boundaries and rows of subabul within the fields) ensured maximum conservation of rainfall water, prevention of runoff of rainfall water and thereby of soil erosion. In addition it simultaneously augmented supply of organic manures and improved the efficacy of chemical fertilisers under rainfed conditions. Both together pushed up yields of crops raised in the short run and improved soil structure in the long run.

(ii) **Inter/Mix Cropping:** Emphasis on inter/mix cropping vs. sole cropping with appropriate combinations of the early maturing short root crops and late maturing deep root structured crops suited to different rainfall zones in the district augmented utilisation of moisture in both the upper and lower layers of the soil thereby ensuring healthy plant growth for both the crops (Inter/mix cropping practices recommended in Akola include cultivation of cotton with green gram or soyabean, hybrid jowar with tur, tur with green or black gram instead of sole cropping of cotton, jowar or tur respectively.

(iii) **Green Manuring Practices:** Emphasis on green manuring practices along with recommendation of chemical fertilisers improved management of fertilisers under rainfed conditions.

(iv) **Flexibility in Crop Sequences/Mixes :** The regional agricultural university (namely, Dr. Punjabrao Deshmukh Krishi Vidyapeeth, Akola) devised cropping patterns and crop sequences for different seasons after studying 90-year rainfall data (1900-1989) to suit varying rainfall situations in order to maximise aggregate output per unit of land. Differential rainfall situations included:

(a) early commencement of monsoon
(b) late commencement of monsoon
(c) normal commencement but with long dry spells in between
(d) longer than normal spell of monsoon and
(e) early withdrawal of monsoon

The four major elements of the dry farming technology in addition to being mutually compatible must have had positive inter-action effect on the

aggregate yield per hectare of land under cultivation. This explains sustained rise in cropping intensity and accelerated growth in all crop output in Akola in the second period in absence of expansion in irrigation.

True, spread of the above mentioned dry farming technology practices had not been widespread and uniform in all the areas of Akola. Yet, due to special extension programmes of the Punjabrao krishi Vidyapeeth and the efforts of T & V organisation operating in the district, farmers were aware of the beneficial impact of these practices and had adopted them in varying degree particularly in the latter part of the eighties.

In this context, it is difficult to comment on the role and impact of the World Bank aided Rainfed Farming Project which was implemented in a few villages of Washim and Mangarulpeer talukas of the district, in the absence of availability of any evaluation report of the programme. But as the research and training component of the World Bank Project was assigned to Punjabrao Krishi Vidyapeeth the Project must have complemented and reinforced the efforts of the latter institute.

It is important to reiterate the role of Regional Agricultural University as also the State's T & V Organisation operating in and the neighbouring districts of Akola in augmenting output impact of the above mentioned strategy. The former, namely, Punbjabrao Deshmukh Krishi Vidyapeeth provided the required research support by (i) ensuring development of the early maturing and/or pest and disease resistant strains of a number of crops particularly of pulses (black gram, green gram, tur, gram etc.), oilseeds (sunflower, soyabean, safflower etc.) cotton etc., (ii) devising crop sequences and mixes alongwith suitable cultivation practices for different rainfall zones in the region and (iii) demonstrating their profitability and superiority over the conventional practices to the farmers in the region.

In addition to Akola district, a few parts of other districts in the Vidarbha region too benefitted from development and diffusion of dry farming technology practices. It was facilitated by the ICAR's centres for dryland agriculture located in Amravati, Yavatmal, Buldhana, Akola (Washim taluka) and Wardha districts in addition to a centre already set up in the Punbjabrao Krishi Vidyapeeth, Akola.

Thus, it is evident that the efforts of the Regional Agricultural University, ICAR's Centres for Dryland Agriculture, the State's T & V Organisation and the World Bank's Rainfed Farming Project complemented each other in development and effective diffusion of the appropriate dry farming technology packages in Vidarbha region, in general, and Akola district in particular.

# CHAPTER 10

## CONCLUSIONS AND IMPLICATIONS

We have analysed in this study the agricultural growth experience of Maharashtra in the green revolution period (1967-1993) by focussing on trends and sources, inter-temporal and spatial pattern of growth and instability in crop production. The major objectives of the study were to (i) evaluate the past growth performance, (ii) identify the constraints under which growth has taken place in the past and (iii) try to explore future prospects of growth.

We have compared the extent and characteristics of growth in the two phases of the period under study, vis., the early phase i.e., 1967-80 and the latter phase i.e., 1980-93, and investigated possible causes responsible for differential growth performance during the two phases. We have also studied inter-district concentration in output growth and input use and the inter-relationship between the two. Additionally, an attempt has been made to identify technology and non-technology variables associated with productivity growth in agriculture.

In the present chapter we summarize briefly the conclusions emerging out of our analyses, highlight the constraints on agricultural growth in Maharashtra, comment on future prospects of growth in various regions of the state and finally, indicate implications of our conclusions for reorientation in the state's agricultural policies.

### 1. Conclusion :

### Trends in and Sources of Growth in Crop Output

Pattern of growth over the two sub-periods under the study was significantly differential across the major crops and crop groups including that of the all crop output. Aggregate growth performance of the crop sector in Maharashtra was commendable as growth in the all crop output exceeded 5% during 1967-80 period. But it slipped down considerably in the post-1981 period (2.36%). Major source of decline in the growth rate of crop output was steep fall in the growth of aggregate crop-yield index.

Cereals and sugarcane were the main crops responsible for depression in growth of the aggregate crop output and yield per hectare after 1980. For cereals, as a group, pace of expansion in yield slowed down greatly after 1981, and reached a very low level i.e., from 5.92% in period I to 1.75% in period II, where as deterioration in growth for yield per hectare of

sugarcane was worse. High positive growth rate (i.e., 3.82%) in its yield per hectare in the pre-1981 period was replaced by a significant negative value (-1.33%) in the post-1981 period.

A more distressing observation was that deceleration in the aggregate output and yield growth was accompanied by progressive increase in the rates of expansion of many key inputs such as fertilisers, pesticides, electricity etc., from the pre-1981 to the post-1981 period. It certainly implied decline in total factor productivity growth in the state's agricultural sector. A detailed investigation of the issue revealed that unfavourable rainfall conditions were only partly responsible for worsening of the growth environment during the 80's. Indeed, a few other factors hastened the process. They were : (1) slack in the pace of yield augmenting seed technology development for cereals particularly rice, jowar, and maize grown in the unirrigated areas (ii) Neglect of varietal improvement programme for an important cash crop like sugarcane, (iii) Failure of policies in ensuring wider dispersal of irrigation water across the crops in the process, denying benefits of incremental irrigation to cereals. (iv) Deterioration in the use and management efficiency of inputs, in general, but especially for heavy-input using sugarcane crop.

An adverse impact of a serious set back to output and yield growth of cereals and sugarcane crops which together accounted for nearly 68% weight in the state's all crop index was contained to some extent by an emergence of a reverse trend of acceleration in output growth for pulses and oilseeds after 1981. Besides, growth in cotton production too continued at a more or less undiminished pace, of 2%. A further support, though marginal, to the process of growth came from rapid expansion in output of a few high value vegetable and fruit crops, since the late 1980's. The main source of output expansion for all these crops, excluding cotton and pulses, had been accelerated expansion in area. Thus, crop pattern changes played an important role after 1981 in supporting the process of growth in crop output. Oilseeds were the major beneficiaries of these changes and were followed by other minor high value crops, pulses and sugarcane in the descending order.

Nevertheless, it is pertinent to recognise that continuation of moderate growth in the all crop output beyond 1981, was not merely the result of crop pattern changes in favour of high value non-cereal crops. Extension of technological advances to crops other than cereals both in the irrigated and rainfed farming areas of the state also played a crucial role.

Benefits of new technology embodied in the use of inputs such as short duration HYVs, fertilisers, pesticides etc., which remained confined mainly to

a few cereal crops till the late 1970s, started spreading rapidly to the other crops during the eighties. Emergence of this new trend explains why a few non-cereal crops like green gram, black gram, groundnut, sunflower, soyabean etc., could register significant positive growth in their yield per hectare and provide an additional support to the process of growth in the crop sector.

**Regional Pattern of Past Growth and Future Prospects**

There was downturn in the growth momentum after 1981, in all the administrative divisions of the state with an exception of Amravati division alone. Yet, the pattern of growth across the divisions underwent a significant change, with reshuffling in their relative positions. This was because the degree of deceleration was not uniform over the divisions and even across the districts within a division.

Aurangabad division i.e., Marathwada region was at the top with highest growth rate (6.5%) in its crop output in period I. But it slipped to the second position with moderate growth (3%) in period II.

Nasik, Pune and Kolhapur divisions which represent Western Maharashtra were next to Aurangabad division, in that order, in both the periods and thus continued in the middle range of the growth ladder. But the process of growth was highly turbulent in the Nasik and Pune divisions where very high growth (5.6% to 6%) in the pre-1981 period was followed by severe depression during the 80's and again some recovery in growth by 1995. Recovery was more impressive in the Nasik division, mainly due to expansion in high value horticulture production. As against, this, high growth in period I in Kolhapur division (4.8%) was replaced by steady but moderate growth (2.3%) since 1981.

Amravati division of Vidarbha region was proved to be unique with sustained high growth above 4% in the entire GR period. It alone experienced acceleration in growth after 1981, when growth rates moved down in all the other divisions. That was why, it moved up from the fifth rank in period I to top position in period II.

It is pertinent to note that the growth pattern across the districts was greatly desperate for Nagpur division of Vidarbha region. Nagpur and Wardha districts resembled closely the steady growth pattern of Amravati division but more irrigated Bandara and Chandrapur districts were characterised by low and highly unstable growth especially in period II. Finally, the Konkan division (i.e., Konkan region) continued at the lower end of the growth ladder even after 1981, with no change in its relative position.

Comparative growth performance of various regions in period I and II suggested broad pattern of the regional prospects of growth. Our final judgement in this respect was, however, guided by the consideration of thee additional factors. They are one, regionwise scope for diffusion of new technologies with promising growth potential, two, potentiality for expansion in high value but minor non-conventional crops and relative impact on growth of the removal of infrastructural bottlenecks, including that of under-development of irrigation, and credit institutes.

Medium to long term prospects of expanding aggregate crop output covering pulses, cotton, cereals and oilseeds are highest in Vidarbha region, particularly, in its Akola, Amravati, Nagpur and Wardha districts. Marathwada region, especially Aurangabad, Parbhani and Beed districts, would follow closely Vidarbha region. Between the two regions Marathwada would lead in expansion of oilseeds while Vidarbha region would excel in expanding output of pulses, cereals and cotton. Progress in sugarcane production is also likely to be significant in Marathwada but not so in Vidarbha region. But the pace of exploitation of the prospects of agricultural growth in both Vidarbha and Marathwada regions would ultimately be determined by progress in removal of infrastructural bottlenecks in these regions.

Western Maharashtra would lead in diversification of agriculture within an accent on production of fruits, vegetables, oilseeds like groundnut and soyabean and other high value minor crops, too. Diversification would be more in favour of fruit crops in Nasik division whereas high-value non-conventional crops and vegetables would lead the process of diversification in Pune division. Besides, success of Krishna valley irrigation development programme might provide a boost to accelerated expansion in agriculture including sugarcane production in this region. But improvements in water and nutrient use efficiency and dispersal of irrigation benefits across the crops would hold a key to transformation of agriculture in this region into a commercialised and vibrant sector.

Lastly, prospects of agricultural growth are relatively low in the Konkan region at least in the medium run, promising potential for expansion of horticultural and other high value plantation crops notwithstanding. Poor state of development of (a) land and irrigation (b) net work of roads, communication, credit institutes and (c) agro-processing units represents the most crippling constraint on growth in the Konkan region.

Finally, significant externality associated with the process of sustained high growth in the agricultural sectors of Vidarbha and Marathwada regions needs to be explicitly recognised. Apart from cereals, these two regions grow many commercial crops like cotton, oilseeds and pulses which require

substantial off-farm processing. They also account for 60% of agricultural labourers in the state and thereby a major share in the state's poor population. A development strategy which aims at higher expansion in irrigation, infrastructure and technology induced multiple cropping in these regions would certainly promote labour intensive expansion in agricultural output and its trading and processing. To that extent, resulting process of development would be more participatory and benefit agricultural labourer too. In other words, sustained high growth in agriculture in these regions would serve the dual goal of raising real incomes of cultivators and simultaneously achieving enduring reductions in the incidence of poverty.

**Output Instability in Crop Sector**

State level instability in the all crop output did not increase significantly in the post - 1981 period, despite relatively more unstable and unfavourable performance of monsoon compared to the pre-1981 period. It must be the result of two different types of forces, having opposite pulls on the aggregate output instability, operating simultaneously in the crop sector.

Increase in the relative contribution of the area component to output growth in the second period vis-a-vis that of the yield component, a more volatile component, must have induced downward pressure on the level of output instability. Likewise, rapid spread of the use of pesticides and also of pest-resistant varieties of many cereal and non-cereal crops must have further helped to contain the output instability during this period. In contrast, increased contributions of high instability regions like Vidarbha and Marathwada to the process of growth in the post - 1981 period but significantly reduced share of low or moderate instability regions like Western Maharashtra must have aggravated instability in the crop output.

Individual crops and crop groups, however, recorded contrasting inter-period changes in output instability. Index of instability rose marginally for cereals and sugarcane, shoot up for pulses and oilseeds but declined for cotton. To a large extent, substantial rise in the use of pesticides must be responsible for a fall in inter-year output instability for a crop like cotton. As against this, changes in the spatial pattern of growth in the output of pulses and oilseeds in favour of high instability regions such as Vidarbha and Marathwada must have aggravated instability in their output. Besides, the extension of new technology to many pulses and oilseed crops grown in the rainfed farming areas must also have contributed to increased inter-year instability in their output.

Analysis of inter-district inequity in the input-use especially, the use of three key inputs namely, percentage of area under HYVs and irrigation and use of fertilisers per hectare revealed no evidence of sustained and

significant decline through both the periods i.e., period I and II.

In period I, fall in inter-disparity was very sharp in respect of the use of HYVs but it was moderate for the extent of irrigation. In contrast, inequity in the use of fertilisers increased significantly during the same period. But period II was, however, characterised by a decline in disparity, in general, for all the three inputs though at greatly desperate rates. Reduction was highest again for the use of HYVs, very moderate for fertiliser use but also negligible with regard to percentage of irrigated area.

Indeed, it was distressing to find that in respect of the extent of irrigation two regions, namely Konkan and Vidarbha (excluding Chandrapur and Bhandara districts) continued to lag behind all the other regions due to their negligible shares in the incremental irrigated area in period I and II, both.

Likewise, the state of inter-district disparities with regard to the other infrastructure crucial to agricultural growth, such as development of credit institutes and transport, too did not improve during the 80's. Regions deprived off of their legitimate shares in infrastructural expansion continued to be the Vidarbha, Konkan and Marathwada regions.

Similarly, there was no evidence of either increased or decreased concentration of output growth across the districts, despite significant reshuffling in the relative positions of many districts with rise or fall in growth rates between the two periods. A few of them namely, Akola, Amravati, Solapur, Satara etc. moved up the growth ladder while many slided down though at differential pace. In contrast, a few others, such as, districts from the Konkan region and Nagpur division of the Vidarbha region were, exceptional as they continued at the bottom of the growth ladder with almost no change in their ranks in period II.

In addition, the analysis demonstrated absence of distinctly identifiable common pattern of input use in the better performing districts. Among them, Akola district from Amravati division of Vidarbha region revealed unique growth pattern. It registered largest increase in the aggregate growth after 1981 over that achieved in period I (i.e, from 4.67% in period I to 6.81% in period (II), its negligible base of irrigation, low fertiliser use and less developed infrastructure of transport and credit network notwithstanding. It demonstrated the success and development potential of the rainfed farming technologies which aimed at maximisation of the overall land productivity rather than the productivity of individual crops. They embodied integration of new seed fertiliser technologies with the locally adaptable cropping sequences, crop-mixes and in situ at water conservation practices.

All the alternative regressions highlighted continued and crucial significance of the rainfall variable for the entire GR period, while indicating, additionally, marginal fall in the elasticity of rainfall in period II. The other variables particularly irrigation, HYVs and fertilisers did not show sustained impact on productivity growth in both the sub-periods. Yet, their significance and relative importance was found to be consistent with the differential growth pattern obtained in the two periods.

Key role of rainfall variations in determination of productivity growth was but natural for a state like Maharashtra in which case hardly 15% of cropped area was irrigated by 1994. Likewise, marginal reduction in sensitivity of the aggregate productivity to the rainfall index in period II was the result of widespread use of pesticides and adoption of seed technology advances ensuring some degree of resistance to moisture deficiency and pest-infestation for many cereal and non-cereal crops after 1981.

Significant influence of irrigation in both the period but its greatly reduced role in period II has also been found to be consistent with the evidence of deterioration in the operational efficiency of the public irrigation systems and a general decline in the on-farm input use efficiency in agriculture during the eighties.

Role of HYVs/hybrid varieties of cereals, too, was differential in the two periods. Their initial swift spread in period I induced very high growth in productivity of cereals and consequent spurt in the aggregate productivity. But behind rapid expansion in the use of HYVs in period I, was also the support of comparatively favourable rainfall conditions and preferential allocation of irrigation to rice, wheat, and maize, which was absent subsequently in period II. Moreover, it is pertinent to note that in period I, the use of fertilisers was negligible and not synergistic to that of HYVs/ hybrid seeds of cereals, especially in respect of the most important cereal crop, namely jowar. In contrast, the role of expansion of HYVs of cereals was limited in period II. Instead, rapid spread of new varieties of many non-cereals i.e., pulses, oilseeds and minor high value crops was accompanied by significant rise in the use of fertilisers in period II in all the areas both irrigated and unirrigated and was the prime force behind productivity growth after 1981. That was why, the role of HYV variable turned out to be significant in period I but ineffective in period II. Vice-versa was the case with regard to productivity impact of the fertiliser variable.

## 2. Implications :

Conclusions emerging from the analyses of various aspects of agricultural development in Maharashtra provide important directions for re-orientation in the agricultural development strategy to be pursued in future. In this respect, we restrict our comments mainly to three areas, namely, irrigation, technology and infrastructural development.

### Irrigation :

Progress of agricultural growth in Maharashtra in undoubtedly linked to the pace of development of irrigation in future. But gains in productivity from expansion in irrigation and its output stabilising impact would inextricably depend upon the degree of its dispersal across the crops and operational efficiency of the irrigation systems. Experience of the past, however, has been very unsatisfactory in this context.

Water supply from irrigation has been progressively diverted to sugarcane crop particularly during the eighties with simultaneous fall in its yield per hectare in almost all the sugarcane growing areas. Operational efficiency of the public irrigation systems too deteriorated with significant reductions in the expenditures on repair and maintenance of the systems (S. Mahendra Dev, 1995 Dhawan B.D., 1996)[1].

Deficiencies in operational performance of irrigation systems are also linked to non-compatibility of the distribution systems with the schedules of water requirements of crops grown in the command area. The latter, many a times is the result of weak coordination between irrigation and agriculture departments of the state especially during the stage of project formulation and the engineering - oriented programmes of CADA. Besides, inefficiency in power supplies (e.g. frequent power failures and load fluctuations) in many rural areas has adversely affected efficiency in use and management of water supplies from the privately owned wells and privately and collectively operated lift irrigation systems. Therefore, there is an urgency to correct the situation. On the one hand adoption of coercive policies, such as denying flood irrigation to sugarcane farms or at least restricting significantly their access to water supplies and making use of water economising devices like drip sets or sprinklers etc., compulsory, especially for water intensive crops, has become all the more inevitable. On the other hand, concurrent and significant improvements in dependability of water and power supply and in quality of the associated services are also called for. The problem is, without financial sustainability of the systems the latter i.e., improvement in their operational efficiency cannot be achieved.

There is yet another major problem of the large backlog of the existing irrigation projects in the state. Indeed, the backlog is reported to be highest in Maharashtra among all the states (S. Mahendra Dev, 1995)[2]. Completion of these projects is equally important as commencement and execution of new projects. In respect of both, the regions which have received negligible benefits from the past investment in irrigation, like Amravati and Konkan divisions should get preferential treatment. Besides, as regeneration of water resources is fundamental for their increased utilisation in many water scarce areas of the state, development of watershed and location specific water conservation techniques must progress simultaneously with the development of irrigation compatible with the former. This implies integrated planning and concurrent investment in both. In other words, financial support needed to accelerate development of irrigation and improve performance of irrigation sector would be stupendous, though increased finance alone would not be enough. Therefore, three types of significant adjustments in the policies must be initiated.

One, allocation of public resources for agricultural development and alongwith it for irrigation and watershed development deserve to be stepped up progressively. This represents a clear departure from the near-stangancy of public investment in agriculture in Maharashtra in the eighties.

Secondly, a phased progamme of increases in water charges and electricity tariffs whether for agriculture or other purposes must be implemented without delay, while ensuring concurrent improvements in management of the systems and increased allocations for their operation and maintenance.

Thirdly, to improve overall performance of the irrigation sector, farmers' collective participation in distribution and management of water in the public irrigation systems and private investment in future development of irrigation must be encouraged to the extent possible.

**Technology Development and Extension :**

Having exploited major gains of extensive diffusion of new seed-fertiliser technologies to a few cereal crops in the 1970's and thereafter to selected non-cereal crops during the eighties, the future task of development and extension of technologies for agriculture is now more complex and challenging.

Yield growth has already tapered off during the 80's for crops like rice, jowar, wheat and maize grown under rainfed conditions in the state. Even at the national level, there are no significant break-throughs in the pipeline

for immediate diffusion for irrigated cereals.[3] Thus, the indications are that the yield growth is unlikely to be dramatic in future, as it was in the initial phase of the GR period. What is said about cereals, holds equally for non-cereals. That is why, the emphasis has to be more on progressive reduction in the gap between the on-farm and the potential yields of the existing or the on-line varieties through improvement in the overall input-use efficiency in agriculture. In other words, now the focus has to be more on achieving integrated and efficient management of all the input, both conventional and non-conventional. The approach would certainly, be different from that of target oriented expansion in the use of either new seeds or other inputs like fertilisers and pesticides in isolation, as was attempted in the past. Special attention needs to be paid, in this context, to promote balanced use of fertilisers and organic manures and integrated pest management.

Emergence of gradual trend towards commercialisation and diversification of agriculture has also added another challenging dimension to the technology development task. Unlike the past, it has to cover now many more crops, both cereals and non-cereals and devise the varieties for more heterogenous environments in the rainfed farming areas from different parts of the state. A more pragmatic strategy under this situation, therefore, would be to concentrate on the evolution of farming systems and cropping sequences/mixes etc., for promoting rapid rise in the aggregate land productivity rather than aiming at large increases in the yields of a few individual crops, through highly input-intensive technologies.

Indeed, the simultaneous focus on achieving the integrated and efficient management of all the inputs and the farming systems approach for promoting aggregate land productivity is far more desirable for the rainfed farming areas of the state. These two proposed components of the future technology development strategy are not only highly mutually compatible but would reduce progressively the trade-off between the goals of accelerated agricultural growth and environmental conservation.

**Credit Expansion and Infrastructural Development :**

Intensive cultivation of land through progressive adoption of new technologies requires continued support of the adequate and unhindered flow of credit to agriculture. This need will become increasingly crucial as the trend towards commercialisation and diversification of agriculture intensifies in future.

The flow of aggregate agricultural credit to Maharashtra has been more or less adequate in the past as the state's share in all India agricultural

credit has been maintained apart from some inter-year fluctuations, close to or above its share in all India net sown area[4]. The more disturbing issue is, however, of the significant inter-regional disparity in the flow of credit. Till 1990-91 shares of Vidarbha, Konkan and Marathwada regions in the state level agricultural credit continued to be below their shares in the aggregate net sown area[5]. The problem of inadequacy in credit appears to be more serious for Vidarbha region particularly the Amravati division. Future expansion in agricultural credit, therefore, must be directed more towards these regions as far as possible. There too, the care has to be taken that the small and marginal farmers are not deprived off their due share in the aggregate credit flow. This is because in addition to inter-regional inequity an equally important and a more general issue of the constrained access to agricultural credit of the small and marginal farmers must be tackled satisfactorily. It is possible, that this problem may get neglected as newly emerging corporate forms, farm houses of the elite urban residents and the resourceful farmers appropriate increasing proportion of the total agricultural credit in future. It is necessary to reiterate, therefore, that special policies need to be devised to ensure easy and timely access of the small and marginal producers to the institutional credit without resorting to popular measures such as 'loan waivers'.

Given the appropriate irrigation and technology development it is the efficient infrastructure particularly good roads, communication and markets which create an enabling environment in which farmers receive their due share in prices paid by the ultimate consumers. Situation in this respect in many rural areas of Maharashtra is far from satisfactory. The producers of not only more perishable products like vegetables, fruits, flowers, etc., but many a times even of others receive unjustifiably low prices for their produce and are not assured of even the minimum stable returns over their cost of production. It is true that collective or cooperative marketing on the part of the producers would greatly help in improving the situation. But we believe that the poor state of rural infrastructure is the major hindrance in many areas in this respect. If a gradual trend towards commercialisation and diversification of agriculture that has emerged in the eighties needs to be sustained and promoted, rural infrastructure supporting trade in farm products and inputs and processing of the produce must be strengthened with an emphasis on its quality. There is a strong case for increased investment in rural infrastructure in the relatively backward and neglected areas like Konkan region and even more so in high growth potential but infrastructurally under developed area like Vidarbha region.

It is thus evident that the resource needs for technology-led high growth based on land intensive and resource efficient agriculture are tremendous. But keeping in view its desirable impact on rural incomes and farm and

non-farm employment and thereby its increasingly positive contribution to the goal of growth with equity and sustainability it deserves priority over other investments by the state. Private sector's participation should also be encouraged to the extent feasible, particularly in relatively more developed and agriculturally progressive rural areas requiring less state intervention. Lastly, we reiterate that concurrent improvement in the quality of state intervention are equally important as the size of investment.

**Issue of Small and Marginal Farmers[6]**

Finally, a special reference to an important issue of the small and marginal farmers and the associated problem of enhancing productivity and efficiency of their farms is inevitable. This is because 74% of ownership holdings and 63% of operational holdings are 'marginal and small' in Maharashtra and they control about 20% of owned/operated area (NSSO, 48th Round, 1992)[7]. Though the rate of marginalisation of both the ownership and operational holdings has slowed down in the eighties compared to the seventies, the process of marginalisation is likely to continue in view of continued demographic pressure on a fixed land base which may even erode in future and absence of significant increase in non-farm employment in the immediate future.

Land is not only a major income generating asset in rural areas but a minimum bargaining power to the marginal and small owners. That is why, any tampering with the existing ceiling for cultivated lands would be grossly contradictory to the goal of special justice. The entitlement to land has assumed crucial importance in view of the fact that the relatively poor state of human development in many rural areas of the state has deprived the small producers and the agricultural labourers the skills required to attain a reasonable standard of living through non-farm employment. This is the result of neglect of rural education, health and infrastructure in the past four decades, in addition to social stratification in a rural society. The existing land ceilings would check, at least, further deterioration in inequality in land ownership. An additional reason for not increasing the ceilings is that it would aggravate land-inequality without any appreciable gains in productive efficiency in agriculture.[8]

The alternative remedial measures may be devised to support the small and marginal farmers. For example, a phased programme of legalisation of tenancy with a right of resumption to the land owner, after a minimum stipulated period may be desirable keeping in view wide-spread incidence of concealed tenancy arrangements (68% of area under unrecorded lease to total area possessed but not owned in Maharashtra as per NSSO, 48th Round, 1992)[9].

It is expected to help the small and marginal owners either to expand their operational holding by leasing in additional land or leasing out their land to others without loosing its ownership. Such freeing of tenancy may initially be attempted in some selective areas and extended to the other areas after assessing its impact in the Former[10].

Besides, we are optimistic that the successful implementation of a technology development strategy proposed in the earlier section, combined with promotion of high value and high productivity crops and significant expansion in irrigation may enable many small farms to cross the threshold of economic viability. A further support to them may also come from the expansion in the rural non-farm employment opportunities especially in trading of farm inputs and services and trading and processing of farm produce associated with accelerated land intensive agricultural growth. We believe that this would provide much needed respite to the small and marginal farmers before they eventually move out of the farm sector for getting absorbed in more productive and paying activities.

We are optimistic about the prospects of stepping up growth in agriculture in Maharashtra, reducing its inter-regional disparity and simultaneously make it serve the goal of poverty alleviation. What is needed is a political commitment to promote investments for development of irrigation and other infrastructure and technologies for agriculture, without neglecting the development backlogs of various regions and districts within them.

## Notes

1. (i) S. Mahendra Dev, (1995), 'Public Expenditure Review of Maharashtra Agriculture', Background Paper prepared for the World Bank's Maharashtra Agricultural Development Project, page VIII, para 15.

   (ii) Dhawan, B.D., (1996), 'Latent Threats to Irrigated Agriculture in the Ninth Five Year Plan' A paper submitted IIMA National Seminar on 'Agricultural Development Perspective for the Ninth Five Year Plan' (Mimeo).

2. 'The case of Maharashtra seems to be unique. In the late 1980's the state alone accounts for about 20% of the total irrigation projects under pipeline in India, with 31 major and 47 medium projects spilling over into the 1990's, involving a total cost of Rs. 60 billion at 1980-81, prices .....
   Source: S. Mahindra Dev. *ibid* page VIII, para 14.

3. (i) Pray, C.E., (1991), 'High Yielding Varieties And the Indian Seed Industry', Background paper prepared for the 1991 Indian Country Economic Memorandum (Mimeo).

   (ii) Sawant, S.D., (1996), 'Foodgrains Output Growth in India: Emerging Constraints And Perspectives for Technology Development Policies' A Paper submitted to IIMA National Seminar on Agricultural Development Perspectives for Ninth Five Year Plan, June 1996.

4. Type of Loans — % share of Maharashtra State in all India agricultural credit in

| | 1973-74 | 1980-81 | 1990-91 |
|---|---|---|---|
| Term loans (Cooperatives, LDBs and Commercial Banks) | 15 | 10 | 18 |
| Short term loans (PACS and Commercial Banks) | 17 | 12 | 13 |

Sources: NABARD, data available for the years from 1973-74 to 1990-91.

5. **Inter-division Disparity in the Institutional Credit Flow**

| Divisions | Divisionwise % shares in | | | |
|---|---|---|---|---|
| | Outstanding Credit of Scheduled Commercial Banks (90-91) | Fresh advances from agricultural and Multi-purpose Credit Societies (90-91) | Loans Outstanding of agricultural and Multi-purpose Credit Societies (90-91) | The net sown area (90-91) |
| (1) | (2) | (3) | (4) | (5) |
| Konkan | 6.4 | 1.6 | 1.9 | 4.5 |
| Nasik | 11.9 | 21.1 | 23.8 | 13.8 |
| Pune | 24.7 | 22.7 | 24.2 | 18.1 |
| Kolhapur | 14.4 | 20.0 | 14.6 | 8.7 |
| Aurangabad | 15.2 | 24.2 | 23.3 | 26.8 |
| Amravati | 11.1 | 6.2 | 7.4 | 17.1 |
| Nagpur | 10.6 | 4.2 | 4.7 | 11.0 |
| Maharashtra | 100.0 | 100.0 | 100.0 | 100.0 |

6. We are grateful to M.L. Dantwala, Professor Emeritus, University of Mumbai for his suggestion to make a reference to this issue.

7. Government of India (1995-96), National Sample Survey Organisation, Land and Livestock Holding Survey, NSS, Fortyeighth Round (January-December 1992), Reports 1 and 2 (Mimeo).

8. C.H.H. Rao (1996), *Op.cit*

9. Government of India (1995), *ibid*, page 152.

10. For a detailed discussion of this issue refer, Sharma HR, 'Land Reforms: Status and Opportunities', in Desai BM (1997), *Op. Cit.*

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## Appendix A.1
## Specifications of Districts and Divisions Covered

**I. Konkan Division :**

1. Thane
2. Raigad
3. Ratnagiri (including Sindhudurg)

**II. Nasik Division :**

4. Nasik
5. Dhule
6. Jalgaon

**III. Pune Division :**

7. Ahmednagar
8. Pune
9. Sholapur

**IV. Kolhapur Division :**

10. Satara
11. Sangli
12. Kolhapur

**V. Aurangabad Division :**

13. Aurangabad (includes Janla)
14. Parbhani
15. Beed
16. Nanded
17. Osmanabad (includes Latur)

**VI. Amravati Division :**

18. Buldhana
19. Akola
20. Amravati
21. Yavatmal

**VII. Nagpur Division :**

22. Wardha
23. Nagpur
24. Bhandara
25. Chandrapur (includes Gadchiroli)

## Appendix A.2

### 2.1. Crops and Crop Groups Included in the State Level Analysis

1. Rice
2. Jowar (Kharif)
3. Jowar (Rabi)
4. Bajra
5. Maize
6. Ragi
7. Wheat
8. Other Cereals (other than 1-7)
9. Gram
10. Tur
11. Other pulses
12. Groundnut
13. Sesemum
14. Linseed
15. Nigerseed
16. Safflower
17. Soyabean
18. Sunflower
19. Sugarcane
20. Cotton
21. Mesta
22. Potato
23. Chillies
24. Onion
25. Banana
26. Tobacco
27. Cereals (1 to 8 combined)
28. Pulses (9 to 11 combined)
29. Oilseeds (12 to 18 combined)
30. All Crops (1 to 26 combined)

### 2.2 Crops and Crop Groups Included in the District Level Analysis

1. Sugarcane
2. Cotton
3. Cereals
4. Pulses
5. Oilseeds
6. All Crops

## Appendix A.3
## Cropss Included in Gross Value of Output and their Prices

| | Crop | Price Rs./ Quintal (1980-81) | Source |
|---|---|---|---|
| 1. | Rice | 201.87 | Farm Harvest Price |
| 2. | Jowar (Kharif) | 151.41 | " |
| 3. | Jowar (Rabi) | 151.41 | " |
| 4. | Bajra | 141.72 | " |
| 5. | Maize | 123.32 | " |
| 6. | Ragi | 123.79 | " |
| 7. | Wheat | 199.92 | " |
| 8. | Other Cereals | 123.79 | Farm Harvest Price for Ragi |
| 9. | Gram | 313.85 | Farm Harvest Price |
| 10. | Tur | 423.01 | " |
| 11. | Other Pulses | 339.00 | Wholesale price of Moong - Aurangabad Market |
| 12. | Groundnut | 387.26 | Farm Harvest Price |
| 13. | Sesemum | 541.17 | " |
| 14. | Linseed | 444.71 | " |
| 15. | Nigerseed | 359.00 | Wholesale price, Bombay Market |
| 16. | Safflower | 323.42 | Wholesale price, Jalgaon Market, Maharashtra |
| 17. | Soyabean | 239.20 | All India price, (average for 1980-83) |
| 18. | Sunflower | 410.80 | " |
| 19. | Sugarcane (Gur) | 380.86 | Farm Harvest Price |
| 20. | Cotton (Kapas) | 1443.90 | " |
| 21. | Mesta | 184.75 | Wholesale price, Calcutta Market |
| 22. | Potato | 123.15 | Farm Harvest Price |
| 23. | Chillies | 826.58 | " |
| 24. | Onion | 61.25 | Wholesale price, Nasik Market, Maharashtra |
| 25. | Banana | 53.33 | Wholesale price, Jalgaon Market, Maharashtra |
| 26. | Tobacco | 600.00 | Farm Harvest Price. |

Note : Farm Harvest refers to state farm harvest prices for Maharashtra.
Sources: 1) Farm Harvest Prices of Principal Crops in India, Ministry of Agriculture, Government of India.

2) Agricultural Prices in India, Ministry of Agriculture, Government of India.

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