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INVESTIGATION OF THE HYPOTHESIS OF DECELERATION IN INDIAN AGRICULTURE

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INTRODUCTION

Preliminary examination of the data regarding production and inputs during the seventies, particularly in the latter half indicated that crop production has failed to keep pace with the increased inputs. There has been virtually no growth in foodgrains production since 1978-79. After having reached a peak level of 131.9 million tonnes, foodgrains production dropped to 109.7 million tonnes in 1979-80, registering a steep decline of 22.2 million tonnes. Thereafter, it partially recovered and again reached a level of 133.1 million tonnes in 1981-82. This was hardly an increase of about one million tonnes over the level reached in 1978-79. Again in 1982-83, the output may be around 126 to 128 million tonnes. Thus, in four consecutive years after 1978-79, production could move upwards barely by a million tonnes. What is significant and more disturbing is that stagnancy in output persisted despite substantial increases in irrigated area, consumption of fertilizers and spread of area under high-yielding varieties (HYVs) in the last four years.

Gross irrigated area expanded from 50.6 million hectares in 1978-79 to 57.2 million hectares in 1981-82. The target for 1982-83 was 59.8 million hectares. The consumption of fertilizers increased from 5.1 million tonnes to about 6.1 million tonnes upto 1981-82 and the target for 1982-83 was 7.1 million tonnes. The area under HYVs had also risen from 41.1 million hectares in 1978-79 to 46.7 million hectares in 1981-82. It was further expected that HYVs would cover about 51 million hectares in 1982-83. Similarly, even the consumption of pesticides and electricity did increase substantially during the same period. Apparently, the additional inputs do not seem to have had any impact on production. Certainly, weather variations cannot explain fully such stagnancy in the face of expanded inputs. Does it then imply significant deceleration in productivity of these inputs ?

To unfold the implications of these latest developments it is necessary to analyse growth in output and inputs relating to crop production as well as their inter-relationships in Indian agriculture. In the present paper we try to verify the hypothesis of deceleration in growth of production alone (with no reference to inputs) through a comparative study of the last three decades, particularly concentrating on the seventies. We also study the movements in Statewise and cropwise production series to identify the States and crops showing presence or absence of deceleration in growth.

The analysis that follows is restricted only to the major foodgrain and non-foodgrain crops, namely, rice, jowar, bajra, maize, wheat, groundnut,

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cotton, jute and sugarcane and covers only the major producing States.[1] The aggregate analysis covers the entire post-Independence period whereas State-wise analysis is restricted only to an examination of the post-green revolution period, *i.e.*, the period from 1967-68 onwards.

GROWTH PERFORMANCE OF FOODGRAINS PRODUCTION: ALL-INDIA

In order to have a broad perspective of growth, we begin with an examination of year-to-year movements in foodgrains production in the last three decades. For this purpose we worked with triennial averages, *i.e.*, three-year moving averages of production rather than yearly production levels which incorporate extreme influences of weather variations. The averages were computed for the series covering the years from 1949-50 to 1981-82. Henceforth, we shall refer the triennial average by the central year of the triennial period, *i.e.*, the average production for 1949-50 to 1951-52 will be referred to as production in 1950-51. The averages are reproduced in Table I.

TABLE I—ALL-INDIA FOODGRAINS PRODUCTION

(million tonnes)

Year	Production	Triennial averages of foodgrains production*
1949-50	60·8	—
1950-51	55·0	57·13
1951-52	55·6	57·47
1952-53	61·8	63·23
1953-54	72·3	68·27
1954-55	70·7	70·77
1955-56	69·3	70·83
1956-57	72·5	69·47
1957-58	66·6	72·63
1958-59	78·8	74·17
1959-60	77·1	79·40
1960-61	82·3	80·60
1961-62	82·4	81·63
1962-63	80·2	81·17
1963-64	80·6	83·38
1964-65	89·4	80·78
1965-66	72·3	78·64
1966-67	74.2	80·54
1967-68	95·1	87·77
1968-69	94·0	96·19
1969-70	99·5	100·65
1970-71	108·4	104·36
1971-72	105·2	103·54
1972-73	97·0	102·29
1973-74	104·7	100·51
1974-75	99·8	108·51
1975-76	121·0	110·68
1976-77	111·2	119·54
1977-78	126·4	123·16
1978-79	131·9	122·67
1979-80	109·7	123·82
1980-81	129·9	123·93
1981-82	133·1	—

*Three-year moving averages.

1. Pulses were excluded from the analysis as their production and productivity per hectare remained almost stagnant especially since 1967-68.

It can be easily seen that the average foodgrains production was almost constant at about 123 million tonnes since 1977-78 for the four consecutive years (Table I). But a cursory glance at the averages for the earlier years revealed that such a phase of stagnancy is not a unique phenomenon in Indian agriculture. In fact, we did have phases of almost stagnant production, with varying lengths, in all the three decades. First such phase occurred during 1954-55 to 1956-57, with average production being about 70 million tonnes. Production then increased continuously during the next three years upto 79.40 million tonnes and was further followed by the second phase of stagnation which was quite long stretched and covered eight consecutive triennia, starting from 1960-61 and ending at 1966-67. In this phase, average production hovered around a figure of 80 million tonnes. Quick jumps in the succeeding years pushed up the average level of foodgrains production to 104.36 million tonnes in 1970-71. Thereafter, the production level remained almost depressed, in fact moved down to 100.5 million tonnes in 1973-74. This was the third phase of stagnation (rather of marginal deceleration). After 1973-74 production increased continuously to reach a substantially higher level of 123.16 million tonnes in 1977-78 which was the first triennial period of the current, *i.e.*, the fourth phase of stagnation.

If, as is expected, the total production in 1982-83 turns out to be around 126 to 128 million tonnes despite the reports of drought conditions in many parts of the country, the average for the latest triennium would rise to about 130 million tonnes. Hopefully, this jump may mark a beginning of an upward movement from the current plateau in production. But this is merely a speculation which may not materialise.

Having noted the general nature of movements in foodgrains production at the all-India level, we now turn to a comparison of growth rates, calculated by alternative ways for different sub-periods in the past.

It would be better to begin with an assessment of growth between the successive phases of stagnation or plateau in production. Alternatively, we may also examine peak to peak growth rates. For measuring the extent of growth between the two successive plateaus in foodgrains production, we considered the compound growth rate between the average production in the last triennium of the plateau and that in the first triennium of the next plateau. The pairs of triennia so picked up from Table I were those with central years 1956-57 and 1960-61, 1966-67 and 1970-71, 1973-74 and 1977-78. The percentage growth rates between them worked out to be 4.55, 6.70 and 5.18 respectively. Thus, it was 4.55 per cent in the fifties, 6.70 per cent in the sixties and finally 5.18 per cent in the seventies, obviously indicating no definite trend in the growth rates between the plateaus, over the past decades.

We further calculated the growth rates between the successive peak levels of foodgrains production observed in the past. Table II provides the list of years with peak levels of production, the corresponding production figures and compound growth rates between the successive peaks. There were three such peaks observed in each of the sixties (*i.e.*, in 1961-62, 1964-65 and 1967-68) and seventies (*i.e.*, in 1970-71, 1975-76 and 1978-79) but only two prominent

TABLE II—ALL-INDIA COMPOUND GROWTH RATES BETWEEN THE PEAK LEVELS OF FOODGRAINS PRODUCTION

Year with a peak in foodgrains production	Production (million tonnes)	Annual compound rate of growth from the preceding peak (per cent)
1949-50	60·8	—
1956-57	72·5	2·52
1958-59	78·8	4·40
1961-62	82·4	1·64
1964-65	89·4	2·75
1967-68	95·05	2·00
1970-71	108·42	4·46
1975-76	121·03	2·21
1978-79	131·90	2·91
1981-82	133·06	0·33

peaks observed in the fifties (*i.e.*, in 1956-57 and 1958-59). A cursory glance at the growth rates given in Table II suggests that the rates of growth obtained between the peaks for the seventies were not decisively lower than those observed for the fifties or the sixties. In fact, they seem to be depressed during the major part of the sixties in comparison with those observed both in the preceding and the succeeding decade. Besides, as the rates of growth obtained upto 1975-76 were 4.46 and 2.21 against 2.91 per cent registered in the latter half of the seventies (*i.e.*, between 1975-76 and 1978-79), no conclusive inference is possible regarding comparison of early seventies with the late seventies.

Thus, in general, the evidence provided by the comparison of growth rates either between the successive plateaus or between the peaks is not conclusive enough to establish either acceleration or deceleration in the late seventies.

There are alternative methods by which the compound growth rates can be calculated for a specified production series. It is possible to use the production figures of a few years in the beginning and at the end of the series to calculate the compound growth rate. However, such a measure of growth is not only heavily influenced by the choice of year/years but it also ignores the data for the years lying in between the two selected years or periods. Obviously, it is desirable to use that measure which takes into account the entire series of observations. Hence, we calculated the growth rates by estimating a log-linear function, namely, $\log y = a + bt$ where y is production and t represents time variable and the growth rate r is given by $(e^b - 1) \times 100$. All the estimates of compound rates of growth referred in the discussion that follows

and reproduced in various tables are based on estimation of log-linear function mentioned above. Time-series of production used for such estimation are the series of three-yearly moving averages.

The growth rates of all-India foodgrains production and also for major foodgrain and non-foodgrain crops computed for the post-Independence period are shown in Table III. For all the three decades together, the com-

TABLE III—COMPOUND GROWTH RATES OF PRODUCTION OF MAJOR FOODGRAIN AND NON-FOODGRAIN CROPS: ALL-INDIA

Crops	Periods of triennial averages with central years from							
	1950-51 to 1960-61	1960-61 to 1970-71	1970-71 to 1980-81	1950-51 to 1980-81	1968-69 to 1980-81	1968-69 to 1975-76	1970-71 to 1975-76	1975-76 to 1980-81
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Rice	3·71*	1·75*	2·34*	2·46*	2·12*	1·20*	1·00	2·31*
Jowar	2·83*	0·14	4·26*	1·27	2·70*	0·71	5·00*	1·93
Bajra	2·22*	5·29*	—1·82*	2·19*	—0·97	—0·82	—3·86*	—1·29
Maize	3·90*	4·36*	0·37	2·87*	0·12	0·42	0·67	—0·46
Wheat	4·81*	9·92*	4·70*	6·03*	5·02*	4·46*	2·12	5·16*
Gram	5·34*	—1·25	0·78	—0·13	—0·89	—1·59	—1·18	—5·45*
Tur	—0·83	0·96	0·94	0·008	0·60	—0·10	0·49	0·39
Total foodgrains ..	3·32*	2·52*	2·41*	2·51*	2·24*	1·45*	1·19	1·90*
Groundnut	5·11*	0·88	0·88	2·05*	1·06*	1·01	0·27	0·28
Cotton	4·48*	0·85	2·86	2·43*	2·86*	2·71*	2·24*	4·35*
Jute	1·99*	—1·09	1·87*	1·20*	1·90*	0·26	—0·02	6·69*
Sugarcane (*gur*) ..	4·87*	2·49*	2·64*	3·15*	2·35*	2·72*	3·83*	—0·07

*Statistically significant at 5 per cent level.

bined growth rate of foodgrains production, based on averages for all the 31 triennia, worked out to be 2.51 per cent. When the function was fitted to each of the three decades separately, the resulting growth rates were 3.32, 2.52 and 2.41 per cent for the first (1950-51 to 1960-61), the second (1960-61 to 1970-71) and the third (1970-71 to 1980-81) decades respectively, thus indicating a steady decline over the past periods.[2] Even the estimate of growth rate for the entire post-green revolution period (2.24 per cent) was found to

2. A substantial increase in acreage during the first decade which slowed down considerably in the latter two decades partially accounted for the higher growth rate in that decade, a significant decline in the second decade and a marginal decline from the second to the third decade.

be again much less than that for the fifties (3.32 per cent) and also for the sixties (2.52 per cent). Again, to verify whether the growth in output was more sluggish during the latter part of the seventies than the earlier one, separate estimates were obtained for the two sub-periods, namely, from 1970-71 to 1975-76 and from 1975-76 to 1980-81. An obvious difficulty in fitting the function to these two sub-periods was regarding the small number of observations. As is expected, the fit was found to be poor in terms of the value of R^2 and the 't' value for the estimate of 'b' particularly for the former period due to substantial variations in production.

The magnitude of growth rate obtained for the early seventies (*viz.*, 1.19 per cent) was less than that estimated for the post-1975-76 period (*i.e.*, 1.90 per cent). But such a comparison is not statistically valid due to non-significance of the former estimate *i.e.*, the one for the early seventies. To overcome this problem, we decided to infer indirectly about the existence of deceleration/acceleration from a comparison of the estimates of growth rates for two alternative periods, namely, (*i*) 1968-69 to 1980-81 and (*ii*) 1968-69 to 1975-76. If the growth rate estimated for the latter happens to be higher than that for the former, we may legitimately suspect relative deceleration in growth in the late seventies. On the other hand, a smaller growth rate for the sub-period upto 1975-76 vis-a-vis the rate obtained for the entire decade would suggest relative acceleration in production growth after 1975-76.

The estimate of growth rate for the entire period, *i.e.*, 2.24 per cent (Table III) was higher than that for the sub-period covering the years upto 1975-76 (*i.e.*, 1.45 per cent). An obvious implication is that there was relative acceleration in the process of growth after 1975-76. However, we should not over-emphasize this conclusion in view of the existence of plateaus or stagnancy in foodgrains production encountered in the beginning and at the end of the seventies which persisted even beyond 1980-81. Increase in foodgrains production occurred only between 1975-76 and 1977-78. That is why an estimate of growth rate may substantially change if we extend or shorten the series by one or more years around the middle of the seventies. For example, when the earlier part of the green revolution period was extended by one year to cover 1976-77, the estimate of growth rate for it worked out to be 2.01 per cent and thus came closer to the growth rate estimate for the entire post-green revolution period, *i.e.*, 2.24 per cent (Table III). It was therefore clear that the estimate of growth rate (and thereby the evidence regarding the existence of acceleration or deceleration in growth) was quite sensitive to the inclusion or exclusion in the production series of any one or more years from 1974-75 to 1977-78. Nevertheless, considerable momentum to growth received during the mid-seventies—as against a perceptible decline in growth in the early seventies—rules out the hypothesis of deceleration in the latter part of the seventies. In fact, the pace of growth remained rather uneven right from the beginning of the sixties, after an impressive performance (with a growth rate of 3.32 per cent) in the fifties. Both the movements in average foodgrains production during the sixties and the seventies as well as the esti-

mates of growth rates obtained for alternative periods (presented below) support the emergence of such an uneven pattern of growth after 1967-68.

Period	Compound rate of growth based on estimate of log y=a + bt
	(per cent)
1950-51 to 1960-61	3·32*
1950-51 to 1967-68	2·15*
1950-51 to 1970-71	2·46*
1950-51 to 1974-75	2·43*
1950-51 to 1980-81	2·51*

*Significant at 5 per cent.

A comparison of growth rates for the first two periods (3.32 and 2.15 per cent) indicates that deceleration in growth was quite formidable between 1960-61 and 1967-68. But it was likely to have disappeared and the rate of growth must have started increasing after 1967-68, *i.e.*, in the post-green revolution period. Unfortunately, the process of recovery was slowed down between 1970-71 and 1974-75, picked up momentum again from 1975-76 and merged finally into a phase of almost negligible growth after 1977-78.

In order to confirm the emergence of either acceleration or deceleration in growth of foodgrains production in different periods, we fitted a quadratic in time variable, *i.e.*, $\log y = a+bt+ct^2$ to the production series. Estimates of this function obtained for different periods are reproduced below:

	Estimate of function	Period
I.	$\log Y = 1{\cdot}770 + 0{\cdot}010t + 0{\cdot}00001t^2$ (6·122)*(0·187)	1950-51 to 1980-81
II.	$\log Y = 1{\cdot}734 + 0{\cdot}024t - 0{\cdot}0008t^2$ (3·746)*(—1·524)	1950-51 to 1960-61
III.	$\log Y = 1{\cdot}733 + 0{\cdot}24t - 0{\cdot}0008t^2$ (7·264)*(—3·893)*	1950-51 to 1964-65
IV.	$\log Y = 1{\cdot}730 + 0{\cdot}025t - 0{\cdot}0009t^2$ (9·572)*(—6·157)*	1950-51 to 1966-67
V.	$\log Y = 1{\cdot}738 + 0{\cdot}022t - 0{\cdot}0007t^2$ (4·544)*(—7·637)*	1950-51 to 1967-68
VI.	$\log Y = 1{\cdot}765 + 0{\cdot}012t - 0{\cdot}0001t^2$ (3·423)*(—0·486)	1950-51 to 1970-71
VII.	$\log Y = 1{\cdot}766 + 0{\cdot}012t - 0{\cdot}0001t^2$ (4·683)*(—0·595)	1950-51 to 1974-75
VIII.	$\log Y = 0{\cdot}803 + 0{\cdot}104t - 0{\cdot}002t^2$ (2·050) (—1·846)	1967-68 to 1974-75
IX.	$\log Y = 1{\cdot}705 + 0{\cdot}017t - 0{\cdot}0001t^2$ (1·12) (—0·390)	1967-68 to 1980-81
X.	$\log Y = 1{\cdot}946 - 0{\cdot}002t + 0{\cdot}0003t^2$ (—0·09) (0·45)	1970-71 to 1980-81
XI.	$\log Y = 1{\cdot}870 + 0{\cdot}020t - 0{\cdot}0001t^2$ (8·48)* (—0·99)	1950-51 to 1980-81 (excluding 1965-66 and 1966-67)

*Indicates that 't' value is significant at 5 per cent.

Significant positive values of the coefficients of time variable (*i.e.*, 't') accompanied by significant negative values of the coefficients of 't^2' in equations III, IV and V confirm significant deceleration in growth rate during the sixties which was likely to have continued upto 1967-68. Moreover, the process of deceleration must have started after 1960-61 as is indicated by non-significance of coefficient of t^2 in equation II fitted for the period from 1950-51 to 1960-61. In respect of the other three equations, namely, I, VI and VII, non-significance of t^2 implies absence of significant acceleration or of deceleration in the entire post-Independence period as well as for its sub-periods ending with 1970-71 or 1974-75. However, the results must be interpreted more cautiously as the statistical non-significance of t^2 obtained in these equations (I, VI and VII) is likely to have emerged due to the existence of uneven pace of growth in foodgrains production after 1960-61, *i.e.*, substantial deceleration between 1960-61 and 1967-68 but significant recovery between 1967-68 and 1970-71 followed by negative growth upto 1973-74 and accelerated growth thereafter which continued upto 1977-78.

Equations VIII, IX and X pertain to the post-green revolution period and non-significance of the coefficients of 't' and 't^2' in these equations imply absence of continuously positive or negative trend (*i.e.*, uneven pattern of growth) together with absence of either acceleration or deceleration in the growth process during the post-1967-68 period. A comparison of estimates of parameters obtained in these equations with those for the pre-green revolution period, *i.e.*, equations III, IV and V is interesting. It exhibits distinct characteristics of these two important phases in Indian agriculture. Equations III, IV and V indicate significant positive growth coupled with a clear evidence of deceleration between 1960-61 and 1966-67 whereas equations VIII to X provide no evidence in favour of significant growth or of either acceleration or deceleration in growth rate. In other words, it appears that the periods involved may be structurally different from each other. To verify this proposition we carried out Chow test for the log-quadratic function with two sets of periods. Under the first set we considered three periods, namely, (*i*) 1950-51 to 1966-67, (*ii*) 1967-68 to 1980-81 and (*iii*) a combined period from 1950-51 to 1980-81. Significant F-value obtained for the test statistic implied statistically significant change in structural parameters in the post-green revolution period vis-a-vis the pre-green revolution period. However, when the test statistic was recomputed dropping the two drought years, *i.e.*, 1965-66 and 1966-67 from the periods mentioned above, it turned out to be statistically non-significant. Hence, it can be argued that after the omission of 1965-66 and 1966-67, the periods before and after 1967-68 do not display statistically significant pattern of production growth and estimates obtained for the combined period—excluding 1965-66 and 1966-67, *i.e.*, estimates given in equation XI above—hold for both the periods. As this equation and equation I which includes all the years from 1950-51 to 1980-81 do not support the existence of either acceleration or deceleration in the recent period, we may finally conclude that the statistical evidence analysed in the

present study rejects the hypothesis of significant relative deceleration in growth in foodgrains production in the post-1975-76 period.

GROWTH IN PRODUCTION: CONTRIBUTION OF MAJOR CROPS

Having analysed the growth pattern of total foodgrains production, we examined the production performance of major foodgrain and non-foodgrain crops at the all-India level. The analysis was restricted mainly to the four periods covering the triennia with central years from (*i*) 1968-69 to 1980-81, (*ii*) 1968-69 to 1975-76, (*iii*) 1970-71 to 1975-76 and (*iv*) 1975-76 to 1980-81. The log-linear fit which provided the estimates of growth rates was found to be poor for many crops especially for the last two sub-periods of the seventies (Table III). Hence, our judgement regarding the relative acceleration/deceleration in production of a particular crop has been based on a combined evidence that emerges from (*i*) comparison of growth rates for the first two periods, *i.e.*, the entire post-green revolution period vis-a-vis the sub-period from 1968-69 to 1975-76 (comparison between columns 6 and 7 in Table III) and (*ii*) the pattern of changes in average production during the entire post-1967-68 period.

Foodgrains production increased at the rate of 2.24 per cent during the entire post-green revolution period. The major contribution to growth was from wheat followed by jowar and rice (column 6, Table III). Production of maize remained almost stagnant but that of bajra declined substantially particularly between 1970-71 and 1975-76. All the four non-foodgrain crops also registered significant positive growth in the entire post-1967-68 period but at differential rates. The growth rate was highest for cotton (2.86 per cent) and lowest for groundnut (1.06 per cent). Comparison of these growth rates with growth rates obtained for the period upto 1975-76 (column 7, Table III) suggest relative but marginal acceleration of growth in foodgrains production to which contribution of wheat, jowar and rice was significant. Among the non-foodgrains, cotton and especially jute experienced considerably accelerated growth in the latter part of the seventies. Sugarcane showed considerable deceleration in growth in the late seventies despite its impressive performance upto the middle of the seventies, which was even better than cotton (columns 8 and 9, Table III). As against these three crops, the performance of groundnut remained relatively depressed all through the seventies but for a small positive growth rate of 1 per cent for the entire post-1967-68 period. Nevertheless, foodgrains production and the production of non-foodgrains continued to be on a slightly higher plateau after 1975-76 compared to the early seventies particularly due to accelerated growth rates in wheat, jowar, rice, jute and cotton. Crops which mainly lagged behind with almost total absence of growth after 1975-76 were bajra, maize, groundnut and sugarcane.

It is interesting to note that, in general, growth in production of the major non-foodgrain crops was remarkable in the fifties, was very poor in the sixties (except for sugarcane) but improved considerably later in the

seventies particularly for cotton and jute. Nevertheless, the growth rates achieved in the fifties largely due to an increase in the area could not be exceeded in the seventies but for a quick increase obtained for jute in the late seventies.

Relative or even absolute deceleration in the production of a crop by itself need not be of grave concern so long as it is induced almost totally by a decline in the acreage. What should bother us is the significant and persistent decline in its productivity. We shall later on investigate this important issue through examination of trends in the productivity of major crops.

GROWTH IN PRODUCTION: CONTRIBUTION OF MAJOR STATES

In terms of overall performance during the entire post-green revolution period (column 2, Table IV), Punjab, Maharashtra, Haryana, Andhra

TABLE IV—STATEWISE COMPOUND GROWTH RATES OF FOODGRAINS PRODUCTION

States	Percentage growth rates based on triennial averages of production with central years from			
	1968-69 to 1980-81	1968-69 to 1975-76	1970-71 to 1975-76	1975-76 to 1980-81
(1)	(2)	(3)	(4)	(5)
Andhra Pradesh	3·29*	3·50*	5·03*	3·92*
	(11·02)	(5·17)	(6·04)	(8·46)
Assam	0·87*	0·93	1·17	0·50
	(4·00)	(1·71)	(1·25)	(0·87)
Bihar	0·90*	0·83	0·83	—0·79
	(3·05)	(0·29)	(1·06)	(—0·83)
Gujarat	2·80*	0·23	—2·52	3·84*
	(3·25)	(0·12)	(—0·77)	(3·74)
Haryana	3·43*	0·49	—1·29	4·42*
	(4·83)	(0·39)	(—0·59)	(3·28)
Jammu & Kashmir	1·65	—0·44	—0·14	4·98*
	(3·73)	(—0·83)	(—0·23)	(14·06)
Karnataka	2·24*	2·04*	1·70	2·52
	(5·99)	(2·53)	(1·19)	(2·02)
Kerala	—0·14	0·54†	0·13	—0·64*
	(—0·91)	(1·96)	(0·40)	(—2·93)
Madhya Pradesh	0·38	0·90	—0·53	—0·76
	(1·21)	(1·55)	(—0·91)	(—0·81)
Maharashtra	6·11*	3·54	1·21*	2·38†
	(4·37)	(1·01)	(2·88)	(2·64)
Orissa	0·43	—1·11†	—0·93	2·38*
	(1·38)	(—2·34)	(—1·31)	(2·80)
Punjab	5·67*	4·15*	2·88*	7·55*
	(17·17)	(8·29)	(12·24)	(12·91)
Rajasthan	1·49†	2·16	—0·44	—2·42
	(2·14)	(1·44)	(—0·22)	(—1·66)
Tamil Nadu	1·38*	0·44	—2·49†	2·46
	(2·72)	(0·38)	(—2·55)	(1·30)
Uttar Pradesh	1·99*	0·11	—0·49	2·43†
	(4·43)	(0·14)	(—0·37)	(2·66)
West Bengal	0·88*	1·42	0·88	—1·75†
	(2·37)	(2·05)	(0·78)	(—2·65)
All-India	2·24*	1·45*	1·19	1·90*
	(8·38)	(3·19)	(1·49)	(2·77)

* Significant at 5 per cent level.
† Significant at 10 per cent level.

Pradesh and Gujarat did relatively much better than the remaining States. Rates of growth in their foodgrain production exceeded the all-India growth rate of 2.24 per cent. In Karnataka foodgrains production increased at a rate which was equal to the all-India growth rate whereas it was only 1.99, 1.65 and 1.38 per cent for Uttar Pradesh, Jammu & Kashmir and Tamil Nadu respectively. In Assam, Bihar and West Bengal, the rate of growth was between 0.8 and 0.9 per cent while the production of foodgrains was nearly stagnant all through the late sixties and the seventies taken together in Orissa, Madhya Pradesh and Kerala (column 2, Table IV).

From among the leading five States, growth performance was consistently substantive only for Punjab and Andhra Pradesh. For the other three it was rather uneven. The production of foodgrains increased at a substantially higher rate throughout the seventies in Andhra Pradesh but it was particularly high for the early seventies (5.03 per cent) and then declined to 3.92 per cent between 1975-76 and 1980-81. Thus, there was a marginal deceleration in an otherwise impressive performance of Andhra Pradesh. The growth rate was 2.88 per cent for Punjab during 1970-71 to 1975-76 but was augmented greatly after 1975-76 to reach a level of 7.55 per cent. The contribution of Punjab, thus, seems to be dominant and unique in the latter half of the seventies. Of the remaining three, in Haryana and Gujarat the growth in average foodgrains production between 1968-69 and 1975-76 was almost negligible (column 3, Table IV) but still they performed considerably well during the latter part of the seventies with a growth rate of 4.42 and 3.84 per cent respectively. The performance of Maharashtra was remarkable during the seventies in the sense that it not only recovered rapidly from the severe setbacks received between 1970-71 and 1972-73 but could achieve continuous and substantial expansion in foodgrains production even beyond 1975-76. Thus, an estimate of 6.11 per cent for the entire post-green revolution period for Maharashtra—the highest among all the major States—is a reflection of its recovery from the heavy reverses in the early seventies. However, most of the expansion in foodgrains production had taken place by 1977-78 and was followed by almost negligible growth upto 1980-81.

In Karnataka, where the growth in foodgrains production was at a rate equal to the all-India growth rate, its performance was marginally better after 1975-76 than that during the early years of the seventies (columns 2 and 3, Table IV). From among the remaining States with overall growth rates in foodgrains production being lower than the all-India growth rate, Uttar Pradesh experienced acceleration in growth in the second half of seventies after near total stagnancy between 1968-69 and 1975-76. Similarly in Jammu & Kashmir, foodgrains production was almost stagnant between 1968-69 and 1975-76 but increased at an accelerated rate of 4.98 per cent after 1975-76. A considerable jump in the growth rate from zero to 2.38 per cent was also achieved in Orissa (columns 4 and 5, Table IV). Assam, Bihar, Madhya Pradesh, Rajasthan, Kerala and West Bengal, however, had either zero or decelerated growth rates particularly after 1975-76.

In order to confirm the existence of statistically significant acceleration or deceleration in the growth of foodgrains production, we fitted the function $\log y = a + bt + ct^2$ to Statewise series of average foodgrains production for the entire post-green revolution period. The estimates of the function are provided in Table V. The regression coefficients of 't' are positive and statistically significant at 5 per cent level for all the States except Madhya Pradesh,

TABLE V—STATEWISE ESTIMATES OF QUADRATIC IN TIME VARIABLE FITTED TO THE TRIENNIAL AVERAGE OF FOODGRAINS PRODUCTION
(Period: 1968-69 to 1980-81)

States	Constant	Regression t	Coefficient of t^2
Andhra Pradesh	9·023	0·033* (12·56)	0·0006 (0·75)
Assam	7·724	0·009* (3·86)	—0·0003 (—0·49)
Bihar	9·084	0·009* (3·12)	—0·0009 (—1·07)
Gujarat	8·166	0·028* (3·36)	0·003 (1·11)
Haryana	8·408	0·034* (5·37)	0·003 (1·61)
Jammu & Kashmir	6·902	0·0164* (6·73)	0·004* (5·08)
Karnataka	8·721	0·022* (6·00)	—0·00004 (—0·03)
Kerala	7·202	0·00014 (—1·33)	—0·0012* (—3·70)
Madhya Pradesh	9·296	0·004 (1·57)	—0·002* (—2·43)
Maharashtra	8·870	0·059* (4·42)	0·005 (1·2)
Orissa	8·480	0·004† (1·82)	0·002* (2·91)
Punjab	9·048	0·055* (19·88)	0·002 (2·17)
Rajasthan	8·816	0·015* (2·37)	—0·004† (—1·88)
Tamil Nadu	8·828	0·014* (2·66)	—0·0006 (—0·36)
Uttar Pradesh	9·810	0·020* (5·02)	0·002† (1·82)
West Bengal	8·962	0·009* (2·63)	—0·002† (—1·91)

Note: Figures in parentheses are the corresponding 't' values.
* Significant at 5 per cent level.
† Significant at 10 per cent level.

Orissa and Kerala. For Orissa the coefficient of time variable was significant at 10 per cent level. Statistically significant acceleration was however indicated only for Punjab, Uttar Pradesh, Orissa and Jammu & Kashmir. At the other extreme, significance of deceleration was confirmed in respect of West Bengal, Rajasthan, Madhya Pradesh and Kerala.

Thus, from the preceding discussion it is clear that considerably accelerated growth rates were registered in Punjab, Haryana, Gujarat, Maharashtra, Uttar Pradesh, Orissa and Jammu & Kashmir in the latter part of the seventies in comparison with the early seventies. But improvement in the growth rate was marginal for Karnataka and Tamil Nadu. However, statistical significance of acceleration could be established only in the case of Punjab, Uttar Pradesh, Orissa and Jammu & Kashmir. On the other hand, the existence of statistically significant deceleration after 1975-76 was confirmed for Rajasthan, West Bengal, Madhya Pradesh and Kerala. Deceleration in respect of Andhra Pradesh was only relative and nominal. The remaining two States, namely, Assam and Bihar represented a situation of almost total stagnancy particularly after 1975-76. Finally, it may be concluded that the States which mainly lagged behind in growth in the latter half of the seventies were West Bengal, Rajasthan, Madhya Pradesh, Assam, Bihar and Kerala.

We further examined the performance of major foodgrain and non-foodgrain crops at the State level to verify whether it was uniformally good or bad across the States. Accelerated growth in rice production after 1975-76 (columns 6 and 7, Table III) observed at the all-India level was shared by many States but the major contribution came from the non-traditional rice growing areas such as Gujarat, Haryana, Maharashtra, Punjab and Uttar Pradesh (Table VI). Among the traditional rice growing States, Andhra Pradesh alone made positive contribution. On the contrary, the production of rice remained more or less depressed or increased at a very slow rate during the entire green revolution period in Orissa, Bihar, Madhya Pradesh Karnataka, Assam, Tamil Nadu, West Bengal and Kerala. As against such differing performance of States with respect to rice, all the major wheat growing States experienced acceleration in the growth of wheat production after 1975-76 with the exception of Bihar (Table VI). Moreover, the growth rates of wheat production during the entire period were in the range of about 5 to 10 per cent in all the States except for Madhya Pradesh. In respect of rice, however, considerably higher growth rates in production were recorded only by the non-traditional rice growing States such as Haryana (11.73 per cent), Punjab (18.09 per cent), Maharashtra (5.12 per cent) and Rajasthan (5.86 per cent). Relative acceleration in the growth of jowar production after 1975-76 obtained at the all-India level was mainly due to accelerated growth rates in three major jowar growing States, namely, Maharashtra (9.24 per cent), Gujarat (4.23 per cent) and Andhra Pradesh (1.13 per cent). As for bajra, significant absolute decline (as obtained in Rajasthan, Haryana and Uttar Pradesh) or stagnancy in production (as observed for Gujarat and Maharashtra) was mainly responsible for its poor performance at the aggregate level. The situation with respect to maize was not very different from that of bajra.

TABLE VI— STATEWISE COMPOUND GROWTH RATES OF PRODUCTION OF MAJOR FOODGRAINS

(*per cent*)

States	Rice		Jowar		Bajra		Maize		Wheat	
	Periods of triennial averages with central years from									
	1968-69 to 1980-81	1968-69 to 1975-76	1968-69 to 1980-81	1968-69 to 1975-76	1968-69 to 1980-81	1968-69 to 1975-76	1968-69 to 1980-81	1968-69 to 1975-76	1968-69 to 1980-81	1968-69 to 1975-76
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Andhra Pradesh	4·12*	3·74*	1·13*	0·73	2·65*	1·77	4·66*	7·11*	—	—
Assam	0·72*	0·39	—	—	—	—	—	—	—	—
Bihar	0·65	0·19	—	—	—	—	2·03	0·30	5·20*	10·29*
Gujarat	3·39*	—1·61	4·23*	1·49	0·96	—2·22	—	—	6·14*	4·92*
Haryana	11·73*	8·29*	—	—	—3·54*	—1·25*	—	—	5·50*	2·42
Jammu & Kashmir	2·16*	—0·16	—	—	—	—	2·00*	0·79	—	—
Karnataka	0·79	—0·74	—0·53	—1·47	3·32*	2·92	—	—	—	—
Kerala	—0·14	0·54	—	—	—	—	—	—	—	—
Madhya Pradesh	—0·09	—1·00	—0·11	—1·26	—5·58*	—2·36	2·71*	3·88*	2·19*	2·01
Maharashtra	5·12*	2·87	9·24*	6·48	1·34	—0·61	—	—	10·21*	13·35*
Orissa	—0·79*	—2·13*	—	—	—	—	—	—	—	—
Punjab	18·09*	16·86	—	—	—8·71*	—7·49	2·28*	0·17	4·86*	3·50*
Rajasthan	5·86*	8·10*	—2·98*	—4·14*	—4·19*	—1·26	—0·56	—4·59	6·30*	6·50*
Tamil Nadu	0·97	0·43	2·05*	1·54	2·25*	0·46	—	—	—	—
Uttar Pradesh	3·57*	2·76*	—0·68	0·71	—1·59*	0·005	—3·67*	—4·80*	5·53*	2·79*
West Bengal	0·87*	0·64	—	—	—	—	—	—	4·90*	15·58*
All-India	2·18*	1·25*	2·76*	0·71	—1·00	—0·82	0·33	0·42	5·13*	4·45*

* Significant at 5 per cent level.

Thus, the major contribution to relatively accelerated increase in foodgrains production was from wheat followed by rice, mainly from the non-traditional rice growing States and jowar. Except for Andhra Pradesh, all the traditional rice growing States had relatively depressed or zero growth rates in foodgrains production all through the late sixties and the seventies.

Among the non-foodgrains, relative acceleration of growth in cotton production was not uniformally shared by all the major cotton producing States, but only by Gujarat, Maharashtra and Haryana (Table VII), the States with much better overall performance in the agricultural sector. Surprisingly, the growth rate of cotton production dropped significantly in Punjab in the second half of the seventies. Deceleration was even more formidable in Karnataka and Rajasthan. In fact, the growth rate in cotton production was about 12 per cent in these two States (column 5, Table VII) in the earlier part of the green revolution period (*i.e.*, upto 1975-76) but the drop was substantial thereafter. However, despite this decline, overall growth rates in the entire period of 1968-69 to 1980-81 were still considerably higher for them, namely, 5.76 and 8.74 per cent, than all the remaining States (column 4, Table VII).

Stagnancy or absolute decline in the production of groundnut after 1975-76 was almost universal for all the major groundnut producing States. This was in fact true for the entire post-1967-68 period. Only Gujarat represented a remarkable exception to this adverse trend particularly due to rapid growth after 1975-76 (column 2, Table VII).

West Bengal and Bihar, although had poor record in the growth of foodgrains production, registered impressive growth rates in the production of jute after 1975-76.

Maharashtra performed extremely well with respect to growth in sugarcane production, followed by Tamil Nadu and Karnataka. But their performance was completely shadowed by relative deceleration in growth in Uttar Pradesh, a State claiming more than 40 per cent share in the all-India sugarcane production (columns 8 and 9, Table VII).

Thus, in general, the States with accelerated growth in foodgrains production in the late seventies had performed better even in respect of non-foodgrains, like groundnut, cotton and sugarcane. The States lagging in the growth of foodgrains production generally failed even in stepping up the production of non-foodgrains. The growth of jute in West Bengal and Bihar and relative deceleration of cotton in Punjab were rather exceptions to the above general observation.

TRENDS IN THE PRODUCTIVITY OF CROPS

Implications of deceleration in production are more serious when it is induced through a persistent decline in productivity. Hence, it is essential to examine the trends in yield per hectare in the last three decades concentrating particularly on the post-green revolution period.

TABLE VII—STATEWISE COMPOUND GROWTH RATES OF PRODUCTION OF NON-FOODGRAINS

(*per cent*)

States	Groundnut		Cotton		Jute		Sugarcane (*gur*)	
	Periods of triennial averages with central years from							
	1968-69 to 1980-81	1968-69 to 1975-76	1968-69 to 1980-81	1968-69 to 1975-76	1968-69 to 1980-81	1968-69 to 1975-76	1968-69 to 1980-81	1968-69 to 1975-76
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Andhra Pradesh	—0·35	2·26	—	—	—	—	0·01	1·69
Assam	—	—	—	—	—0·57	1·49	—	—
Bihar	—	—	—	—	2·49*	0·26	—3·66*	—2·49*
Gujarat	4·68*	—0·78	1·62*	0·31	—	—	—	—
Haryana	—	—	5·06*	4·63*	—	—	—1·09	—1·00
Jammu & Kashmir	—	—	—	—	—	—	—	—
Karnataka	0·41	1·38	5·76*	11·69*	—	—	3·25*	2·06*
Kerala	—	—	—	—	—	—	—	—
Madhya Pradesh	—2·45*	1·23	—0·79*	0·18	—	—	—	—
Maharashtra	0·59	—2·62	2·90*	1·02	—	—	6·01*	3·91
Orissa	—	—	—	—	1·09	1·48	—	—
Punjab	—	—	4·40*	7·41*	—	—	0·11	1·98
Rajasthan	—	—	8·74*	11·93*	—	—	—	—
Tamil Nadu	0·53	1·49	2·07	—2·86*	—	—	4·40*	4·35*
Uttar Pradesh	—3·87*	3·57	—	—	—	—	1·83*	2·81*
West Bengal	—	—	—	—	3·46*	1·23	—	—
All-India	1·08*	1·01	2·93*	2·73*	2·03*	0·26	2·40*	2·72*

* Significant at 5 per cent level.

Average levels of productivity were considerably higher in the post-green revolution period in comparison with those in the pre-green revolution period for a number of major crops excluding groundnut, jute, gram and *tur*. The growth in productivity of groundnut, jute and gram was relatively much lower whereas it was almost zero for *tur* in the post-1967-68 period over the levels realised during the pre-green revolution period. For the other major crops, not only the averages but even the levels of troughs and peaks were pushed almost uniformally upwards in the post-1967-68 period.

However, we may leave aside the absolute levels of productivity and compare their growth rates in the period prior to 1967-68 with those realised in the post-1967-68 period. The former, *i.e.* growth rates in the pre-green revolution period were found to be higher than the latter for many crops excluding wheat, jowar and cotton (columns 2 and 4, Table VIII). This seems to be quite consistent with the observation made earlier regarding deceleration in growth of their production in the sixties and the seventies compared to the first decade. The period from 1967-68 to 1975-76 was particularly more sluggish with respect to the productivity of all the major crops except wheat, in which case the yield per hectare was likely to have increased at an increasing rate. Nevertheless, significant positive growth rates for the entire post-1967-68 period (column 4, Table VIII) for rice, jowar, cotton and sugarcane, in addition to, of course, wheat, vis-a-vis the period before 1975-76 (column, 3, Table VIII) suggest relative acceleration in growth of their productivity in the late seventies as against the early seventies. Of these, jowar, wheat and cotton crossed the growth rates achieved even in the pre-green revolution periods. Crops mainly lagging behind in the growth of yield per hectare were thus bajra, maize, groundnut and jute.

TABLE VIII—ALL-INDIA COMPOUND GROWTH RATES OF YIELD PER HECTARE

Crops	Periods			
	1949-50 to 1964-65	1967-68 to 1975-76	1967-68 to 1981-82	1949-50 to 1981-82
(1)	(2)	(3)	(4)	(5)
Rice	2·10*	1·21	1·51*	1·47*
Jowar	1·47*	1·66	3·17*	1·48*
Bajra	1·27*	0·69	0·78	1·63*
Maize	1·17*	—0·06	0·37	0·80*
Wheat	1·27*	2·19*	2·59*	3·05*
Gram	0·99	—1·49	—0·71	0·50*
Tur	—1·98*	0·61	0·19	—0·50
Total foodgrains	+1·45*	1·50*	1·93*	1·74*
Groundnut	0·30	1·87	1·35	0·53
Cotton	2·03*	3·01	2·54*	2·00*
Jute	0·49	1·67	0·91	0·50
Sugarcane (*gur*)	1·15*	0·84*	1·10*	1·15*

* Significant at 5 per cent level.

Having reviewed the all-India trends in productivity, it would be more meaningful and revealing to relate production growth rates to trends in yield per hectare at the State level. The analysis was carried out only for the post-green revolution period in order to verify whether the changes in productivity were mainly responsible for acceleration/deceleration in production of major crops (Tables IX and X).

Even a cursory glance at the growth rates presented in Table IX reveals that in none of the States the yield per hectare of any major foodgrain declined significantly during the post-green revolution period. It is true that in respect of crops like maize and partly even with respect to rice, bajra and jowar a number of States experienced stagnancy in the yield levels, yet absolute deceleration in their production wherever observed at the State level was unlikely to be mainly yield-induced. On the contrary, for quite a few States accelerated growth in production after 1975-76 for even crops such as bajra and jowar was accompanied by similar trends in their yields per hectare. But this does not necsssarily mean that the contribution of area was negligible for all the major foodgrain crops. Considerably higher growth rates of production vis-a-vis the growth in yield per hectare of rice and particularly of wheat indicate the importance of the role played by the increase in acreage under these crops.[3] As against this, acceleration in the growth rate of productivity must be largely responsible for a corresponding increase in the growth rates of production of jowar and bajra in quite a few States.

In contrast to significant positive trends in the yield per hectare of major foodgrains registered in many States, the yield levels of jute and groundnut remained almost depressed in all the major jute and groundnut producing States (Table X). But it was not so in respect of cotton and especially sugarcane. Rise in the growth rate of yield per hectare of cotton in Tamil Nadu and Haryana was mainly responsible for acceleration in the growth of its productivity at the all-India level. Besides, a substantial relative decline in the growth of cotton production in Karnataka, Punjab and Rajasthan must have been dominantly influenced by a similar decline in the per hectare productivity of cotton in them towards the end of the seventies.

Unlike all other crops, absolute levels of yield per hectare of sugarcane dropped significantly in Bihar and Karnataka during the entire post-green revolution period. But deceleration in productivity growth after 1975-76 was only relative in respect of Maharashtra, Punjab and Tamil Nadu. Obviously, increased growth rates of production of sugarcane in two of these States, namely, Maharashtra and Tamil Nadu, in the second half of the seventies, imply that deceleration in the productivity growth must have been more than compensated by accelerated rise in acreage under them.

In general, the upward or downward movements in acreage must have had dominant influence on relative acceleration or deceleration in the growth of production of non-foodgrain crops in contrast to the more important role played by productivity changes in the case of major foodgrains.

3. At an aggregate level, however, the total area under foodgrains remained almost constant since 1973-74, apart from marginal weather induced fluctuations.

TABLE IX—STATEWISE COMPOUND GROWTH RATES OF YIELD PER HECTARE OF MAJOR FOODGRAINS

(per cent)

States	Rice		Jowar		Bajra		Maize		Wheat	
	1967-68 to 1981-82	1967-68 to 1975-76	1967-68 to 1981-82	1967-68 to 1975-76	1967-68 to 1981-82	1967-68 to 1975-76	1967-68 to 1981-82	1967-68 to 1975-76	1967-68 to 1981-82	1967-68 to 1975-76
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Andhra Pradesh	2·60*	2·49*	2·33*	0·37	3·47*	2·34	2·75*	4·64*	—	—
Assam	0·15	0·53	—	—	—	—	—	—	—	—
Bihar	0·006	0·30	—	—	—	—	1·70	—3·07	2·34*	4·43
Gujarat	4·49	0·81	6·97*	5·97	3·63*	—1·05	—	—	3·04*	4·50*
Haryana	5·05*	4·45*	—	—	—1·51	—1·02	—	—	2·05*	—0·27
Jammu & Kashmir	1·41	1·36	—	—	—	—	2·70*	2·34	—	—
Karnataka	1·17*	0·91	3·26*	6·49*	2·60	8·69*	—	—	—	—
Kerala	0·78*	0·91	—	—	—	—	—	—	—	—
Madhya Pradesh	—0·77	—0·73	0·23	0·38	—	—	0·75	1·80	2·08*	2·46*
Maharashtra	3·84*	2·35	5·35*	—0·06	3·35*	—0·29	—	—	6·44*	9·62*
Orissa	0·10	—1·61	—	—	—	—	—	—	—	—
Punjab	6·04*	8·47*	—	—	—	—	0·49	—0·43	2·48*	2·14*
Rajasthan	1·46	4·37	0·38	0·08	—2·02	0·35	—1·50	—4·53	0·02*	2·75
Tamil Nadu	1·75*	2·74	2·16*	0·86	3·34*	1·05	—	—	—	—
Uttar Pradesh	2·22	2·67*	0·60	2·25	0·12	2·20	—0·88	—3·14	2·39*	0·27
West Bengal	0·47	—0·03	—	—	—	—	—	—	0·40	5·80
All-India	1·51*	1·21	3·17*	1·66	0·78	0·69	0·37	—0·06	2·59*	2·19*

* Statistically significant at 5 per cent level,

TABLE X—STATEWISE COMPOUND GROWTH RATES OF YIELD PER HECTARE OF MAJOR NON-FOODGRAINS

(*per cent*)

States	Groundnut		Cotton		Jute		Sugarcane (*gur*)	
	1967-68 to 1981-82	1967-68 to 1975-76	1967-68 to 1981-82	1967-68 to 1975-76	1967-68 to 1980-81	1967-68 to 1975-76	1967-68 to 1981-82	1967-68 to 1975-76
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Andhra Pradesh	0·64	2·65	—	—	—	—	0·18	0·97
Assam	—	—	—	—	—0·37	—0·23	—	—
Bihar	—	—	—	—	0·85	2·44	—1·23*	0·21
Gujarat	3·65	—0·28	1·31	—1·11	—	—	—	—
Haryana	—	—	1·15*	0·70	—	—	—0·67	—0·51
Jammu & Kashmir	—	—	—	—	—	—	—	—
Karnataka	0·47	1·74	5·11*	11·87*	—	—	—1·49*	—2·74*
Kerala	—	—	—	—	—	—	—	—
Madhya Pradesh	—0·54	0·41	0·05	0·25	—	—	—	—
Maharashtra	1·52	—0·30	3·00	—0·20	—	—	3·03*	4·25*
Orissa	—	—	—	—	0·88	1·19	—	—
Punjab	—	—	—0·67	1·15*	—	—	3·69*	5·90*
Rajasthan	—	—	0·10	7·24	—	—	—	—
Tamil Nadu	0·74	1·30	2·16*	2·57	—	—	1·94*	2·34*
Uttar Pradesh	—0·83	1·79	—	—	—	—	0·57	0·22
West Bengal	—	—	—	—	1·00	0·43	—	—
All-India	1·35	1·87	2·54*	3·01	0·91	1·67	1·10*	0·84*

* Statistically significant at 5 per cent level.

CONCLUDING REMARKS

Following broad conclusions emerge from the analytical evidence presented in the foregoing sections:

(*i*) The decelerating trend in the growth of foodgrains production was set by the beginning of the sixties after an impressive performance of growth during the fifties which was mainly due to expansion in area.

(*ii*) Deceleration in the growth of foodgrains production was arrested with the onset of the green revolution in Indian agriculture but reversal of the process of deceleration could not be sustained without interruption beyond 1970-71. Nevertheless, for the combined period of three decades, statistical evidence did not support the hypothesis of either acceleration or deceleration in growth.

(*iii*) Again due to the uneven pace of growth during the seventies, the existence of statistically significant deceleration or acceleration in growth in the latter half of the seventies could not be conclusively established. Yet the scrutiny of movements in foodgrains production in the seventies and an indirect inference based on comparison of magnitudes of growth rates did support relatively marginal acceleration in growth since 1975-76 compared to the early years of the seventies.

(*iv*) In terms of overall performance during the entire post-green revolution period, Punjab, Maharashtra, Haryana, Andhra Pradesh, Gujarat and Karnataka did relatively much better than the remaining States. Among them, however, the performance was consistently good and substantive only for Punjab and Andhra Pradesh.

(*v*) The States which substantially contributed in pushing up the all-India growth rate of foodgrains production particularly in the latter half of the seventies in comparison with the early seventies were Punjab, Haryana, Maharashtra, Gujarat, Uttar Pradesh, Orissa and Jammu & Kashmir. On the contrary, the contribution of West Bengal, Rajasthan, Madhya Pradesh and Kerala was rather negative due to substantial deterioration in their process of growth since 1975-76. Foodgrains production in Assam and Bihar was almost totally stagnant after 1975-76.

(*vi*) The major contribution to relatively accelerated growth in foodgrains production came from wheat followed by rice—that too mainly from the non-traditional rice growing States and jowar. But for Andhra Pradesh, all the traditional rice growing regions had relatively depressed or zero growth rates in foodgrains production all through the late sixties and the seventies.

(*vii*) Among the non-foodgrains, cotton and jute experienced expansion in production at a higher rate during the late seventies but the production of sugarcane and groundnut either declined or remained stagnant after 1975-76 in quite a few States.

(*viii*) In general, the States with accelerated growth in foodgrains production in the latter part of the seventies performed better even in respect of growth in the production of non-foodgrains. The States lagging in the

growth of foodgrains production generally failed even in stepping up the production of non-foodgrains, with a very few exceptions.

(*ix*) In general, the growth rates in productivity of many foodgrain and non-foodgrain crops excluding wheat, jowar and cotton were either higher or almost the same in the pre-green revolution period in comparison with the post 1967-68 period. The period between 1967-68 and 1975-76 was particularly more sluggish with respect to the growth in the productivity of all the major crops except wheat. The situation improved after 1975-76 due to relatively increased growth rates of yield per hectare of rice, jowar, cotton and sugarcane, in addition to, of course, wheat. Crops lagging behind were particularly bajra, maize and jute.

(*x*) Increased productivity played a major role in relative acceleration of growth in production of major foodgrains whereas the dominant contribution to relatively increased growth rates in production of groundnut, cotton and jute after 1975-76 was from area.