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REPORT OF THE SYMPOSIUM ON ALLEGED DECELERATION OF
RATE OF GROWTH OF AGRICULTURE IN THE
SOUTHERN STATES OF INDIA AND ORISSA*

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The Symposium addressed itself to the following two issues: (i) examination and analysis of statistical data on agricultural growth in the Southern States of India and Orissa, and (ii) factors underlying the changes in growth rates.

Following 13 papers which were presented at the Symposium formed the bases for discussion:

1. S. D. Sawant, "Investigation of the Hypothesis of Deceleration in Indian Agriculture."
2. T. V. S. Rao and P. V. Sarma, "Trends in Agricultural Growth in the Southern States of India and Orissa."
3. V. P. Subrahmanyam, "Agroclimatic Factors in the Southern States and Orissa as Seen from Data of Meteorological Stations."
4. R. V. Rama Rao, "Surface and Groundwater Resources of Southern States vis-a-vis Agricultural Production."
5. M. Gopalakrishnan, "Strategy for Agricultural Development and Rural Development: Some Aspects."
6. A. R. Rajapurohit, "Recent Trends in Agricultural Growth Rates in Karnataka."
7. Mruthyunjaya, S. Bisaliah and V. R. Srinivasan, "Pace and Pattern of Agricultural Output Growth in Karnataka."
8. V. Rajagopalan, "Deceleration of Rates of Agricultural Growth in Tamil Nadu: Trends and Explanatory Factors."
9. C. Arputharaj, "Deceleration of Rates of Agricultural Growth in Tamil Nadu."
10. Sunil Sen Gupta, "Orissa's Agriculture : Deceleration or Something More ?"
11. Baidyanath Misra, "Deceleration of Rates of Agricultural Growth in Orissa: Trends and Explanatory Factors."
12. G. Parthasarathy, "Deceleration of Rate of Growth of Foodgrain Produce in Southern States of India and Orissa: Notes on Some Issues."
13. M. Jagadeswara Rao and G. Ramachandrudu, "Economic and Demographic Impact of Drought in Srikakulam District—Some Preliminary Results of a Village Survey."

Besides these papers, some basic data on changes in input pattern from studies of the Agro-Economic Research Centre and also data on prices of inputs and of output were circulated for the use of participants in the Symposium.

* Organized at the Agro-Economic Research Centre, Andhra University, Waltair on 20th and 21st July, 1983.

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The Symposium which was conducted in five sessions considered the issue of alleged deceleration which was examined in two papers. The second session was devoted to an examination of the specific question pertaining to the role of weather, and also to surface and groundwater resources, the discussion being initiated by a Professor of Meteorology and a Professor of Geo-Engineering respectively. Statewise papers which examined the alleged deceleration and also the factors behind were considered in the third and fourth sessions. The last session was devoted to certain issues emerging out of the previous sessions. The absence of opportunity for a dialogue with the development administrators and agronomists at the Symposium was found to be a handicap, especially in the light of the inaugural address of the Vice-Chancellor, Shri A. Sambasiva Rao who emphasized administrative failures.

ALLEGED DECELERATION IN THE RATE OF AGRICULTURAL GROWTH
IN SOUTHERN STATES OF INDIA AND ORISSA

Of the two papers, Sawant's paper considered the issue both at the all-India and State levels while Rao and Sarma focussed their paper on the States in question. Sawant's paper was found to be methodologically more satisfactory. The results of the second paper on the question of alleged deceleration were based on quadratic function while they should have used the log-quadratic function: the small number of observations in each period (six) resulting in the insignificance of regression coefficients except in a few cases has led to statistical exercises on which no firm conclusions could be drawn.

Though Sawant's paper concentrated particularly on the seventies as in the paper of Rao and Sarma, it sought to verify the hypothesis through a comparative study of last three decades while the latter paper missed the long-term perspective against which the recent events needed examination. It has also the merit of application of alternative approaches to an examination of changes in growth rates: (1) compound growth rates between the successive phases of stagnation or plateau in production; (2) peak to peak compound growth rates; (3) log-linear functions, (4) linear functions; and (5) log-quadratic function. At the all-India level the results obtained on application of different approaches are not uniform. Growth rates based on successive phases of stagnation showed a rise in the sixties and a decline in the seventies. Compound growth rates between the peak levels of foodgrains production showed a high level in the fifties, a fall in the early sixties, improvement in the late sixties and a fall again in the late seventies. Peak to peak growth rates broadly support deceleration in the seventies on the whole in comparison with the fifties. Both the log-linear trends fitted to the triennial average data showed a deceleration in growth rates as we proceeded from the fifties to the seventies. But a confusing picture however emerged if the periods chosen are 1968-69 to 1980-81 and 1968-69 to 1975-76, and 1975-76 to 1980-81. While the longer period which included upto 1980-81 showed higher growth rates (2.23 linear and 2.24 log-linear) as compared to the growth rates of the

period 1968-69 to 1975-76 (1.43 linear and 1.45 log-linear), suggesting acceleration; the growth rate of the longer period was also higher than the growth rate of 1975-76 to 1980-81 (1.84 linear and 1.90 log-linear), suggesting a deceleration starting with the late seventies.

Thus while the analysis of Sawant based on linear and log-linear functions casts doubts on the conclusions drawn in the study of the Centre for Monitoring Indian Economy (CMIE),¹ it does not offer firm evidence to reject the deceleration hypothesis.

The results based on log-quadratic functions for all-India while suggesting deceleration upto 1967-68 do not lend evidence for firm rejection or acceptance of deceleration or acceleration hypothesis. The results are found to be quite sensitive to the periods chosen, the cut-off points, the years included and the methodology. At the all-India level quinquennial averages for the year starting with 1949-50 and ending with 1983-84 examined by the Symposium showed a definite pattern, which pointed to deceleration starting with the late seventies. In the light of the difficulties in the verification of hypothesis, the Symposium took the view that the validity of the results of statistical exercises could be judged only by the supporting evidence on the pattern of input use and productivity of input. The Symposium also underlined the fact that irrespective of deceleration, the growth rates have been lower than the Plan targets, and only marginally above the rates of growth of labour force and population; and this should be a cause for concern.

Results for Southern States and Orissa

In examining the alleged deceleration for the Southern States and Orissa, the Symposium considered not only the results contained in the two papers presented to it but also the results of other exercises relevant to this and the results contained in the Statewise papers. Log-linear compound growth rates for different periods considered by the Symposium are presented in Table I for the Southern States of India and Orissa.

The data show strikingly the sensitivity of the results to the period chosen, cut-off points, years included and the method adopted. It is only in the study of the Centre for Monitoring Indian Economy in which the growth rates are based on end periods that deceleration of rate of growth is observable in the States in question as well as at the all-India level. Exercises of Alagh and Sharma suggest the possibilities of deceleration for Karnataka, Kerala and Orissa between the 1960s and 1970s, and acceleration for Tamil Nadu and Andhra Pradesh. But in all except Andhra Pradesh, the rate of growth of foodgrains production fell below the all-India rate of 2.74 in the 1970s.

As regards the question whether the late seventies and early eighties are marked by deceleration as compared to the earlier period, the Symposium had to turn to the work of Sawant, and Rao and Sarma. For Andhra Pradesh, these show conflicting results; while Sawant's work shows deceleration in the

1. Centre for Monitoring Indian Economy, "Agricultural Production in India—State-wise and Crop-wise Data: 1949-50 to 1981-82", Bombay, 1983.

late seventies as compared to the early seventies, Rao and Sarma's results suggest acceleration, the differences in the two sets of results being accounted for by the variations in the years included for the statistical analysis and also the method. For Karnataka, while Sawant's study suggests acceleration, the study of Rao and Sarma suggest deceleration. There is agreement in the direction of change of rate of growth between Sawant's study and Rao and Sarma's study only in respect of Tamil Nadu and Orissa. *But what is significant in all the results is that in all sets of data the rates of growth in the seventies were low in Kerala, Tamil Nadu and Orissa, fell behind the all-India average and were generally lower than the rate of growth of population, and labour force.* The picture for Karnataka suggests deceleration as more recent years get included in the analysis. It is only in Andhra Pradesh that the rates of growth of foodgrains production have been above the rates of growth of labour force and population. Even while no firm conclusions could be drawn from the analysis presented in the papers on the question of alleged deceleration, the Symposium noted that the general phenomenon of low rates of growth in the Southern States and Orissa should be a cause for concern and there is need for an examination of the underlying factors for low rates of growth independent of the question of deceleration.

TABLE I—GROWTH RATES OF FOODGRAINS FOR DIFFERENT PERIODS

	Andhra Pradesh	Karna-taka	Kerala	Tamil Nadu	Orissa	All-India
Sawant						
1968-69 to 1980-81	3.29*	2.24*	-0.14	1.38*	0.43	2.24*
1968-69 to 1975-76	3.50*	2.04*	0.54**	0.44	-1.11	1.45*
1970-71 to 1975-76	5.03*	1.70	0.13	-2.49**	-0.93	1.19
1975-76 to 1980-81	3.92*	2.52	-0.64*	2.46	2.38*	1.90*
Rao and Sarma						
1970-71 to 1975-76	6.0690**	3.9186	0.3274	-2.6488	0.6916	—
1976-77 to 1981-82	6.5175**	2.9389	-0.0969	-1.0503	5.5983	—
1970-71 to 1981-82	3.7532*	1.6644	-0.5276***	0.0869	1.6212	—
Alagh and Sharma†						
1960-61 to 1969-70	0.39	2.85	2.01	0.69	2.16	1.85
1969-70 to 1978-79	3.46	2.24	-0.14	1.44	0.95	2.74*
1960-61 to 1978-79	1.69	3.40	1.39	1.83	1.19	2.77*
Centre for Monitoring Indian Economy						
Quinquennia ended 1953-54 and 1964-65	3.6	4.1	4.4	4.5	5.6	3.4
Quinquennia ended 1964-65 and 1981-82	2.2	2.9	0.9	1.5	1.3	2.5
Quinquennia ended 1953-54 and 1981-82	2.7	3.4	2.3	2.6	3.0	2.9

Note:—Asterisk marks indicate statistically significant results. N.A.=Not available.

† Yoginder K. Alagh and P. S. Sharma, "Growth of Crop Production: 1960-61 to 1978-79—Is It Decelerating?", *Indian Journal of Agricultural Economics*, Vol. XXXV, No. 2, April-June 1980 pp. 110-111.

FACTORS UNDERLYING THE RECENT CHANGES IN RATES OF GROWTH

Relationship of Weather to Crop Production

The second session of the Symposium took up the specific question of weather and its relationship to the changes in the rates of growth with particular focus on the late 1970s and early 1980s. The paper of Subrahmanyam examines, among others, the question whether rainfall during the period 1976 to 1981 has been abnormal as to expect a deceleration in the rate of growth of agricultural output. For this purpose, he examined the variation in the south-west monsoon rainfall and also the annual rainfall as seen from the data of meteorological stations at Cuttack, Hyderabad, Madras, Bangalore and Trivandrum for the years 1976 to 1981. The variations are related to the normal rainfall pertaining to the entire period of record from the beginning of the observational programme for each station and also the standard deviation values for the six years under consideration, namely, 1976 to 1981. An important conclusion drawn by Subrahmanyam was that while there was large variations both in the yearly as well as seasonal rainfall at each station during the six-year period, the fluctuations were almost entirely within the limits of their respective standard deviation values. Based on his analysis, the author drew the conclusion that "if there has been reduction in agricultural production or areas of cultivation it cannot be ascribed to climatic factors alone though the latter may have had their impact on other non-climatic influences which have to be identified through other criteria." This conclusion is however questioned on several grounds: his analysis is based on extremely limited evidence at a few meteorological stations located in metropolitan centres; there is a need for more disaggregated analysis, the disaggregation being related to the seasonal requirements of crops; and, the adequacy of the tests applied in drawing the conclusions is also questioned.

Radhakrishna *et al.*² (not presented at this Symposium) note that rainfall during the south-west monsoon has positive effect on output, and summer rainfall has negative effect. The variation in rainfall during the south-west monsoon is observed to be quite large. It is observed that 100 mm. increase (fall) in rainfall during the south-west monsoon results in 8 per cent rise (fall) in the production of rice, bajra and *ragi* and 5 per cent rise (fall) in the production of pulses. Rainfall is seen to affect the output by affecting both yield and area. They further noted that rainfall effects had been more adverse during the period 1968-69 to 1974-75. In the light of these results, there is need for a more systematic enquiry into the pattern of changes in weather in the recent years as compared to the past.

2. R. Radhakrishna, S. Subrahmanyam, and B. Kamaiah, "Growth Performance in Andhra Pradesh Agriculture: 1956-80", Centre for Economic and Social Studies, Hyderabad, 1982 (unpublished).

Declining Rate of Growth of Area

The attention of the Symposium was drawn to the rates of growth of area in the Southern States and Orissa. The data presented by the Centre for Monitoring Indian Economy show that the South Indian States reveal a more acute scarcity of land as compared to the all-India.

TABLE II—RATE OF GROWTH OF AREA IN SOUTHERN STATES AND ORISSA

State	Annual rate of increase between the quinquennia ended		
	1953-54 and 1964-65	1964-65 and 1981-82	1953-54 and 1981-82
1. Andhra Pradesh	1.0	-0.1	0.3
2. Karnataka	1.6	-0.2	0.4
3. Kerala	1.0	—	0.4
4. Tamil Nadu	1.3	-0.3	0.4
5. Orissa	1.4	1.7	1.5
All-India	1.4	0.5	0.9

There is not only a precipitous drop in the annual rate of increase of area but it tended to be negative in the second period in all the Southern States except Orissa. Thus a rapid decline in the contribution of area could be a factor that could account for possible deceleration in the rate of growth in all these Southern States except Orissa. Further light was thrown on this aspect in the Statewise papers presented at the Symposium and other papers not presented but reviewed here. For Andhra Pradesh land even when standardised for irrigation³ showed the following results:

TABLE III—TRENDS IN LAND AREA STANDARDISED FOR IRRIGATION IN ANDHRA PRADESH*

(1960-61=100)				
1955-56 to 1959-60	1960-61 to 1964-65	1965-66 to 1969-70	1970-71 to 1974-75	1975-76 to 1979-80
101.87	105.43	103.94	106.73	104.69

* Parthasarathy, *ibid.*

These show that the contribution of area to rate of growth even when standardised for irrigation has virtually come to a halt as seen in 1964-65.

3. G. Parthasarathy, "Trends in Aggregate Factor Productivity in Andhra Pradesh Agriculture: 1955-56 to 1979-80—A Preliminary Exercise" (unpublished). In standardising the land, irrigated area is taken to be twice the unirrigated area.

For Karnataka, while log-linear growth rates of foodgrain area was 1.55 for the period 1951-52 to 1964-65, the period 1965-66 to 1977-78 was marked by negative rates, *i.e.*, -0.74 for the latter period, as noted by Mruthyunjaya *et al.* Compound growth rates of net sown area as per Rajapurohit's paper were: 0.59 for 1950-51 to 0.12 for 1964-65 to 1975-76. A sharp decline in the rate of growth of area of foodgrains was associated also with shifts from foodgrains to other crops. In Tamil Nadu, the area under foodgrains hardly showed any increase between 1970-71 and 1979-80, while the year 1980-81 was marked by an abnormal drop of the order of nearly 20 per cent due to drought conditions. In Kerala, the compound rate of growth of area of all crops between 1952-53 to 1978-79 was 1.857, the corresponding rate for the period 1974-75 to 1978-79 was -2.402 and for 1970-71 to 1978-79, -0.169 .⁴

Thus, in all the four Southern States the rapidly declining contribution of area to rates of growth is evident, and could possibly account for deceleration, if deceleration in the rate of growth of area is not compensated by acceleration in the rate of growth of productivity.

Changes in Rates of Growth Cropwise and the Slow Growing Crops

The papers presented at the Symposium examined also the changes in the growth rates of individual crops. The position for the South Indian States and Orissa from Sawant, and Rao and Sarma is shown in Table IV.

The growth rates computed are statistically non-significant in many cases both in the exercises of Sawant and of Rao and Sarma, suggesting sharp fluctuations and absence of conclusive trends. Even where they are significant they are found to be quite sensitive to the years included. Therefore, it may not be quite appropriate to rely on compound growth rates of short periods marked by high degree of fluctuation for identification of slow growth crops and also for judging their significance to the changes in growth rates in recent years. It may be more appropriate to judge the trends by examining the data in the context of longer periods. The study of the Centre for Monitoring Indian Economy suggests that the period 1964-65 to 1981-82 was marked by lower growth rate for jowar in Andhra Pradesh, Karnataka and Tamil Nadu compared to the period 1953-54 to 1964-65: 0.2 against 2.4 in Andhra Pradesh; 1.3 against 3.5 in Karnataka and 0.2 against 2.3 in Tamil Nadu.

Cropwise log-linear rates of growth of area in Andhra Pradesh in respect of jowar, bajra, *korra*, *varagu* and *samai*, computed at the Agro-Economic Research Centre, Andhra University, for Andhra Pradesh showed negative signs both for 1955-56 to 1966-67 and also for 1967-68 to 1978-79, though the coefficients have not been found to be statistically significant, except in the case of *varagu* and *samai*. Similarly, among pulses negative rates of growth have been observed for Bengal gram, horsegram and other pulses, though

4. P. P. Pillai (Ed.): Agricultural Development in Kerala, Agricole Publishing Company, New Delhi, 1982.

statistically significant coefficients have been noted only in respect of horse-gram for the period 1967-68 to 1978-79 and for Bengal gram for the period 1955-56 to 1966-67. Oilseeds also showed negative rates of growth of area.

TABLE IV—COMPOUND GROWTH RATES OF PRODUCTION OF SELECTED CROPS

	Sawant		Rao and Sarma		
	1968-69 to 1980-81	1968-69 to 1975-76	1970-71 to 1975-76	1976-77 to 1981-82	1970-71 to 1981-82
Rice					
Andhra Pradesh	4.12*	3.74*	6.6624*	8.1174**	4.5063*
Karnataka	0.79	-0.74	2.1741	5.6741	1.4099
Tamil Nadu	0.97	0.43	-3.6423	1.4157	-0.0635
Orissa	-0.79*	-2.13*	-0.2459	4.1770	0.2849
Kerala	-0.14	0.54	0.3453	-0.1698	-0.5480***
Jowar					
Andhra Pradesh	1.13*	0.73	3.6424	0.4819	1.6753
Karnataka	-0.53	-1.47	-1.2726	-1.7748	-1.7053
Tamil Nadu	2.05*	1.54	-3.6423	1.4157	0.6525
Orissa	—	—	—	—	—
Kerala	—	—	—	—	—
Bajra					
Andhra Pradesh	2.65*	1.77	7.3187	6.9480	4.1270**
Karnataka	3.32*	2.92	7.4937	-9.7108	1.5757
Tamil Nadu	2.25*	0.46	-1.9532	-10.7191	0.8278
Kerala	—	—	—	—	—
Groundnut					
Andhra Pradesh	-0.35	2.26	2.2834	10.9942	-0.7336
Karnataka	0.41	1.38	0.5105	5.4313	-1.1002
Tamil Nadu	0.53	1.49	-3.3481	3.2619	-0.1765
Cotton					
Andhra Pradesh	—	—	26.3502***	24.6585	15.0083**
Karnataka	5.76*	11.09*	10.5846	-2.4698	2.0028
Tamil Nadu	2.07	-2.86	-8.6269	-8.8226	-0.1235
Sugarcane					
Andhra Pradesh	0.01	1.69	2.7697	2.9803	1.1122
Karnataka	3.25*	2.06*	1.8332	3.4934	3.6832*
Tamil Nadu	4.40*	4.35*	6.6533	4.6124	4.8113*

Note:—Asterisk marks indicate statistically significant results.

The trends in the area for both the periods though not statistically significant, are mainly due to shifts in area to rice and sugarcane associated with developments in irrigation. For rice and sugarcane the rates of growth of area have been high and significant: for rice 1.8428 for the period 1955-56 to 1966-67 and 1.8520 for the period 1967-68 to 1978-79, and for sugarcane, 6.0188 for the period 1955-56 to 1966-67, and 3.2848 for the period 1967-68 to 1978-79. Cotton which showed negative rates of growth of area in the first period showed positive rates in the second period, though not statistically significant. The Symposium could not assess the impact of the differential rates of growth of area of crops in relation to the changes in the overall rate of growth.

In Andhra Pradesh, the shifts in area have been essentially from low value crops like millets to high value crops like rice, sugarcane and cotton, and could not be said to affect the rate of growth of overall agricultural production. In fact such shifts from low to high value crops should have had a favourable effect on the rate of growth, though regions with predominance of slow growing crops should have been affected.

For Karnataka, the paper of Mruthyunjaya *et al.* throw light on cropping shifts and output shifts within agriculture for the periods 1951-52 to 1964-65 and 1965-66 to 1977-78. In Karnataka, the pattern of shifts is found to be different. While in Andhra Pradesh there is a shift in area and production towards rice and sugarcane, in Karnataka rice, sugarcane and other pulses are found to have recorded lower growth rates while *ragi*, maize, small millets, total pulses, sesamum, cotton, tobacco and chillies have experienced higher output growth rate during period II than during period I. It has not been possible for the Symposium to evaluate the changes in growth rate as a result of such crop shifts. For Karnataka, Rajapurohit's paper suggests that the trends observed between 1965-66 and 1977-78 continued during the period 1976-77 to 1981-82 in respect of rice. During the period 1976-77 to 1981-82 there was a marked deceleration in rice production. The growth is not only negative but high. This is attributed to a sharp fall in the area (-2.73 per cent) and a setback in the yield.

In Tamil Nadu, bajra, *ragi*, other millets, pulses and cotton witnessed negative rates of growth during the period 1956-57 to 1966-67. The shifts have been towards rice, groundnut and sugarcane. The negative rates of growth of bajra, *ragi* and other millets continued during the period 1967-68 to 1978-79. Rice and sugarcane continued to be the beneficiaries of shift of area from millets.

Pillai's study of growth of agricultural output in Kerala suggests a much higher negative rate of growth of area for food crops than for non-food crops, suggesting a shift toward non-food crops during 1970-71 to 1978-79. A similar trend continued during 1974-75 to 1978-79.

While the Symposium has not been able to assess the overall impact of such shifts in cropping pattern, in so far as cropping pattern shifts have been from low value crops such as millets to high value crops like rice and

sugarcane as in Andhra Pradesh and Tamil Nadu, deceleration of growth rates, if any, cannot be attributed to these shifts.

PROGRESS OF HIGH-YIELDING VARIETIES AND RATES OF GROWTH

The papers presented at the Symposium for different States did not go in depth into the progress of high-yielding varieties (HYVs) in the Southern States. At the all-India level the achievements of area under HYVs are seen to fall behind the targets for 1981-82 in respect of all the crops. The lapses are found to be more in respect of paddy than for wheat.

In Andhra Pradesh, recorded statistics show that there were discrete jumps in area under HYV rice varieties. The first big jump was between 1968-69 and 1969-70. In the latter year the percentage area under HYV stood at around 15 per cent. Until 1972-73, there was only a slow progress. In this year the percentage area under HYV was 34 per cent. There was another quantum jump between 1972-73 and 1974-75 when the HYV proportion rose to 67.9 per cent. The period since 1974-75 has been marked by near stagnation until 1977-78. It is possible that the plateau reached in HYV area under rice could account for a lower rate of growth of yield since 1975-76. Along with the plateau reached in HYV, there are indications from recent studies of the Agro-Economic Research Centre that differences in inputs between traditional and HYV crops are not significant and as a result yield increases due to shift to HYV are far less than expected. Further, despite the progress in HYVs the area covered by them in total cropped area in 1977-78 fell below 30 per cent.

Rajagopalan's paper on Tamil Nadu describes in some detail the developments relating to HYV seeds. Technological transformation in Tamil Nadu began since 1967-68. IR 8, IR 20 and their derivatives, CSM sorghum, hybrid bajra, MCUS and other hybrids of cotton, new CO canes made a mark and induced productivity gains. Various programmes such as IAAP, and crash programmes provided organizational support. The period starting with 1972-73 was marked by stress. The seed quantity tended to decline either due to loss of initial vigour and quality or because of inadequate production and marketing systems. Continued use of high rates of fertilizers, and intensive cropping all round the year induced pest and diseases for which technical solutions and guidance were not adequately forthcoming. The period since 1972-73 shows a lower rate of growth.

In Karnataka, the growth rate of production was quite high during the pre-green revolution period 1950-51 to 1964-65. This was attributed to introduction of new improved seeds associated with improved cultivation practices, particularly the replacement of drill sowing by transplantation. The period 1964-65 to 1975-76 was marked by a decline in the growth rate of rice due to competition by lucrative crops such as sugarcane. Yet the rate exceeded 3 per cent with the introduction of IR strains. The period 1976-77 to 1981-82 shows a marked deceleration tending to be negative. The growth

rate of yield, though positive, was extremely low, suggesting that HYV progress ceased to have favourable effects. In the case of jowar, hybrid jowar strains were unsuccessful because of the stem-borers. Further, hybrid jowar strains are not suitable during the *rabi* season in the North Karnataka region. Surprisingly, when the new hybrid varieties of jowar suitable to the black soils of the northern districts were reported to have been successfully introduced, the growth rates of yield of jowar have shown a sharp decline in the period 1976-77 to 1981-82. Rajapurohit suggests that the stem-borer menace causing drastic decline in yields could have remained unnoticed.

There were however some positive factors in relation to some crops. The successful introduction of new varieties of *ragi* under rainfed conditions has contributed to substantial increases in the rate of growth of *ragi* yield. Similarly, the performance of pulses has also been better in recent years.

Unlike the all-India pattern, agricultural production grew at a compound rate of only 2.758 per cent annually during the fifties, but at a much higher rate of 4.365 per cent per annum during the sixties. The declining phase in Kerala agriculture started with 1975-76. Kerala does not show a distinct phase of growth which has the impact of HYVs.

In Orissa, the coverage under HYV is very poor. Both Baidyanath Misra and Sunil Sen Gupta suggest that stagnation has been the dominant feature of agriculture in Orissa.

In brief, the States under consideration show evidence of tapering off of the accelerating effects of HYVs on growth.

IRRIGATION AND RATE OF GROWTH

In Andhra Pradesh, much of the growth in output prior to mid-sixties can be largely explained by the increases in irrigated area and traditional inputs. In contrast since mid-1960s, the growth of agricultural output has clearly been the result of expansion in irrigated area along with expansion in modern inputs. Thus irrigation is the common factor throughout the period. However, one can notice distinct phases in the expansion of net area irrigated; it increased from 2.82 million hectares during the triennium ending 1958-59 to 3.10 million hectares by the triennium ending 1963-64, remained constant until the triennium ending 1973-74 and thereafter expanded rapidly to 3.41 million hectares in the triennium ending 1979-80.⁵ Yet, the area irrigated has not increased commensurate with irrigation facilities created. There has been some improvement in the percentage utilized out of potential created in recent years. Yet the full potential of irrigation is not being utilized. Among the South Indian States, Andhra Pradesh records the lowest potential utilized; in 1981-82 the potential utilized was only 71.0 per cent as against 78.0 per cent of all-India.⁶

5. Radhakrishna *et al.*, *op cit.*

6. See Government of India: Annual Plan 1982-83, Planning Commission, New Delhi, 1982, Annexure-6.2, p. 50.

There is also another factor which is relevant to a consideration of recent changes in growth rates. Even while irrigation is expanding rapidly, an area of about ten million hectares in Andhra Pradesh is vulnerable to drought. A recent study identified 48 drought-prone taluks concentrated mainly in the districts of Rayalaseema and Mahbubnagar of Telangana.⁷ The 48 drought-prone taluks account for 17 per cent of population, 27 per cent of geographical area and 33 per cent of net sown area in Andhra Pradesh. In these taluks, irrigation facilities are meagre, and even in areas with such facilities there is great reliance on tanks and wells. Drought-prone taluks in Rayalaseema are largely dominated by groundnut, jowar and small millets. Mahbubnagar is essentially a jowar region. There is as yet very little break-through in the dryland agricultural technology. The coexistence of drought-prone areas and slow growth crops is the principal reason for the virtual stagnation of agriculture in the dry and drought affected areas. The Irrigation Commission, 1972 made two suggestions: (i) improving the moisture for crop growth through conjunctive use of water from rainfall, surface and groundwater resources and (ii) introduction of suitable crop pattern that would provide optimum protection against drought. For conjunctive use of rainfall, surface and groundwater there must be effective conservation of rainfall water through techniques like ridges, guided terraces, grassed water ways, farm ponds, etc. There is need for treating watershed as a single management unit, and this will call for certain collective or co-operative action. As regards cropping pattern, the present cropping pattern is adjusted to drought conditions and what is required is to bring about better yields in the existing crops through better strains of seeds suitable for dry areas and better moisture management. The adverse employment consequences of 'economic tree' crops need to be carefully considered before public policy encourages a shift in cropping pattern towards tree crops.⁸

In Tamil Nadu, the high growth rates in the late sixties and early seventies were traceable to advances in groundwater and pumpset revolution, which appear to have lost their momentum. Some of the critical issues are: water resource management at regional level consistent with objectives of growth with equity, need for water users organizations for optimum use of water through land consolidation, water pricing and the like. As regards groundwater, the lowering of water table and the consequent increase in the cost of well irrigation are noted to be a general phenomenon, especially in Coimbatore district. The discussions at the Symposium have indicated that as water is getting scarce and costlier, there have been shifts to high value crops, though the adjustments have been slow. The Symposium has not been able to assess the quantitative significance of the developing constraints in the utilization of water resources in relation to changing growth rates but

7. D. Narasimha Reddy, "Agricultural Development in the Drought Prone Areas of Andhra Pradesh: A Draft for Discussion", Centre for Economic and Social Studies, Hyderabad 1982 (unpublished).

8. See Narasimha Reddy, *ibid.*

the indications are that water management would be a critical constraint in sustaining planned rates of growth in Tamil Nadu.

In Karnataka, the percentage of gross irrigated area to gross sown area in 1978-79 was only 28.2. The papers presented at the Symposium do not throw much light on the changes in irrigation in relation to growth rate. However, Rajapurohit's paper on Karnataka suggests that since 1964-65 there has been a sharp decline in the percentage area under foodgrains and a simultaneous increase under some newly emerging crops like coconut, mulberry, fruits and vegetables. The share of the latter crops under irrigation should have increased, as compared to the share of foodgrains. These developments would explain the decline in the growth rate of foodgrains production.

In Kerala, the proportion of irrigated area under paddy to total paddy area nearly doubled from 31 per cent in the First Plan to 60 per cent in the Fourth Plan.⁹ But for the State as a whole, the percentage increase in yields of irrigated over unirrigated area is only 19.57 for autumn and only 10.83 per cent for winter. Cost escalation was reported to be the highest.¹⁰ The benefits of irrigation consist more in the stability it has imparted to crop yields than the increase in productivity. A diagnostic study of Neyyar, Periyar Valley and Malampuzha projects shows gross under-utilization of irrigation potential generated on account of various technical, economic, agronomic and organizational problems.¹¹ In the Neyyar project only 65 per cent of the area under the command area is actually brought under irrigation. Generation of storage capacity in the reservoirs and scheduling the release of water according to irrigation requirements needed lot of improvement. Delay in the construction of field channels has been one of the major handicaps experienced by the farmers especially at the tail end of irrigation structures and water channels. Field to field irrigation is still in vogue. There is need for development of optimum cropping pattern.

In Orissa, floods, droughts and cyclone occur almost in every alternate year in a severe form. Baidyanath Misra indicates that there has been a crop loss in 11 out of 17 years due to natural calamities between 1964-65 and 1980-81 and so far only about 20 per cent of the cultivated area under rice is under irrigation. Summer paddy is possible only with irrigation and the success of winter paddy largely depends upon water management. Irrigation without water management is not found to have much impact on productivity. At present water management does not exist during rainy season, nor is it easy. Though summer irrigation is very important, inadequate control structures and absence of field channels are found to result in wastage of irrigation water. In fact, poor water management is leading to excessive inundation, waterlogging in low lying areas and scarcity conditions in tail reaches at crucial stages of cultivation leading to low productivity. The rate

9. M. V. George and N. G. Nair, "Irrigation and Agricultural Development in Kerala", in Pillai (Ed.): *op. cit.*, p. 130.

10. *ibid.*, p. 134.

11. *ibid.*, p. 136.

of growth of foodgrains production for the period 1957-58 to 1977-78 was estimated to be lower as compared to the period 1961-62 to 1965-66.

RATE OF GROWTH OF INPUTS AND PRODUCTIVITY OF INPUTS

The Symposium reviewed the data relating to fertilizer use per unit of gross cropped area for all-India and also for the States under consideration. At the all-India level the average annual rate of growth of fertilizer consumption declined from 19.7 per cent for the period 1951-52 to 1964-65 to 10.80 per cent for the period 1966-67 to 1980-81. Per hectare use of fertilizer shows only a very slow rise since 1978-79.¹² The decelerating trends in fertilizer use are attributed to slackening of demand rather than the supply or the lack of distribution channels. The position in respect of Southern States and Orissa for selected years is shown in Table V.

TABLE V—STATEWISE CONSUMPTION OF FERTILIZERS PER UNIT OF GROSS CROPPED AREA

State	(kg./hectare)				
	1970-71	1975-76	1979-80	1980-81	1981-82
Andhra Pradesh	22.74	31.1	42.7	45.9	50.0
Karnataka	14.75	20.2	33.2	31.1	34.4
Kerala	19.86	21.6	36.2	33.4	32.9
Tamil Nadu	37.46	39.2	69.3	63.2	66.7
Orissa	3.75	6.5	8.5	9.6	9.9
All-India	13.19	17.1	30.5	32.5	—

At the all-India level fertilizer consumption increased from 13.19 kg. per hectare in 1970-71 to 32.50 kg. in 1980-81. The level of fertilizer consumption per hectare was higher in all the South Indian States in 1970-71. Orissa, however, recorded the lowest level of fertilizer consumption. The slow down in the rate of growth of fertilizer consumption between 1970-71 and 1975-76 is much more evident in the case of Kerala and Tamil Nadu. But both Kerala and Tamil Nadu showed high rates of expansion in the use of fertilizers between 1975-76 and 1979-80. The three years 1979-80 to 1981-82 are marked by near stagnation and decline in Karnataka, Kerala and Tamil Nadu, while Andhra Pradesh alone shows a continuing trend of rise. Orissa continues to record low levels of fertilizer use.

12. R. Nagaraj, "Trend Deceleration in Fertiliser Consumption: A Preliminary Analysis", *Economic and Political Weekly*, Vol. XVII, No. 39, September 25, 1982, pp. A-74 to A-84 and "Determinants of Fertiliser Use in Indian Agriculture", *Economic and Political Weekly*, Vol. XVIII, No. 13, March 26, 1983, pp. A-2 to A-15.

For Andhra Pradesh, the study of Radhakrishna *et al.*¹³ computed total input index from the indices of net sown area, labour, annual power, pumpsets, tractors and fertilizers. They used the factor shares for 1960 and 1970 for this purpose; 1960 factor shares for the period 1956-57 to 1966-67 and 1971 factor shares for the period 1967-68 to 1978-79. A broad conclusion is that factor productivity has fallen during the period 1967-68 to 1978-79 as compared to the period 1956-57 to 1966-67 for Andhra Pradesh as a whole. Their results for West Godavari district and Srikakulam are of significance. Total factor productivity for West Godavari district recorded impressive growth between 1956-57 and 1969-70. It was sustained at high levels until 1974-75, and showed a steep fall during the period 1975-76 to 1978-79. There is some suggestion of the tapering off of the effects of green revolution. Srikakulam, a backward district, shows not only a fall in factor productivity, but factor productivity levels were much lower in the late 1970s as compared to early 1950s.

*Changes in Prices of Inputs and Output and Their Bearing
on Changes in Growth Rates*

The Symposium has not been able to consider in depth the changes in input-output price ratios. However, for Tamil Nadu, the paper by Rajagopalan throws some light on the nature of relationships.

TABLE VI—PRICE RATIOS OF FERTILIZER TO RICE AND FERTILIZER USE PER HECTARE:
TAMIL NADU

Year	PN/PR*	Fertilizer** use (nutrients kg. per hectare)	Per hectare
1971-72	3.78	65.59	14.24
1972-73	3.84	78.05	17.03
1973-74	3.26	75.30	18.05
1974-75	5.88	79.79	20.16
1975-76	5.43	106.18	25.16
1976-77	5.14	88.59	19.73
1977-78	4.52	108.71	20.07
1978-79	3.96	121.12	20.31
1979-80	4.14	123.25	16.30
1980-81	—	124.29	19.37

Note:— *PN = price of N/kg.

PR = price of paddy/kg. as fixed by the Agricultural Prices Commission.

**Data from Cost of Cultivation of Principal Crops (CCPC) Scheme run by the Tamil Nadu Agricultural University.

13. Radhakrishna *et al.*, *op. cit.*

There is a suggestion that fertilizer use continued to show an increase until 1977-78 despite the rise in the input-output price ratio possibly because of favourable productivity ratios. The latter years are marked by stagnation in fertilizer use despite lower price ratios. "The suggestion is that, productivity of fertilizer may be falling." This has support in the evidence presented by Nagaraj and Srivastava. Nagaraj's analysis suggests that the response to fertilizer application under actual field conditions is lower than that achieved in simple fertilizer trials.¹⁴ Srivastava notes that in Tiruchirapalli and Thanjavur, the productivity of rice declined despite substantial increase in fertilizer consumption.¹⁵ It is quite likely that districts with high intensity of fertilizer use are experiencing diminishing returns to inputs. A fact of significance is that while fertilizer use has increased in all size-groups, the rates of growth of fertilizers among small farmers are lagging behind those of others, the major constraints being inadequate finance and risk aversion behaviour. The Tamil Nadu experience suggests that even while price ratios are important, productivity of inputs and effective servicing of credit and extension to small farms are even more important.

The price factor appears to be much more relevant in explaining the deceleration of rate of growth of Kerala, particularly of paddy. George analysed the prices received by farmers and prices paid for three periods, viz., 1953-54 to 1959-60, 1960-61 to 1969-70, and 1970-71 to 1980-81. In Kerala, while prices received by farmers increased at a greater rate as compared to farm costs during the first period, the latter period was marked by a higher rate of increase in farm cultivation costs as compared to prices received. The rate of increase in farm costs between 1974-75 and 1980-81 had been much higher and the index of farm cultivation costs with 1952-53 = 100 was 603 as against 480 for prices received by farmers. An analysis of the changes in the wages of both male and female paddy workers and the index of farm price for paddy indicates that the wage rates had increased much faster than farm prices. Further, among the agricultural commodities paddy price increase was much smaller than the increase in the price of many other items. These two factors might probably account for the stagnation of paddy production in Kerala.¹⁶ The consequences of unfavourable price ratios for paddy have been adverse to the interests of labour despite the rise in the wage rates particularly in areas in which conditions are favourable for mechanization. Cultivators are increasingly taking to mechanization for specific operations such as ploughing and levelling.¹⁷

14. Nagaraj, *op. cit.*

15. A. P. Srivastava, "Agricultural Production and Increasing Fertiliser Application", *Economic and Political Weekly*, Vol. XVIII, No. 13, March 26, 1983.

16. P. S. George, "Agricultural Price Movements in Kerala", in Pillai (Ed.): *op. cit.*, p. 153.

17. S. Natarajan, "Labour Input in Rice Farming in Kerala—An Inter-Regional, Inter-Temporal Analysis", in Pillai (Ed.): *op. cit.*, p. 229.

CONCLUSIONS

(1) No conclusive answers could be provided on the alleged deceleration on the basis of statistical analysis. The sensitivity of the results to years included, cut-off points chosen and statistical methods subject the conclusions of an analysis of short period trend results, which in most cases are statistically non-significant, to doubtful validity.

(2) Deceleration or no deceleration, the rates of growth continue to be lower than planned and only marginally above the rates of growth of population in the States of South India. Orissa continues to be marked by stagnation.

(3) Long-term factors underlying growth rates suggest the possibility and the prospects of declining growth rates; the South Indian States show more rapid decline in the contribution of area; the progress of high-yielding varieties and their impact on rates of growth show signs of tapering off; cost escalation of irrigation and water management problems are becoming more acute; the progress in dryland farming has been inadequate; and the contribution of newly irrigated areas to the rate of growth has not possibly been adequate enough to compensate for stagnation in dry and drought-prone areas, and the declining rates of growth in the old deltas. The rate of growth of fertilizer consumption shows signs of decline in the context of declining factor productivity, especially in areas with high levels of fertilizer use. In brief, the prospects of deceleration are real in the absence of upward shifts in the production, and institutional and organizational arrangements for more effective use of inputs, and of implementation of policies such as watershed as the management unit in dry areas. The price issue is likely to become much more dominant with the declining productivity of inputs.

(4) The cost escalation of water charges is found to result in shifts in cropping pattern towards high value crops, and away from foodgrains consumed by the poorer groups. These trends are likely to continue with adverse effects on the rates of growth of foodgrains production. The consequences of these on employment and nutrition also need consideration.