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GROWTH AND FLUCTUATIONS IN INDIAN AGRICULTURE: 1956-57 TO 1972-73

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In this paper an attempt is made to assess the performance of various Indian States with respect to agricultural production during the period following the reorganisation of States in 1956-57. For this purpose, we have constructed index numbers of agricultural production for 15 States,[1] making use of the crop wise production data annually published by the Union Ministry of Agriculture.[2] The period covered by the study is from 1956-57 to 1972-73 — the latter being the latest year for which production figures could be obtained in published form.

The methodology pursued in the preparation of these index numbers calls for some elaboration. Final estimates of production[3] and area of principal crops in each State were taken and the corresponding index numbers worked out with 1956-57 as the base. To arrive at a consolidated index of agricultural production weights were assigned to individual crops and the weighted averages estimated.[4] The weights given to each crop corresponds to the percentage share of its value (physical output multiplied by average farm price per unit of output) in the total value of agricultural output in 1956-57. These weights for each State are given in Appendix A.

Using the weights given, we have also estimated the index numbers for various sub-groups like coarse cereals, pulses, foodgrains, fibres and oil seeds. However, for estimating the index numbers of area for all crops or sub-groups of crops,

only the acreages involved were added up and no weighting procedure was adopted.*

A major difficulty in making time series studies on agricultural output arises from changes in the crop estimation procedure in some States from traditional methods to modern sample crop cutting survey techniques. Estimates of output derived under these different techniques are not strictly comparable. This study being a preliminary attempt in constructing the overall trends in agricultural production of various States, we have not made any effort to render such figures fully comparable by adopting suitable methods.[5] However, in the case of one State, i.e., Orissa, we have adopted the corrected index numbers of agricultural production[6] till 1959-60, for in that year there was a sudden spurt in the estimate of crop output of Orissa on account of the introduction of crop cutting survey methods for Rice, which is the most important crop of the State. In the case of most other States, a shift to modern crop cutting methods for estimating the output of major crops (which account for more than 75% of the total weights) had come about prior to 1959-60. Earlier, a set of index numbers of production furnished in the course of the preparation of this paper were presented by Professor K.N.Raj in his paper "Growth and Stagnation in Indian Industrial Development".[7] The consolidated index numbers given in this paper are an improvement upon the earlier set of figures, for, in the earlier draft only

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*Detailed Statewise tables of these index numbers are not given here, for reasons of space. They are, however, available with the author for reference.

important crops, whose total value of weights hardly exceeded 75 per cent of the total weight in each State were taken into account in estimating the index numbers. The tables presented here have been worked out from data relating to all the crops, making the total value of weights equal to hundred per cent wherever possible.[3/] Besides, there were certain procedural errors that entered into the estimation of the earlier figures, which have been corrected in this study.

In the next section we shall briefly examine the agricultural production performance of different States in terms of the growth rates and variations in output levels; and in the subsequent sections we shall offer some explanations for the differences in production trends among the States.

II

The index numbers of agricultural production estimated for each State for the years 1956-57 to 1972-73 are given in Table 1. We have estimated the compound growth rates of agricultural production for States from triennial averages of the base and the terminal years of the index numbers. Further we also tried to measure the magnitude of year to year fluctuations of these index numbers from the trend line. For this, first we worked out a three year moving average of index numbers to represent the trend line. The year to year variations from the moving average were estimated and their standard deviation worked out to get a measure of dispersion. The estimated rate of growth of agricultural production along with the corresponding measure of dispersion for each State is given in Table II.

Table I

Consolidated Index Numbers of Agricultural Production - Statewise

Base 1956-57 = 100.00

Year	Andhra Pradesh	Assam	Bihar	Gujarat	Karnataka	Kerala	Madhya Pradesh	Maharash-tra	Orissa	Punjab/ Haryana	Rajas-than	Tamil Nadu	Uttar Pradesh	West Bengal
1956-57	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
1957-58	95.91	101.03	78.68	118.56	112.89	101.68	77.44	108.64	78.40	100.28	94.04	103.23	89.66	97.49
1958-59	103.96	103.89	134.92	173.97	115.54	104.94	108.23	114.50	94.58	111.68	106.75	102.32	104.16	102.58
1959-60	101.99	102.98	126.61	122.20	118.21	109.62	104.95	105.51	107.40	106.76	104.96	108.93	105.11	104.16
1960-61	93.05	99.66	142.97	158.68	115.00	111.14	111.19	135.17	106.11	119.48	104.57	117.02	127.08	122.25
1961-62	112.10	108.20	140.55	184.28	131.74	109.52	104.23	116.25	111.16	121.71	121.40	121.47	123.16	122.55
1962-63	108.46	98.86	140.44	175.08	129.59	113.47	96.62	120.36	120.62	120.18	119.61	124.57	113.63	114.86
1963-64	116.26	107.46	141.09	180.71	123.11	115.79	106.28	122.87	136.56	120.31	92.52	123.53	104.86	123.14
1964-65	125.63	115.07	147.61	215.73	144.43	120.20	118.17	122.19	142.35	134.96	120.42	124.63	136.66	142.73
1965-66	99.87	107.80	138.16	159.71	97.30	118.85	74.60	89.91	112.17	118.83	96.62	116.53	123.50	122.63
1966-67	121.35	110.98	80.00	155.57	124.57	127.53	70.33	104.87	126.40	174.57	97.35	127.20	103.68	121.99
1967-68	120.93	117.94	160.69	215.30	136.04	135.54	115.52	122.19	129.65	173.99	138.54	127.85	135.57	133.64
1968-69	114.14	124.92	174.26	155.21	153.84	143.08	107.55	126.60	156.36	174.58	85.74	126.38	139.36	140.19
1969-70	120.22	124.80	148.84	195.98	166.77	146.95	110.08	125.46	147.64	209.67	104.40	138.77	153.20	155.26
1970-71	121.96	126.78	156.46	267.15	167.15	150.55	120.97	106.59	147.70	219.41	202.51	152.27	164.91	160.03
1971-72	125.29	131.56	183.24	269.27	171.96	159.74	127.77	95.09	131.13	229.04	149.78	155.84	147.13	172.00
1972-73	96.53	144.50	186.13	129.53	138.26	160.39	117.62	62.42	138.95	220.07	126.50	152.34	156.57	150.14

Table II

Percentage Rates of Growth of Agricultural Production (A) and the Standard Deviation of Fluctuations of Production(B) in Different States for the Period 1957-58 to 1971-72

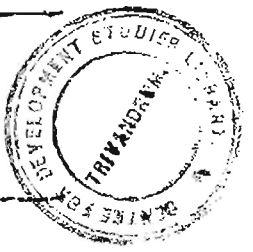
States	A	B
Andhra Pradesh	0.98	6.77
Assam	2.01	3.07
Bihar	3.76	17.45
Gujarat	3.85	25.36
Karnataka	2.80	10.32
Kerala	3.11	1.53
Madhya Pradesh	1.79	10.52
Maharashtra	-1.25	8.04
Orissa	3.08	8.04
Punjab/Haryana	5.60	7.32
Rajasthan	3.38	19.91
Tamil Nadu	2.97	2.42
Uttar Pradesh	3.39	8.95
West Bengal	3.45	5.61

Table II indicates that Punjab/Haryana registered the highest rate of growth in agricultural production, about 6 per cent per annum for the period under review. There are seven more States with

impressive records where groth rates range well above 3 per cent per annum. They are Gujarat, Bihar, West Bengal, Uttar Pradesh, Rajasthan and Kerala and Orissa. States like Tamil Nadu, Karnataka, and Assam have had growth rates ranging between 2 and 3 per cents. The States which have had very low growth rates are Madhya Pradesh, Andhra Pradesh and Maharashtra. Maharasthra is the unique case which recorded a negative growth rate during the period under review.

In order to make a more useful assessment the performance of various States, one should also take into account the measure of dispersion around the trend line of output. The lower the measure of the fluctuations in any State greater would be its consistency in the growth of output over time. We have attempted a two-way classification of States on the basis of the rates of growth and also the standard deviation of output fluctuations. On the one axis, States have been classified into three groups: (i) those showing high rates of growth, i.e., above 3 per cent per annum; (ii) those showing moderately high rates of growth, i.e., between 2 and 3 percents; and (iii) those showing low rates of growth, i.e., less than 2 per cent per annum. On the other axis, a similar classification of States is made into those (i) having low range of output fluctuations, i.e., standard deviation being less than 7.5; (ii) having moderately high degree fluctuations, i.e., standard deviation ranging between 7.5 and 15; and (iii) having high degree of fluctuations, i.e., standard deviation being above 15.

Rates of Growth / Range of Fluctuations	Low (s.d.< 7.5)	Moderate (7.5> s.d.< 15)	High (s.d.> 15)
	(1)	(2)	(3)
High (g.r.> 3.00%)	1. Punjab/Haryana 2. West Bengal 3. Kerala	1. Orissa 2. Uttar Pradesh	1. Gujarat 2. Bihar 3. Rajasthan
	(4)	(5)	(6)
Moderate (2.00> g.r.< 3.00)	1. Tamil Nadu 2. Assam	1. Karnataka	
	(7)	(8)	(9)
Low (g.r.< 2.00)	1. Andhra Pradesh	1. Madhya Pradesh 2. Maharashtra	



States which appear in block 1 are those which registered high rates of growth along with lesser annual variations in output levels. Punjab and Haryana with the highest rate of increase in production along with relatively lower degree of fluctuations, turn out to be cases of exceptionally good performance among Indian States. States which appear in block 1, 2, 4 and 5 with relatively better rates of growth and also moderate to low degree of fluctuations, i.e., Punjab/Haryana, West Bengal, Kerala, Uttar Pradesh, Tamil Nadu, Assam, Karnataka and Orissa have, on the whole displayed better performance than other States falling in blocks 3, 7 and 8 in that agricultural output levels in the former group of States were marked by greater stability during the period of our analysis.

In block 3 we have three States, viz., Gujarat, Bihar and Rajasthan which in spite of their good record in agricultural output increase, have a high degree of fluctuations in output. In the last row, we have 3 States with low rates of growth; but with different levels of output fluctuations. They are Andhra Pradesh, Madhya Pradesh, and Maharashtra. The low range of output fluctuations in Andhra Pradesh only indicates that the economy was marked by near stagnation in performance during the period.

We can disaggregate the relative rates of growth of production in different States into that of area and yield. Such disaggreated figures (Table III) would give further insight into the composition of agricultural growth in terms of area and productivity effects. The rate of growth of productivity for each State has been estimated by subtracting the rate of increase in area from that of production.

Among the eight States which showed high agricultural growth rates (above 3 per cent per annum) only three viz., Punjab/Haryana, Gujarat and Bihar attained rates of growth in productivity exceeding 3 per cent. In other cases such high increases in production were partly due to the higher rates of expansion in area under cultivation; an outstanding example of this is Kerala which recorded in acreage increase of 2.19 per cent per annum and thereby accounted for over 70 per cent of the rate of increase in production. However, in Karnataka, Uttar Pradesh, Tamil Nadu, West Bengal and Rajasthan, agricultural productivity registered rates of increase above 2 per cent and significantly contributed

Table III

Compound Rates of Growth of Aggregate Production, Area and Productivity of Agricultural Crops in Indian States during 1957-58 to 1971-72

(Figures are given in Percentages)

States	Production	Area	Productivity
Andhra Pradesh	0.98	0.03	0.95
Assam*	2.01	1.56	0.45
Bihar	3.76	0.53	3.23
Gujarat	3.85	0.13	3.72
Karnataka	2.80	-0.48	3.28
Kerala	3.11	2.19	0.92
Madhya Pradesh	1.79	1.03	0.76
Maharashtra	-1.25	-0.35	-0.90
Orissa	3.08	1.88	1.20
Punjab/Haryana	5.60	0.83	4.77
Rajasthan	3.38	1.22	2.16
Tamil Nadu	2.97	0.60	2.37
Uttar Pradesh	3.39	0.88	2.51
West Bengal	3.45	1.28	2.17
INDIA**	2.48	0.66	1.82

* In the case of Assam, area figures relating to Tea were not available, and hence were not taken into account in estimating the index numbers.

**Growth rates relating to INDIA were worked out directly from index numbers estimated by the Ministry of Agriculture.

Source: Estimates of Production and Area of Principal Crops in India 1972-73, op.cit.

to higher rates of increase in production. An exceptionally important case is that of Karnataka which recorded a 3.28 per cent rate of increase in productivity but shows a lesser magnitude in output increase, due to the fact that total acreage in the State declined at 0.48 per cent per annum. Besides Kerala, there are four States which showed rates of increase in productivity of less than 1 per cent per annum. They are Andhra Pradesh, Assam, Madhya Pradesh and Maharashtra. The lowest figure is that of Maharashtra, which turns out to be the only State which recorded a negative rate of increase in productivity during the entire period.

We can break up the period of analysis into two, one from 1957-58 to 1963-64 and the other from 1963-64 to 1971-72 and examine the corresponding rates of growth of production area and productivity in the different States. The figures are given in Table IV.

Table IV shows that the rates of growth of agricultural production in most States, viz., Andhra Pradesh, Bihar, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Tamil Nadu and West Bengal in the earlier period, i.e., upto 1963-64 were much higher compared to those in the subsequent period. In all these States rates of growth of acreage as well as productivity declined in the latter period (except in Madhya Pradesh where productivity rates have shown marginal improvement).

Tablve IV

Compound Rates of Grow th* of Aggregate Production, Area and Productivity of Agricultural Crops in Indian States

(Figures are given in percentages)

States	1957-58 to 1963-64			1963-64 to 1971-72		
	Produ- ction	Area	Produ- ctivity	Produ- ction	Area	Produ- ctivity
Andhra Pradesh	2.63	0.75	1.88	-0.23	-0.51	0.28
Assam	0.88	1.51	-0.63	2.86	1.59	1.27
Bihar	5.37	1.15	4.22	2.57	0.02	2.55
Gujarat	6.46	0.99	5.47	1.93	-0.50	2.43
Karnataka	3.22	-0.26	3.48	2.49	-0.65	3.14
Kerala	2.20	1.81	0.39	3.79	2.48	1.31
Madhya Pradesh	1.96	1.27	0.69	1.66	0.84	0.82
Maharashtra	1.25	0.70	0.55	-3.66	-1.14	-2.52
Orissa	5.74	3.32	2.42	0.56	0.81	-0.25
Punjab/Haryana	3.13	0.25	2.88	7.48	1.29	6.19
Rajasthan	1.70	1.21	0.49	4.65	1.23	3.42
Tamil Nadu	3.37	0.88	2.49	2.68	0.39	2.29
Uttar Pradesh	3.21	1.31	1.90	3.53	0.73	2.80
West Bengal	4.32	1.33	2.99	2.80	1.23	1.57
INDIA	2.90	1.13	1.77	2.17	0.31	1.86

*The growth rates have been estimated from the triennial averages of index numbers for the base and terminal years.

It is interesting to note that Maharashtra had positive rates in the period prior to 1963-64. However, in the subsequent period it registered the sharpest decline in production reaching the lowest rate of growth of -3.7 per cent per annum. The rate of decline in productivity during the same period in Maharashtra was of the order of 2.5 per cent per annum. Yet another State, which has shown drastic decline in growth rate is Andhra Pradesh. From a rate of increase in agricultural production of 2.6 per cent attained in the earlier period, it has come down to -0.2 per cent in the latter period along with near stagnation in the productivity levels.

The States which have improved their performance in the period after 1963-64 are Assam, Kerala, Punjab/Haryana, Rajasthan, and Uttar Pradesh. Assam appears to have achieved significant improvements in production in the latter period. From an aggregate rate of growth of production ranging below 1 per cent in the early phase gone upto 2.5 per cent per annum in the second period. The rate of increase in productivity it has also leaped from -0.6 to 1.3 per cent per annum. Unfortunately we cannot place a high degree of reliability on the figures relating to Assam, as we could not include the acreage under tea plantations in constructing the index numbers of total area under cultivation in the State. In the case of Kerala, the high rate of growth recorded in the latter period (3.6 per cent) was mostly on account of increase in acreage, though there was also marked improvement in the yield rates.

The three cases Punjab/Haryana, Rajasthan, and Uttar Pradesh deserve our special attention. They have experienced significant improvements in the productivity levels during the period after 1963-64. The most striking case in this group of States is that of Punjab/Haryana, which has moved up from 2.9 per cent per annum to 6.2 per cent per annum in the latter period, which also happens to be the highest rate of growth of productivity among the Indian States.

It would also be interesting to examine how the output levels fluctuated in different States during the two sub periods we have taken into account. In Table V we try to compare for different States the standard deviations of variations of agricultural output from the triennial averages for the two sub periods between 1957-58 and 1971-72, along with the corresponding rates of growth of agricultural production.

One important observation is that in all the Indian States (with the exception of Assam and Maharashtra) fluctuations in agricultural output have substantially widened during the latter period. This is true for all States irrespective of whether agricultural growth rates have tended to increase or decrease. Consider the States which showed lower growth rates in the second phase: in the case of Andhra Pradesh, Karnataka, and Tamil Nadu the magnitudes of fluctuations have more than doubled; in the case of Bihar and Gujarat they have increased by more than 45 per cent and in Madhya Pradesh and West Bengal by more than 35 per cent.

TABLE V

Compound Rates of Growth of Agricultural Production (A) and the Standard Deviation of Fluctuations of Production (B) in Different States for the Two Periods 1957-58 to 1964-65 and 1963-64 to 1971-72

States	1957-58 to 1963-64		1963-64 to 1971-72	
	A	B	A	B
Andhra Pradesh	2.63	3.97	-0.23	7.90
Assam	0.88	3.50	2.86	2.42
Bihar	5.37	13.26	2.57	19.24
Gujarat	6.46	19.11	1.93	28.09
Karnataka	3.22	4.38	2.49	13.15
Kerla	2.20	0.99	3.79	1.78
Madhya Pradesh	1.96	8.36	1.66	11.30
Maharashtra	1.25	8.56	-3.66	7.12
Orissa	5.74	5.03	0.56	9.42
Punjab/Haryana	3.13	4.00	7.48	8.90
Rajasthan	1.70	8.57	4.65	25.27
Tamil Nadu	3.37	1.32	2.68	2.90
Uttar Pradesh	3.21	7.28	3.53	10.46
West Bengal	4.32	4.31	2.80	6.01
INDIA	2.90	3.60	2.17	5.62

Also among the States, which improved their growth performance in the latter period, the fluctuations in output levels have tended to widen. Particularly interesting is the case of Rajasthan,

where corresponding to a nearly three fold increase in the rate of growth of output, there has been a more than proportionate increase in the magnitude of fluctuations. In Punjab/Haryana and Kerala the standard deviation has nearly doubled, while in Uttar Pradesh, it has increased by more than 40 per cent.

Thus an important observation which emerges from this study is that in Indian agriculture the period since the mid 'sixties was marked by lesser growth rates and also a higher degree of output fluctuations. The 'disturbing fact' which S.R.Sen[9/] observed earlier after analysing the agricultural production data for India during the period 1951-52 to 1965-66: 'that the instability in Agriculture tended to increase with the rate of growth' remains valid also for the subsequent period; with one crucial difference that the increasing instability in output levels are associated with lower rates of growth, as is the case observed in most of the Indian States.

III

A major explanatory factor for the Statewise differences in growth rates and also the level of output fluctuations, is probably the adequacy of water resources in each State which in turn are directly related to the rainfall conditions and also the irrigation facilities existing in the respective regions.

Variability and unreliability of rainfall makes for a high degree of vulnerability to drought conditions. The findings of the Irrigation Commission[10] of 1972, suggest that the only regions in the country which are not vulnerable to drought are Assam, West Bengal, Orissa, the West Coast and certain parts of Central India. Using the annual and South West Monsoon rainfall data from 1901 to 1960 for about 500 stations, which are fairly representative of the whole country, the Indian Meteorological Department has identified the drought and chronic drought areas of the country as follows:[11]

(a) Drought areas:
(20 per cent probability of rainfall departure of more than (-) 25 per cent from the normal)

(1) Gujarat, Rajasthan and adjoining parts of Punjab, Haryana, West Uttar Pradesh and West Madhya Pradesh;

(2) Madhya Maharashtra, Interior Mysore, Rayalseema, South Telengana and parts of Tamil Nadu;

(3) A small portion of North-West Bihar and adjoining East Uttar Pradesh; and

(4) A small portion of North-East Bihar and adjoining portion of West Bengal.

(b) Chronically drought affected areas: (40 percent probability of rainfall departure more than (-) 25 per cent)

Western parts of Rajasthan and Kutch.

As indicated by the figures in Table II, the low to moderately high level of fluctuations in output in States like Assam, Orissa, West Bengal and Kerala can be attributed to the fact that these

States are less vulnerable to drought conditions. These are also States which give a higher weightage to the production of Rice. /Refer Appendix A_7. A higher weightage being given to the production of perennial crops seem to be yet another factor leading to greater consistency in output levels. States like Kerala, Assam and West Bengal bear out this observation.

The States lying in the drought prone areas, tend to show high degree of fluctuations in output levels. Rajasthan and Gujarat which have shown highest range of output fluctuations, have the most chronic drought prone areas of the country within them. However, expansion in irrigation facilities in the arid zones has been considerably effective in minimising the magnitude of fluctuations. As examples, we could cite instances of Punjab/Haryana, Andhra Pradesh and Tamil Nadu, where there took place large scale expansion of irrigation facilities during the last two or three decades.

Net area irrigated has more than doubled itself in India during the course of the present century. It has increased from 14.5 million hectares covering 18 per cent of the net sown area in 1910-11 to 31.5 million hectares forming 23 per cent of the net sown area in 1971-72 (See Table VI). Two important features associated with this accretion to irrigated acreage viz., (1) the high degree of regional concentration in the creation of new facilities and (2) the changing importance of the different sources of irrigation, would provide us further clues to the spatial and temporal variations in agricultural growth rates and output fluctuations in India.

TABLE VI

Net Area Irrigated, and the Relative Proportions of Different Sources of Irrigation in India: 1910-15 to 1971-72.

Period	Area Irrigated ('000 hectares)	Percentage of Area Irrigated under					
		Government canals	Wells	Tanks	Private canals	Other sources	Total
1910-15	14500	27.6	30.3	..	..	42.1	100.00
1940-45	19000	31.6	28.4	..	..	40.0	100.00
1956-57	22534	35.1	29.1	19.9	6.0	9.8	100.00
1964-65	36156	37.7	29.9	18.4	4.3	9.6	100.00
1971-72	31593	37.7	38.1	13.1	2.9	8.2	100.00

Source: For the period upto 1940-45, figures have been taken from the Report of the Irrigation Commission, op.cit. Table 4.2 For the years 1956-57 onwards, the data are from various issues of the Statistical Abstract of the Indian Union, C.S.O., Government of India.

First about the regional differences in the spread of irrigation facilities.

> "Prior to Independence, the Government's irrigation efforts were largely confined to what now constitute the territories of Haryana, Punjab, Uttar Pradesh, Andhra Pradesh & Tamil Nadu. The first two States were one Province at the time and together accounted for 22 per cent of the canal irrigation in 1949-50 and others for 23 per cent, 17 per cent and 11 per cent respectively. The States highly vulnerable to drought, such as erstwhile Bombay State, Mysore, Madhya Pradesh and Rajasthan accounted for only two to five per cent." 12/

The uneven development of irrigation facilities is clearly brought out by figures in Table VII, which give the proportion of net

irrigated acreage in different States relating to two different points of time.

TABLE VII

Net Area Irrigated (A) and Its Proportion out of Net Sown Area (B) in Different States for 1956-57 and 1971-72

(Area in '000 hectares)

States	1956-57		1971-72	
	A	B	A	B
Andhra Pradesh	2,860	25.15	2,998	26.60
Assam	620	29.94	574	25.59
Bihar	1,774	22.84	2,384	28.81
Gujarat	..	..	1,209	12.97
Karnataka	740	7.34	1,378	13.34
Kerala	335	18.30	439	20.07
Madhya Pradesh	829	5.34	1,643	8.90
Maharashtra	..	..	1,344	8.11
Orissa	977	17.43	1,149	18.78
Punjab/Haryana	3,019	41.20	4,520	59.14
Rajasthan	1,412	11.36	2,173	14.24
Tamil Nadu	2,233	38.28	2,710	42.69
Uttar Pradesh	4,622	27.32	6,989	40.36
West Bengal	1,218	23.47	1,489	26.07
INDIA	22,534	17.27	31,593	22.67

Source: Statistical Abstract of the Indian Union, CSO Government of India, 1959 and 1974.

During the last two decades, the most spectacular improvements in irrigation facilities were attained in States like Punjab/Haryana and Uttar Pradesh where the relative proportions of irrigated acreage went up from 41 and 27 per cents to 59 and 40 per cents respectively between the two terminal years. In Andhra Pradesh and Tamil Nadu by 1956-57, there was already more than 25 per cent of the net sown area under irrigation; in the case of the former, there was hardly any improvement in the subsequent period, while in Tamil Nadu the proportion of irrigated area increased to over 40 per cent by 1971-72. There were also some improvements in Bihar and W.Bengal where the corresponding proportions were brought upto more than 25 per cent. However, States like Rajasthan, Gujarat, Maharashtra, Madhya Pradesh and Karnataka, most parts of which lie in the arid zone of the country, the proportion of irrigated acreage remined at less than 15 per cent even by 1971-72.

Inadequate coverage of irrigation in the arid belt of the country, would readily explain the low growth rates and high degree of fluctuations. In the case of Andhra Pradesh, which has a higher weightage given to the production of Rice, the virtual stoppage in expansion of irrigation in the post Independence period also seems to be responsible for the stagnation in agricultural production during the period under review.13/ Among the States where the coverage of irrigation (contd.p.21)

is relatively smaller, the differential preference in growth rates can be contributed to the degree of normalcy that prevailed with regard to the incidence of rainfall in these States. The relatively improved performance of Karnataka could possibly be explained in this line. An extent to which there was deviation from normalcy in monsoon showers could be examined to explain the very poor performance of Maharashtra.[14/]

A comprehensive study on the role of monsoons, both in terms of the quantity and timing would also enable us to explain why certain States (like Rajasthan and Gujarat) in the arid belt have recorded higher growth rates along with higher level of output fluctuations. Other parameters like the cropping pattern, the extent of adoption of high yielding varieties, the coverage irrigation facilities, and the resultant differences in growth rates of individual crops are also relevant to such an analysis.

A second and still more important observation is that in the creation of additional facilities, government canals sources have receded in importance compared to 'well irrigation' (see Table VI). Prior to 1956-57, most of the expansion in irrigated acreage was rendered possible by public investment in Government canals. This was subsequently outpaced by the growth of private investment in tube well irrigation. Perhaps these came more in response to the requirements of the new technology in Indian agriculture. The rapid growth of private investment is also directly related to the progress of capitalism within agriculture, a process actively being supported by the State through various measures like subsidies, credits and pricing policies. Such developments are prominently discernable in States like Punjab, Haryana and U.P. which have

attained the highest coverage of irrigation facilities among Indian States.

TABLE VIII

Irrigated Area Under Different Sources in Punjab/ Haryana and Uttar Pradesh (Area in '000 hectares)

	1956-57	1964-65	1971-72
Punjab/Haryana			
Government canals	1946	2227	2339
Wells	998	10 57	2158
Total	3019	3385	4520
Uttar Pradesh			
Government canals	1721	2167	2487
Wells	2190	2484	3966
Total	4622	5378	6989

Source: Statistical Abstract of the Indian Union, 1958 1969 and 1974, C.S.O., Government of India.

In these States there was rapid increase in the area brought under well irrigation, compared to that under Government canals, especially in the period after 1964-65 (See Table VIII). In Punjab Haryana over 95 per cent and in U.P. over 85 per cent of the addition to total irrigation facilities between 1964-65 and 1971-72 were achieved through the expansion of tube well irrigation. From this, it could be argued that those States which in the absence of adequate increase in public investment, managed to expand irrigation facilities by promoting private investment in tube wells, could attain higher levels of crop output as compared to States where there was no such breakthrough in the irrigation front.

The widening of output fluctuations we noticed in most States especially since the mid 'sixties are partly due to the differential rates of growth of individual crops, brought under the aegis of the new technology in agriculture.[15] From Tables (B) and (C) given in Appendix it comes out that Wheat, Bajra and Maize in most States have made remarkable strides in productivity compared to other foodgrain crops. An important observation in this regard is that in the cultivation of irrigated crops like Wheat, the introduction of HYV seeds have facilitated higher growth rates and greater consistency in output levels. However, in the case of rainfed crops like Bajra and Maize, the introduction of HYV seeds, under conditions of uncertain rainfall has rendered possible higher output levels only in years of favourable monsoons. Hence the outcome was that although the States, which give a greater weightage the production of such crops, achieved remarkably high growth rates in aggregate production they also experienced wide fluctuations in output levels which were markedly high in the period since the mid 'sixties.

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NOTES AND REFERENCES

1/ We restricted this study to 15 major States, as time series data on production were not available for all the States. Out of these 15 Punjab and Haryana have been clubbed into one unit, as data relating to the period prior to 1964-65 are not separately available. Also needs to be borne in mind that figures relating to Assam include those of Nagaland and Mizoram.

2/ Estimates of Area and Production of Principal Crops in India -- annually published by the Directorate of Economics and Statistics, Ministry of Agriculture, Government of India.

3/ The figures relating to 1972-73 are not final and are subject to revision.

4/ These weights have been taken from a publication brought out by the Ministry of Agriculture in 1968. Growth Rates in Agriculture 1949-50 to 1964-65 Directorate of Economics and Statistics, Ministry of Food and Agriculture, Government of India, 1968.

5/ Panse and Menon have devised a methodology to work out the agricultural crop production estimates backwards as to make the figures comparable with the output obtained by crop cutting surveys, See, Panse V.G. and Menon V.S., "Index Numbers of Agricultural in India", in Indian Journal of Agricultural Economics, Vol.XVI (2) April-June, 1961 pp.18-36, also"..... a further comment". IJAE XVI (4) October-December, 1961, p.53.

6/ See Notes given in "Estimates of Area and Production of Principal Crops in India, 1972-73", op.cit.

7/ K.N.Raj, "Growth and Stagnation in Indian Industrial Development" - Economic and Political Weekly - Annual Number, 1976.

8/ Only Tamil Nadu and Karnataka are exceptions as in these States the total output of coffee and some other minor crops were not available. Hence the total value of weights do not exceed 89.11 and 84.09 respectively. See Appendix A.

9/ S.R.Sen, 'Growth and Instability in Indian Agriculture', Journal of Indian Society of Agricultural Statistics, June 1967.

10/ Report of the Irrigation Commission, 1972, Vol.I, p.163, Ministry of Irrigation and Power, New Delhi.

11/ Ibid, pp.164-165.

12/ Ibid. p.159

13/ In the case of Andhra Pradesh we should also examine alternate hypothesis formulated by C.H.Hanumantha Rao (Technological Change and Distribution of Gains in Indian Agriculture, p.82. Macmillan Company, Delhi 1975), that the price factor, i.e., the price of traditional varieties of rice vis a vis the high yielding varities served as a disincentive to the adoption of the high yielding varieties. This argument sounds reasonable, since Andhra Pradesh, appears to be a unique case where inspite of a 95 per cent coverage of irrigated acreage under Rice, the productivity of Rice has only increased at an extremely low rate of 1.31 per cent during the period 1957-58 to 1971-72.

14/ A study conducted by Cummings (R.W.) and Ray (S.K.) "1968-69 Foodgrain Production - Relative Contribution of Weather and New Technology":(Economic and Political Weekly, September 27, Review of Agriculture, 1969) deserve special mention in this context. The authors attempt to construct a rainfall index for cereal production in India, for the period 1951-52 to 1968-69 based on deviations in monsoon showers from the normal levels. However, it needs to be pointed out that they take into account only the total quantum of rainfall, and not the timing of its incidence during the cropping period, which is of special importance to the determination of agricultural output.

15/ C.H.Hanumantha Rao highlights this issue of the cropwise differences in the adoption of the high yielding variety seeds and the consequent variations in output growth. See "Technological Change and Distribution of Gains in India Agriculture, Op.cit. C.2.

APPENDIX A

WEIGHTS OF INDIVIDUAL CROPS IN TOTAL AGRICULTURAL OUTPUT - FOR STATES IN 1956-57

States	Rice	Jowar	Bajra	Maize	Ragi	Wheat	Pulses	Food-grains	Fibres	Oil-seeds	Sugar cane	Plantation crops	Miscellaneous crops*	Total crops
Andhra Pradesh	44.14	10.29	2.55	0.95	2.31	0.07	2.34	65.45	3.10	16.13	5.82	-	15.32	100.00
Assam	43.71	-	-	0.14	-	0.02	0.63	44.53	6.01	2.23	2.01	41.46	5.77	100.00
Bihar	70.40	- -	-	4.72	1.03	3.79	7.26	89.02	0.54	0.78	6.00	-	9.66	100.00
Gujarat	7.56	8.77	10.08	1.72	0.82	7.97	2.56	40.47	28.36	26.39	2.17	-	4.78	100.00
Karnataka	26.10	11.57	1.43	0.10	8.98	1.61	6.05	57.45	3.08	12.60	6.44	0.17	10.79	84.09
Kerala	28.63	0.02	-	-	0.25	-	0.28	29.18	0.31	29.81	0.75	15.24	24.99	99.53
Madhya Pradesh	45.97	14.55	0.32	0.49	-	10.98	5.31	87.68	4.68	6.51	0.54	-	1.13	100.00
Maharashtra	17.38	27.48	5.09	0.13	1.77	4.34	8.66	65.81	12.95	9.81	7.61	-	11.43	100.00
Orissa	78.76	0.07	0.04	0.23	0.55	0.12	6.23	86.43	4.70	2.50	4.81	-	6.33	100.00
Punjab/Haryana	4.91	0.47	2.87	8.42	-	31.70	23.75	74.19	11.99	3.52	7.14	-	10.30	100.00
Rajasthan	3.20	6.27	13.03	7.95	-	21.77	16.28	77.68	1.18	7.44	1.99	-	13.70	100.00
Tamil Nadu	45.67	4.57	2.24	-	3.04	-	0.96	58.95	4.08	12.84	3.57	3.60	9.04	89.11
Uttar Pradesh	14.21	2.06	2.68	4.50	0.41	19.81	16.38	68.62	0.34	9.23	19.98	-	21.81	100.00
West Bengal	67.72	-	-	0.64	-	0.49	4.49	73.61	9.09	1.27	2.39	9.22	6.81	100.00

APPENDIX B

PERCENTAGE RATES OF GROWTH OF PRODUCTION OF PRINCIPAL FOODGRAIN CROPS IN DIFFERENT STATES DURING 1957-58 TO 1971-72

State	Rice	Wheat	Jowar	Ragi	Bajra	Maize	Coarse cereals	Pulses	Food grains
Andhra Pradesh	1.61	-	-1.39	-1.45	-2.81	5.95	-1.19	2.00	0.58
Assam	1.74	-	-	-	-	-	-	-	1.93
Bihar	1.94	15.67	-	-	-	3.71	1.95	0.16	3.90
Gujarat	1.71	8.11	0.67	-	6.14	5.40	4.33	-0.27	4.61
Karnataka	3.47	-	3.52	0.69	3.55	-	3.06	-	3.10
Kerala	2.71	-	-	-	-	-	-	-	2.66
Madhya Pradesh	1.45	3.88	0.58	-	-	5.02	0.85	4.79	2.01
Maharashtra	0.07	1.06	-4.50	-0.72	-0.97	-	-3.56	-1.87	-1.84
Orissa	1.97	-	-	-	-	-	-	-	2.35
Punjab/Haryana	10.72	9.55	-	-	8.18	3.49	4.23	-5.23	6.12
Rajasthan	4.72	4.01	1.79	--	5.41	3.56	3.50	2.54	3.18
Tamil Nadu	3.66	-	-0.28	- 1.11	1.11	-	-0.21	2.39	2.38
Uttar Pradesh	2.40	6.89	-2.16	-	1.78	3.53	1.08	-0.81	3.06
West Bengal	2.43	-	-	-	-	-	-	0.74	3.33

APPENDIX C

PERCENTAGE RATES OF GROWTH OF AREA UNDER PRINCIPAL FOODGRAIN CROPS IN DIFFERENT STATES DURING 1957-58 TO 1971-72

States	Rice	Wheat	Jowar	Ragi	Bajra	Maize	Coarse cereals	Pulses	Food-grains
Andhra Pradesh	0.30	-	-0.12	-1.55	-1.33	2.02	-0.79	0.10	-0.29
Assam	1.39	-	-	-	-	-	-	-	1.53
Bihar	0.10	7.67	-	-	-	1.80	-0.08	-1.60	0.58
Gujarat	-0.47	1.22	-1.05	-	0.22	2.52	-0.23	-2.03	-0.29
Karnataka	1.04	-	-1.23	0.02	-1.25	-	-0.73	-0.77	-0.44
Kerala	0.95	-	-	-	-	-	-	-	0.82
Madhya Pradesh	0.87	1.50	0.58	-	-	1.99	0.84	1.37	1.12
Maharashtra	0.55	-0.13	3.11	-0.58	-1.47	-	-0.46	-0.33	-0.31
Orissa	1.09	-	-	-	-	-	-	-	1.81
Punjab/Haryana	5.74	3.93	-	-	0.62	2.56	0.57	-4.14	0.75
Rajasthan	3.17	1.42	0.16	-	2.06	2.40	1.53	0.69	1.21
Tamil Nadu	1.13	-	-0.33	-1.37	-0.41	-	-0.64	1.28	0.42
Uttar Pradesh	1.02	3.23	-2.05	-	-0.37	2.42	-0.71	-1.61	0.52
West Bengal	1.00	-	-	-	-	-	-	-0.35	1.22