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THE DECELERATION HYPOTHESIS AND YIELD-INCREASING INPUTS IN INDIAN AGRICULTURE

Gunvant M. Desai and N. V. Namboodiri*

Three questions are examined in this paper: First, does the performance of Indian agriculture in recent years indicate deceleration in the long-term growth rates of production ? Second, how does one explain poor growth in production in the face of substantial growth in the use of inputs ? Third, what additional light does the experience of the Western region throw on these questions ?

I

RECENT AGRICULTURAL PERFORMANCE AND THE DECELERATION HYPOTHESIS

In the four years after 1978-79, the production of foodgrains in India has exceeded the 1978-79 level only once, and that by only one million tons. This is obviously disturbing. More so because there has been substantial increase in the use of all dominant yield-increasing inputs. But can we conclude from this that the long-term growth rate in Indian agriculture has decelerated ?

Questions about the growth performance of Indian agriculture are not new. Until a couple of years back, the central issue was whether there was an acceleration in production trends after the introduction of high-yielding varieties (HYVs). The deceleration hypothesis is a more serious matter and deserves most careful attention. Not only because it highlights falling growth rate in production which has been inadequate but also because it alludes to the law of diminishing returns by pointing at the growth in yield-increasing inputs. Since growth in production has become increasingly dependent on growth in yields, and will remain so in the future, the hypothesis raises serious questions about the strategy and policy instruments behind growth in agricultural production.

Empirical examination of the hypothesis is fraught with many difficulties. Therefore, two questions need to be distinguished. First, does the poor growth in foodgrains production in recent years mean deceleration in their long-term trends ? Second, *if* this is so, is it really due to the law of diminishing returns ? It is pointless to talk about the law of diminishing returns, especially for the agricultural sector of India's size and diversity, unless the aggregate production trends show unmistakable deceleration.

The deceleration hypothesis can be meaningfully examined only against the backdrop of the past performance of long-term trends. Table I shows the all-India index numbers of production of foodgrains and of all crops for the period from 1960-61 to 1981-82 and annual percentage changes in the two series. Since the hypothesis is based on poor growth during the past four

* Centre for Management in Agriculture, Indian Institute of Management, Ahmedabad.

TABLE I—ALL-INDIA INDEX NUMBERS OF PRODUCTION OF FOODGRAINS AND ALL CROPS, 1960-61 TO 1981-82

Year	Index numbers of production[a]		Per cent change		Three-year moving averages of index numbers[b]	
	Foodgrains	All crops	Foodgrains	All crops	Foodgrains	All crops
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1960-61	86·1	86·7	7·1	8·2	84·4	84·5
1961-62	86·8	86·8	0·8	0·1	85·6	86·3
1962-63	83·8	85·3	—3·5	—1·7	85·3	86·4
1963-64	85·3	87·2	1·8	2·2	87·8	89·8
1964-65	94·3	96·9	10·5	11·1	85·1	88·3
1965-66	75·8	80·8	—19·6	—16·6	82·4	86·1
1966-67	77·1	80·7	1·7	—0·1	83·9	86·8
1967-68	98·7	98·9	28·0	22·6	91·0	92·3
1968-69	97·3	97·3	—1·4	—1·6	100·0	100·0
1969-70	104·0	103·8	6·9	6·7	104·7	104·2
1970-71	112·9	111·5	8·6	7·4	109·4	108·8
1971-72	111·4	111·2	—1·3	—0·3	108·9	108·3
1972-73	102·3	102·3	—8·2	—8·0	108·0	108·6
1973-74	110·3	112·4	7·8	9·9	105·6	107·8
1974-75	104·3	108·8	—5·4	—3·2	113·9	115·3
1975-76	127·2	124·8	22·0	14·7	119·6	116·7
1976-77	115·7	116·4	—9·0	—6·7	125·5	124·6
1977-78	133·6	132·7	15·5	14·0	129·5	129·0
1978-79	139·3	137·8	4·3	3·8	129·2	129·2
1979-80	114·8	117·1	—17·6	—15·0	130·5	129·9
1980-81	137·5	134·9	19·8	15·2	131·0	131·5
1981-82	140·8	142·6	2·4	5·7	—	—

Source: Derived from Economic Survey 1982-83, Ministry of Finance, Government of India, 1983, and *Agricultural Situation in India*, Vol. XXXIII, No. 10, January 1979.

a. Triennium ending 1969-70=100.

b. Centred on the middle year.

years, it would be useful to focus on annual changes during these years against such changes in the past.

Columns 2 and 3 of Table I not only reveal fluctuations in production but also suggest that growth in production stalled periodically. Three-year moving averages (columns 6 and 7) show plateaus in the early 1960s, the early 1970 and the late 1970s. (Inclusion of the 1950s reveals a plateau in the mid-1950s.) As columns 4 and 5 show, large year to year changes in production were not confined to the period between the two plateaus. Perhaps because of this reason, and also because they are difficult to explain, plateaus are not as commonly acknowledged as fluctuations. But they cannot be ignored while discussing long-term growth rates underlying the trends.

The first year of the last plateau was 1977-78. Perhaps 1980-81 was the last year but this can be said with certainty only after data for a few years after 1981-82 are available. There was a setback to production in 1982-83. From this, however, one cannot say whether the last plateau ended in 1980-81 or production was still stalling in 1982-83. As mentioned above, year to year growth rates (columns 4 and 5 in Table I) fluctuate between the last year of a

plateau and the first year of the next plateau as well as during the plateau period. Viewed thus, the deceleration hypothesis has little empirical support.

This is also suggested by the estimates of compound growth rates made by the Directorate of Economics and Statistics, Ministry of Agriculture, Government of India for the periods from 1967-68 to 1977-78, and from 1967-68 to 1980-81. For foodgrains, the rates are 2.40 per cent and 2.39 per cent respectively. For all crops, they are 2.50 per cent and 2.36 per cent respectively. While the growth rates are marginally lower for the later period, they may not be significantly different from each other. In any case, the rates for 1967-68 to 1981-82 (not yet available) would be higher because production in 1981-82 was substantially higher than in 1980-81 especially of all crops taken together. This also suggests that it would be incorrect to infer deceleration in Indian agriculture from the recent evidence on production of foodgrains alone. For instance, in 1981-82 foodgrains production was up by only 2.4 per cent but production of all crops had increased by 5.7 per cent.

Thus, at least at this stage, one can argue that the growth performance of the recent years does *not* support the deceleration hypothesis because of four reasons. First, there are plateaus in aggregate production trends, and since recent years were in the last plateau, it is unscientific to judge long-term growth rates at this stage. Second, despite recent years being in the plateau period, long-term trend growth rates have not declined. Third, in none of the years of the last plateau (except 1979-80) production was lower than in the immediately preceding year. This was *not* the case in the previous plateaus. What is more, production indices of foodgrains as well as all crops in 1972-73 were lower than even in 1969-70. Finally, when linear trends are fitted to annual growth rates (*i.e.*, column 4 and 5), although the growth parameters are statistically non-significant because of wide fluctuations, they have *positive* signs.

II

RECENT PRODUCTION PERFORMANCE AND GROWTH IN USE OF INPUTS

Even if there was no deceleration, it is still pertinent to ask why was the growth in production so very modest despite substantial increase in the use of major yield-increasing inputs. Between 1977-78 and 1980-81, irrigated area increased by 6 million hectares (by 13 per cent). The area under HYVs of five cereals also went up by 6 million hectares (by 16 per cent) and fertilizer consumption rose by 1.2 million tons (by 29 per cent). But production of either foodgrains or of all crops increased by no more than 3 per cent. (Firm data on irrigation, HYVs and index numbers of yields are available only upto 1980-81.)

The answer to the above question seems to lie in distinguishing between total production and per hectare yields of individual crops.

It is important to focus on yields rather than on production especially because of decline in the area between 1977-78 and 1980-81 and also because the three inputs contribute to additional production through raising yields. But the 1980-81 yield indices of either foodgrains or all crops were only 3 to 4

per cent higher than the 1977-78 levels (Table II). It is, therefore important, to examine the yields of individual crops. But before we do this, following three important points emerging from Table II deserve attention.

TABLE II—ALL-INDIA INDEX NUMBERS OF YIELDS OF FOODGRAINS AND ALL CROPS, IRRIGATED AREA, AREA UNDER HYVs AND FERTILIZER CONSUMPTION, 1967-68 TO 1981-82

Year	Index numbers of yield[a]		Irrigated area[b] (million hectares)	HYVs area[c] (million hectares)	Fertilizer consumption (million tons)
	Foodgrains	All crops			
(1)	(2)	(3)	(4)	(5)	(6)
1967-68	99·9	100·5	34·76	6·05	1·54
1968-69	98·2	98·3	35·76	9·24	1·76
1969-70	101.9	101·2	36·93	12·85	1·98
1970-71	109·9	107·7	38·01	15·38	2·26
1971-72	107·8	107·1	39·37	18·17	2·66
1972-73	101·4	100·6	40·82	22·32	2·77
1973-74	105·0	106·2	42·18	26·04	2·84
1974-75	102·2	104·3	48·65	27·33	2·57
1975-76	117·2	115·6	45·30	31·89	2·89
1976-77	109·1	109·2	46·91	33·56	3·41
1977-78	122·1	119·6	48·49	38·93	4·29
1978-79	125·5	122·2	50·65	40·13	5·12
1979-80	106·2	107·6	52·60	38·38	5·26
1980-81	127·0	123·5	54·60	45·25	5·52
1981-82	N.A.	N.A.	57·45[d]	46·68[d]	6·06

Source: Various issues of Economic Survey, and Indian Agriculture in Brief, Government of India.
a. Triennium ending 1969-70=100.
b. These statistics are from various issues of Economic Survey. They are not comparable with irrigated area statistics published by the Directorate of Economics and Statistics, Ministry of Agriculture, Government of India.
c. Relates to rice, wheat, jowar, bajra and maize.
d. Anticipated achievement.
N.A.=Not available.

First, since 1967-68 there has been an uninterrupted increase in the use of all three inputs year after year. The only two exceptions relate to fertilizer consumption in 1974-75 and HYVs area in 1979-80. On the other hand, the time-series in yields of either foodgrains or all crops had setbacks five times. Thus, even with respect to the directions of change, there is no simple association between the time-series on yields and on inputs.

Second, irrigated areas increased by about 20 million hectares between 1967-68 and 1980-81. About two-thirds of this increment came by 1976-77. Nearly 85 per cent of the increase in the area under HYVs also came in the period between 1967-68 and 1976-77. In the case of increment in fertilizer consumption also, the share of the period up to 1976-77 was 47 per cent. Against this, it is the latter period (i.e., years between 1977-78 and 1980-81) which dominates in the growth of yields. For both foodgrains and all crops, this period accounts for 60 per cent or more of the increment in the index number of yields.

Finally, as shown in Table II, both yield indices fell during the plateau of the early 1970s despite increase in the use of *all* three inputs. Against this, there was an upward movement in both yield indices during the plateau of the

late 1970s. Even in 1979-80, despite widespread monsoon failure, both yield indices were 25 to 30 per cent higher than in the drought year of 1965-66.

Clearly, the above facts cannot be ignored while discussing the impact of growth in inputs on the growth of yields. Thus, the relevant question seems to be why did the growth in the use of the three inputs *not* have substantial impact *up to* 1977-78 rather than *after* 1977-78. But questions like this cannot be answered satisfactorily with aggregate data.

We must consider different crops separately. These inputs cover relatively a small proportion of cropped area. Thus, neither irrigation nor HYVs had covered more than one-third of the total cropped area by 1980-81. Until 1976-77 fertilizer use had also not spread to more than 70 per cent of the gross cropped area.[1] Furthermore, all crops do not have equal and unchanging shares in the use of these inputs. It is, therefore, important to focus on yields of individual crops.

Table III shows 1967-78 to 1981-82 trends in the yields, irrigation level and coverage by HYVs of rice and wheat. Fertilizer consumption is average

TABLE III—TRENDS IN YIELDS OF RICE AND WHEAT AND THREE YIELD-INCREASING INPUTS, 1967-68 TO 1981-82

Year	Rice			Wheat			Fertilizer consumption[a] (kg./ha.)
	Yield (kg./ha.)	Per cent area		Yield (kg./ha.)	Per cent area		
		Irrigated	HYVs		Irrigated	HYVs	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1967-68	1,032	38·6	4·9	1,103	43·4	7·3	9·4
1968-69	1,076	38·4	7·1	1,169	49·8	30·0	11·1
1969-70	1,073	39·4	11·5	1,209	51·1	29·6	12·2
1970-71	1,123	38·1	14·9	1,307	54·4	35·4	13·6
1971-72	1,141	38·8	19·6	1,380	54·6	41·1	16·1
1972-73	1,070	39·2	22·3	1,271	57·6	52·3	17·1
1973-74	1,151	38·4	26·1	1,172	57·7	59·4	16·7
1974-75	1,045	38·8	29·6	1,338	61·5	62·1	15·7
1975-76	1,235	38·2	31·5	1,410	61·9	65·8	16·9
1976-77	1,088	38·4	34·6	1,387	64·9	69·9	20·4
1977-78	1,308	40·2	40·6	1,480	64·0	73·6	24·9
1978-79	1,328	41·6	41·7	1,568	65·2	70·2	29·2
1979-80	1,074	N.A.	40·6	1,436	N.A.	67·8	30·0
1980-81	1,336	N.A.	46·1	1,630	N.A.	78·1	31·5
1981-82	1,317	N.A.	47·5[b]	1,696	N.A.	79·2[b]	34·6

Source: Various issues of Indian Agriculture in Brief, and Economic Survey. Fertilizer consumption from Fertiliser Statistics, 1981-82, Fertiliser Association of India, New Delhi, 1982.
a. Average fertilizer consumption (nutrients) per hectare of gross sown area of *all crops*.
b. Anticipated achievement.
N.A. = Not available.

rate on area under *all crops* because time-series of cropwise consumption are not available. In the all-India index numbers of production, rice and wheat have 56 per cent weight. They accounted for 60 per cent of total fertilizer consumption in 1976-77, 66 per cent of irrigated area in 1978-79 and 80 per cent of the area sown to HYVs of the five cereals in 1980-81. Thus, these two

1. For data base and methodology of this estimate, see Gunvant M. Desai: Sustaining Rapid Growth in India's Fertilizer Consumption: A Perspective Based on Composition of Use, International Food Policy Research Institute, Washington, D.C., 1982.

crops are ideally suited to examine the impact of growth in the use of these inputs on their yields at the all-India level.

There was no growth in the percentage of rice area irrigated between 1967-78 and 1976-77. Since then there has been a marginal increase. By 1980-81, about 46 per cent of rice area was fertilized at the average rate of 78 kg. per hectare. In the subsequent years, fertilizer use on rice must have been increased because total fertilizer consumption in the country has nearly doubled. Against this background, the time-series of rice yield reveals (*i*) fluctuating but unmistakably upward trend, (*ii*) virtually each successive peak being higher than the previous peak, and (*iii*) yield level above 1,300 kg. per hectare in *all* years from 1977-78 except 1979-80. It is also important to note that the average rice yield in 1979-80 was about 25 per cent higher than in 1965-66. Since there has been hardly any growth in the percentage of rice area irrigated over time, the higher average yield of 1979-80 was clearly due to the growth in the use of HYVs and fertilizers.

The growth in wheat yield is well-known and needs little elaboration. Three points, however, are worth noting. First, there has been a vast growth in the use of all the three inputs on wheat. Second, there was virtual stagnation in wheat yield between 1971-72 and 1976-77. Third, the average wheat yield in 1981-82 was 20 per cent higher than in 1975-76 (*i.e.*, the highest level before 1977-78). The compound growth rate in wheat yield between 1975-76 and 1981-82 was 3.1 per cent per year which is impressive especially after the stagnation in the first half of the 1970s.

That growth in yield during recent years was not confined to rice and wheat alone can be seen from Table IV. The table shows the percentage share

TABLE IV—YIELD PERFORMANCE OF MAJOR CROPS BETWEEN 1977-78 AND 1981-82 AND LEVELS OF INPUT USE—ALL-INDIA

Crop	Per cent gross sown area 1978-79	Per cent crop area			Highest yield (kg./ha.)		No. of years col. 6 yield exceeded	Compound growth rate peak to peak
		Irrigated 1978-79	HYVs 1980-81	Fertilized 1976-77	1971-72 to 1976-77	1977-78 to 1981-82		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Rice	23·1	41·6	46·1	44·9(78)[a]	1,235	1,336	4	1·6
Wheat	12·9	65·7	78·1	55·1(73)	1,410	1,696	5	3·1
Jowar	9·2	4·2	26·4	17·3(57)	711	716	2	0·1
Bajra	6·5	3·7	32·6	11·5(39)	544	489	0	—ve
Maize	3·3	15·1	23·1	36·5(43)	1,203	1,159	0	—ve
Barley	1·1	51·6		19·1(17)	1,139	1,269	4	2·2
Cereals	60·2	33·2			1,041	1,160	4	1·8
Pulses	13·6	7·9			533	515	0	—ve
Foodgrains	73·8	28·5			944	1,033	4	1·5
Sugarcane	1·9	77·0		69·7(146)	5,529[b]	5,914	4	1·7
Groundnut	4·2	9·2		38·5(40)	935	972	1	0·6
Cotton	4·6	24·9		42·4(85)	161[c]	167	2	0·9

Source: Indian Agriculture in Brief, 1982. Column 5 from Desai: Sustaining Rapid Growth in India's Fertilizer Consumption: A Perspective Based on Composition of Use, *op. cit.*

a. Average rate of fertilizer on fertilized area (kg./ha.)

b. In terms of *gur*.

c. In terms of lint.

of major crops in the total sown area, 1978-79 irrigation levels on them, spread and rates of fertilizer application on them in 1976-77, and coverage of HVYs by 1980-81 in the case of jowar, bajra and maize. It also shows the yield performance of these crops during recent years. Whereas no crop fared as well as wheat, the yield performance of barley and sugarcane was better than that of rice. Even cotton, jowar and groundnut yields attained new peaks in recent years. Their yield growth rates were unimpressive but the share of these crops in the use of the three inputs was not high either. But more about these crops in the next section since they dominate the cropping pattern in the Western region.

Our overall conclusion is that questions about the impact of growth in the use of inputs on yields cannot be answered satisfactorily by comparing changes in the national aggregates. In fact, even at the disaggregate levels, there are many conceptual difficulties which are further compounded by data constraints. Just a beginning in tackling some of these difficulties indicates that the impact of the yield-increasing inputs has not been as inconsequential as a mere comparison of the aggregative national data suggests.

III

EXPERIENCE OF THE WESTERN REGION

The Western region (comprising Rajasthan, Madhya Pradesh, Gujarat and Maharashtra) accounts for about 40 per cent of the country's gross sown area, 21 to 22 per cent of gross irrigated area and fertilizer consumption, and nearly 30 per cent of the area under HYVs of the five cereals. While its share in the total production of all foodgrains is only about 26 per cent; it is 55 to 66 per cent in jowar, bajra and gram. Among non-foodgrains, the region accounts for 54 per cent of cotton, 47 per cent of groundnut and 21 per cent of sugarcane production in the country.

Three points are stressed about the important features of agricultural sector in the Western region : First, 44 per cent of its cultivated area falls in 'low' rainfall region (below 750 mm.), 31 per cent in 'medium' rainfall region (751 to 1,150 mm.), and only 25 per cent in the 'high' rainfall region (above 1,150 mm.) of the country. Second, only 15 per cent of its gross sown area is irrigated against 28 per cent for the country as a whole. Third, the average level of fertilizer consumption (19 kg per. hectare) is also considerably lower than the all-India average (35 kg. per hectare).

There are important differences among the four States of the Western region. Gujarat and Rajasthan have 70 to 90 per cent of their gross sown area in the low rainfall region whereas Madhya Pradesh has only 4 per cent and Maharashtra has 36 per cent in this region. The latter two States have greater proportion of the cultivated land in high rainfall region than Gujarat, and Rajasthan has none in this rainfall region. On the other hand, Rajasthan and Gujarat have 19 to 20 per cent of gross sown area with irrigation against 11 to 12 per cent in Madhya Pradesh and Maharashtra. Fertilizer consumption levels vary widely between 8 kg. per hectare in Madhya Pradesh and

39 kg. per hectare in Gujarat, but only in Gujarat it is higher than the national average.

Index numbers of production of all crops are not available at State levels. But the data on production of total foodgrains and dominant non-foodgrain crops indicate poor growth in agricultural production in the Western region during recent years. As at the all-India level, this was so in spite of significant growth in the use of at least two inputs. Fertilizer consumption in each of the four States in 1981-82 was 40 to 100 per cent more than in 1976-77. Similarly, HYVs had also spread to 25 to 54 per cent of the total areas under the five cereals in each State by 1980-81. It is difficult to say anything about the growth in irrigation since data are unavailable for the years after 1978-79.

It would be, however, incorrect to conclude that the growth in the use of inputs did not have significant impact on the agricultural performance, more so in the case of the Western region than the country as a whole because of the relatively low levels of use of these inputs. What is required is a scrutiny by crops.

Table V is similar to Table IV. It focuses on the yield performance of the major crops in recent years, and use of inputs on them in the four States. Following major conclusions emerge.

TABLE V—YIELD PERFORMANCE OF MAJOR CROPS BETWEEN 1977-78 AND 1981-82 AND LEVELS OF INPUT USE, WESTERN REGION

Crop	Per cent gross sown area 1978-79	Per cent crop area			Highest yield (kg./ha.)		No. of years col. 6 yield exceeded	Compound growth rate peak to peak
		Irrigated 1978-79	HYVs 1980-81	Fertilized 1976-77	1971-72 to 1976-77	1977-78 to 1981-82		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Rajasthan								
Rice	1·2	37·9	29·4	31·0(69)[a]	1,445	1,286	0	—ve
Wheat	11·4	77·5	73·2	46·1(52)	1,279	1,660	5	5·4
Bajra	25·9	0·6	7·0	5·7(36)	382	253	0	—ve
Maize	4·6	8·8	4·0	15·8(44)	1,140	970	0	—ve
Barley	2·3	77·1		43·0(9)	1,252	1,403	2	5·9
Gram	10·0	17·5		N.A.	767	909	1	5·8
Foodgrains ..	71·1	19·0		N.A.	624	629	1	0·3
Sugarcane ..	0·3	93·2		N.A.	4,841[b]	3,871	0	—ve
Groundnut ..	2·2	2·3		N.A.	668	715	1	7·0
Cotton	2·3	85·9		58·5(79)	223[c]	241	1	2·6
Madhya Pradesh								
Rice	22·1	17·0	36·7	14·8(29)	838	938	1	3·8
Wheat	17·3	25·9	39·8	24·6(64)	843	994	4	2·4
Jowar	8·5	0·1	20·5	N.A.	889	824	0	—ve
Maize	3·2	0·4	11·0	9·8(39)	1,134	909	0	—ve
Gram	8·0	7·1		N.A.	681	662	0	—ve
Foodgrains ..	81·6	11·2		N.A.	688	719	3	0·7
Sugarcane ..	0·5	94·5		42·9(50)	3,197	3,004	0	—ve
Groundnut ..	1·9	0·2		N.A.	828	739	0	—ve
Cotton ..	3·1	8·6		N.A.	118	92	0	—ve

(*Contd.*)

TABLE V(*Concld.*)

Crop	Per cent gross sown area 1978-79	Per cent crop area			Highest yield (kg./ha.)		No. of years col. 6 yield exceeded	Compound growth rate peak to peak
		Irrigated 1978-79	HYVs 1980-81	Fertilized 1976-77	1971-72 to 1976-77	1977-78 to 1981-82		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
				Maharashtra				
Rice	7·5	26·4	73·3	51·2(69)	1,592	1,609	1	0·2
Wheat	6·0	40·8	92·3	51·0(71)	1,065	876	0	—ve
Jowar	32·8	5·3	36·8	20·6(53)	731	801	4	3·1
Bajra	7·9	3·4	41·0	N.A.	383	445	1	3·8
Foodgrains ..	70·9	9·6		N.A.	683	744	5	1·7
Sugarcane ..	1·2	100		92·4(230)	10,006	10,608	4	0·8
Groundnut ..	4·1	4·9		26·7(61)	790	848	1	1·2
Cotton ..	12·6	3·9		44·2(80)	117	111	0	—ve
				Gujarat				
Rice	4·4	39·2	59·7	63·4(54)	1,246	1,476	2	2·9
Wheat	6·0	61·0	73·2	61·9(41)	1,808	2,000	3	1·5
Jowar	9·9	5·5	6·1	19·3(39)	556	644	5	3·0
Bajra	14·1	3·2	79·7	26·8(33)	787	1,064	4	6·2
Foodgrains ..	44·2	15·1		N.A.	891	1,162	4	4·5
Sugarcane ..	0·6	93·1		68·3(115)	5,545	5,958	5	1·4
Groundnut ..	19·7	3·1		57·2(29)	1,240	979	0	—ve
Cotton	16·9	17·2		33·9(60)	161	233	5	7·7

Source: Various issues of Indian Agriculture in Brief. Column 5 from findings of the National Council of Applied Economic Research surveys used in Desai: *op. cit.*

a. Average rate of fertilizer on fertilized area (kg./ha.) Reference year for Madhya Pradesh 1975-76.
b. In terms of *gur*.
c. In terms of lint.
N.A. = Not available.

Gujarat ranks first among the four States. Between 1977-78 and 1981-82, yields of all major crops except groundnut had higher peaks than in the previous six years. More importantly, as column 9 shows, yields of these crops exceeded the previous peaks either in all five years or at least in three years between 1977-78 and 1981-82. The only exception was rice which exceeded the pre-1977-78 peak yield only twice. The compound growth rates between the pre-1977-78 peak and the post-1976-77 peak are also impressive.

Maharashtra comes next to Gujarat. Among major crops, only wheat and cotton did not have a higher peak in the post-1976-77 period. Yields of all foodgrains taken together, jowar and sugarcane were higher than the pre-1977-78 peak at least in four out of five most recent years. However, for bajra and groundnut, this was true only once.

The performance of the other two States was much inferior. Only wheat yield surpassed the pre-1977-78 peak in 4 to 5 years after 1976-77. For most other crops, either the peak yields of the post-1976-77 period was lower than the pre-1977-78 period (as in Madhya Pradesh), or exceeded them only once or twice (as in Rajasthan). Between Rajasthan and Madhya Pradesh, the former fared better in wheat and a couple of other crops while the latter did better in all foodgrains taken together.

Gujarat also ranks first with respect to all foodgrains taken together. The peak to peak growth rate was 4.5 per cent per year. Its 1981-82 yield was considerably higher than the peak yields of the three other States during recent years. It was also 13 per cent higher than the national average. While Maharashtra's growth rate of foodgrains yield between peaks (1.7 per cent per year) was not as good as Gujarat's, its yield surpassed the peak yield of the pre-1977-78 period in all five recent years. The other two States also had positive yield performance for all foodgrains taken together but not as good as Maharashtra's.

Among individual foodgrains, wheat fared the best in the Western region taken as a whole. Next came jowar, essentially because of Gujarat and Maharashtra. Bajra did well only in Gujarat. In Rajasthan, which accounts for the country's 42 per cent of area under bajra, the peak yield during 1977-78 to 1981-82 period was only two-thirds of the peak yield between 1971-72 and 1976-77. Rice yield surpassed the pre-1977-78 peak in all States except Rajasthan but it happened in only one or two of the five most recent years.

Among the non-foodgrain crops, the yield of sugarcane exceeded the pre-1977-78 peak in all five years in Gujarat and in four years in Maharashtra. Cotton had a record similar to sugarcane in Gujarat but in Maharashtra and Madhya Pradesh its post-1976-77 peak yields were lower than the previous peaks. Groundnut reached a new peak in Rajasthan and Maharashtra but not in Gujarat and Madhya Pradesh.

Thus, to conclude, the yield performance of a number of crops in Gujarat and Maharashtra has been quite impressive in the recent years. Even in the other two States, wheat yields did register impressive growth. Since most of the crops in these States are grown mainly under unirrigated condi-

tions, the main inputs behind the yield performance were fertilizers and HYVs. The experience of the Western region, therefore, reveals that even with low levels of irrigation, yield-based growth in production is possible with the other two inputs. In this context, it is relevant to note that in 1981-82, with less than 20 per cent of area irrigated, Gujarat had the highest level of fertilizer consumption per hectare among all States with irrigation levels up to 40 per cent. That this was not due to heavy fertilizer use on limited areas sown to a few crops is brought out both by the findings presented in column 5 of Table V and also by the impressive yield performance. The differences in fertilizer consumption levels and patterns among the four States are also consistent with the differences in their yield performances.

IV

CONCLUSIONS AND QUESTIONS

Four conclusions emerge from the above sections. First, it would be both hasty and erroneous to conclude deceleration in the *long-term* trends of aggregate production from poor growth over the last five years. There are more reasons than one behind this as shown in section I.

Second, since as yet there is no clear-cut evidence on deceleration in the long-term trends, it is meaningless to relate poor growth performance of agriculture in the recent years with substantial growth in irrigation, HYVs and fertilizers with a view to say (or imply) that at the national level the law of diminishing returns to these inputs has already set in.

Third, the impact of growth in the above inputs cannot be correctly judged from all-India aggregate data on levels of production and use of inputs. Nor can it be judged by focusing only on the last five years. In fact, there is a clear evidence on the impact of the three inputs on yield performance of crops and regions where sustained growth in their use has occurred.

Fourth, the experience of the Western region (especially differences among its four constituent States) clearly demonstrates that impressive growth in yields through growth in the use of fertilizers and HYVs is possible *even* under conditions of low irrigation.

These conclusions do not intend to convey that poor agricultural performance in the recent years is not a matter of serious concern. Also, they do not imply that all is well with growth in the use of inputs and policies to generate growth in them. Nor do they contend that diminishing returns to these inputs have not set in *anywhere*. These are separate issues. They should not be mixed up with whether there is deceleration in long-term trends, or how important are the yield-increasing inputs in the national context. Similarly, comparing growth rates of trends up to the early 1960s with those of much longer periods to show deceleration in them is not very meaningful. Growth rates in the early periods were governed by both expansion of cultivated land and yield increases; those of the period after the mid-1960s have been increasingly dependent on yield increases. For instance, the entire

growth in aggregate production in the last five years has been due to changes in yield.

Various findings of the previous section also suggest three questions for unhurried and in-depth probing. First, what is the explanation behind recurring plateaus in our aggregate production trends? Is this merely a statistical phenomenon at the all-India level, or are there identifiable causes behind it? It would be also useful to examine in how many respects does the most recent plateau differ from the previous plateaus, why, and what are their implications. In pursuing these questions, we must attempt a clear understanding of the anatomy of the plateaus (the dependent variable) before we attempt identification of causal factors (the independent variables) behind the plateaus.

Second, what is the explanation behind poor growth in all-India average yields of even such crops as wheat and rice during the first half of the 1970s despite substantial growth in the use of yield-increasing inputs on them? Could it be that the levels of input use have to attain some minimum levels before their impact becomes visible in national average yields? If this is so, then which are these inputs, what are the critical minimum levels of their use, and what are the implications of these findings to raise yields of such crops where there is no sustained growth in yields as yet?

Finally, what is the explanation behind impressive growth in the yield performance of Gujarat's agriculture despite low irrigation and relatively poor rainfall environment?[2] Inasmuch as this was due to sustained broad-based growth in fertilizer consumption, it would be useful to probe into what explains such growth performance of fertilizer consumption. Careful enquiry in this direction is pertinent not only because yield-based growth cannot be sustained without growth in fertilizer use but also because many States with higher levels of irrigation and better rainfall environment do not have as impressive growth in fertilizer consumption as Gujarat.

2. Mahesh T. Pathak and Haribhai F. Patel: Inter-District Variations in Agricultural Development in Gujarat, 1949-50 to 1978-79, Agro-Economic Research Centre, Sardar Patel University, Vallabh Vidyanagar, Gujarat, 1982.