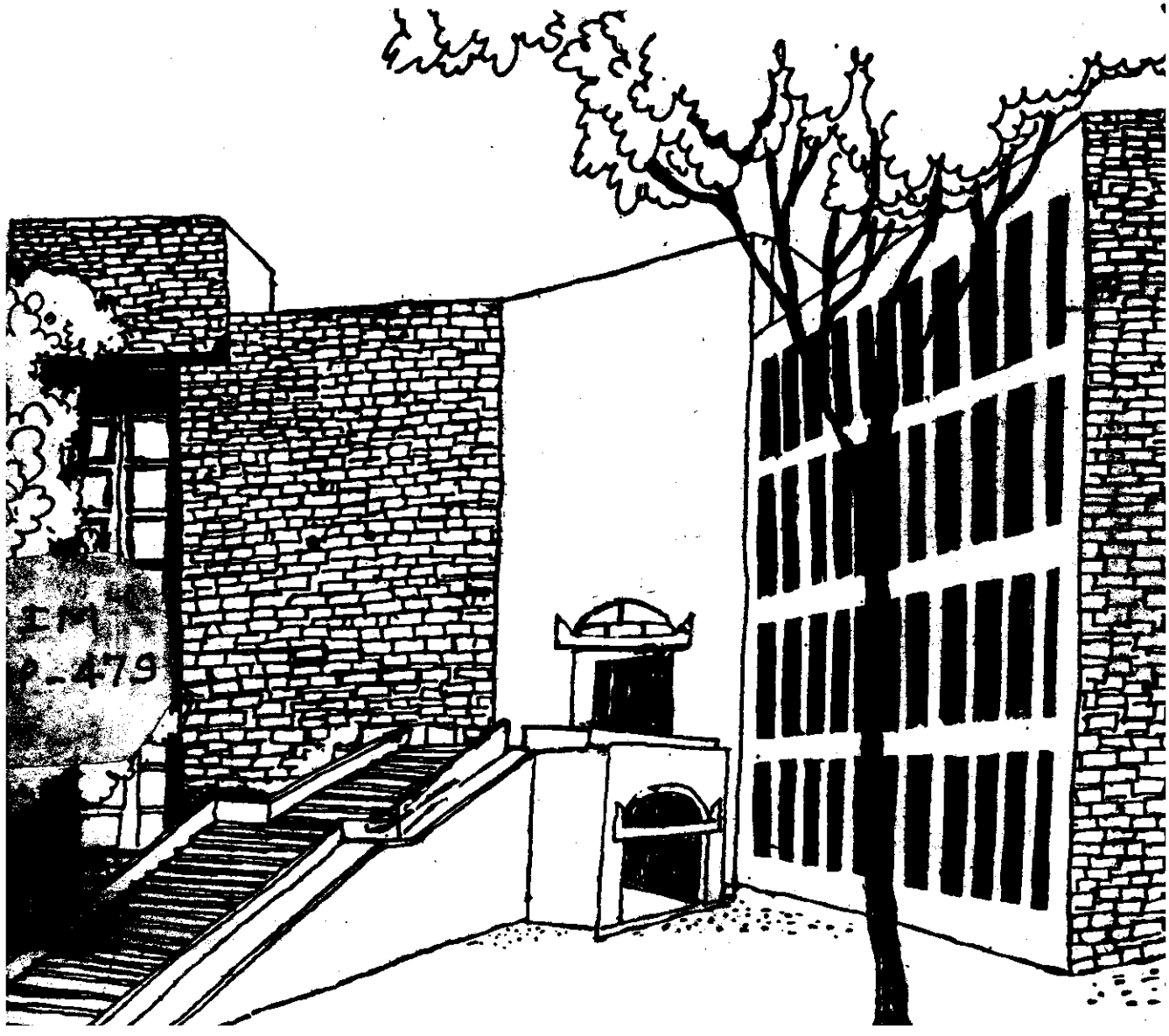
Working Paper



THE DECELERATION HYPOTHESIS AND YIELD INCREASING INPUTS IN INDIAN AGRICULTURE

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W P No. 479

September 1983

INDIAN INSTITUTE OF MANAGEMENT
AHMEDABAD-380015
INDIA

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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? Accordingly, the paper is divided into three sections. The last section brings together major conclusions and raises some questions which need further probing.

SECTION I

RECENT AGRICULTURAL PERFORMANCE AND THE DECELERATION HYPOTHESIS

The total production of foodgrains in India has exceeded the 1978/79 level only once, and that too marginally. An increment of only one million tons over a period of four years is obviously disturbing. More so because there has been substantial

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Paper for the Symposium on "Recent Trends in Agricultural Growth in the Western Region in India" organised by the Indian Society of Agricultural Economics and Centre for Management in Agriculture, Indian Institute of Management Ahmedabad, September 9-10, 1983.

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 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, it is necessary to distinguish between two questions even though they are interrelated. First, does the poor growth in foodgrain 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? Obviously, it is pointless to talk about the Law of Diminishing Returns, especially for agricultural sector of India's size and diversity, unless the aggregate production trends show unmistakable deceleration.

Table 1 shows all-India index numbers of production of foodgrains and all crops for the period from 1960/61 to 1981/82. It also shows year to year percentage changes in the two series. The deceleration hypothesis can be meaningfully examined only against the backdrop of the past performance of long term trends. And, inasmuch as the hypothesis is based on poor growth during the past four years, it would be useful to

Table 1: All India Index Numbers of Production of Foodgrains and All Crops, 1960/61 to 1981/82

Year	I.Nos.of Production[a]		Percent Change		3 Years Moving Averages of I.Nos[b]	
	FGs	ACs	FGs	ACs	FGs	ACs
(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	100
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		

a Triennium ending 1969-70 = 100; FGs = Foodgrains; ACs = All Crops

b Centered on the middle year

Source: Derived from Economic Survey, Government of India, and Agricultural Situation in India, January 1979.

focus on annual changes during these years against such changes in the past.

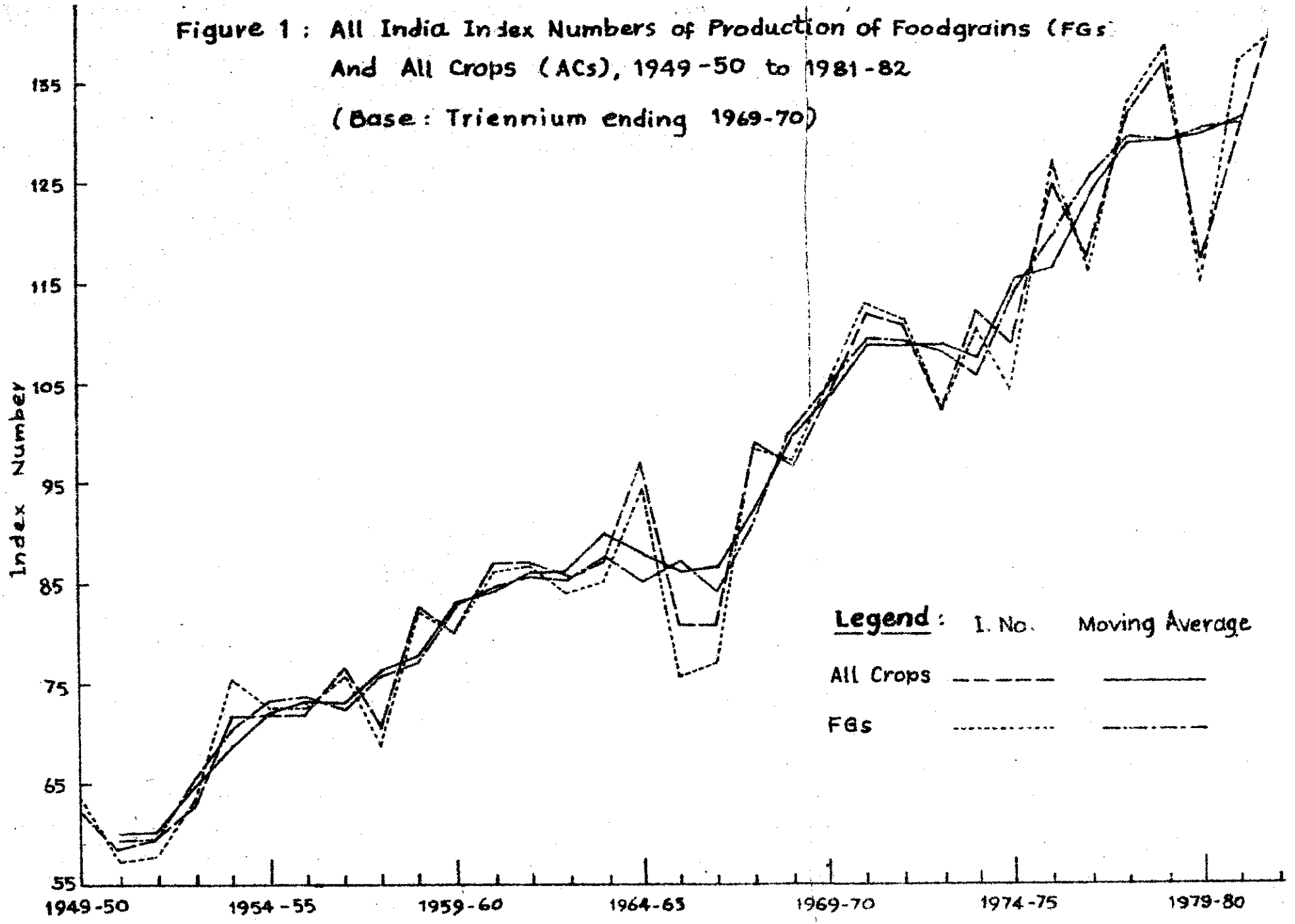
A graph of Columns 2 and 3 of Table 1 (Figure 1) not only reveals fluctuations in production but also suggest that growth in production stalled periodically. Three-year moving averages (columns 6 and 7) show plateaus in the early 1960s, the early 1970s and the late 1970s. (Inclusion of the 1950s in Figure 1 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 if they "exist" in the production trends, as they seem to, then they cannot be ignored while discussing long term growth rates underlying the trends. Viewed thus, the deceleration hypothesis has little empirical support.

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. Although firm estimates for 1982/83 are not yet available, there was a setback to production. 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 1) fluctuate between the last year of a plateau and the first year of the next plateau as well as during the plateau period.

It is thus clear that on the basis of poor growth in production during the post-1977/78 period, it would be erroneous to say that the long term growth rate has decelerated. This is also suggested by the estimates of compound growth rates made by the Directorate of Economics and Statistics for the periods from 1967/68 to 1977/78, and from 1967/68 to 1980/81. For

Figure 1 : All India Index Numbers of Production of Foodgrains (FGs) And All Crops (ACs), 1949-50 to 1981-82

(Base : Triennium ending 1969-70)



foodgrains, the rates are 2.40 percent and 2.39 percent respectively. For all crops, they are 2.50 percent and 2.36 percent respectively. While the growth rates are marginally smaller 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 1981/82 production was substantially higher, especially for all crops, than that of 1980/81. This also suggests that it would incorrect to infer deceleration in Indian agriculture from the recent evidence on production of foodgrains alone. Thus, for instance, in 1981/82 foodgrains production was up by only 2.4 percent but production of all crop 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 state. 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 preceeding 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 in them, they have positive signs.

SECTION II

RECENT PRODUCTION PERFORMANCE AND GROWTH IN USE OF INPUTS

Even if there is no deceleration in the long term growth rate of agricultural production, it is still relevant to ask what has been the impact of 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 percent). Area under HYVs of five cereals also went up by 6 million hectares (by 16 percent) and fertilizer consumption rose by 1.2 million tons (by 29 percent). But production of either foodgrains or all crops increased by no more than 3 percent. (We are not considering 1981/82 because firm data on growth of irrigation and HYVs as well as on index numbers of yields are available only upto 1980/81). It is thus pertinent to ask why was the growth in production so very modest.

The answer to the above question seems to lie in distingishing between total production and per hectare yield, and most importantly between average yield of all foodgrains (or all crops) and yields of individual crops.

Whereas index number of foodgrains production rose by only 4 percentage points, the index number of foodgrains area fell by 1.5 percentage points between 1977/78 and 1980/81. Similarly during the same period, the index number of production of all crops rose by 3.9 percentage points but the index number of area under all crops fell by 1.3 percentage points. Thus, it is necessary to focus on yields rather than production especially because the three inputs contribute to additional production through raising yields. But this explains only a small part since the 1980/81 yield indices were only 3 to 4 percent higher than the 1977/78 levels(Table 2). What is more important is to examine yields of individual crops. But before

Table 2: 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	I.Nos.of Yield		Irrigated Area[a]	HYVs Area[b]	Fertilizer Consumption
	FGs	ACs.			
	Triennium ending		Million Hectare		Million Tons
1967/68	99.9	100.5	34.76	6.05	1.54
1968/69	98.2	98.3	35.75	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	43.65	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[c]	46.68[c]	6.06

a These statistics are from various issues of Economic Survy. They are not comparable with irrigated area statistics published by the Directorate of Economics and Statistics.

b Relates to Rice, Wheat, Jowar, Bajra and Maize.

c Anticipated Achievement

Source: Various issues of Economic Survey and Indian Agriculture in Brief.

this, following three important points emerging from Table 2 deserve attention.

First, since 1967/68 there has been an uninterrupted increase in the use of all thre 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, and nearly two-thirds of this increment came by 1976/77. Nearly 85 percent 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 fertilizers consumption also, the share of the period up to 1976/77 was 47 percent. Against this, it is the latter period (i.e., years between 1977/78 and 1980/81) which dominates in the growth of yields. For foodgrains, this period accounts for two-thirds of the increment in the index number of yield; and in the case of all crops, it accounts for 60 percent of the increment in the index number of yield.

Finally, as shown in Table 2, both yield indices fell during the plateau of the early 1970s despite increase in the use of <u>all</u> three inputs. Against this, there was an upward movement in both yield indices during the plateau of the late 1970s. Even in 1979/80, when monsoon failure was perhaps most severe, both yield indices were 25 to 30 percent higher than in 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. This is so because use of 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 percent 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 3 shows 1967/68 to 1981/82 trends in the yields of rice and wheat. It also shows irrigation levels and coverage by HYVs. Fertilizer consumption in the last column is average rate of application per hectare of gross sown area under all crops since time-series of fertilizer consumption are not available by crops. The focus is on rice and wheat because of their importance. In the all-India index number of production of crops, rice and wheat have a total weightage of 56 percent. Their share in gross irrigated area of the country was 66 percent in 1978/79; they accounted for 80 percent of the HYVs area under five cereals in 1980/81; and they had a share of 60 percent in total fertilizer consumption in 1976/77. Thus, at the all-India level, these two crops are ideally suited to examine the impact of growth in the use of these inputs on their yields.

There was hardly any growth in the percentage of rice area irrigated until 1976/77. Since then there has been marginal increase. By 1980/81, about 46 percent of rice area was sown to HYVs. Similarly, about 45 percent of rice area was fertilized by 1976/77, and the average rate on this area was 78 kgs. per hectare. In the subsequent years, there must have been further growth since total fertilizer consumption in the country

Table 3: Trends in Yields of Rice and Wheat and Three Yield Increasing Inputs, 1967/68 to 1981/82

Year	Rice			Wheat			Fertilizer Consumption[a] (Kgs/Ha)
	Yield (Kgs/Ha)	Percent Area Irrigated	Percent Area HYVs	Yield (Kgs/Ha)	Percent Area Irrigated	Percent Area HYVs	
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	1,303	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	NA	40.6	1,436	NA	67.8	30.0
1980/81	1,336	NA	46.1	1,630	NA	78.1	31.5
1981/82	1,317	NA	47.5[b]	1,696	NA	79.2[b]	34.6

a Average fertilizer consumption (nutrients) per hectare of gross sown area of all crops.

Source: Various issues of Indian Agriculture in Brief, and Economic Survey. Fertilizer consumption from Fertiliser Statistics, 1981/82.

has increased substantially. 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 1300 kgs. per hectare in all years from 1977/78 except 1979/80. One could still maintain that the compound growth rate of 1.6 per cent between the two peaks of 1975/76 and 1980/81 is inadequate to meet the requirements. But that is a separate issue and should not be mixed up with whether growth in the spread of HYVs and fertilizer consumption had decisive impact on rice yields in the recent years. The answer to this cannot be negative once we recognise the problems of increasing rice production through yield increases. It is also important to note that average rice yield in 1979/80 was about 25 percent 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 three inputs (including irrigation) on wheat. Second, there was virtual stagnation in wheat yield between 1971/72 and 1976/77. Third, average wheat yield in 1981/82 was 20 percent 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 percent per year. This cannot be considered insignificant especially after stagnation in wheat yields in the first half of the 1970s.

That growth in yield during recent years was not confined to rice and wheat alone and it can be seen from Table 4. The table shows percentage share of major crops in total sown area, 1978/79 irrigation levels on them, spread and rates of fertili-

Table 4: Yield Performance of Major Crops between 1977/78 and 1981/82 and Levels of Input Use - All India

Crop	Percent GSA 1978/79	Percent Crop Area			Highest Yield (Kgs/Ha)		No.of Years Col.6 Yield Exceeded	Compound Gr.Rate Peak to Peak
		Irrigated 1978/79	HYVs 1980/81	Fertilized 1976/77	1971/72 to 1976/77	1977/78 to 1981/82		
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

a Average rate of fertilizer on fertilized area (kgs./Ha)

b In terms of gur

c In terms of lint

Source: Indian Agriculture in Brief, 1982. Column 5 from Gunvant M.Desai, Sustaining Rapid Growth in India's Fertilizer Consumption: A Perspective Based on Composition of Use, IFPRI, Washington D.C. 1982.

zer application on them in 1976/77, and coverage of HYVs by 1980/81 in the case of jowar, bajra and maize. It also shows yield performance of these crops during recent years. Whereas the yield performance of no crop was as good as wheat, that of barley and sugarcane was comparable to rice if not better. Even cotton, jowar and groundnut yields, at the all-India level, attained new peak in recent years. While their yield growth rates are unimpressive, it is relevant to note that the share of these crops in the use of the three inputs was not high either. But more about these crops are in the next section since they dominate the cropping pattern in the Western region.

Our overall conclusion is that whereas questions about the impact of growth in the use of inputs in view of poor agricultural performance in recent years must be asked, but it is important to recognise that they 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.

SECTION III
EXPERIENCE OF THE WESTERN REGION

Table 5 shows the importance of the Western region (and its four constituent states) in Indian agriculture, and a few important features of its agricultural sector. The region accounts for about 40 percent of the country's gross sown area, 21 to 22 percent of gross irrigated area and fertilizer consumption, and

Table : Some Indicators of Western Region's Importance and Important Features of Its Agricultural Economy

		Ref.Year	Rajasthan	M.P.	Maharashtra	Gujarat	W. Region
			Percent Share of All India				
1	Gross Sown Area	1978/79	10.0	12.4	11.3	5.9	39.6
2	Gross Irrigated Area	"	7.2	5.0	4.8	4.0	21.0
3	HYV Area, 5 Cereals	1980/81	4.7	8.0	11.8	4.4	28.9
4	Fertilizer Consumption	1981/82	2.3	3.9	8.7	6.6	21.5
5	Foodgrains Area/Production	1979/80-81/82	9.7/5.1	13.9/8.8	11.1/8.3	3.6/3.6	38.3/25.8
6	Rice Area/Production	"	0.4/0.3	12.0/6.5	3.8/4.4	1.2/1.2	17.4/12.4
7	Wheat Area/Production	"	8.2/7.6	14.6/8.1	5.1/2.7	3.1/3.9	31.0/22.3
8	Jowar Area/Production	"	5.8/2.7	14.1/14.4	40.8/43.9	5.4/5.1	66.1/66.1
9	Bajra Area/Production	"	42.0/15.9	1.6/1.6	14.4/14.7	12.0/27.6	70.0/59.8
10	Maize Area/Production	"	15.3/10.9	13.1/10.4	1.3/2.0	5.2/4.9	34.9/28.2
11	Barley Area/Production	"	24.0/26.9	11.5/8.4	0.5/0.4	0.4/0.1	36.4/35.8
12	Gram Area/Production	"	21.2/23.3	27.6/26.7	6.3/4.1	1.0/1.2	56.1/55.3
13	Sugarcane Area/Production	"	1.2/0.8	1.7/0.8	9.1/16.5	2.6/2.7	14.6/20.8
14	Groundnut Area/Production	"	4.1/2.3	4.9/3.5	11.1/9.9	28.9/31.1	49.0/46.8
15	Cotton Area/Production	"	4.7/5.8	7.6/3.7	33.3/19.7	2 .1/24.9	65.7/54.1
			Important Features				
16	Gross Sown Area(Million Ha.)	1978/79	17.50	21.75	19.86	10.39	69.50
17	Percent GSA Irrigated	"	19.7	11.1	11.6	18.6	14.54
18	Percent GSA and GIA in Region with						
	a Normal Rainfall above 1150 mm	"	-	56.5/46.5	21.4/26.8	7.2/8.5	24.9/18.8
	b Normal Rainfall 750 mm to 1150 mm	"	12.3/16.2	39.3/40.7	42.6/30.3	24.9/29.1	31.3/27.8
	c Normal Rainfall Below 750 mm	"	87.7/83.8	4.2/12.8	36.0/42.9	67.9/62.4	43.8/53.4
19	Per Hectare Fertilizer Consumtion(Kg)	1981/82	7.9	10.9	26.6	38.6	18.8

Source: Indian Agriculture in Brief, 1982, Directorate of Economics and Statistics, Ministry of Agriculture, New Delhi, 1982; Fertilizer Statistics, 1981/82, Fertiliser Association of India, New Delhi, 1982.

nearly 30 percent of the area under HYVs of the five cereals. While its share in the total production of all foodgrains is only about 26 percent; it is 55 to 66 percent in jowar, bajra and gram. Among non-foodgrains, the region accounts for 54 per cent of cotton, 47 percent of groundnut and 21 percent of sugarcane production in the country.

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

There are important differences among the four states of the Western region. Gujarat's gross cropped area is considerably less than the other three states among whom the differences are not big. Gujarat and Rajasthan have 70 to 90 percent of their gross sown area in the low rainfall region whereas M.P., has only 4 percent and Maharashtra has 36 percent 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 percent of gross sown area with irrigation against 11 to 12 percent in M.P., and Maharashtra. Fertilizer consumption levels vary widely between 8 kgs. per hectare in M.P., and 39 kgs. per hectare in Gujarat, but only in Gujarat it is higher than the national average. Foodgrains account for 71 to 82 percent of gross cropped area in all states except in Gujarat where the share is 44 percent. Among foodgrains, jowar and/or bajra dominate everywhere except in M.P., where nearly 40 percent of the area is sown to

rice and wheat. Among non-foodgrains, oilseeds and/or cotton dominate. Sugarcane is also important, especially in Maharashtra, and to a lesser extent in Gujarat.

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 total 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 percent more than in 1976/77. Even as compared to 1978/79, it was about 25 to 40 percent higher in Gujarat, Madya Pradesh and Maharashtra. Only in Rajasthan it was barely 3 percent higher. Similarly, HYVs had also spread to 25 to 54 percent of the total areas under the five cereals in each state by 1980/81. About growth in irrigation it is difficult to say anything since no data are available 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 country as a whole because of the relatively low levels of use of these inputs. What is required is a scrutiny by crops as in the previous section.

Table 6 is similar to Table 4. 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.

Gujarat ranks first among the four states with respect to yield perfofmance in recent years. Between 1977/78 and 1981/82, yieldsof 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

Table 6 : Yield Performance of Major Crops between 1977/78 and 1981/82 and Levels of Input Use, Western Region

Crop	Percent GSA 1978/79	Percent Crop Area			Highest Yield (Kgs/Ha)		No.of Years Col.6 Yield Exceeded	Compound Gr. Rate Peak to Peak
		Irrigated 1978/79	HYVs 1980/81	Fertilized 19.5/77	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		NA	767	909	1	5.8
Foodgrains	71.1	19.0		NA	624	629	1	0.3
Sugarcane	0.3	93.2		NA	4,841[b]	3,871	0	-ve
Groundnut	2.2	2.3		NA	668	715	1	7.0
Cotton	2.3	85.9		58.5(79)	223[c]	241	1	2.6
M.P.								
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	NA	889	824	0	-ve
Maize	3.2	0.4	11.0	9.8(39)	1,134	909	0	-ve
Gram	8.0	7.1		NA	681	662	0	-ve
Foodgrains	81.6	11.2		NA	688	719	3	0.7
Sugarcane	0.5	94.5		42.9(50)	3,197	3,004	0	-ve
Groundnut	1.9	0.2		NA	828	739	0	-ve
Cotton	3.1	8.6		NA	118	92	0	-ve

Continued

Table 6 continued

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	NA	383	445	1	3.8
Foodgrains	70.9	9.6		NA	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	840	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		NA	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

a Average rate of fertilizer on fertilized area (kgs./Ha). Reference year for M.P. 1975/76.

b In terms of gur

c In terms of lint

Source: Various issues of Indian Agriculture in Brief. Column 5 from findings of the NCAER surveys used in Gunvant M.Desai, Sustaining Rapid Growth in India's Fertilizer Consumption: A Perspective Based on Composition of Use, IFPRI, Washington D.C. 1982.

five years or at least in 3 to 4 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 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 than Gujarat and Maharashtra. 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 M.P.), or exceeded them only once or twice (as in Rajasthan). Between Rajasthan and M.P., 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 percent 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 percent higher than the national average. While Maharashtra's growth rate of foodgrains yield between peaks (1.7 percent 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 come 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-thids 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, 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 M.P. 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 M.P.

From the above, it is clear that the yield performance in the Western region, especially in Gujarat and Maharashtra, was 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 conditions, the main inputs behind the yield performance were fertilizers an HYVs. Thus, the experience of the Western region 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 percent 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 6 and by the impressive yield performance. The differences in fertilizer consumption levels and pattern among the four states are also consistent with the differences in their yield performances.

SECTION 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 the agriculture in 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 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 focussing 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.

The above conclusions are not meant to convey that poor agricultural performance over last five years should not be a matter of serious concern, nor to say that all is well with growth in the use of inputs and policies to generate growth

in them, nor even to argue that diminishing returns to these inputs have not set in anywhere. But these are separate issues. They should not be mixed up with whether there is deceleration in long term trends, or how important are 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 whereas those of the period after the mid-1960s have been increasingly dependent on yield increases. For instance, entire growth in aggregate production in the last five years has been due to changes in yield. Therefore, the focus should be on the period when growth in output due to area expansion was no more substantial.

Various findings of the previous section also suggest three questions unhurried in-depth probing. First, what is the explanation behind recurring plateaus in our aggregate production trends? Is this merely a statistical phenomenon at 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 especially through stereotype regression analysis based on aggregate data.

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 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.

FOOT-NOTE

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.

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.