

201

WP: 201

Working Paper

IIM
WP-201



**INDIAN INSTITUTE OF MANAGEMENT
AHMEDABAD**

GROWTH OF FOODGRAINS PRODUCTION IN
INDIA, 1960-61 TO 1975-76: SOURCES
OF GROWTH AND FUTURE PROSPECTS

by

Gurvant M. Desai
D.C. Sah

WP201

I AMBA LIBRARY FOR THE BAHAI FAITH

WP

1978

(201)

W P No. 201
Feb. 1978

The main objective of the working paper series
of the IIMA is to help faculty members
to test out their research findings
at the pre-publication stage

INDIAN INSTITUTE OF MANAGEMENT
AHMEDABAD

GROWTH OF FOODGRAINS PRODUCTION IN INDIA, 1960-61 TO 1975-76

SOURCES OF GROWTH AND FUTURE PROSPECTS

Gunvant M. Desai

D.C. Sah

Centre for Management in Agriculture
Indian Institute of Management, Ahmedabad

1 Introduction

This paper focuses on growth in foodgrains (FGs) production in India between 1960-61 and 1975-76. To understand the sources of this growth, we have scrutinised year to year changes in FGs production, estimated the relative importance of changes in area and per hectare yield of FGs in causing these changes, and examined the extent to which the annual changes in FGs production and yield were "systematically" associated with changes in irrigation levels, spread of HYVs and consumption of fertilisers.

The four most important conclusions of the paper are as follows: First, not only was the growth rate of FGs production over the 15-year period very modest but the trend was quite unsteady and halting. Second, changes in average yield rather than in area under FGs were the prime determinant of both overall growth and year to year changes in FGs production. Third, notwithstanding the dominant influence of weather conditions, the magnitudes of year to year changes in yield were systematically and significantly associated with changes in irrigated areas under FGs, spread of HYVs of FGs and fertiliser consumption taken together. And fourth, much of the scope for further spread of currently available HYVs of FGs on areas which

are already irrigated is already exhausted. This is also true for sizeable growth in fertiliser consumption year after year. Consequently, the prospects of rapid and sustained growth in FGs production depend on vigorous policy measures based on the correct understanding of the urgency and major complexities of the problem.

2 Growth in FGs Production after 1960-61

Table 1 shows annual production of FGs from 1960-61 to 1976-77, and absolute and percentage changes in it.

The production increased from a little over 80 million tonnes in the early 1960s to about 121 million tonnes in 1975-76. In 1976-77, however, it dropped by about 9 million tonnes to 112 million tonnes. Currently it is estimated at about 118 to 121 million tonnes for 1977-78. The lowest level during the above period was 72.3 million tonnes in 1965-66, and the highest was 120.8 million tonnes in 1975-76.

The growth in FGs production was quite unsteady. In 7 years it declined (on an average by about 6.5 million tonnes or 6.5 per cent a year). These years were 1962-63, 1965-66, 1968-69, 1971-72, 1972-73, 1974-75 and 1976-77. Thus, 4 out of these 7 years were in the 1970s. The maximum decline in production was 17 million tonnes (19 per cent) in 1965-66. In 9 years, the production registered an increase over the previous year (on an average by about 8.5 million) tonnes or 10.4 per cent a year. The maximum increase in production was 21 million tonnes (21 per cent) in 1975-76. In 6 years, the increase was over 5 million tonnes. Five out of these 6 years were after the introduction of HYVs. Because of such upward and downward movements,

Table 1 : Foodgrain Production Trends in India, 1960-61 to 1976-77

Year (1)	Foodgrain Production (Million Tonnes) (2)	Changes in Foodgrain Production	
		Absolute (3)	Percentage (4)
1960-61	82.0	-	-
1961-62	82.7	0.69	0.8
1962-63	80.2	-2.56	-3.1
1963-64	80.6	0.49	0.6
1964-65	89.4	8.71	10.8
1965-66	72.3	-17.01	-19.0
1966-67	74.2	1.88	2.6
1967-68	95.1	20.82	28.0
1968-69	94.0	-1.04	-1.1
1969-70	99.5	5.49	5.8
1970-71	108.4	8.92	9.0
1971-72	105.2	-3.25	-3.0
1972-73	97.0	-8.14	-7.7
1973-74	104.7	7.64	7.9
1974-75	99.8	-4.84	-4.6
1975-76	120.8 ¹	21.01	21.0
1976-77	112.0 ²	-8.83	-7.3

1 Provisional

2 Quick estimates

Source : Various publications of Directorate of Economics and Statistics, Ministry of Agriculture and Irrigation, Government of India.

the average annual growth between 1960-61 and 1976-77 was only 1.87 million tonnes (or 1.97 per cent). In 9 out of 16 years (including the 7 years of decline), the annual change was below this average rate.

The upward movement in FGs production was not only unsteady but also halting. Broadly, in the early 1960s, the production stalled between 80 and 83 million tonnes, in the late 1960s between 95 and 100 million tonnes, and in the early 1970s between 105 and 108 million tonnes. This pattern seems to have continued with the production stalling between 115 and 120 million tonnes in the recent years.

3 Annual Changes in FGs Area and Average Yield

Table 2 shows total area under FGs, average yield of FGs, and annual changes in them between 1960-61 and 1975-76¹.

Total area under FGs increased from about 116 million hectares in 1960-61 to about 128 million hectares in 1975-76. Most of the increase in FGs area came after mid-1960s. The upward trend in area, however, was not steady. During the 15-year period, the area declined 6 times. Five of these years coincide with 5 of the 6 years in which FGs production also declined. The two exceptional years were 1962-63 and 1963-64.

The average growth in FGs area between 1960-61 and 1975-76 was 0.84 million hectares (0.69 per cent) per annum. In 10 out of 15 years, the annual change in FGs area was below these rates. In 4 years, area increased by over 3 million hectares over the previous

1 For want of data, 1976-77 is not covered in this analysis.

Table 2 : Area and Average Yield of Foodgrains, 1960-61 to 1975-76

Year	Total Area under Foodgrains (Million Hect)	Average Yield of Foodgrains (Kg/Hect)	Change in (2)		Change in (3)	
			Absolute	Percentage	Absolute	Percentage
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1960-61	115.58	710	-	-	-	-
1961-62	117.23	705	1.65	1.4	-5	-0.6
1962-63	117.84	680	0.61	0.5	-25	-3.6
1963-64	117.42	687	-0.42	-0.4	7	1.0
1964-65	118.11	756	0.69	0.6	69	10.2
1965-66	115.10	629	-3.01	-2.5	-128	-16.9
1966-67	115.30	644	0.20	0.2	15	2.4
1967-68	121.42	783	6.12	5.3	139	21.6
1968-69	120.43	781	-0.99	-0.8	-2	-0.3
1969-70	123.57	805	3.14	2.6	24	3.1
1970-71	124.32	872	0.75	0.6	67	8.3
1971-72	122.62	858	-1.69	-1.4	-14	-1.7
1972-73	119.28	814	-3.35	-2.7	-44	-5.2
1973-74	126.13	830	6.85	5.7	16	2.0
1974-75	121.62	821	-4.51	-3.6	-9	-1.1
1975-76	128.18	943 ¹	6.57	5.4	122	14.8

1 Provisional

Source : Various publications of Directorate of Economics and Statistics, Ministry of Agriculture and Irrigation, Government of India.

year. These years were 1967-68, 1969-70, 1973-74 and 1975-76 - - all after the introduction of HYVs. In each of these years, the total production of FGs increased substantially over the previous year. Similarly, in 3 years when the area declined by over 3 million hectares (1965-66, 1972-73 and 1974-75), the total production also declined substantially.

The average per hectare yield of FGs increased from 710 Kgs in 1960-61 to 943 Kgs in 1975-76. As in the case of area, most of the increase in yield also came after mid-1960s. Similarly, the upward trend in yield was also not steady. In 7 years it declined from the level in the previous year. In each of these years except 1961-62, total production was also lower than in the previous year.

The average growth in yield between 1960-61 and 1975-76 was 15.7 Kgs per hectare (1.91 per cent) per year. In 9 out of 15 years, the annual change in yield was below 15.7 Kgs. It was below the average of 1.91 per cent in 8 years. In 4 years, yield increased by more than 50 Kgs per hectare (by more than 8 per cent). These years were 1964-65, 1967-68, 1970-71 and 1975-76. Each of them also registered a substantial growth in total production over the previous year. Incidentally, area also increased substantially over the previous year in 2 out of these 4 years. The average yield dropped by over 40 Kgs per hectare (more than 5 per cent) only twice (in 1965-66 and 1972-73). In both these years FGs area also declined significantly. Consequently, total FGs production declined substantially.

To recapitulate, between the early 1960s and mid-1970s, total FGs production increased by about 1.87 million tonnes (1.97 per cent) per year. The upward trend in production was not only very unsteady but also halting. During the same period, both total area under FGs as well as average yield had upward but very unsteady trends. The average increment of area works out at 0.84 million hectares (0.69 per cent) per year while that of average yield works out at 15.7 Kgs (1.91 per cent) per year. In 5 out of 6 years during this period when total production declined, both area and yield were lower than in the previous year. Similarly, in 7 out of 9 years with positive change in production, both area and yield were higher than in the previous year. Thus, in 12 out of 15 years, the directions of year to year changes in total FGs production were the same as in both area under and average yield of FGs.

4 Relative Importance of Changes in Area and Yield in Year to Year Changes in FGs Production

Table 3 shows percentage "contribution" of changes in area under FGs and average yield of FGs to year to year changes in total production of FGs between 1961-62 and 1975-76².

2 These estimates are based on the following identity:

$$Q_t - Q_{t-1} = Y_{t-1} (A_t - A_{t-1}) + A_{t-1} (Y_t - Y_{t-1}) + (A_t - A_{t-1}) (Y_t - Y_{t-1})$$

Where,

Q = Total FGs Production (in million tonnes)

A = Area under FGs (in million hectares)

Y = Yield of FGs (in tonnes per hectare)

Table 3 : Components of Foodgrain Production, 1960-61 to 1975-76

Year (1)	Change in Foodgrain Production over the previous year (Million tonnes) (2)	Percentage of (2) due to changes		
		Total Area (3)	Average Yield (4)	Interaction Term (5)
1960-61	-	-	-	-
1961-62	0.69	170	-69	-1
1962-63	-2.56	17	-116	-1
1963-64	0.49	-59	160	-1
1964-65	8.71	5	94	1
1965-66	-17.01	-13	-89	2
1966-67	1.88	9	93	a
1967-68	20.82	19	77	4
1968-69	-1.04	-75	-26	1
1969-70	5.49	45	54	1
1970-71	8.92	6	93	1
1971-72	-3.25	-45	-55	1
1972-73	-8.14	-35	-67	2
1973-74	7.64	73	26	1
1974-75	-4.84	-77	-24	1
1975-76	21.01	26	71	3
Total Period	38.8	23	69	8

a Less than 0.5

Source : Derived from Table 1 & 2

Between 1960-61 and 1975-76, total FGs production increased by 38.8 million tonnes. In this growth, the relative contribution of increase in average yield was three times more important (69 per cent) than that of increase in area under FGs (23 per cent).

In 7 out of the 9 years with positive growth in FGs production, the relative contribution of changes in yield was higher than that of changes in area. The two exceptional years were 1961-62 and 1973-74. The former was a year of decline in average yield while the latter had a substantial growth (nearly 7 million hectares) in area under FGs. In 6 out of the 7 years, increase in yield contributed 70 to 95 per cent to the annual growth in FG production. On the other hand, there was no upward trend in the relative contribution of increase in yield to the annual changes in FGs production³.

In 4 out of the 6 years with decline in FGs production, the negative impact of changes in yield on total FGs production was higher than that of changes in the area under FGs. Incidentally, 2 of these 4 years were 1971-72 and 1972-73 - - years after the introduction of HYVs. But, on the whole, the negative impact of changes in yield during years with decline in FGs production was less important than the positive impact of changes in yield during years of increase in FGs production.

3 Between 1967-68 and 1975-76 FGs production increased by 25.8 million tonnes. The share of increase in area in this growth was still as high as 21 per cent (against 23 per cent for the entire period). The share of increase in yield was, however, 75 per cent (against 69 per cent for the entire period).

Thus, it is clear that though changes in both total area and average yield have consistently affected year to year changes in FGs production, the relative importance of changes in yield was much more than that of area. Also, this has been more true in the case of years of increase in FGs production over the previous year than years of decline in production. To illustrate, in 1967-68, and again in 1975-76, FGs production increased by over 20 million tonnes. In both these years, increase in yield contributed over 70 per cent of the increment in production despite increase in area under FGs by over 6 million hectares.

5 Year to Year Changes in Factors Affecting Yield

Broadly, the factors affecting yield could be categorised as (i) weather conditions (for example, substantial decline in yield in 1965-66 and 1972-73 when weather was bad, and substantial increase in yield in 1964-65 and 1967-68 when it was good) and (ii) such variables as level of irrigation, fertiliser consumption and spread of HYVs. In this section we focus on the year to year changes in irrigated area under FGs, area under HYVs of FGs and fertiliser consumption (Table 4).

Irrigated area under FGs increased from 22 million hectares (19 per cent of total FGs area) in 1960-61 to 32 million hectares (27 per cent of total FGs area) in 1974-75. In 3 out of 14 years, it declined (Cols. 5 and 6 of Table 4). The year to year changes in it fluctuated between -1.03 million hectares (-4.3 per cent) in 1965-66 and 3.05 million hectares (13.5 per cent) in 1966-67. On an average the irrigated area under FGs increased by 0.74 million hectares (2.8 per cent) per year. In 8 out of 14 years, however, the annual increment was lower than the average.

Table 4 : Irrigated Area Under FGs, HYV Area Under FGs and Total Fertiliser Consumption, 1960-61 to 1976-77

Year (1)	Irrigated FGs Area (2)	HYV Area under FGs (3)	Total Fertiliser Consumption (4)	Change in(2)		Change in(3)		Change in(4)	
				Absolute (5)	% (6)	Absolute (7)	% (8)	Absolute (9)	% (10)
	Million Hectares		000 Tonnes						
1960-61	22.03 (19.1) ^a	-	240 (1.6) ^b	-	-			-	-
1961-62	22.45 (19.2)	-	379 (2.2)	0.42	1.9			98	40.8
1962-63	23.27 (19.8)	-	452 (2.9)	0.83	3.7			114	33.3
1963-64	23.21 (19.8)	-	544 (3.5)	-0.07	-0.3			92	20.4
1964-65	23.67 (20.0)	-	773 (4.9)	0.46	2.0			229	42.1
1965-66	22.64 (19.7)	-	784 (5.1)	-1.03	-4.3			11	1.4
1966-67	25.70 (22.3)	1.89 (2) ^c	1101 (7.0)	3.05	13.5			317	40.4
1967-68	26.00 (21.4)	6.05 (5)	1539 (9.1)	0.30	1.2	4.16	220	438	39.9
1968-69	27.86 (23.1)	9.24 (8)	1761 (11.0)	1.87	7.2	3.19	53	222	14.3
1969-70	29.55 (23.9)	12.85 (10)	1982 (12.1)	1.68	6.0	3.61	39	221	12.6
1970-71	30.59 (24.6)	15.38 (12)	2256 (13.5)	1.04	3.5	2.53	20	274	13.8
1971-72	30.54 (24.9)	18.31 (15)	2656 (16.2)	-0.05	-0.2	2.93	19	400	17.7
1972-73	30.74 (26.9)	22.12 (19)	2768 (17.1)	0.20	0.7	3.81	21	112	4.3
1973-74	31.17 (24.7)	25.84 (21)	2839 (16.8)	0.43	1.4	3.72	17	71	2.5
1974-75	32.40 ^d (26.6)	26.49 (22)	2573 (15.7)	1.20	3.8	0.65	3	-266	-9.3
1975-76	NA	32.37 (25)	2894 (17.5)	NA	NA	5.88	22	321	12.4
1976-77	NA	33.00	3411 (20.7)	NA	NA	0.63	2	517	17.9

Contd ...

(Table 4 : Contd)

- a Percentage of total foodgrain area irrigated.
- b Nutrient consumption in Kgs per hectare.
- c Percentage of total foodgrain area under HYV.
- d Likely achievement.

Source : From various publications of the Directorate of Economics and Statistics, Ministry of Agriculture and Irrigation, Government of India; and Fertiliser Statistics, Fertiliser Association of India.

Area under HYVs of FGs increased from a little less than 2 million hectares (2 per cent of total FGs area) in 1966-67 to about 33 million hectares (about 25 per cent of total FGs area) by 1976-77. On an average it increased by a little over 3 million hectares per year (with maximum of 5.88 million hectares in 1975-76 and minimum of 0.63 million hectares in 1976-77). In 4 out of 10 years, the increment was less than 3 million hectares. These years were 1970-71, 1971-72, 1974-75 and 1976-77, all in the 1970s.

Total fertiliser consumption increased from 0.24 million tonnes in 1960-61 to 3.41 million tonnes in 1976-77⁴. Only once during this period, in 1974-75, it was lower than in the previous year. On an average, fertiliser consumption increased by about 200,000 tonnes (about 17 per cent) per year. In 7 years, the annual change was lower than 200,000 tonnes. Despite substantial annual increase in irrigated areas under FGs (between 1968-69 and 1970-71) and also in HYV areas under FGs (between 1967-68 and 1973-74), there was no acceleration in the trends of fertiliser consumption between 1967-68 and 1974-75. In fact, 3 out of 7 years with less than 200,000 tonnes average annual growth fertiliser consumption were in this period⁵.

4 We have focussed on total fertiliser consumption and not on fertiliser consumption on FGs for want of data. This, however, does not much affect the analysis in this paper because nearly 70 per cent of total fertiliser consumption is on FGs. Over time this percentage might have changed marginally upwards.

5 See Gunvant M. Desai, "Fertiliser Consumption after 1974-75, A Critical Review" (to be published), Gunvant M. Desai, Fertilisers in India's Agricultural Development, Problems and Policies, Indian Institute of Management, Ahmedabad Working Paper 154, April 1977, and Gunvant M. Desai and Gurdev Singh, Growth of Fertiliser Use in Districts of India, Past Performance and Policy Implications, Centre for Management in Agriculture, Indian Institute of Management, 1973, for explanation of this phenomenon.

How were the year to year changes in these three major variables associated with the year to year changes in FGs production and in its average yield?

6 Association between Year to Year Changes in Production or Yield of FGs and Irrigation, Spread of HYVs and Fertiliser Consumption

Table 5 brings together various columns of Tables 1 to 4 to focus on the above issue. We have chosen the absolute magnitude of year to year changes as it is analytically more appropriate.

A scrutiny of the table shows that there is very weak association between year to year changes in either total FGs production or yield on the one hand and the changes in irrigated area under FGs or area under HYVs of FGs or fertiliser consumption on the other hand.

To illustrate, of the 6 years with the decline in FGs production and 7 years with decline in yield between 1961-62 and 1975-76, there were only 2 (1965-66 and 1971-72) in which irrigated area under FGs had also declined. Similarly, substantial growth in FGs production and yield in 1964-65, 1967-68 and 1973-74 was not associated with substantial increase in irrigated area under FGs in these years. The weak association between these magnitudes of year to year changes in either total FGs production or yield and irrigated area under FGs is indicated by low and not significant Spearman's Rank Correlation Coefficients between these variables (Table 6).

The association between annual changes in FGs production or yield and fertiliser consumption was even weaker. In only one of the 6 years of decline in FGs production and 7 of the decline in yield

Table 5 : Year to Year Changes in Foodgrain Production, Foodgrain Yield and Three Yield Increasing Inputs

Year	Foodgrain Production	Foodgrain Yield	Irrigated Area under Foodgrain	HEV Area under Foodgrain	Fertiliser use
(1)	(2)	(3)	(4)	(5)	(6)
<u>Changes over previous year</u>					
	<u>Million Tonnes</u>	<u>Kg/Hect</u>	<u>Million Hect</u>		<u>'000 Tonnes</u>
1960-61	-	-	-		-
1961-62	0.69	-5	0.42		98
1962-63	-2.56	-25	0.83		114
1963-64	0.49	7	-0.07		92
1964-65	8.71	69	0.46		229
1965-66	-17.01	-128	-1.03		11
1966-67	1.88	15	3.05		317
1967-68	20.82	139	0.30	4.18	438
1968-69	-1.04	-2	1.87	3.19	222
1969-70	5.49	24	1.68	3.61	221
1970-71	8.92	67	1.04	2.53	274
1971-72	-3.25	-14	-0.05	2.93	400
1972-73	-8.14	-44	0.20	3.81	112
1973-74	7.64	16	0.43	3.72	71
1974-75	-4.84	-9	1.20	0.65	-266
1975-76	21.01	122	NA	5.88	321
1976-77	-8.83	NA	NA	0.63	517

Source : Derived from Table 1, 2 & 4.

Table 6 : Spearman's Rank Correlation Coefficients between Year to Year Changes in FGs Production, Yield and Major Yield Increasing Inputs

	Change in FGs Production	Change in Yield
	<u>Rank Correlation Coefficients</u>	
1 <u>Change in Irrigated Area under FGs</u>		
1961-62 to 1974-75	0.31	0.32
1967-68 to 1974-75	0.12	0.31
2 <u>Change in Fertiliser Consumption</u>		
1961-62 to 1974-75	0.55*	0.51
1967-68 to 1974-75	0.52	0.43
3 <u>Changes in Areas under HYVs of FGs</u>		
1967-68 to 1974-75	0.26	0.19

* Significant at 5 per cent level

between 1961-62 and 1975-76, there was decline in fertiliser consumption, namely 1974-75. Worse still in 1976-77 when fertiliser consumption recorded the highest ever increment of over half a million tonne, the total FGs production was nearly 9 million tonnes lower than in 1975-76. A similar situation can also be seen in 1971-72. On the other hand, substantial growth in both total FGs production and yield in 1967-68 and 1964-65 were positively associated with relatively substantial increments in fertiliser consumption. On the whole, however, the association was very weak as can be seen from the low and not-significant rank correlation coefficients (Table 6).

Nor was the association between changes in FGs production or yield and areas under HYVs of FGs strong. In fact, between 1967-68 and 1975-76, both production and yield declined in 4 years in spite of substantial increments in area under HYVs of FGs. The rank correlation coefficients between these variables are also low and not significant.

Was there greater association between annual changes in FGs production (or yield) and irrigated areas under FGs or fertiliser consumption after 1967-68 when the HYVs came on the scene? Again, as the rank correlation coefficients in Table 6 shows, it is clear that such was not the case.

The above results are not surprising. We have highlighted them because they show how erroneous it is to single out one factor to generate rapid growth in FGs production.

Obviously, the magnitude and direction of year to year changes in total production of FGs and yield would be affected both by weather

conditions and changes in all major yield determining factors taken together rather than by changes in any one of them. While it is not possible to take into account changes in weather conditions, in what follows, an attempt is made to see if there was a systematic and significant association between the magnitudes of annual changes in FG production or yield and the above three yield increasing factors taken together.

For this purpose, a composite rank based on the ranks of annual changes in (i) irrigated areas under FGs, (ii) areas under HYVs of FGs and (iii) fertiliser consumption was developed for each year between 1961-62 and 1974-75 (Table 7). Spearman's Rank Correlation Coefficient between changes in FGs production and the composite rank is estimated at 0.59 and it is significant at 5 per cent level. Similarly, the coefficient between changes in yield and the composite rank is 0.58 and significant at 5 per cent level. Similar exercise for the period between 1967-68 and 1974-75 given even higher rank correlation coefficients-- 0.71 for production and the composite rank, and 0.74 for yield and the composite rank. Both these coefficients are also significant at 5 per cent level. Thus, notwithstanding the proverbial influence of weather conditions, it is clear that year to year changes in the magnitudes of FGs production as well as yield were systematically and significantly associated with year to year changes in the magnitudes of irrigated area under FGs, area under HYVs of FGs and fertiliser consumption taken together. It is also clear that the association has become stronger after the introduction of HYVs.

Table 7 : Ranks according to Year to Year Changes in FGs Production,
Yield and Major Yield Increasing Inputs

Year	Ranks according to Annual Changes in Composite Rank ^a					
	Production of FGs (2)	Average Yield (3)	Irri.Area under FGs (4)	HYV Area under FGs (5)	Fertiliser Consumption (6)	based on (4),(5)&(6) (7)
1961-62	7	8	9	-	10	12
1962-63	10	12	6	-	8	8
1963-64	8	7	13	-	11	13
1964-65	3	2	7	-	5	6
1965-66	14	14	14	-	13	14
1966-67	6	6	1	-	3	1
1967-68	1	1	10	1	1	2
1968-69	9	9	2	5	6	3
1969-70	5	4	3	4	7	4
1970-71	2	3	5	7	4	5
1971-72	11	11	12	6	2	7
1972-73	13	13	11	2	9	10
1973-74	4	5	8	3	12	9
1974-75	12	10	4	8	14	11

a Average of (4), (5) and (6)

7 Summing Up

In this section we would like to highlight one most important implication of the various findings of this paper.

The growth in FGs production during last decade and a half, though at a much lower rate than desired, has been primarily due to growth in per hectare yields. More significantly, despite the dominating influence of weather conditions, the magnitudes of year to year changes in yield, particularly in the upward direction, were clearly and significantly associated with the magnitude of changes in irrigated areas under FGs, areas under HYVs of FGs and fertiliser consumption taken together. Inasmuch as these are variables can be controlled, they indicate room for accelerating the trends in the production of FGs through efforts to step up the trends in irrigation, spread of HYVs and fertiliser consumption. It would be, however, most unfortunate to infer from this that even sustaining (as quite apart from accelerating) the past trends in the growth of yield will be a relatively easy task. This is because of the following reasons.

The past growth in per hectare average yield of FGs has been due to the combined effect of increase in irrigated areas under FGs, continuous further diffusion of HYVs of FGs, and growth in fertiliser consumption. In this framework, though growth in irrigated area under FGs was not all that impressive, it did not adversely affect the spread of HYVs or growth in fertiliser consumption because there was enough scope on the already irrigated areas for these two variables. In other words, the annual increments in irrigated areas were not all

that crucial for further rapid spread of HYVs of FGs or continuous sizeable growth in fertiliser consumption. By mid-1970s, however, this situation has changed.

As shown in Table 4 (Col. 3), by 1975-76, HYVs had covered about 33 million hectares under FGs. It is well known that a very high percentage of this are also irrigated FGs areas. Since total irrigated areas under FGs by mid-1970s amount to about the same number (32 to 33 million), it is clear that there is little scope left for further diffusion of HYVs of FGs on already irrigated areas. Thus, if shifts in irrigated areas from non-FGs to FGs and rapid diffusion of HYVs of FGs on rainfed areas are ruled out, henceforth, increments in irrigated areas under FGs will play a much more important role in determining the rate of growth in areas under HYVs of FGs than in the past. And, in this context, the past growth rates in irrigated areas cannot be considered adequate by any standard.

What is true of the prospects of further rapid spread in HYVs of FGs is even more true of fertiliser consumption, notwithstanding the impressive growth after 1974-75. As shown elsewhere, most of the recent growth in fertiliser consumption has been by way of recovery after poor growth in 1972-73 and 1973-74 and a substantial decline in consumption in 1974-75⁶. And inasmuch as sizeable growth in fertiliser consumption, year after year is tied up with the growth in irrigated areas and further spread of HYVs, the above reasoning

6 See Gunvant M. Desai, " Fertiliser Consumption after 1974-75, A Critical Review " (To be published).

applies to the determinants of the prospects of rapid growth in fertiliser consumption as well.

What is argued above is not to present one more pessimistic picture of the prospects of further growth in FGs production. In fact, the recent emphasis on stepping up the growth in irrigated areas indicates room for optimism. Our chief concern, therefore, is to highlight the seriousness of the problem, and to draw attention to some of the major complexities which will have to be grasped before planning the future efforts, including those which emphasise irrigation, to generate accelerated growth in FGs production.