CHAPTER II

A Cross Section Analysis Based on a Sample Survey

The Sample

For our sample survey we selected the districts of Muzaffarnagar (U.P.) and Karnal (Haryana). Given the limitations of funds we restricted our enquiry to 50 farms, 25 in Muzaffarnagar for wheat and the other 25 in Karnal for rice. For selecting these farms, villages were selected purposively, keeping in mind the availability of irrigation facilities and the use of fertilizers as well as oil fueled machines. From the villages farms were selected randomly after stratifying all farms by size.

Wheat, a winter crop, is grown mostly in the north-western region which is homogeneous in respect of oil, climate and rainfall. Muzaffarnagar is fairly representative of this region, except that it is typical of progressive wheat culture. The latter feature introduces a bias and reliability was also affected by the small size of the sample. More progressive farmers are likely to exhibit greater sensitivity to a rise in fertilizer prices, if not for any other reason, for their higher fertilizer input per unit of land and hence their lower marginal product. It is clear that no quantitative conclusion can be drawn from this sample regarding all farmers cultivating wheat. In the case of rice, the bias and reliability problems are even greater. Firstly, while the predominant crop in Karnal district is rice, the district itself is not a part of any major rice growing tract in the country, such as, Andhra Pradesh, Tamil Nadu, Orissa, West Bengal. Secondly, rice culture in India presents a much more varied picture than wheat even amongst the major rice growing tracts. Here again convenience dictated the choice of the district, and since Karnal, too, is a progressive district, quantitative information obtained from it would perhaps be more applicable to the more progressive districts.

The 50 farms were grouped into three sizes - small, medium and large. In Karnal, holdings below 4.05 hectares were classified as small, those between 4.05 to 8.09 hectares as medium and those above 8.09 hectares as large. In Muzaffarnagar, the proportions of medium and, specially, large farms corresponding to the size classification in Karnal were small in the selected villages and hence, the three size classes used were: below 4.05 hectares (small), between 4.05 and 6.06 hectares (medium) and above 6.06 (large).

While the character of the technology in use in these districts can be regarded as neutral to farm size, resources available to the farmers with holdings of different sizes may not necessarily be the same. For instance, a given dose of fertilizer nutrient per hectare would yield the same output of wheat in a small or a large farm, if other inputs are the same, but it is possible that the small farmer may not be able to secure the same quantity of fertilizers as a large farmer because of lack of funds or access to bank or cooperative credit. Similarly, while a large farmer may be in a position to stock his surplus produce of wheat in order to take advantage of an expected rise in price, a small farmer may not be able to do so and may be forced to sell his produce at the comparatively low post-harvest price. Thus, while for technical reasons, it may not be necessary to distinguish between farms of different sizes, it would be useful to do so for other reasons.

The size-distribution of selected farms along with their land use pattern for crop cultivation is shown in Tables 3 and 4.

Table 3

Number of Sample Farms, Average Cultivated Area, Gross Cropped Area and Intensity of Cropping by Size of Farm, Karnal, 1973-74 and 1974-75

Size of farm (in hectares)	Number of sample farms	Cultivated area (hectares)	Gross cropped area (hectares)	Intensity of cropping * (per cent)
		1973-74		
Small (below 4.05)	11	2.55	5.10	200.0
Medium (4.05 - 8.10)	10	5.51	10.85	196.9
Large (8.10 & above)	4	10.93	21.66	198.2
All farms	25	5.18	10.25	197.9
		1974-75		
Small	11	2.61	5.10	195.4
Medium	10	5.51	10.52	191.0
Large	4	10.53	20.43	194.0
All farms	25	5.04	9.72	192.9

* Ratio of cropped area to cultivated area.

Table 4

Number of Sample Farms, Average Cultivated Area, Gross Cropped Area and Intensity of Cropping by Size of Farm, Muzaffarnagar, 1973-74 and 1974-75

Size of farm (hectares)	Number of sample farms	Cultivated area (hectares)	Gross cropped area (hectares)	Intensity of cropping*	
				A (per cent)	B (per cent)
		1973-74			
Small (below 4.05)	15	2.24	3.46	154.5	205.4
Medium (4.05 - 6.07)	6	4.76	6.64	139.5	205.9
Large (6.07 & above)	4	6.98	9.38	134.4	196.0
All farms	25	3.60	5.17	143.6	202.8
		1974-75			
Small	15	2.24	3.55	158.5	209.4
Medium	6	4.76	7.03	147.7	213.4
Large	4	6.98	9.77	140.0	204.0
All farms	25	3.60	5.38	149.4	209.2

*A = Intensity of cropping computed by counting area under sugarcane once.
= Intensity of cropping computed by counting area under sugarcane twice, because sugarcane is an annual crop whereas most other crops are seasonal.

From each farm detailed information on all inputs (quantity and cost) for each crop grown and the yields (quantity and value) achieved was obtained. In order to assess the impact of the increase in the prices of oil-based inputs, this information was obtained for the agricultural year 1973-74 which preceded, and the agricultural year 1974-75 which succeeded, the rise in these prices.

The survey was conducted in February 1975. By this time most of the rice grown in the 1974-75 kharif season was already sold by the sample farmers and the prices secured by them were known. However, the wheat crop was not yet harvested, though all inputs other than those in harvesting or post-harvest operations had already been employed. For information on these inputs a second visit was made after the harvest. Even at this time, the farmers had not disposed of any of their output. For valuing the sample farmers' output, therefore, the previous year's average price secured by all sample farmers was used.

The cropping pattern of sample farms

With three-fourths of the gross cropped area, rice and wheat dominate the cropping pattern of Karnal farms. Fodder crops (including jowar) command another fifth of the year, with sundry crops (including vegetables, grams, etc.), utilising the remainder (Table 5). Karnal farmers grow rice mainly for the market and wheat both for home consumption and sale.

Table 5

Average Area Under Major Crops per Farm by Size of Farm Among Sample Farmers in Karnal, 1973-74 and 1974-75

(In hectares)

Size of farm	Area under crops							
	Paddy			Wheat	Jowar	Borseem (fodder)	Others	Total
	IR-8	'Basmati'	Total					
				1973-74				
Small	1.56 (30.6)	0.40 (7.8)	1.96 (38.4)	1.81 (35.5)	0.59 (11.6)	0.74 (14.5)	- -	5.10 (100.0)
Medium	3.40 (31.4)	0.97 (8.9)	3.37 (40.3)	4.01 (37.0)	1.09 (10.0)	1.36 (12.5)	0.02 (0.2)	10.85 (100.0)
Large	4.25 (19.6)	3.34 (15.4)	7.59 (35.0)	7.49 (34.6)	1.97 (9.1)	1.92 (8.9)	2.69 (12.4)	21.66 (100.0)
All farms	2.77 (27.0)	1.13 (11.0)	3.90 (38.0)	3.67 (35.8)	1.03 (10.0)	1.19 (11.6)	0.46 (4.6)	10.25 (100.0)
				1974-75				
Small	1.58 (31.0)	0.42 (8.2)	2.00 (39.2)	1.78 (34.9)	0.57 (11.1)	0.67 (13.1)	0.08 (1.7)	5.10 (100.0)
Medium	3.52 (33.5)	0.81 (7.7)	4.33 (41.2)	3.56 (33.8)	1.09 (10.4)	1.32 (12.5)	0.22 (2.1)	10.52 (100.0)
Large	4.20 (20.6)	2.88 (14.1)	7.08 (34.7)	6.58 (32.2)	1.87 (9.2)	1.92 (9.4)	2.98 (14.1)	20.43 (100.0)
All farms	2.78 (28.6)	0.97 (10.0)	3.75 (38.6)	3.26 (33.5)	0.99 (10.2)	1.13 (11.6)	0.59 (6.1)	9.72 (100.0)

Note: Figures in brackets are the percentage of the average area under the crop to total gross cropped area.

Muzaffarnagar farmers devote a much smaller proportion - just a third, - of the gross cropped area to rice and wheat, with rice having only a fourth of the area under wheat. Sugarcane is clearly the major crop of the region , with two-fifths of the area under it. Fodder crops account for a fourth and sundry crops for the remaining area (Table 6). Muzaffarnagar farmers grow rice for home consumption and wheat for both home consumption and sale.

Table 6

Average Area Under Major Crops per Sample Farm by Size of Farm, Muzaffarnagar, 1973-74 and 1974-75

(in hectares)

Size of farm	Area under crops						
	Sugarcane	Wheat	Paddy	Jowar	Berseem	Other	Total
			1973-74				
Small	1.14	1.07	0.31	0.73	0.15	0.06	3.46
	(32.9)	(31.0)	(8.9)	(21.2)	(4.3)	(1.7)	(100.0)
Medium	3.16	1.60	0.40	1.26	0.15	0.07	6.64
	(47.7)	(24.1)	(6.0)	(19.0)	(2.2)	(1.0)	(100.0)
Large	4.30	2.29	0.32	2.12	0.30	0.08	9.38
	(45.7)	(24.3)	(3.4)	(22.6)	(3.2)	(0.8)	(100.0)
All farms	2.13	1.39	0.34	1.08	0.17	0.06	5.17
	(41.2)	(26.9)	(6.6)	(20.9)	(3.3)	(1.1)	(100.0)
			1974-75				
Small	1.14	1.16	0.29	0.78	0.12	0.06	3.55
	(32.1)	(32.7)	(8.1)	(22.0)	(3.4)	(1.7)	(100.0)
Medium	3.13	1.92	0.37	1.32	0.15	0.14	7.03
	(44.5)	(27.3)	(5.3)	(18.8)	(2.1)	(2.0)	(100.0)
Large	4.47	2.12	0.35	2.20	0.30	0.33	9.77
	(45.7)	(21.7)	(3.6)	(22.5)	(3.1)	(3.4)	(100.0)
All farms	2.15	1.49	0.32	1.15	0.15	0.12	5.38
	(40.0)	(27.7)	(5.9)	(21.4)	(2.8)	(2.2)	(100.0)

Note: Figures in brackets are percentages of the average area under the crop to total gross cropped area.

In Karnal the cropping pattern is closely similar on farms of all sizes. In Muzaffarnagar, because of the needs for home consumption, the proportion of gross cropped area under foodgrains rises, displacing sugarcane, as the farm sizes decline.

Changes in the net cultivated and the gross cropped area between 1973-74 and 1974-75

First of all let us consider the possibility that the farmer, having fixed financial resources, decides to use the same input mix at a higher fertilizer price and hence cultivates a smaller area.

It can be seen that, between the two years there was no change in the net cultivated area in Muzaffarnagar (an average of 3.60 hectares in both years) and only a marginal decline in Karnal (from 5.18 hectares to 5.04 hectares) which was caused mainly by a shift in lease arrangements. Among farms of different sizes, the area cultivated in

small farms increased, while there was a decline in the area cultivated on large farms. These facts would tend to indicate that the rise in fertilizer prices had no significant effect on the area cultivated in the selected farms.

Given water, the ecological conditions in India make it possible to raise more than one crop in a year from the same land. It is therefore possible for the farmer to have a larger cropped area than the land area available to him for cultivation. Gross cropped area can therefore be equal to or exceed the net cultivated area to the extent that a farmer cultivates any part of his land more than once.

The principal factor which determines the extent of multiple cropping during any year is irrigation. While in India 22.5 per cent of the cultivated area is irrigated, the farms selected for our enquiry both in Karnal and Muzaffarnagar are fully irrigated. The average gross cropped area on the farms in both districts is thus twice as large as the net cultivated area. The extent to which an area is cultivated more than once is referred to as the cropping intensity and is measured as a ratio of the gross cropped area to the net cultivated area. It can be seen from Tables 3 and 4 that between 1973-74 and 1974-75 there was a marginal decline in the cropping intensity in Karnal, while in Muzaffarnagar there was an increase. The decline in Karnal was shared by medium and large farms only, while in Muzaffarnagar the increase was shared by farms of all sizes. In Karnal, at least, a part of the decline in gross cropped area was due to a fall in the cultivated area; there was also a marginal increase in fallows on a few farms. On enquiry it was found that the slight increase in the fallow area was due to the weather and not to any other reason. One can therefore conclude that, on the whole, there was no discernible impact of higher fertilizer prices on the farmers' cropping intensity.

Another alternative available to the farmer, if he does not reduce his net cultivated or gross cropped area, is to change his cropping pattern in favour of crops which use less fertilizers. It was found that in both districts there was some change in the cropping pattern over the two years under review, though a marginal one (Table 5 and 6). The proportion of gross cropped area under foodgrains remained the same in Muzaffarnagar, but declined slightly in Karnal. In Muzaffarnagar wheat gained in area while rice lost; in Karnal the shift was in the opposite direction. In both districts fodder crops retained their position, while the share of sundry crops increased. Besides being too small to be of consequence, these changes present no consistent pattern that could be attributed to a common cause, such as the rise in fertilizer prices.

Concepts of costs

Before presenting cost information from our survey it is necessary to define the cost concepts used. Four concepts of cost are currently identified in India and used for estimating the cost of production in agriculture. These are called cost A_1, A_2, B and C, and are defined as follows:

Cost A_1 — Value of all material inputs, hired human labour, hired and owned bullock and machine labour, depreciation on implements and farm buildings, irrigation charges, land revenue and taxes and interest on working capital including crop loans.

Cost A_2 — Cost A_1 plus rent paid on leased-in land.

Cost B Cost A_2 plus imputed rental value of owned land (less land revenue paid on it) and imputed interest on present value of owned fixed capital (excluding land).

Cost C Cost B plus imputed value of family labour.

These concepts are being used in the Comprehensive Scheme for studying the cost of cultivation of principal crops referred to earlier. The method of imputing value to non-traded factors is now fairly standardised. Family labour is valued at the going wage cost per day for permanent farm hands. The wage cost per day of a permanent farm hand is estimated by dividing his annual wage by the number of days he actually works. Rent for owned land is imputed at the prevailing rent for identical land in the same locality and interest on owned fixed capital at the current long-term lending rate of commercial banks.

The Comprehensive Scheme adopts the following methods for estimating the value of bullock labour and machine use. The net cost of maintaining bullocks is obtained by deducting from the total maintenance cost amounts received in charges for hiring out bullock labour plus income accruing from the yield of by-products (dung manure). The net maintenance cost of bullocks is attributed to crops in proportion to the hours of bullock labour used. Similarly, the cost of machine input is estimated on the basis of maintenance and operational expenditure plus depreciation and is allocated to crops according to the time the machine is used for each crop. Home grown seeds are valued at the going rate for seeds in the sowing season.

In calculating the cost of production for our sample farms the same cost concepts and methods of estimation were used as in the Comprehensive Scheme.

The average Indian farmer operates with his household as the basic unit of production. Members of the household share the work in accordance with their age and sex. The income earned is the household's income. Decisions relating to production are taken by the household usually through the head of the household. The motivation that guides decision-making is income maximisation or more precisely household welfare maximisation. The income earned is not divisible between its components, such as wages, interest, profit or rent. The entire household as a unit is the recipient of all these incomes. No purpose is served in splitting the household income into its components, attributed to differentiated factorial functions, when such differentiation is not made by the household. We must, therefore, treat the household income as an indivisible whole.

For accounting purposes it may be useful to impute values to factors which in fact receive no specific payments for work done or services rendered. But when these imputed values accrue to the farm household, they essentially represent a way of splitting the household income into known categories. To the farmer this procedure makes no difference; in fact, he is not even aware of it. He takes his decisions in relation to his total household income and allocates the household resources with reference to this income. To him the imputed value of family labour is not a cost but an indistinguishable part of his total income and so also is the imputed rent of owned land or imputed interest on owned fixed capital.

In our analysis we shall, therefore, attach no importance to costs B and C. We shall concern ourselves with A_2 cost only, which consists of the amounts paid out by the household and determines the household's income when deducted from the value of output produced.

Changes in the per quintal cost of production of wheat between 1973-74 and 1974-75

Simply for record we present all four costs, A_1, A_2, B and C. For producing a quintal of wheat, each of the four costs rose between 1973-74 and 1974-75 in Karnal almost equally on small and large farms but considerably less on medium farms (Table 7). A_2 cost, with which we are principally concerned, increased by a little over 15 per cent for all farms, over 23 per cent for both small and large and only 6 per cent for medium farms.

Table 7

Average Cost of Production per Quintal of Wheat and Percentage Change in 1974-75 over 1973-74 by Cost Concepts and Size of Farm Among Sample Farms in Karnal and Muzaffarnagar

Cost	Karnal			Muzaffarnagar		
	1973-74 (Rs.)	1974-75 (Rs.)	Percentage change over 1973-74	1973-74 (Rs.)	1974-75 (Rs.)	Percentage change over 1973-74
			Small farms			
A_1	37.65	45.93	+ 21.99	78.41	60.08	- 23.38
A_2	38.57	47.64	+ 23.52	79.13	60.56	- 23.47
B_2	68.12	79.41	+ 16.57	112.22	82.49	- 28.21
C	72.33	83.39	+ 15.29	130.93	94.91	- 27.51
			Medium farms			
A_1	44.07	47.43	+ 7.62	83.61	63.07	- 24.57
A_2	48.61	51.60	+ 6.15	83.61	63.07	- 24.57
B_2	74.21	77.65	+ 4.64	120.36	87.82	- 27.04
C	76.75	79.64	+ 3.77	135.30	96.61	- 28.60
			Large farms			
A_1	44.32	55.28	+ 24.73	98.23	58.55	- 40.39
A_2	51.04	63.11	+ 23.65	98.23	58.55	- 40.39
B_2	71.01	82.02	+ 15.50	143.79	83.36	- 42.03
C	71.59	82.45	+ 15.17	149.85	87.15	- 41.84
			All farms			
A_1	42.72	49.63	+ 16.18	84.62	60.65	- 28.33
A_2	47.20	54.51	+ 15.28	84.96	60.87	- 28.35
B_2	71.75	79.51	+ 10.82	122.07	84.35	- 30.90
C	73.99	81.46	+ 10.10	136.68	93.60	- 31.52

In Muzaffarnagar, on the other hand, the per quintal A_1, A_2, B and C costs of producing wheat declined significantly in farms of all sizes. The decline in A_2 cost was 23.5 per cent for small 24.6 per cent for medium and 40.4 per cent for large farms with an average of 28.4 per cent for all farms.

The diametrically contrasting cost behaviour in Muzaffarnagar was due mainly to the wide variation in the weather conditions in this district over the two years. Whereas in Karnal 1973-74 was rated as 'normal' and 1974-75 a good year, in Muzaffarnagar 1973-74 was a bad and 1974-75 as exceptionally good year. The extraordinarily low yield rate in Muzaffarnagar in 1973-74 greatly inflated the per quintal cost of production while the bumper crop in 1974-75 did exactly the opposite by deflating it.

On the other hand, if we compare the per hectare A_2 cost of cultivating wheat we find that, not only does it increase in both districts, the increase is greater in Muzaffarnagar (21 per cent) than in Karnal (19 per cent). Here is a telling example of how weather fluctuation can affect the cost of cultivation per unit of output. The farmer normally tends to make his outlay on inputs in the expectation that he will encounter normal weather conditions through the full period of plant growth unless, of course, some untoward turn in the weather conditions in the initial period of crop growth is so damaging as to rule out such an expectation.* Often a farmer will aim to counter the ill-effects of bad weather in the early part of the season by additional effort and inputs. He realises expected yields at planned cost per quintal** if weather conditions maintain their normal course throughout the season. When this does not happen, yields fall or rise in comparison with the expected and the actual cost per quintal is more or less than the planned cost. For a study of the farmer's response to a change in the circumstances influencing his input use, therefore, it is the per hectare cost and not the per quintal cost that should interest us.

Change in the cost of cultivation per hectare of wheat between 1973-74 and 1974-75

The per hectare cost of growing wheat increased in both Karnal and Muzaffarnagar by a fifth between 1973-74 and 1974-75 (Table 8). To this rise all items in cost A_2 contributed in Karnal and all the major items in Muzaffarnagar (Table 9). In Table 10 major items which account for more than four-fifths of the total A_2 cost are listed. The percentage increase in fertilizer cost was clearly dominant in Karnal, although it was high for seeds and tractor use also. In Muzaffarnagar, however, the pattern of cost increase was somewhat different. While the percentage increase in seed cost was similar to Karnal, fertilizer cost increased by much less and both hired labour and machine operation by much more.

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*It is possible, as Srinivasan argues, that a farmer's perception of the vagaries of weather varies with the size of the farm; farmers with larger holdings running a greater risk and therefore optimising their factor mix at lower levels of inputs./3/ However, we are not concerned here with explaining inter-farm variations in inputs or yields, but with comparing cost per unit of output over time for the same farm or the same group of farms.

**This is not to be confused with the optimal cost, for technically it is not so for most farmers. Moreover, two identical combinations of inputs may yield very different results even with the same weather conditions, if one farmer's know-how is superior to another's. Since we measure material inputs only, the optimum mix of inputs becomes highly variable between farmers.

Table 8

Average Cost of Cultivation per Hectare of Wheat by Size of Farm in Sample Farms in Karnal and Muzaffarnagar, 1973-74 and 1974-75

Cost	Karnal			Muzaffarnagar		
	1973-74 (Rs.)	1974-75 (Rs.)	Percentage change over 1973-74	1973-74 (Rs.)	1974-75 (Rs.)	Percentage change over 1973-74
			Small farms			
A_1	1424.0	1620.5	13.8	1825.3	2238.5	22.6
A_1	1448.8	1666.1	15.0	1839.1	2252.8	22.5
B^2	2243.8	2511.2	11.9	2475.3	2905.5	17.3
C	2357.2	2617.0	11.0	2836.3	3274.8	15.5
			Medium farms			
A_1	1389.3	1633.1	17.5	2050.7	2403.8	17.2
A_1	1496.1	1741.9	16.4	2050.7	2403.8	17.2
B^2	2098.2	2422.8	15.5	2795.6	3165.6	13.2
C	2157.9	2474.6	14.7	3098.5	3436.4	10.9
			Large farms			
A_1	1499.5	1883.8	25.6	1930.2	2339.1	21.2
A_1	1667.7	2093.9	25.6	1930.2	2339.1	21.2
B^2	2167.4	2600.6	20.6	2700.4	3128.3	15.8
C	2182.1	2612.1	19.7	2802.7	3248.5	15.9
			All farms			
A_1	1433.9	1711.0	19.3	1915.1	2312.4	20.7
A_1	1544.7	1837.4	18.9	1921.5	2319.0	20.7
B^2	2151.6	2501.4	16.3	2623.4	3036.4	15.7
C	2207.0	2553.1	15.7	2899.7	3318.7	14.4

It is fairly obvious that the seed rate (quantity of seeds sown per hectare) would tend to remain constant on farms with assured irrigation provided the same seed variety is used and there is no other technological innovation affecting the seed rate. Even a substantial change in the price of seeds, as indeed did occur between 1973-74 and 1974-75, would not significantly change the seed rate although some marginal adjustments might be made. The decline (3.9 per cent) in the seed rate in Muzaffarnagar might be attributed to the relatively high price rise (39 per cent), but in it would be difficult to explain the increase in the seed rate (2.9 per cent) with a less (29 per cent) but substantial increase in the price of seeds in Karnal by the same logic. It is more likely that the change in the seed rate in both places was incidental or that, it was caused by factors other than price*.

*We could not find a satisfactory explanation for the higher seed rate in Muzaffarnagar, though the same seeds were used in both places; nor, for the larger dose of fertilizers and manures in 1973-74. These were attributed to cultural practices, but it is possible that a deeper investigation might reveal agronomical features which offer a better explanation.

Table 9

Break-down of Cost of Cultivation Per Hectare of Wheat and Percentage Change in 1974-75 over 1973-74, among Sample Farms in Karnal and Muzaffarnagar

Items	Karnal			Muzaffarnagar		
	1973-74 (Rs.)	1974-75 (Rs.)	Percentage change over 1973-74	1973-74 (Rs.)	1974-75 (Rs.)	Percentage change over 1973-74
1. Human labour	386.5	403.8	+ 4.5	504.1	583.6	+ 15.8
a) family	55.4	51.7	- 6.7	276.3	282.3	+ 2.2
b) hired	331.1	352.1	+ 6.3	227.8	301.3	+ 32.3
2. Bullock labour	234.2	247.1	+ 5.5	422.5	547.0	+ 8.2
3. Seeds	134.8	178.9	+ 32.7	221.9	295.0	+ 32.9
4. Manures	-	-	-	108.5	170.6	+ 57.2
5. Fertilizers	301.9	426.4	+ 41.2	421.8	486.2	+ 15.3
6. Irrigation cost	56.8	65.4	+ 15.1	162.7	151.8	- 6.7
7. Tractor cost	135.4	148.5	+ 9.7	81.3	87.4	+ 7.5
8. Thresher cost	121.5	139.3	+ 14.7	104.1	189.7	+ 82.2
9. Land revenue, etc.	3.2	3.2	0.0	8.8	8.4	- 4.5
10. Depreciation	56.3	68.1	+ 21.0	98.0	95.9	- 2.1
11. Repairs	43.8	55.0	+ 25.6	39.0	37.9	- 2.8
12. Interest on working capital	14.9	27.0	+ 81.2	18.6	31.1	+ 67.2
13. Rent for leased in land	110.8	126.4	+ 14.1	6.4	6.6	+ 3.1
14. Interest on fixed capital	70.4	115.0	+ 63.4	132.0	167.6	+ 27.0
15. Rental value of owned land	536.5	549.0	+ 2.3	569.9	549.8	- 3.5
Total	2207.0	2553.1	+ 15.7	2899.7	3318.7	+ 14.5

Labour input would also tend to be unaltered, if there were no severe mid-season damage to the crop and no major substitution of a mechanical device for labour. Thus, for instance, if ploughing is done by a tractor and continues to be so done, labour input in this operation would remain unchanged irrespective of what other inputs are used or what the size of the crop is. This would be true of all other operations as well. It is, of course, conceivable that at some price of tractor use, the farmer may find it more economical to use bullocks instead, in which case labour input would rise. Labour input, on the other hand, would fall if, as the crop season advances and drought or some other blight makes it evident that a major portion of the crop will inevitably be lost, the farmer decides that no purpose will be served in putting in the normal labour input, in say, the inter-culture operation. In both Karnal and Muzaffarnagar, we find that the rise in the price of tractor use (mostly hiring charges) did not induce the farmers to change over to bullocks and that there was very little change in the total or hired labour input.

Table 10

Price and Quantity Change in the Major Inputs Between 1973-74 and 1974-75 in Sample Farms in Karnal and Muzaffarnagar

	Karnal		Muzaffarnagar	
	Price increase/ decrease (per cent)	Quantity increase/ decrease (per cent)	Price increase/ decrease (per cent)	Quantity increase/ decrease (per cent)
1. Seeds	+ 29	+ 2.9	+ 39	- 3.8
2. Fertilizers (NPK nutrients)	+ 84.9	- 23.5	+ 86.4	- 38.0
3. Manures	-	-	+ 53.0	+ 4.2
4. Hired labour	+ 5.4	+ 1.7	+ 28.0	+ 2.6
5. Bullock labour (feed cost)	+ 2.0	+ 2.6	+ 8.0	+ 0.3
6. Tractor 1/	15 to 25.0	- 12.2	+15 to 20.0	- 10.3
7. Threshers 2/	-	+ 14.7	-	+ 82.0
8. Irrigation 3/	-	+ 11.8 4/	+ 100.0 5/	-

1/ Rent for tractors varies; cooperatives have the lowest rate, while the rate charged by private owners is both higher and differentiated. The rates also vary for ploughing, harrowing and levelling. The rate is fixed per acre for ploughing/levelling/harrowing.

2/ Rent in kind at 3 kgs. per 40 kgs. of wheat threshed in Karnal. Rent @ Rs.12.50 per quintal in Muzaffarnagar in both years.

3/ Irrigation is done by canal as well as tubewells. For wheat in Karnal only tubewells are used, while both tubewells and canals are used in Muzaffarnagar. In Karnal tubewells are run on electricity and in Muzaffarnagar by diesel engines.

4/ Change in the electricity rate per unit.

5/ Change in the price of diesel oil.

There was, however, a rise in wages (earnings of hired labour per day) in both Karnal and Muzaffarnagar, modest (5.4 per cent) in the former and substantial (28.0 per cent) in the latter. In reality, the rise in wages in Muzaffarnagar was due mainly to the higher yield which enabled hired labour to earn more because the wage for harvesting is fixed as a proportion (in kind) of the quantity harvested. It is to be noted that the time taken by a labourer to harvest one hectare, or the area he harvests in a working day, remains more or less the same whether the yield rate is good or poor. But his remuneration rises with the yield rate because the amount of grain he harvests per unit of time increases.* For this reason wages in Muzaffarnagar in 1973-74 must be regarded as abnormally depressed as the yield rate in that year was exceptionally low. It is obvious that changes in this type of yield-tied wages play no part in determining the demand for labour. It should also be pointed out that while payment in kind for harvesting as a proportion of the amount harvested is traditional and constant, when expressed in terms of money it varies with the price at which the conversion is done. Since the normal practice is to make this conversion at the current price of the grain harvested, money wages for harvesting also rise with the rise in the price of the grain harvested. In Muzaffarnagar, however, the price of wheat for both years was the same for all farmers, and hence it did not contribute to the rise in money wages of workers.

Preparation of the soil before sowing usually consists of a set of well defined operations: harrowing, ploughing and levelling. The number of times each of these operations is required to be repeated to ensure optimum results for any crop is fairly fixed and, in normal circumstances, a farmer usually adheres to the established pattern. But, he may find room for deviation, if there is more than normal rainfall just before he starts his preparatory tillage or during its earlier stages. What the farmer ultimately aims to achieve is the desired loosening of the soil and rain helps in the process.

While rain makes preparatory tillage easier, the time available to the farmer acts as a constraint. For wheat, in areas where double cropping is the normal practice, the time available for preparatory tillage is confined to that between the last operation for the kharif (summer) crop and the latest possible sowing period for wheat (a winter crop). This time is limited, and depending on the size of the farm, farmers may or may not find it enough to efficiently prepare all the land they wish to put under wheat. If they do not, either less land is prepared or more land is prepared less well. This constraint has led many farmers to use tractors either by acquiring them or using them on hire. Most farmers in our survey hired them. Since tractors plough, harrow, etc., much quicker, the time constraint has practically disappeared. However, farmers still own bullocks mainly because they need them in certain operations for raising other crops, for instance, rice in Karnal and sugarcane in Muzaffarnagar. These bullocks are maintained throughout the year and could easily be used for preparatory tillage for wheat, if desired, with little additional cost, mainly for labour. It is, therefore, conceivable that a rise in the hiring charge for tractor

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*The proportion of the output that goes to a worker as wages for harvesting might vary from place to place, but it is fairly rigid in the same place. In Muzaffarnagar as well as in Karnal,it is fixed at one out of twenty or 5 per cent.

use could lead farmers to switch over to owned bullocks. If, with a given increase in the hiring charges for tractors, the farmer does not turn to bullocks, it is because he continues to find tractors more gainful even at the higher price.

Between 1973-74 and 1974-75 hiring charges for tractors went up by 25 per cent in Karnal and 20 per cent in Muzaffarnagar, due to the rises in the price of HSD, lubricants, tyres and labour. But, inspite of this no farmer switched over to bullocks. He could, of course, have cut cost by repeating the required operations for a lesser number of times and thereby sacrificing some of the efficiency of preparatory tillage. This he apparently did but with no significant adverse effect, thanks to the exceptionally good rainfall in 1974-75. Thus what might have otherwise caused a 25 per cent increase in the cost of tractor use in Karnal and 20 per cent in Muzaffarnagar, led to an increase of only 9.7 per cent in Karnal and 7.5 per cent in Muzaffarnagar.

While the farmer was seemingly compensated for the reduced use of tractors by good weather, the question remains whether he would have made less use of tractors as a result of higher cost had the weather not been so helpful. This question was put to the farmers at the time of our survey and the answer in almost all cases was that the increase in cost did not deter them from using tractors to the extent required. For a farmer who can use a tractor on hire, it becomes possible to dispense with all his bullocks or, at any rate, to reduce their number, which makes tilling much cheaper. This is the context in which a farmer hiring a tractor takes his decision. He reckoned in 1974-75, for instance, that even with the rise in hiring charges it was still cheaper to use a tractor than to go back to bullocks. Farmers owning tractors had the same view, except that, some responded to the higher cost - of tyres and lubricants more than HSD - by cutting down their pleasure trips into town.

In the case of most wheat as well as rice farmers, one should remember that, the cost of tractor use is less than 10 per cent and, in many cases, closer to 5 per cent of the total paid out cost of production. To this cost HSD contributes only a fraction. Even when other operational costs (tyres, lubricants, labour and repairs) are also considered and the hiring charges go up by 20 per cent or more as they did in 1974-75, farmers do not react by using tractors less. A major reason for this is that the return on efficient preparatory tillage is high.

The pattern of irrigating wheat is fairly standard. Depending on the weather, a farmer irrigates 3 to 5 times between sowing and harvesting. If winter rains are dispersed and adequate, he will irrigate 3 times, if skimpy or concentrated over a short period 5 times. Besides rain, if the temperature rises sharply in spring, or dry, hot westerly winds set in early, the farmer would use more irrigation. Irrigation, where available, is a basic input and specially if high yielding varieties of seeds and chemical fertilizers are used. The cost of irrigation as a proportion of total cost is low and the return to cost, even where no chemical fertilizers are used, high. One can thus expect the use of irrigation, like the seed rate, to be highly price inelastic.

Where only one source of irrigation is available the cost of irrigation, between any two years, would go up if the

weather conditions require a larger number of irrigations or the cost per irrigation increases. If we assume constant labour input and wage rates the cost per irrigation would go up with the rise in the irrigation rate for canal irrigation, the electricity rate for tubewells or pumpsets (worked on electricity) and the price of HSD for tubewells or pumpsets worked by diesel engines. However, where, as in Karnal and Muzaffarnagar, more than one source of irrigation is available, a change in the cost of irrigation can also occur when one source of irrigation is substituted for another. Canals and tubewells are used in both districts, but in Karnal canal water is not available during the winter months, i.e., for the wheat season. Thus in Karnal for growing wheat, tubewells are the only source of irrigation. Further, in Karnal tubewells are mostly run on electricity, while the diesel engine dominates in Muzaffarnagar. If the same number of irrigations were used in both years in Karnal, one would expect the cost of irrigation to go up, if the electricity rate went up. However, in Muzaffarnagar the cost of irrigation may or may not go up if the price of HSD goes up, depending on the extent to which canal irrigation is substituted for tubewell irrigation. It may be noted that the cost of canal irrigation is universally lower than tubewell irrigation, irrespective of whether the tubewell is powered by electricity or HSD. However, despite this tubewell irrigation is preferred because it provides a greater control over irrigation.

The electricity rate in Karnal was raised by 11.8 per cent in 1974-75 compared with the previous year and the cost of irrigation per hectare went up by over 15 per cent. It is possible that, in spite of good and well dispersed winter rains in 1974-75, the farmer used more intensive irrigation compared with the previous year when electricity was rationed on account of an overall shortage.* Moreover, a number of farmers used tubewells on hire and the charge for tubewells went up by more than the increase in the electricity rate.

Between the wheat season of 1973-74 and that of 1974-75,the price of HSD went up by about 15 per cent. But the per hectare cost of irrigation in Muzaffarnagar, where tubewells, powered mainly by HSD are used, declined by 6.7 per cent. For this seemingly contradictory result there were basically two reasons: (1) winter rains were exceptionally good and, as the farmers claimed, almost tailored to their needs which is very unusual; (2) with the rise in the cost of HSD, farmers used more canal irrigation. The latter neutralised the rise in the price of HSD and the former, by reducing the intensity of irrigation, reduced its cost per hectare.

Threshing costs depend largely on the size of harvest; a larger harvest will call for more threshing and a smaller harvest less. At this point the farmer has little choice. He might, if the cost of mechanical threshing rises too high, switch over to bullocks, but he will, nevertheless, thresh his entire harvest. Thus the use of a mechanical thresher will rise or fall directly with the size of the harvest. When mechanical threshers are not owned but hired, one might expect the hiring charge to rise with a good harvest and fall with a bad one. One does not, however, find evidence of this; on the contrary, the hiring charge in both Muzaffarnagar and Karnal was the same in 1973-74 and 1974-75. While in Karnal there was only a modest

*The overall supply of electricity improved during the winter months of 1974-75. The supply of electricity was particularly stringent during the rabi (wheat) season of 1973-74 and kharif (rice) of 1974-75.

increase in yield in the latter year, in Muzaffarnagar the increase was substantial and, in spite of a hiring charge in money (Rs.12.50 per quintal) instead of in kind (7.5 per cent) of the quantity of wheat threshed, as in Karnal, there was no rise in the hiring charge. Because of the highly specialised nature of the equipment, it appears that the owner of a mechanical thresher reckons to gain more when the harvest is good through greater capacity utilisation of the equipment than through a higher per quintal hiring charge. The vastly different increase in the cost of threshing between the two years in Muzaffarnagar and Karnal is thus due entirely to the difference in the increase of yield per hectare experienced in the two districts.

We have dealt with the inputs, the use of which depends mainly on the decision to cultivate. Let us now turn to those that depend either on the yield rate aimed at or actually achieved. Once the quality of seed is given - in this case a high-yielding variety of seed - and the facility for irrigating the crop at will, the yield rate aimed at will depend on the input of organic manures, chemical fertilizers, plant protection chemicals and labour associated with the application of these inputs and 'know-how'. The yield rate actually achieved will depend on all these inputs as well as the weather. Inputs for all post-harvest operations (threshing ,winnowing, etc.) will vary with the yield achieved and not the yield aimed at.

Of all these inputs, two, viz., 'know-how' and weather do not lend themselves to any simple quantitative measure, nor have we made any attempt in this direction. About the relative levels of 'know-how'among the farmers in our sample we know nothing. We do, however, know that the weather in 1974-75 was good to excellent for wheat as compared with poor to moderately good in 1973-74. While weather is an exogenous factor over which the farmer himself has no control, 'know-how' can be acquired and, within limits, depends on the efforts a farmer is willing to put in to acquire it. Between one season and the next,normally no significant change in the general level of 'know-how' may occur, though for a single farmer it is quite conceivable. For our purpose, however, we are assuming that it remains unchanged.

Among the cultural practices for wheat in north India plant protection is relatively unimportant. All farmers undertake a number of inter-culture operations to get rid of weeds when the crop is young and to aerate the soil. Only some farmers use fungicides, insecticides or pesticides. In our sample none used them in Karnal, though some did in Muzaffarnagar. The two common fungal diseases of wheat plants - wheat rust and wheat smut - have been successfully controlled through breeding resistent seeds, and hence the need for using chemicals for plant protection does not usually arise unless there is an attack of some other insect or pest.

The major input shift that occurred in our sample farms in 1974-75 was in respect of chemical fertilizers and, prima facie, can be attributed to the steep, sudden though expected rise in their prices. For the average NPK combination of fertilizer nutrients used by Karnal farmers the composite price in terms of nutrients rose by 85 per cent from Rs.2.18 per kg. to Rs.4.03 per kg. The price rise for Muzaffarnagar farmers, from Rs.2.36 per kg. to Rs.4.40 per kg. was slightly higher at 86.4 per cent. The difference in the increase of the composite price of the NPK bundle is

due to the varying degrees to which the farmers in Karnal and Muzaffarnagar reduced each nutrient and/or switched the source of nitrogen.

As the prices of fertilizers went up sharply farmers decided to use less of them. The overall fall in fertilizer inputs per hectare in terms of the combined nutrients, NPK, was 23.5 per cent in Karnal and 38.4 per cent in Muzaffarnagar. It can be seen from Table 11 that despite the larger percentage fall, fertilizer inputs in Muzaffarnagar in 1974-75 were still higher than in Karnal, though only marginally.

Table 11

Input of Fertilizer (Nutrient) per Hectare of Wheat by Size of Farm in Sample Farms in Karnal and Muzaffarnagar, 1973-74 and 1974-75

(In kgs.)

Size of farm	Karnal				Muzaffarnagar			
	N	P_2O_5	K_2O	Total	N	P_2O_5	K_2O	Total
				1973-74				
Small	86.4	25.0	0.8	112.2	116.0	50.3	3.9	170.2
Medium	96.3	32.9	3.6	132.8	130.3	50.5	12.5	193.3
Large	121.2	46.4	8.0	175.6	97.5	66.5	17.0	181.0
All farms	101.3	34.2	2.8	138.3	115.1	54.6	9.7	178.4
				1974-75				
Small	62.2 (-26.9)	14.5 (-48.0)	0.2 (-75.0)	77.9 (-30.6)	75.2 (-35.2)	35.3 (-29.8)	0.9 (-76.9)	111.4 (-34.5)
Medium	75.2 (-21.9)	32.9 (0.0)	1.6 (-55.6)	109.7 (-17.4)	71.2 (-45.4)	29.9 (-40.8)	0.42 (-66.4)	105.3 (45.5)
Large	93.4 (-22.9)	24.7 (-46.8)	2.9 (-63.7)	121.0 (-31.1)	73.2 (-24.9)	33.4 (-50.2)	9.4 (-44.7)	116.0 (-35.9)
All farms	78.2 (-22.8)	25.9 (-24.3)	1.7 (-39.3)	105.8 (-23.5)	73.5 (-36.1)	33.3 (-39.0)	3.8 (-60.8)	110.6 (-38.0)

Note: Figures in brackets are the percentage change in fertilizer input per hectare in 1974-75 over 1973-74.

The recommended dose of each fertilizer nutrient for the high yielding variety of wheat in common use in Muzaffarnagar and Karnal is 90 kgs. of N.24 kgs. of P_2O_5 and 45 kgs. of K_2O per hectare. This recommended combination of nutrients is, however, not the optimal dose of fertilizers for a variety of reasons. First, it does not specifically relate to soil characteristics which vary from farm to farm; second, to be optimal the fertilizer dose would need to be a part of an optimal mix of all inputs including cultural practices; and third, it would vary with output and input prices. Thus the recommended dose is simply a guide towards a more efficient use of fertilizers than the average current practice. However, even after allowing for these, the use of nitrogen in both Karnal and Muzaffarnagar would appear to be relatively high in 1973-74. It is

a well documented fact that the return to fertilizer nutrients declines as the dose is raised beyond a point.* Consequently if the current use of a fertilizer nutrient is relatively high, its marginal return will be correspondingly low and the quantity used will be more sensitive to a given price change. This is exactly what seems to have occurred when the farmers in Muzaffarnagar responded to the rise in fertilizer prices by reducing their input of N more than the farmers in Karnal. It is interesting to note that the input of each nutrient in Muzaffarnagar and Karnal was much closer after the price rise than it was before it.

While the input of N in both districts was high vis-a-vis the recommended dose before the price rise, this was not true either for the input of P_2O_5 or K_2O in Karnal and K_2O in Muzaffarnagar. Here again one must emphasise that the recommended NPK ratio may not necessarily be the one suited to a particular farmer's needs; even so, it seems to be a normal tendency among Indian farmers to attach major importance to the input of N and to underrate the role of P_2O_5 or K_2O because their individual effect on the crop is not directly perceptible. The significance of the right combination of nutrients to obtain the maximum return from each nutrient is not fully comprehended as yet. A rise in the price of all nutrients has, therefore, resulted in a similar reduction in N and P_2O_5 and a higher reduction in K_2O in spite of its very modest use, probably because its utility is least understood.

While it does not appear to be the practice in Karnal to use organic manures, in Muzaffarnagar all farmers do so. In 1974-75 our sample farmers, on an average, used 4.5 per cent more organic manures than they did in 1973-74 and they did this despite a rise of 53 per cent in the price of organic manures. The observed insensitivity of the demand for organic manure over the given range of its price increase appears to be due to the fact that, (a) for the wheat-sugarcane cropping pattern, besides nitrogen, humus obtained from organic manures in an important input, and (b) there is a higher prefernce for N from organic manures than from chemical fertilizers.

Change in the per hectare yield of wheat between 1973-74 and 1974-75

The extent to which fertilizer inputs per hectare were reduced in Karnal and especially in Muzaffarnagar in 1974-75, with practically no change in the other major inputs, should have resulted in at least some fall in the yield rate. In fact, the yield rate increased, moderately (7.0 per cent) in Karnal, substantially (62.0 per cent) in Muzaffarnagar (Table 12). This contrary outcome was caused by a favourable turn in the weather, from good to better in Karnal and from poor to excellent in Muzaffarnagar. The latter explains the widely different increase in yields between the two districts. A totally extraneous factor intruding in this manner frustrates any analysis of causality between inputs and output for the two years. What makes the situation even more complex is the clear possibility that good weather, especially in Muzaffarnagar, may not only have compensated for the lesser input of fertilizers but may even have induced it, at least in part.

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*Minhas and Srinivasan [4] state that the first kilogram of N per hectare for high yielding variety of wheat yields an additional 16 kgs. of wheat, while the 101st kg. yields only 2 kgs. of wheat. Similarly Panse [5] shows that while the average return per kg. of N per hectare when 56 kgs. of N is used is 13.3 kgs., it is reduced to 8.9 kgs. when 112 kgs. of N are used.

In other words, influenced by the persistence of favourable weather as the crop season progressed, the farmer might have decided to use less fertilizer inputs than he would otherwise have done even at the higher prices.

Table 12

Average Yield of Wheat per Hectare and Percentage Change in 1974-75 over 1973-74 by Size of Farm in Sample Farms in Karnal and Muzaffarnagar

Size of farms	Karnal			Muzaffarnagar		
	1973-74	1974-75	Percentage change	1973-74	1974-75	Percentage change
Small	2691	2660	- 1.2	1925	2976	+ 54.6
Medium	2352	2613	+11.1	2027	3079	+ 51.9
Large	2503	2668	+ 7.1	1690	3180	+ 88.2
All farms	2473	2616	+ 7.0	1891	3054	+ 61.5

Change in the cost of production of rice between 1973-74 and 1974-75

Our sample for rice cultivation is drawn entirely from Karnal, where two types of rice are grown - IR8 (a high yielding variety) and Bansmati, the well-known aromatic, high quality indigenous rice. Normally Karnal farmers put more than twice the area under IR8 rice than Bansmati rice.

Between 1973-74 and 1974-75 the cost of production (A_2cost) for a quintal of IR8 rice increased from Rs.39.57 to Rs.55.22 or 39.6 per cent. The corresponding increase for Bansmati rice was Rs.54.27 to Rs.68.7 or 26.9 per cent. The increase in cost varied among farms of different sizes. For both IR8 and Bansmati rice the increase was the least in large farms (Table 13).

Change in the cost of cultivation per hectare for rice between 1973-74 and 1974-75

The increase in the cost of cultivation (A_2 cost) per hectare between 1973-74 and 1974-75 was from Rs.1,705.4 to Rs.1,980.3 or 16.1 per cent and for Bansmati rice from Rs.1,560.3 to Rs.1,702 or 9.1 per cent. The lower increase in the cost of cultivation as compared with the cost of production was due to a fall in per hectare yield in 1974-75 (Table 14).

Let us again first consider the change in the inputs which are relatively fixed once the decision to cultivate is taken (Table 15).

For preparatory tillage the farmers mainly use tractors supplemented by bullocks for puddling. The hiring charge for tractors went up from 15 to 25 per cent between 1973-74 and 1974-75, whereas the per hectare cost of tractor was increased by 19.2 per cent for IR-8 rice and 21.8 per cent for Bansmati rice, indicating that there was, if at all, a negligible reduction in the use of tractors. There is also no evidence that bullocks were substituted for tractors as there was no increase in bullock-labour days employed for Bansmati rice and, in the case of IR-8 rice, there was, in fact, a small decline.

The price of seeds, both IR-8 and Bansmati, increased by about 4.5 per cent, and the seed rate declined for IR-8 rice and increased for Bansmati, both marginally. There is

Table 13

Average Cost of Production per Quintal of Paddy (IR8 and Bansmati) by Different Cost Concepts and Size of Farm Among Sample Farms in Karnal, 1973-74 and 1974-75

Cost	Paddy - IR8			Paddy Bansmati		
	1973-74 (Rs.)	1974-75 (Rs.)	Percentage change over 1973-74	1973-74 (Rs.)	1974-75 (Rs.)	Percentage change over 1973-74
			Small farms			
A_1	36.55	51.28	+40.30	42.31	56.30	+33.07
A_2	37.21	52.71	+41.66	42.31	56.30	+33.07
B	54.53	74.90	+37.36	68.87	92.63	+34.50
C	56.90	77.85	+36.82	71.81	96.34	+34.16
			Medium farms			
A_1	34.63	50.68	+46.35	46.35	59.33	+28.00
A_2	36.25	52.95	+46.07	53.73	68.60	+27.68
B	50.60	73.31	+44.88	72.38	95.90	+32.50
C	51.39	74.41	+44.79	74.79	98.49	+31.69
			Large farms			
A_1	46.81	57.54	+22.92	52.50	67.74	+29.03
A_2	51.26	62.78	+22.47	59.75	75.47	+26.31
B	67.76	79.75	+17.69	76.83	99.39	+29.36
C	68.24	80.25	+17.60	77.62	100.21	+29.10
			All farms			
A_1	37.61	52.46	+39.48	48.42	62.52	+29.12
A_2	39.57	55.22	+39.55	54.27	68.87	+26.90
B	55.09	75.24	+36.58	73.76	96.75	+31.17
C	56.21	76.68	+36.42	75.53	98.78	+30.78

Table 14

Average Cost of Cultivation per Hectare of Paddy (IR-8 and Bansmati) by Different Cost Concepts and Size of Farm Among Sample Farms in Karnal, 1973-74 and 1974-75

Cost	Paddy - IR8			Paddy - Bansmati		
	1973-74 (Rs.)	1974-75 (Rs.)	Percentage change over 1973-74	1973-74 (Rs.)	1974-75 (Rs.)	Percentage change over 1973-74
			Small farms			
A_1	1656.7	1883.9	+13.7	1637.5	1958.4	+19.6
A_2	1685.6	1935.1	+14.8	1637.5	1958.4	+19.6
B	2445.0	2730.8	+11.7	2608.1	3168.2	+21.5
C	2548.9	2836.7	+11.3	2715.5	3291.7	+21.2
			Medium farms			
A_1	1611.2	1819.9	+13.0	1254.9	1312.8	+ 4.6
A_2	1683.7	1899.7	+12.8	1444.5	1509.7	+ 4.5
B	2327.9	2613.0	+12.2	1923.7	2089.4	+ 8.6
C	2363.6	2651.8	+12.2	1986.4	2144.4	+ 8.0
			Large farms			
A_1	1617.1	2016.0	+24.7	1232.6	1643.5	+33.3
A_2	1766.8	2195.7	+24.3	1621.5	1824.3	+12.5
B	2321.8	2778.0	+19.6	2066.4	2384.0	+15.4
C	2338.0	2795.0	+19.5	2087.0	2403.1	+15.1
			All farms			
A_1	1623.4	1883.5	+16.0	1399.4	1551.4	+10.7
A_2	1705.4	1980.3	+16.1	1560.3	1702.9	+ 9.1
B	2353.7	2682.6	+14.0	2096.0	2367.9	+13.0
C	2400.4	2733.0	+13.9	2144.7	2416.3	+12.7

Table 15

Average Cost of Cultivation per Hectare in Paddy, IR-8 and Bansmati Varieties, and Percentage Change Between 1974 over 1973, in Sample Farms in Karnal

Items	Paddy - IR8			Paddy - Bansmati		
	1973-74 (Rs.)	1974-75 (Rs.)	Percentage change over 1973-74	1973-74 (Rs.)	1974-75 (Rs.)	Percentage change over 1973-74
1. Human labour	625.4	621.7	- 0.6	615.3	607.4	- 1.3
a) Family	46.7	50.4	+ 7.9	48.7	48.4	- 0.6
b) Hired	578.7	571.3	- 1.3	566.6	559.0	- 1.3
2. Bullock labour	189.2	178.1	- 5.9	213.1	208.4	- 1.2
3. Seeds	40.3	42.1	+ 4.5	51.1	53.3	+ 4.3
4. Manures	101.2	103.2	+ 2.0	115.1	111.1	- 3.5
5. Fertilizers	376.6	578.7	+53.7	127.8	212.6	+66.4
6. Pesticides	-	1.7	-	1.8	2.7	+50.0
7. Irrigation cost	125.3	141.1	+12.6	120.9	141.3	+16.9
8. Tractor cost	87.9	104.8	+19.2	97.3	118.5	+21.8
9. Land revenue	3.5	3.5	-	2.7	3.2	+18.5
10. Depreciation	54.7	69.2	+26.5	47.5	62.9	+32.4
11. Repairs	47.2	58.1	+23.1	42.4	57.9	+36.6
12. Interest on working capital	18.9	31.7	+67.7	13.1	20.5	+56.5
13. Rent paid for leased land	82.0	96.8	+18.0	160.9	151.5	- 5.8
14. Interest on fixed capital	66.7	112.6	+68.8	57.4	104.5	+82.1
15. Rental value of owned land	581.6	589.7	+ 1.4	478.3	560.5	+17.2
Total	2400.4	2733.0	+13.9	2144.7	2416.3	+12.7

no evidence here that these slight changes in the seed rate were induced by the increase in seed prices or any other factor. In fact, such variations in the seed rate are likely to be mainly due to random fluctuations.

The bulk of labour input in rice, IR-8 as well as Bansmati, in Karnal is hired (about 93 per cent). The total labour input for Bansmati rice was almost the same in 1974-75 as in the previous year, and for IR-8 rice marginally less (2.9 per cent). There was no significant change in the wage earnings of labour (cost of labour per unit to the farmer) as money wages increased only slightly and the effect of a lower yield and a higher price of the product on payments in kind tended to offset each other.

Turning now to yield-raising or yield-dependent inputs, the pattern of change is similar in character to what was found in the case of wheat. Contrary to the sharp increase in the price of organic manures noticed in the case of wheat in Muzaffarnagar there was a decrease in it, though very slight, in Karnal. The quantity of organic manures used for IR-8 rice rose marginally and for Bansmati declined similarly. There is no evidence that these shifts were any more than random. Inter-culture operations were carried out as usual and a negligible quantity of chemicals for plant protection was used in both years.

In response to the rise in fertilizer prices the farmers in Karnal reduced the input of NPK nutrients by 12.0 per cent for the cultivation of IR-8 rice and 8.8 per cent for Bansmati rice. This reduction separately for N, P_2O_5 and K_2O is shown in Table 16. The composite cost of the average combination of NPK input in nutrients for all farmers for IR-8 rice increased by 74.8 per cent, from Rs.2.46 per kg. to Rs.4.30 per kg. and by 82.5 per cent, from Rs.2.40 per kg. to Rs.4.38 per kg. for Bansmati rice. The larger increase for Bansmati rice was due to the greater reliance on urea (for which the price was higher as a source of N).

The recommended dose of fertilizer for irrigated IR-8 rice in Karnal is 120 to 150 kgs. of N per hectare with a 2 : 1 : 1 ratio for N, P_2O_5 and K_2O*. Farmers in Karnal thus used a relatively high dose of N for IR-8 rice, but a much lower dose of P_2O_5 and K_2O, with an NPK ratio of 19 : 1.4 : 1. The reduction in yield as a result of a 15 per cent reduction in the input of N from 130 kgs. per hectare, other things remaining the same, would be relatively small. However, Karnal farmers decided to increase the input of P_2O_5 despite the rise in price, presumably to improve the NP ratio from 8 : 1 in 1973-74 to 6 : 1 in 1974-75. As Table 16 will show, this was not done equally by all farmers; but those who did it viz., the large farmers, benefited from it. Their yields in 1974-75 increased, though marginally, while the yields of all others declined. Further, it is almost certain that the large farmers would have achieved a more handsome increase in their yields had the weather been as good as it was in the previous year.

It is interesting to note here that the same farmer's response to the same increase in the price of P_2O_5 was quite different for rice and wheat and suggests that, in the farmer's experience the two crops respond differently to N and P_2O_5. If the farmer's experience is valid,

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*The normal recommendation for IR-8 rice is 120 kgs. of N per hectare, but since Karnal soils tend to be alkaline a slightly high dose (upto 150 kgs. per hectare) is advised.

it is in conflict with the common 2 : 1 : 1 recommended ratio of NPK for both wheat and rice.

In the case of Bansmati rice also, the farmer responded similarly by reducing the input of N and increasing the input of P_2O_5. He did not use any K_2O in either year. The percentage reduction in N and the percentage increase in P_2O_5 was less for Bansmati than for IR-8. The former was probably due to the much lower input even in 1973-74 and, therefore, the greater expected loss in output per unit of reduction.

Table 16

Average Fertilizer (Nutrient) Consumption per Hectare of Paddy, IR-8 and Bansmati, by Size of Farm Among Sample Farms in Karnal, 1973-74 and 1974-75

(In kgs.)

Size of farm	Paddy - IR-8				Paddy - Bansmati			
	N	P_2O_5	K_2O	Total	N	P_2O_5	K_2P	Total
				1973-74				
Small	114.0	22.6	4.1	140.7	55.6	11.4	-	67.0
Medium	134.1	15.0	5.5	154.6	52.0	7.1	-	59.1
Large	136.8	12.3	12.3	161.4	44.8	-	-	44.8
All farms	130.1	16.1	6.9	153.1	49.0	4.2	-	53.2
				1974-75				
Small	93.5	19.5	3.0	116.0	48.2	9.8	-	58.0
	(-18.0)	(-13.7)	(-26.8)	(-16.6)	(-13.3)	(-14.0)	-	(-13.4)
Medium	11.8	13.2	4.1	129.1	22.7	8.5	-	31.2
	(-16.6)	(-12.0)	(-25.5)	(-16.5)	(-56.3)	(+19.7)	-	(-47.2)
Large	126.9	28.6	10.1	165.6	56.8	-	-	56.8
	(- 7.2)	(+32.5)	(-17.9)	(+ 2.6)	(+26.8)	-	-	(+26.8)
All farms	110.9	18.5	5.3	134.7	43.8	4.7	-	48.5
	(-14.8)	(+14.9)	(-76.8)	(+12.0)	(-10.6)	(+11.9)	-	(- 8.8)

Note: Figures in brackets are percentage change in the average fertilizer consumption per hectare in 1974-75 over 1973-74.

Change in the per hectare yield of paddy between 1973-74 and 1974-75

The yield of IR-8 paddy* declined from 41.77 quintals per hectare in 1973-74 to 35.07 quintals in 1974-75 (16.1 per cent) and of Bansmati paddy from 27.49 quintals per hectare to 23.86 quintals (13.2 per cent). This decline was the compounded effect of a reduction in fertilizer input, comparatively less favourable weather conditions (mainly inadequate rains) and rationing of electricity for irrigation. This was a year when rainfall in Karnal was below normal and its distribution not in accordance with requirements. Meanwhile, irrigation (for which the farmers use electric tubewells) to the extent needed was not feasible because of cuts imposed on electricity consumption due to a general shortage of electricity supply. Farmers interrogated were very voluble about their dissatisfaction with

*Rice is taken as 62.5 per cent of the weight of paddy. This proportion can vary slightly depending on the variety of rice and whether paddy is dry or wet when milled.

the electricity supply because it had prevented them from coping adequately with the deficiency of rain.

As will be noticed, the percentage reduction in the NPK combination of nutrients in 1974-75 for rice cultivation was half of what it was for wheat in Karnal, yet the per hectare output of wheat increased, while the per hectare output of both IR-8 and Bansmati rice fell (Table 17). Quite obviously the weather more than offset the negative effect of a lower fertilizer input on the yield rate of wheat while it accentuated it in the case of rice. It is, of course, impossible to unscramble the two effects on the yield rate of rice, or even to say with certainty that, had the weather and/or electricity availability been normal the yield rate would have declined. However, it is likely that there would have been some decline, although less than what actually occurred, had the weather been the same in both years. Here again one cannot say with certainty whether the farmer would have used the same amount of fertilizers in 1974-75 as he did, were the weather better than it was.

Table 17

Average Yield of IR-8 and Bansmati Varieties of Paddy per Hectare, and Percentage Change in 1974-75 over 1973-74 by Size of Farm in Sample Farms in Karnal

Size of farm	Paddy - IR-8			Paddy - Bansmati		
	1973-74 (kgs.)	1974-75 (kgs.)	Percentage change	1973-74 (kgs.)	1974-75 (kgs.)	Percentage change
Small	4383	3585	- 18.2	3654	2955	- 19.1
Medium	4490	3505	- 21.9	2569	2123	- 17.4
Large	3365	3431	+ 2.0	2605	2340	- 10.2
All farms	4177	3507	+ 16.0	2749	2386	- 13.2

It is well established that the Indian farmer, given his state of knowledge, is rational in his production decisions. We have seen that the principal change in his input structure, whether for wheat or rice, in response to the change in the relative prices of inputs in 1974-75 was to reduce the input of fertilizers whose prices had increased the most. He made no significant shift in land allocation to the different crops he grows and hence in his product-mix. In the case of both wheat and rice he was expecting a rise in prices, which in fact occurred in the case of rice, but did not occur in the case of wheat. In both years he bore the risk of weather uncertainties, while taking his input decisions. For rice the weather proved worse than what he might have expected and for wheat better. For his future calculations, he will ignore the loss he might attribute to bad weather in the case of rice and the gain to good weather in the case of wheat. Even when he does this he is likely to come to the conclusion that the sharp increase in the price of fertilizers and of hiring charges of tractors (only partly caused by the increase in the price of diesel oil), had led to a decrease in his income from wheat and/or rice cultivation.

Change in the cost structure and net return

As a result of the farmers' response to relative changes in input prices and the expected level of output prices, the cost structure for rice as well as wheat changed in both districts (Tables 18-21). We have seen that the major price-induced quantitative reduction in input use for both wheat and rice was in fertilizers, followed by a moderate one in machine use in the case of wheat. The change in the cost structure was influenced by this fact, and also by the unequal rates by which the price of different inputs had risen and the variations in the base input mix.

Table 18

Percentage Distribution of Cost A_2 for Wheat by Factor Inputs and Size of Farm in Sample Farms in Karnal, 1973-74 and 1974-75

(In per cent)

Inputs	Small		Medium		Large		All farms	
	1973-74	1974-75	1973-74	1974-75	1973-74	1974-75	1973-74	1974-75
1. Seeds	8.8	9.4	8.8	9.0	8.6	10.7	8.7	9.7
2. Fertilizers	17.8	19.7	19.6	25.0	20.5	23.5	19.5	23.2
3. Irrigation	4.3	4.1	3.7	3.6	3.3	3.1	3.7	3.6
4. Machine cost	22.0	21.3	15.4	14.0	15.3	14.2	16.7	15.7
5. Hired human labour	20.1	19.2	21.8	19.3	21.7	19.2	21.4	19.2
6. Animal labour	17.1	14.7	15.4	12.3	13.8	14.0	15.2	13.4
7. Land revenue	0.3	0.2	0.2	0.2	0.1	0.1	0.2	0.2
8. Depreciation	4.7	4.5	4.2	4.7	2.5	2.1	3.6	3.7
9. Repairs	2.3	2.5	2.8	4.0	3.1	2.1	2.8	3.0
10. Interest on working capital	0.9	1.7	1.0	1.7	1.0	1.0	1.0	1.4
11. Rent for leased in land	1.7	2.7	7.1	6.2	10.1	10.0	7.2	6.9
Total (Cost A_2)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 19

Percentage Distribution of Cost A_2 for Wheat by Factor Inputs and Size of Farms in Sample Farms in Muzaffarnagar, 1973-74 and 1974-75

(In per cent)

	Inputs	Small		Medium		Large		All farms	
		1973-74	1974-75	1973-74	1974-75	1973-74	1974-75	1973-74	1974-75
1.	Seeds	12.1	13.4	11.3	12.7	10.9	11.4	11.5	12.7
2.	Manures	5.6	6.3	5.2	8.1	6.2	8.3	5.6	7.4
3.	Fertilizers	22.1	23.0	22.0	20.7	21.7	17.7	22.0	21.0
4.	Irrigation	8.4	5.8	8.5	6.5	8.5	8.1	8.5	6.5
5.	Machine cost	10.4	13.3	12.0	11.8	5.7	9.3	9.7	12.0
6.	Hired human labour	9.6	10.3	11.2	11.9	16.4	19.8	11.9	13.0
7.	Animal labour	24.6	21.5	20.5	19.9	19.4	16.0	22.0	19.7
8.	Land revenue	0.4	0.4	0.4	0.4	0.5	0.4	0.5	0.4
9.	Depreciation	4.1	3.3	5.5	4.5	6.3	5.3	5.1	4.1
10.	Repairs	0.9	0.7	2.4	2.2	3.5	2.6	2.0	1.6
11.	Interest on working capital	1.0	1.4	1.0	1.3	0.9	1.1	0.9	1.3
12.	Rent for leased in land	0.8	0.6	-	-	-	-	0.3	0.3
	Total (Cost A_2)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 20

Percentage Distribution of Cost A_2 per Hectare of IR-8 Paddy by Inputs and Size of Farm in Sample Farms in Karnal, 1973-74 and 1974-75

(In per cent)

	Inputs	1973-74	1974-75	1973-74	1974-75	1973-74	1974-75	1973-74	1974-75
1.	Seeds	3.1	2.8	2.5	2.3	1.5	1.2	2.3	2.1
2.	Manures	7.4	6.2	5.1	4.7	6.3	5.1	6.0	5.2
3.	Fertilizers	19.9	27.0	23.3	29.3	21.6	31.4	22.1	29.2
4.	Pesticides	-	0.1	-	0.1	-	-	-	0.1
5.	Irrigation cost	8.7	8.6	7.5	7.3	5.9	5.5	7.3	7.1
6.	Tractor cost	5.3	5.8	5.1	5.2	5.1	5.0	5.1	5.3
7.	Thresher cost	-	-	-	-	-	-	-	-
8.	Hired human labour	33.6	28.3	34.3	29.2	33.6	28.8	34.0	28.8
9.	Bullock cost	12.9	11.0	10.5	7.7	10.7	9.4	11.1	9.0
10.	Land revenue	0.2	0.2	0.2	0.2	0.1	0.1	0.2	0.2
11.	Depreciation	3.9	3.6	3.4	4.3	2.3	1.9	3.2	3.5
12.	Repairs	2.1	2.1	2.7	3.9	3.4	1.9	2.8	2.9
13.	Interest on working capital	1.2	1.7	1.1	1.6	1.0	1.5	1.1	1.6
14.	Rent for leased in land	1.7	2.6	4.3	4.2	8.5	8.2	4.8	5.0
	Total(Cost A_2)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 21

Percentage Distribution of Cost A_2 per Hectare of Bansmati Paddy by Inputs and Size of Farm in Karnal, 1973-74 and 1974-75

(In per cent)

Inputs	Small		Medium		Large		All farms	
	1973-74	1974-75	1973-74	1974-75	1973-74	1974-75	1973-74	1974-75
1. Seeds	5.4	4.9	2.7	2.7	3.0	2.7	3.3	3.1
2. Manures	7.9	6.5	5.7	7.1	8.3	6.2	7.4	6.5
3. Fertilizers	9.7	15.4	9.9	8.0	6.6	13.9	8.2	12.5
4. Pesticides	-	0.2	0.4	0.4	-	-	0.1	0.2
5. Irrigation cost	7.5	8.4	9.0	10.0	7.0	7.3	7.8	8.3
6. Tractor cost	4.8	5.8	7.0	6.7	6.2	7.6	6.2	7.0
7. Hired human labour	39.7	34.4	33.0	31.2	37.4	33.2	36.3	32.8
8. Bullock cost	15.5	13.9	12.5	9.0	13.8	13.5	13.7	12.2
9. Land revenue	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.2
10. Depreciation	5.9	5.8	3.2	5.2	2.1	2.0	3.0	3.7
11. Repairs	2.4	3.1	2.4	5.4	3.0	2.3	2.7	3.4
12. Interest on working capital	1.0	1.4	0.9	1.1	0.8	1.2	0.8	1.2
13. Rent for leased in land	-	-	13.1	13.0	11.7	9.9	10.3	8.9
Total(Cost A_2)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Given the expected level of output prices, the change in cost structure should normally be viewed as motivated by the farmer's objective to maximise his gain under the new price relationships. But since, the price of all inputs and fertilizers rose by an extraordinarily large amount, the weather-risk which normally increases with the cost of cultivation was magnified. In fact, the increase in cost for the same input-mix was so high that the attendent risk would have appeared inhibitive even when the price of output was expected to rise at a high rate. The dominant consideration in the farmer's mind would have, therefore, been to minimise his risk. That it was so can be seen from the evidence presented below.

In Tables 22-24 and 26a the return on both A_2 and C costs for 1973-74 and 1974-75 is compared for the selected farms in Karnal. A similar comparison for Muzaffarnagar with respect to A_2 cost is also made in Tables 26b and 26c, but no analysis is attempted because of the exceptional increase in the yield rate in 1974-75.

The net return on both A_2 and C costs per hectare for wheat as well as rice declined in 1974-75 over the previous year The decline was sharper for rice and was mainly due to fall in its yield rate (16 per cent) though to some extent (8 per cent) it was made good by a rise in price. In contrast, the yield rate of wheat increased (6.7 per cent) and at the time of survey no change in the price of wheat was assumed for 1974-75.

Table 22

Average Surplus per Hectare Over Cost A_1, A_2 and C of Wheat by Size of Farms in Sample Farms in Karnal, 1973-74 and 1974-75

(In rupees)

Size of farms	Average surplus per hectare over cost			
	A_1	A_2	B	C
		1973-74		
Small	2104	2079	1284	1171
	(147.8)	(143.5)	(57.2)	(49.7)
Medium	1707	1600	998	938
	(122.9)	(106.9)	(47.6)	(43.5)
Large	1860	1692	1193	1178
	(124.0)	(101.4)	(55.0)	(54.0)
All farms	1840	1729	1122	1067
	(128.3)	(111.9)	(52.1)	(48.3)
		1974-75		
Small	1890	1845	1000	894
	(116.6)	(110.7)	(39.8)	(34.2)
Medium	1818	1709	1028	976
	(111.3)	(98.1)	(42.4)	(39.4)
Large	1654	1444	937	926
	(87.8)	(69.0)	(36.0)	(35.4)
All farms	1783	1657	993	941
	(104.2)	(90.2)	(39.7)	(36.9)

Table 23

Average Surplus per Hectare Over Cost A_1, A_2, B and C of IR-8 Paddy by Size of Farm in Sample Farms in Karnal, 1973-74 and 1974-75

(In rupees)

Size of farms	Average surplus per hectare over cost			
	A_1	A_2	B	C
		1973-74		
Small	1675	1646	887	783
	(101.1)	(97.6)	(36.3)	(30.7)
Medium	1819	1746	1102	1066
	(112.9)	(103.7)	(47.3)	(45.1)
Large	997	847	292	276
	(61.6)	(47.9)	(12.6)	(11.8)
All farms	1572	1490	841	795
	(96.8)	(87.4)	(35.7)	(33.1)
		1974-75		
Small	1219	1168	372	266
	(64.7)	(60.3)	(13.6)	(9.4)
Medium	1193	1113	400	361
	(65.5)	(58.6)	(15.3)	(13.6)
Large	990	810	228	211
	(49.1)	(36.9)	(8.2)	(7.5)
All farms	1150	1054	351	301
	(61.0)	(53.2)	(13.1)	(11.0)

Note: Figures in brackets are the average surplus per hectare expressed as a percentage of the corresponding cost.

Table 24

Average Surplus per Hectare Over Cost A_1, A_2, B and C of Bansmati Paddy by Size of Farms, in Sample Farms in Karnal, 1973-74 and 1974-75

(In rupees)

Size of farms	Average surplus per hectare over cost			
	A_1	A_2	B	C
		1973-74		
Small	2205	2205	1235	1127
	(134.7)	(134.7)	(47.3)	(41.5)
Medium	1438	1248	769	707
	(114.7)	(86.4)	(40.0)	(35.6)
Large	1481	1092	648	627
	(120.1)	(67.3)	(31.3)	(30.0)
All farms	1476	1315	779	730
	(105.5)	(84.3)	(37.2)	(34.0)
		1974-75		
Small	1743	1743	533	409
	(89.0)	(89.0)	(16.8)	(12.4)
Medium	1038	841	262	207
	(79.1)	(55.7)	(12.5)	(9.6)
Large	983	803	243	224
	(59.8)	(56.2)	(12.4)	(10.1)

Note: Figures in brackets are the average surplus per hectare expressed as a percentage of the corresponding cost.

Since the 1973-74 price of wheat was used to calculate the value of output for 1974-75 also, the percentage increase in the per hectare value of wheat output should have been the same as the percentage increase in its yield rate. A glance at Table 25 will show that, in fact, it is not so, and that, the variation widens when farms of different sizes are considered. This happens because of the method used for valuing the output. For 1973-74 all quantities sold were valued at the price actually secured, and this varied from farmer to farmer, as each of them sold varying amounts at different times and not necessarily in the same wholesale market (mandi). The amount retained for consumption was valued at the average price secured by all farmers and, therefore, was the same for all farmers. Thus the average price at which the farmer's total output was valued varied from the average price at which the entire output of all farmers was valued. It was the latter which was used for valuing the total output of each farmer in 1974-75. There are thus two reasons why the increase in the value of output in 1974-75 could be different from the increase in the yield rate: (i) differences in the average price secured by individual farmers for the amounts sold and (ii) varying proportions of the total output marketed.

In large farms (Table 25) the increase in yield in 1974-75 was higher than that of the value of output. In small and medium farms it was the other way around. Large farms secured higher prices for the amounts sold, a fact that reflects their superior capacity to hold stock and take

advantage of a rise in price later in the year. During 1973-74 inflation in India was at its peak and farmers who had any capacity to hold stocks did so and gained by it. Their relative inability to hold stock at will puts the smaller farmers at a disadvantage vis-a-vis large farmers. As wheat prices normally tend to rise during winter and spring, large farmers usually get a better price for their marketed surplus than other farmers.

Table 25

Average Yield and Gross Value of Output per Hectare of Wheat by Size of Farm in Sample Farms in Karnal, 1973-74 and 1974-75

Size of farm	Yield per hectare (kgs.)	Value of output per hectare		
		Grain	Straw	Total
		1973-74		
Small	2691	3117	411	3528
Medium	2352	2743	353	3096
Large	2503	2970	390	3360
All farms	2473	2896	378	3274
		1974-75		
Small	2660	3112	399	3511
	(-1.2)	(-0.2)	(-2,9)	(-0,5)
Medium	2613	3057	394	3451
	(11.1)	(11.4)	(11.6)	(11.5)
Large	2681	3136	402	3538
	(7.1)	(5.6)	(3.1)	(5.3)
All farms	2646	3096	398	3494
	(7.0)	(6.9)	(5.3)	(6.7)

Note: Figures in brackets are the percentage changes in average values per hectare in 1974-75 over 1973-74.

The net return per hectare for wheat declined by over 4 per cent in 1974-75 (Table 26). The decline was substantially higher for small (11.3 per cent) and large farms (14.7 per cent). Medium farms were the exception, as in their case the net return instead of declining increased (6.8 per cent). This favourable result was achieved mainly because their response to the increase in fertilizer prices was the least elastic. Against a decrease of 31 per cent in fertilizer inputs among small and large farms, the decline in medium farms was only 17 per cent. Consequently the yield rate in medium farms rose and nearly equalled the level in small and large farms, when in the previous year it was significantly lower. Of course, had the weather been the same, it is more than likely that the net return even in medium farms would have declined, though to a lesser extent that in small or large farms. However, the point to be emphasised is that all farmers did not respond in the same manner to the increase in fertilizer prices; some perceived the risk attached to additional input cost to be lower than others or were willing to take greater risk and,in the event, were proved right by receiving a better net return.

TABLE 26

Gross Value of Output, Cost A_2, and Surplus over Cost A_2 per Hectare, Average Area and Total Surplus per Farm, for Wheat in Sample Farms in Karnal, 1973-74 and 1974-75

Size of farms	Per hectare of wheat			Area (hectare)	Total surplus (Rs.)
	Value of output (Rs.)	Cost A_2 (Rs.)	Surplus (Rs.)		
		1973-74			
Small	3528	1449	2079	1.81	3763
Medium	3096	1496	1600	4.01	6416
Large	3360	1668	1692	7.49	12673
All farms	3274	1545	1729	3.67	6345
		1974-75			
Small	3511	1666	1845	1.78	3284
	(-0.5)	(+15.0)	(-11.3)	(-1.7)	(-12.7)
Medium	3451	1742	1709	3.56	6084
	(+14.7)	(+16.4)	(+ 6.8)	(-11.2)	(- 5.2)
Large	3538	2094	1444	6.58	9502
	(+ 5.3)	(+25.6)	(-14.7)	(-12.2)	(-25.0)
All farms	(6.7)	(+18.9)	(- 4.2)	(-11.2)	(-14.9)

Table 26a

Surplus Over Cost A_2 for Wheat, Paddy and Other Crops per Farm by Size of Farm in Sample Farms in Karnal, 1973-74 and 1974-75

(In rupees)

Size of farms	Surplus over cost A_2 per farm				
	Wheat	Paddy IR-8	Paddy Bansmati	Other crops	Total
			1973-74		
Small	3763	2568	882	3211	10424
Medium	6416	5936	1211	9027	22590
Large	12673	3600	3647	17292	37212
All farms	6345	4127	1486	7989	19947
			1974-75		
Small	3284	1845	732	2845	8706
	(12.7)	(28.2)	(17.0)	(11.4)	(16.5)
Medium	6084	3918	681	7264	17947
	(5.2)	(34.0)	(43.8)	(19.5)	(20.6)
Large	9502	3402	2313	12180	27397
	(25.0)	(5.5)	(36.6)	(29.6)	(26.4)
All farms	(14.9)	(29.0)	(37.5)	(23.3)	(22.9)

Note: Figures in brackets are the percentage decline in total surplus per farm in 1974-75 over 1973-74.

Table 26b

Gross Value of Output, Cost A_2 and Surplus Over Cost A_2 per Hectare, Average Area and Total Surplus per Farm for Wheat in Sample Farms in Muzaffarnagar 1973-74 and 1974-75

Size of farms	Per hectare of wheat			Area (hectare)	Total surplus
	Value of output (Rs.)	Cost A_2 (Rs.)	Surplus (Rs.)		(Rs.)
		1973-74			
Small	2721	1839	882	1.07	944
Medium	2864	2051	813	1.60	1301
Large	2277	1930	347	2.29	795
All farms	2643	1922	721	1.39	1002
		1974-75			
Small	4111 (+15.1)	2253 (+22.5)	1858 (+110.7)	1.16 (+ 8.41)	2155 (+128.3)
Medium	4249 (+48.4)	2404 (+17.2)	1845 (+126.9)	1.92 (+20. 0)	3542 (+172.3)
Large	4388 (+92.7)	2339 (+21.2)	2049 (+490.5)	2.12 (- 7. 4)	4344 (+444.4)
All farms	4216 (+59.5)	2319 (+20.7)	1897 (+163.1)	1.49 (+ 7. 2)	2827 (+182.1)

Table 26c

Surplus Over Cost A_2 for Wheat and Other Crops per Farm by Size of Farm in Sample Farms in Muzaffarnagar, 1973-74 and 1974-75

(In rupees)

Size of farms	Surplus of cost A_2 per farm		
	Wheat	Other	Total
	1973-74		
Small	944	6336	7280
Medium	11201	18380	19681
Large	795	20798	21593
All farms	1002	11530	12532
	1974-75		
Small	2155 (128.3)	5676 (-10.4)	7831 (7.6)
Medium	3542 (172.3)	15221 (-17.2)	18763 (-4.3)
Large	4344 (446.4)	16036 (-22.9)	20380 (-5.6)
All farms	2827 (182.1)	9644 (16.4)	12471 (-0.5)

Note: Figures in brackets are percentage changes in average surplus per farm in 1974-75 over 1973-74

It is tempting to speculate that, had all farms used the same quantity of fertilizers in both years, yields would have been much higher, thanks to the weather, and like medium farms all farms would have improved their net return. Such a conclusion would, of course, be an over simplification, for a glance at Table 11 will readily show that although different categories of farms used different quantities of fertilizers per hectare in 1974-75, their yields were roughly the same. Again it would not be correct to conclude that the marginal product of fertilizers in the case of medium and large farms was near zero since, with higher inputs than small farms, they got the same yield, because it is possible that the mix of inputs used by small farms was superior, either because of a more efficient combination of material inputs or of material and human inputs. The latter seems likely. Small farmers usually give more personal attention to their farm operations, depend less on hired labour, and, partly as a result of this, use better cultural practices or the same cultural practices more efficiently. Thus while it is more than likely that the net return for all farms would have increased in 1974-75 had they used the same quantity of fertilizers as they did the previous year, it would be hazardous to quantify this speculation.

The net return for the wheat crop declined more than the net return per hectare because there was some decrease in the area under wheat in each category of farm. It was for this reason that an increase in the per hectare net return for wheat in medium farms turned into a decrease for the wheat crop. Prima facie, it might appear that the rise in per hectare cost of cultivation and the corresponding increase in risk led the farmer to sow less land with wheat. In fact, as we have stated earlier, enquiries revealed that the decline in area was mainly due to the normal annual shifts in land lease arrangements and was independent of the increase in cost.

For a majority of farm households the level of income is so low that any fall in it means a large loss in welfare. The farmer responds to this situation by making a delicate calculation which aims at protecting his family's welfare without unduly increasing the extent of loss in case the weather becomes unfavourable. Increase in productivity occurs cautiously along this narrow ridge, with the farmer always working out his trade-off between possible increments in welfare and the danger of having it rudely slashed. In this calculus he is concerned with maximising household welfare under conditions where risk is exaggerated on account of the low welfare base of the farm household. In the minds of the farmers, both in Karnal and Muzaffarnagar, it appears that the increased risk incumbent on the larger cost for the same input mix dominated and the farmer tried to minimise this with the least sacrifice of welfare. All of this, it must be repeated, the farmer did on the assumption of average weather conditions. If his net return turned out to be better because of good weather, he must have viewed it as a bonus and would not allow it to enter into his calculations next year when he is taking his input decisions.

Srinivasan /3/ has argued that the observed lower productivity of land in large compared with small farms can be attributed to the bigger commitment of input costs (in absolute terms) in large farms, which leads them to use an inferior input mix to reduce risk. While we would not contest the generality of this observation, we must point out that, for our sample of farmers, it was certainly not true. So far as material inputs are concerned large farmers

used a more costly input mix per hectare (though not necessarily superior) in 1973-74 and their cost per hectare increased more compared to others, in 1974-75 after the rise in fertilizer and other prices. This would tend to show that their perception of risk carried a lower profile than either the medium or the small farmers. This is quite plausible since smaller farmers are likely to lose more in terms of welfare, were the weather to fail, than larger farmers. Thus for the same proportionate fall in income due to bad weather, a larger farmer would be prepared to take a greater risk than a small farmer. To this we must add the fact that large farmers normally secure, as pointed out earlier, a better price for their product and hence, to start with, bear a lesser risk than small farmers because they are assured of a better return on the same cost of inputs.

We can conclude that for an increase in input cost, which threatens to lower the net return with average weather expectations the small farmer is likely to impose a bigger cut on his inputs than a large farmer. If the weather is good and the harvest better than average, prices will tend towards stability during the course of the year and the large farmer's ability to stock and sell later will give him only a marginal advantage. On the other hand, if the weather turns out to be adverse and a poor crop causes shortages leading to a sharp rise in price later in the year, small farmers would suffer relatively more. Since our year of enquiry (1974-75) was a good one it tended to narrow the fall in the net return of small and large farms. Estimates of net return for 1974-75 in Table 22 are based on a single price of wheat for all farms, which to be true in reality would mean that there is very little change in the price of wheat throughout the year. A normal rise would benefit the large more than the small farmers. It is quite likely that it was such an expectation that induced the large farmers to raise their cost per hectare by 25 per cent against a much lower increase that the smaller farmers permitted themselves.

Farmers' response to the increase in fertilizer and other prices in the case of paddy was similar to wheat. However, since the weather turned out to be worse than average instead of better, the net return per hectare declined more sharply, though income from paddy declined somewhat less as there was an increase in the area (except in large farms) under paddy (Tables 27 and 28).

As between small, medium and large farms again one finds a similar response in paddy to that in wheat. Large farmers took a greater risk than small or medium farmers and, despite unfavourable weather, it paid off. The decline in their net return was much less than for small or medium farmers, mainly for two reasons: (i) while small and medium farms suffered a substantial decline in their yield (Tables 29 and 30) large farms achieved a marginal increase; and (ii) large farms secured a better price for their crop. In 1973-74 the yield on large farms was substantially lower than that for small or medium farms. In 1974-75, though still lower, it was of the same order of magnitude. Since all farms faced the same weather conditions this transformation must be attributed to the improved input mix of the large farms. Referring back to Table 16 one can notice the specific character of this change in respect of fertilizers. Firstly, as against a decrease of 16 to 18 per cent in fertilizer inputs (quantities) in small and medium farms, there was an increase of 2.5 per cent in large farms. (Similar deviant behaviour was noticed on the part of medium farmers in the case of wheat). Secondly, while small and

Table 27

Gross Value of Output, Cost A_2 and Surplus over Cost A_2 per Hectare, Average Area and Total Surplus per Farm for IR-8 Paddy in Sample Farms in Karnal, 1973-74 and 1974-75

Size of farms	Per Hectare of paddy - IR-8			Area	Total surplus
	Value of output (Rs.)	Cost A_2 (Rs.)	Surplus (Rs.)	(hectare)	(Rs.)
		1973-74			
Small	3332	1686	1646	1.56	2568
Medium	3430	1684	1746	3.40	5936
Large	2614	1767	847	4.25	3600
All farms	3195	1705	1490	2.77	4127
		1974-75			
Small	3103	1935	1168	1.58	1845
	(-6.9)	(+14.8)	(-29.0)	(+1. 3)	(-28.2)
Medium	3013	1900	1113	3.52	3918
	(-12.2)	(+12.8)	(-36.3)	(+3. 5)	(-34.0)
Large	3006	2196	810	4.20	3402
	(+15.0)	(+24.3)	(- 4.4)	(-1. 2)	(- 5.5)
All farms	3034	1980	1054	2.78	2930
	(- 5.0)	(+16.1)	(-29.3)	(+0. 4)	(-29.0)

Table 28

Gross Value of Output,Cost A_2 and Surplus over Cost A_2 per Hectare,Average Area and Total Surplus per Farm for Bansmati Paddy in Sample Farms in Karnal, 1973-74 and 1974-75

Size of farms	Per Hectare of Paddy - Bansmati			Area	Total surplus
	Value of output (Rs.)	Cost A_2 (Rs.)	Surplus (Rs.)	(hectare)	(Rs.)
		1973-74			
Small	3843	1638	2205	0.40	882
Medium	2693	1445	1248	0.97	1211
Large	2714	1622	1092	3.34	3647
All farms	2875	1560	1315	1.13	1486
		1974-75			
Small	3701	1958	1743	0.42	732
	(- 3.7)	(+19.6)	(-21.0)	(+5. 0)	(-17.0)
Medium	2351	1510	841	0.81	681
	(-12.7)	(+ 4.5)	(-32.6)	(-16. 5)	(-43.8)
Large	2627	1824	803	2.88	2313
	(- 3.2)	(+12.5)	(-26.5)	(-13. 8)	(-36.6)
All farms	2661	1703	958	0.97	929
	(- 7.5)	(+ 9.1)	(-27.1)	(-14. 2)	(+37.5)

Note: Figures in brackets are percentage changes in 1974-75 over 1973-74.

Table 29

Average Yield and Gross Value of Output per Hectare of IR-8 Paddy by Size of Farm Among Sample Farms in Karnal, 1973-74 and 1974-75

Size of farms	Yield per hectare (kgs.)	Value of output per hectare		
		Grain (Rs.)	Straw (Rs.)	Total (Rs.)
		1973-74		
Small	4383	3277	55	3332
Medium	4490	3374	56	3430
Large	3365	2558	42	2614
All farms	4177	3143	52	3195
		1974-75		
Small	3586 (-18.2)	3058 (- 6.7)	45 (-18.2)	3103 (-6.9)
Medium	3505 (-21.9)	2969 (-12.0)	44 (-21.4)	3013 (-12.2)
Large	3431 (+ 2.0)	2964 (+15.9)	42 (0.00)	3006 (+15.0)
All farms	3507 (-16.0)	2990 (- 4.9)	44 (-15.4)	3034 (- 5.0)

Table 30

Average Yield and Gross Value of Output per Hectare of Bansmati Paddy by Size of Farm Among Sample Farms in Karnal, 1973-74 and 1974-75

Size of farms	Yield per hectare (kgs.)	Value of output per hectare		
		Grain (Rs.)	Straw (Rs.)	Total (Rs.)
		1973-74		
Small	3654	3752	91	3843
Medium	2569	2629	64	2693
Large	2605	2649	65	2714
All farms	2749	2806	69	2875
		1974-75		
Small	2955 (-19.1)	3618 (- 3.6)	83 (- 8.8)	3701 (- 3.7)
Medium	2123 (-17.4)	2298 (-12.6)	53 (-17.2)	2351 (-12.7)
Large	2340 (-10.2)	2568 (- 3.1)	59 (- 9.2)	2627 (- 3.2)
All farms	2386 (-13.2)	2601 (- 7.3)	60 (-13.0)	2661 (- 7.4)

Note: Figures in brackets are percentage changes in average values per hectare in 1974-75 over 1973-74.

medium farmers reduced the input of N, P_2O_5 and K_2O, large farmers reduced the input of N and K_2O (though by a much smaller amount) but more than doubled the input of P_2O_5. It will also be seen from Tables 31 and 32 that, while the cost of hired labour and bullock labour for small and medium farms declined in 1974-75, it increased for large farms, indicating, perhaps, a more intensive effort on their part. The deviant behaviour of large paddy farmers is very significant, especially in the context of a general tendency in the wake of the rise in fertilizer prices to sacrifice P_2O_5 in favour of N. It is of considerable research interest to find out why the response of the same farmers to the same rise in the price of P_2O_5 was so different for paddy and wheat.

It is a moot point whether a similar shift in the NPK mix in small and medium farms would have retrieved most of their loss. It is possible that it might have, to a considerable degree, though the effect of bad weather would still have given them a lower yield. Further, it should be noted that small and medium farms, despite their seemingly inferior mix of NPK, did obtain better yields than large farms, drawing attention again to the overall superiority of the input mix in smaller farms. Given this, one would be right in concluding that had the risk of a higher cost for the same input mix been externally set off (for instance, by better credit facilities) the loss in paddy cultivation for small and medium farmers in 1974-75 would have been lower and the output of paddy higher.

The decline in the net return per hectare observed for wheat and paddy was true for most other crops grown. For all crops grown by all selected farmers in Karnal, the net return declined by 23 per cent, which is quite considerable. The decline was greatest for paddy (particularly Bansmati) and the least for wheat (Table 26a). In Muzaffarnagar too, where the net return for wheat increased substantially, the net return for all crops declined, though marginally (Table 26c).

Table 31

Average Cost of Cultivation per Hectare in IR-8 Paddy by Size of Farm, Among Sample Farms in Karnal, 1973-74 and 1974-75

(In rupees)

Items	1973-74				1974-75			
	Small	Medium	Large	All farms	Small	Medium	Large	All farms
1. Human labour								
(a) Family	103.9	35.7	16.2	46.7	105.9	38.8	17.0	50.4
(b) Hired	566.7	577.2	593.1	578.7	548.0	553.2	633.2	571.3
2. Bullock labour	217.1	176.5	188.6	189.2	214.2	146.9	205.9	178.1
3. Seeds	51.7	41.6	27.1	40.3	53.5	43.6	27.1	42.1
4. Manures	124.7	85.6	110.6	101.1	120.7	90.3	112.0	103.2
5. Fertilizers	336.4	392.5	381.5	376.6	520.1	555.1	688.5	578.7
6. Pesticides	-	-	-	-	1.7	2.6	-	1.7
7. Irrigation cost	147.2	125.9	104.1	125.3	166.5	138.0	121.2	141.1
8. Tractor cost	89.8	85.8	90.4	87.9	112.1	99.3	109.0	104.8
9. Thresher cost	-	-	-	-	-	-	-	-
10. Land revenue	3.7	3.7	2.7	3.5	3.5	3.8	2.7	3.5
11. Depreciation	63.8	57.8	40.4	54.7	70.4	82.0	40.9	69.2
12. Repairs	35.2	45.7	61.0	47.2	40.4	74.8	41.7	58.1
13. Interest on working capital	20.4	18.9	17.6	18.9	32.8	30.3	33.8	31.7
14. Rent for land leased in	28.9	72.5	149.7	82.0	51.2	79.8	179.7	96.8
15. Interest on fixed capital	79.6	70.6	47.2	66.7	119.2	131.3	66.5	112.6
16. Rental value of owned land	679.8	573.6	507.8	581.6	676.5	582.0	515.8	589.7
Total	2548.9	2363.6	2338.0	2400.4	2836.7	2651.8	2795.0	2733.0

Table 32

Average Cost of Cultivation per Hectare of Bansmati Paddy by Size of Farm Among Sample Farms in Karnal, 1973-74 and 1974-75

Items	1973-74				1974-75			
	Small	Medium	Large	All farms	Small	Medium	Large	All farms
1. Human labour								
(a) Family	107.4	62.7	20.6	48.7	123.5	55.0	19.1	48.4
(b) Hired	649.3	476.9	606.8	566.6	671.4	470.4	606.2	559.0
2. Bullock labour	254.0	180.9	224.2	213.1	271.7	135.4	246.4	208.4
3. Seeds	87.7	38.2	49.4	51.5	96.5	40.4	49.4	53.3
4. Manures	129.6	82.2	134.7	115.1	128.0	107.4	112.6	111.1
5. Fertilizers	158.8	143.2	107.1	127.8	302.0	121.3	254.4	212.6
6. Pesticides	-	5.1	-	1.8	4.8	5.6	-	2.7
7. Irrigation cost	122.7	129.9	113.7	120.9	165.0	150.5	132.7	141.3
8. Tractor cost	79.0	101.5	99.8	97.3	113.4	101.3	137.8	118.5
9. Land revenue	3.9	3.0	2.2	2.7	4.8	3.2	2.7	3.2
10. Depreciation	96.7	46.0	33.8	47.5	113.0	78.8	36.7	62.9
11. Repairs	39.5	35.3	48.5	42.4	60.3	82.2	42.6	57.9
12. Interest on working capital	16.3	12.7	12.4	13.1	27.5	16.3	22.3	20.5
13. Rent for leased in land	-	189.6	188.9	160.9	-	196.9	180.8	151.5
14. Interest on fixed capital capital	130.1	49.2	41.4	57.4	203.7	120.0	62.7	104.5
15. Rent value of owned land	840.5	430.0	403.5	478.3	1006.1	459.7	497.0	560.5
Total	2715.5	1986.4	2087.0	2144.7	3291.7	2144.4	2403.1	2416.3