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per hectare were about 1.7 times higher from the Mexican red wheats than the Indian amber wheats. The total revenue, total cost and net profit from the level of nitrogen application, as recommended by the agronomists were 2.5 times higher for the Mexican wheats than the Indian wheats.

The minimum and maximum levels of nitrogen recommended by the agronomists for the Mexican red wheats were, 120 and 150 kgs. per hectare respectively as against 50 and 60 kgs. in the case of Indian amber wheats. Net profits per hectare incident to nitrogen application from the Mexican wheats at the minimum nitrogen recommendations of the agronomists were not much different from the net profits obtained by applying the most profitable dose of nitrogen. For the Indian wheat varieties, the net profits per hectare incident to nitrogen application at the most profitable dose of nitrogen application were close to the net profits obtained by applying the maximum level of nitrogen recommended by the agronomists.

ECONOMICS OF HIGH-YIELDING VARIETIES IN PACKAGE DISTRICT, ALIGARH

G. S. LAVANIA

AND

R. S. DIXIT

Faculty of Agriculture
Banaras Hindu University, Varanasi-5

A number of schemes and programmes to increase agricultural production have been launched from time to time during the last two decades in different parts of the country. Their achievements have been either slow or meagre to merit any place of pride in our development programmes. The package programme once started in selected favourable districts did not achieve its objective of increasing food production by 50 per cent during the Third Plan period in many a district. This necessitated drastic changes in technology and thus marked the introduction of High-Yielding Varieties Programme from the *kharif* season of 1966-67.

Aligarh is a 'package district' in Uttar Pradesh where the Intensive Agricultural District Programme was launched in 1961-62. The High-Yielding Varieties Programme was introduced in the district from the *kharif* of 1966-67 and covered wheat, maize, bajra, paddy and jowar. It was started with the objective of introducing newly identified high-yielding strains responsive to high doses of fertilizers. The programme is aimed at attaining self-sufficiency in food by the end of 1970-71.

That the high-yielding strains give higher yields than the local varieties is too general a observation for any economic analysis. The success of a programme of this nature should consider the net gains of the farm family and not mere increases in the physical product. The present study, therefore, is intended to examine the economics of high-yielding strains and compare it with that of the local varieties in one of the blocks of Aligarh district where the package programme is in operation for over seven years.

Sampling

The Hathras block of Aligarh district was purposively selected for facilities of investigation.[1] From the list of villages in the Hathras block, one village was randomly selected and two nearest villages were taken to form a cluster. The study thus covered a cluster of three villages in the block. A list of farmers growing high-yielding varieties was obtained from block records and arranged in ascending order of area of operational holding. Farmers growing only high-yielding or local varieties were deleted from the list (such cases were less than 5 per cent of the total number of farms). The farms were then classified into three strata, *viz.*, (1) small farms with operational holding less than 2 hectares; (2) medium farms with operational holding of 2 to less than 4 hectares; and (3) large farms with operational holdings of 4 hectares and above. Thirty-three per cent farms from each size-group were selected randomly for field study. The number of selected farms under the small, medium and large size-groups was 17, 21 and 16 respectively.

As the area under paddy and jowar was negligible in the block, the study covered only three crops, *viz.*, wheat, maize and bajra.

Findings

The average size of farms and intensity of cropping for the sampled farms is given in Table I.

TABLE I—NUMBER, AVERAGE SIZE OF FARMS AND INTENSITY OF CROPPING

(hectares)

Size of farms (hectares)	No. of farms	Total cultivated area in the size-group	Average size of farms	Net area sown	Total cropped area	Intensity of cropping
Below 2 ..	17 (31.48)	23.08 (11.66)	1.36	22.48	43.06	186.57
2 — 4 ..	21 (38.89)	76.19 (38.50)	3.63	72.28	134.20	176.14
4 and above ..	16 (29.63)	98.64 (49.84)	6.16	84.50	154.50	156.63
All farms ..	54 (100.00)	197.91 (100.00)	3.66	179.26	331.76	167.63

1. The authors have cultivation in the block under study.

It way be noted that the intensity of cropping was high for all the farms, showing a declining trend with an increase in size.

The distribution of area under the high-yielding and local varieties of wheat, maize and bajra and other crops is given in Table II.

TABLE II—CROPPING PATTERN BY SIZE OF FARMS

Size of farms (hectares)	Area under crops in hectares						Others	Total cropped area
	Wheat		Maize		Bajra			
	H.Y.	Local	H.Y.	Local	H.Y.	Local		
Below 2 ..	4.43 (10.29)	9.56 (22.21)	2.96 (6.88)	2.87 (6.65)	4.08 (9.48)	4.57 (10.61)	14.59 (33.88)	43.06 (100.00)
2 — 4 ..	10.88 (8.11)	12.8 (9.59)	4.98 (3.71)	5.81 (4.33)	6.89 (5.13)	7.26 (5.41)	85.51 (63.72)	134.20 (100.00)
4 and above ..	21.10 (13.66)	33.44 (21.64)	4.14 (2.68)	6.16 (3.99)	6.80 (4.40)	9.90 (6.41)	72.96 (47.22)	154.50 (100.00)
All farms ..	36.41 (10.97)	55.87 (16.84)	12.08 (3.64)	14.84 (4.47)	17.77 (5.36)	21.73 (6.55)	173.06 (52.17)	331.76 (100.00)

Notes : (1) H. Y. denotes high-yielding varieties.
(2) Figures in parenthesis give the percentage to the total cropped area.
(3) Since the study relates to wheat, maize and bajra, the remaining crops are grouped under 'others.'

Wheat occupied nearly 27 per cent of the total cropped area, varying from 17.70 per cent in the second size-group to 32.50 per cent in the first size-group. Bajra covered 12 per cent area on all farms with a minimum percentage area to total cropped in the second size group and maximum in the first. In the case of maize, this varied from 6.67 per cent on large farms to 13.53 per cent on small farms.

TABLE III—PERCENTAGE DISTRIBUTION OF AREA UNDER HIGH-YIELDING AND LOCAL VARIETIES FOR CROPS UNDER STUDY

(per cent)

Size of farms (hectares)	Wheat		Maize		Bajra	
	H.Y.	Local	H.Y.	Local	H.Y.	Local
Below 2	31.66	68.34	50.77	49.23	47.17	52.83
2 — 4	45.81	54.19	46.15	53.85	48.69	51.31
4 and above	38.69	61.31	40.20	59.80	40.72	59.28
All farms	39.46	60.54	44.87	55.13	44.99	55.01

Of 92.28 hectares under wheat on all farms, 39.46 per cent was under the high-yielding variety. The difference in respect of area between the local and high-yielding wheat varieties was small on medium sized farms and high on farms in the first size-group. The area under high-yielding maize covered 44.87 per cent of the total area under the crop. On small farms, high-yielding maize occupied more than 50 per cent of the total maize area while the local maize covered more than 50 per cent of the total area under the crop on farms in the second and third size-groups. Bajra high-yielding variety had 40.72 per cent area on large farms and 48.69 per cent on medium sized farms.

Supply of Seed

High-yielding seeds were supplied by co-operatives, package seed stores and other sources as given in Table IV.

TABLE IV—SOURCES OF SEED SUPPLY

(*in rupees*)

Sources/crop	Size of farms (hectares)			
	Below 2	2 — 4	4 and above	All farms
Wheat				
(a) Package seed stores ..	158.97 (26.32)	352.48 (33.13)	929.27 (44.05)	1,440.72 (38.14)
(b) Co-operatives	183.13 (30.32)	406.96 (38.25)	823.70 (39.04)	1,413.79 (37.43)
(c) Others*	261.90 (43.36)	304.50 (28.62)	356.63 (16.91)	923.03 (24.43)
Maize				
(a) Package seed stores ..	43.22 (23.89)	88.61 (33.17)	32.63 (34.79)	164.46 (30.35)
(b) Co-operatives	60.09 (33.22)	104.82 (39.23)	39.30 (41.90)	204.21 (37.69)
(c) Others	77.59 (42.89)	73.26 (27.60)	21.87 (23.31)	173.22 (31.96)
Bajra				
(a) Package seed stores ..	28.40 (29.87)	50.80 (40.28)	54.90 (44.62)	134.10 (38.97)
(b) Co-operatives	30.90 (32.49)	44.40 (35.21)	46.08 (37.49)	121.38 (35.27)
(c) Others	35.80 (37.64)	30.90 (24.50)	21.92 (17.83)	88.62 (25.76)

Note : Figures in parenthesis denote the percentage to the total seed supplied.
* Others include the supply of seed from cultivators and U. P. Agricultural University, Pantnagar.

It could be concluded from Table IV that maximum supplies of high-yielding wheat and bajra seeds were made by package seed stores, followed by co-operatives and other sources. In the case of maize, co-operatives supplied maximum seed followed by package seed stores and other sources. The small farmers were less benefited by package seed stores and co-operatives as compared to the medium and large farmers.

The cost of production of wheat, maize and bajra per hectare according to the different cost concepts is estimated in Table V (*a*), (*b*) and (*c*).

TABLE V(a)—COST OF PRODUCTION OF WHEAT PER HECTARE ON THE BASIS OF DIFFERENT COST CONCEPTS

(in rupees)

Different costs	Size of farms (hectares)			
	Below 2	2 — 4	4 and above	All farms
Wheat H.Y.				
Cost A_1	985.71	831.39	793.45	828.18
	(100.00)	(100.00)	(100.00)	(100.00)
Cost A_2	985.71	867.28	813.63	850.60
	(100.00)	(104.31)	(102.54)	(102.71)
Cost B	1,226.72	1,055.64	874.34	971.62
	(124.45)	(126.97)	(110.19)	(117.32)
Cost C	1,425.70	1,225.65	1,091.46	1,174.91
	(144.63)	(147.42)	(137.56)	(141.86)
Wheat local				
Cost A_1	718.97	676.22	618.15	648.77
	(100.00)	(100.00)	(100.00)	(100.00)
Cost A_2	737.81	714.17	648.95	679.18
	(102.62)	(105.61)	(104.98)	(104.68)
Cost B	974.87	928.33	730.27	817.75
	(135.59)	(137.28)	(118.14)	(126.04)
Cost C	1,177.32	1,085.51	902.13	966.40
	(163.75)	(160.52)	(145.94)	(148.96)

Note : Figures in parenthesis denote per cent increase over Cost A_1.

Cost A_1 includes hired human labour, bullock labour, value of seed, value of manures and fertilizers, depreciation, irrigation charges, land revenue, interest paid on crop loan.

Cost A_2 includes Cost A_1 + rent paid for leased-in land.

Cost B includes Cost A_2 + rental value of owned land, interest on owned fixed capital and working capital.

Cost C includes Cost B + imputed value of family labour.

TABLE V(b)—COST OF PRODUCTION OF MAIZE PER HECTARE ON THE BASIS OF DIFFERENT COST CONCEPTS

(in rupees)

Different costs	Size of farms (hectares)			
	Below 2	2 — 4	4 and above	All farms
Maize H.Y.				
Cost A_1	618.25 (100.00)	686.03 (100.00)	799.55 (100.00)	708.33 (100.00)
Cost A_2	729.74 (118.03)	686.03 (100.00)	963.80 (120.54)	831.72 (117.42)
Cost B	1,188.35 (192.21)	1,322.95 (192.84)	1,391.52 (174.03)	1,313.50 (185.43)
Cost C	1,438.89 (232.73)	1,461.76 (213.07)	1,592.27 (199.14)	1,501.72 (212.01)
Maize local				
Cost A_1	529.02 (100.00)	499.62 (100.00)	479.98 (100.00)	496.92 (100.00)
Cost A_2	529.02 (100.00)	575.18 (115.12)	465.04 (138.55)	569.86 (114.68)
Cost B	952.45 (180.98)	899.14 (180.18)	779.44 (162.39)	680.73 (123.21)
Cost C	1,172.27 (221.59)	1,016.75 (203.75)	943.08 (196.48)	1,016.24 (204.51)

TABLE V(c)—COST OF PRODUCTION OF BAJRA PER HACTARE ON THE BASIS OF DIFFERENT COST CONCEPTS

(in rupees)

Different costs	Size of farms (hectares)			
	Below 2	2 — 4	4 and above	All farms
Bajra H.Y.				
Cost A_1	467.84 (100.00)	510.90 (100.00)	561.47 (100.00)	520.36 (100.00)
Cost A_2	471.76 (100.84)	592.18 (115.90)	682.35 (121.53)	599.04 (115.12)
Cost B	746.65 (159.59)	784.57 (153.56)	855.52 (152.37)	802.89 (154.29)
Cost C	886.07 (189.39)	900.73 (176.30)	935.57 (166.63)	910.69 (175.01)
Bajra local				
Cost A_1	432.12 (100.00)	463.07 (100.00)	462.60 (100.00)	456.35 (100.00)
Cost A_2	432.12 (100.00)	551.23 (119.04)	512.11 (110.70)	508.36 (111.39)
Cost B	451.38 (104.46)	752.28 (162.45)	695.16 (150.27)	705.04 (154.49)
Cost C	832.99 (197.77)	861.07 (185.95)	839.20 (181.41)	845.20 (185.21)

The different costs in the case of wheat showed a declining trend with an increase in the size-group. But an opposite trend was noticed for maize. This may be explained due to increasing inputs in the form of fertilizers and also irrigation which was less secure for small farmers during the *Kharif* season. In the case of high-yielding bajra, this trend was similar to that of wheat but for local varieties the maximum cost was incurred in the second size-group and minimum on farms in the first size-group.

Cost C for the high-yielding wheat was approximately Rs. 200 more than that for the local variety and the maximum difference was noted for farms in the first size-group. For maize, Cost C for the high-yielding variety was nearly Rs. 500 more than that for the local variety and the maximum difference was observed for the large farms. The difference in Cost C between the high-yielding bajra and the local varieties was only Rs. 65. The cost of cultivation of maize was higher than that of wheat because maize was given repeated inter-cultural operations and watching was a costly item. In bajra, the difference was mainly accounted by seed costs.

Output

TABLE VI—YIELD PER HECTARE

(in quintals)

Size of farms (hecrate)	Wheat		Maize		Bajra	
	H.Y.	Local	H.Y.	Local	H.Y.	Local
Below 2 ..	30.05 (203.59)	14.76 (100.00)	34.85 (165.32)	21.08 (100.00)	26.01 (148.48)	17.52 (100.00)
2—4 ..	25.98 (191.45)	13.57 (100.00)	40.73 (215.39)	18.91 (100.00)	28.71 (191.93)	14.99 (100.00)
4 and above ..	26.06 (225.82)	11.54 (100.00)	48.04 (288.18)	16.67 (100.00)	32.12 (228.94)	14.03 (100.00)
All farms ..	26.52 (211.14)	12.56 (100.00)	41.75 (226.90)	18.40 (100.00)	29.42 (195.09)	15.08 (100.00)

Note : Yield of local varieties is taken as 100 and figures in parenthesis show increase over the local varieties.

The yield of high-yielding variety of wheat was more than two times of the local varieties, the maximum difference being noted for the large farms. In the case of maize, the difference in yield between the high-yielding and local varieties increased with an increase in the size-group, so much so that for the large farms maize yields for the high-yielding variety were nearly three times of the local varieties. For bajra also the high-yielding varieties gave more yields than the local ones.

Table VII gives the value of output for different crops.

TABLE VII—VALUE OF OUTPUT PER HECTARE

(*in rupees*)

Size of farms (hectares)	Wheat		Maize		Bajra	
	H.Y.	Local	H.Y.	Local	H.Y.	Local
Below 2 ..	2,308.92 (138.43)	1,667.88 (100.00)	1,830.48 (136.20)	1,343.94 (100.00)	1,688.58 (130.78)	1,291.13 (100.00)
2—4 ..	2,019.43 (131.57)	1,534.83 (100.00)	2,119.43 (174.13)	1,217.13 (100.00)	1,872.88 (168.75)	1,109.81 (100.00)
4 and above ..	2,060.72 (156.64)	1,315.56 (100.00)	2,503.82 (224.25)	1,116.51 (100.00)	2,098.39 (201.97)	1,038.93 (100.00)
All farms ...	2,078.58 (145.73)	1,426.35 (100.00)	2,180.36 (181.71)	1,199.88 (100.00)	1,916.85 (171.81)	1,115.65 (100.00)

Note : (1) The harvest price has been taken to estimate the value of output. (2) The value of yield of the local varieties has been taken as 100 to compare the difference between the high-yielding and local varieties.

It is observed from Table VII that the value of output goes on decreasing in the case of high-yielding and local varieties of wheat and local varieties of maize and bajra, while it gives a reverse trend for the high-yielding varieties of maize and bajra. The maximum difference between high-yielding and local varieties of wheat was observed on large farms and the same was true for maize and bajra. It is interesting to note that the price of high-yielding varieties of the main product was Rs. 5 to 10 less than that of the local varieties. The by-product was generally mixed for sale and consumption.

TABLE VIII—PERCENTAGE CONTRIBUTION OF MAIN AND BY-PRODUCT BY SIZE OF FARMS

Crops	Below 2 hectares		2-4 hectares		4 hectares and above		All farms	
	Main product	By-product	Main-product	By-product	Main product	By-product	Main product	By-product
Wheat H.Y.	82.50	17.50	82.39	17.61	83.20	16.80	82.85	17.15
Wheat local	77.02	22.98	77.20	22.80	76.99	23.01	77.05	22.95
Maize H.Y.	90.10	9.90	90.42	9.58	89.99	10.01	90.18	9.82
Maize local	87.20	12.80	87.59	12.41	87.13	12.87	87.33	12.67
Bajra H.Y.	87.08	12.92	88.10	11.90	87.11	12.87	87.49	12.51
Bajra local	85.60	14.40	85.13	14.87	84.99	15.01	85.15	14.85

It may be concluded from Table VIII that the contribution of grain was higher in high-yielding varieties as compared to that of the local ones.

Net income is the difference between value of output and Cost C. However, it has been estimated in Table IX according to the different concepts of cost.

TABLE IX—NET GAINS OVER DIFFERENT COSTS

(in rupees)

Size of farms/ Costs	Crops					
	Wheat H.Y.	Wheat local	Maize H.Y.	Maize local	Bajra H.Y.	Bajra local
Below 2 hectares						
Cost A_1 ..	1,323.21	948.91	1,212.23	814.92	1,220.74	683.53
Cost A_2 ..	1,323.21	930.07	1,100.74	814.92	1,216.82	683.53
Cost B ..	1,082.20	693.01	642.13	391.49	941.93	664.27
Cost C ..	883.22	490.56	391.59	101.99	801.93	282.66
2—4 hectares						
Cost A_1 ..	1,188.04	858.61	1,433.40	717.51	1,361.98	646.74
Cost A_2 ..	1,152.15	820.66	1,433.40	641.95	1,280.70	558.58
Cost B ..	963.79	606.50	796.48	317.99	1,088.31	357.53
Cost C ..	793.78	449.29	657.67	200.38	972.15	248.74
4 hectares and above						
Cost A_1 ..	1,267.27	697.41	1,704.27	636.53	1,536.92	576.33
Cost A_2 ..	1,247.09	666.61	1,540.02	451.47	1,416.04	526.82
Cost B ..	1,186.38	585.29	1,112.30	337.07	1,242.87	343.77
Cost C ..	969.26	413.43	911.55	173.43	1,162.82	199.73
All farms						
Cost A_1 ..	1,250.40	777.58	1,472.03	702.96	1,396.49	659.30
Cost A_2 ..	1,227.98	747.17	1,348.64	630.02	1,317.81	607.29
Cost B ..	1,106.96	608.60	866.86	339.15	1,113.96	410.61
Cost C ..	903.67	459.95	678.64	183.64	1,006.16	270.45

Net income (gross output minus Cost C) per hectare for local wheat showed declining trend with an increase in the size of farms while for high-yielding varieties it was maximum for large farms and minimum for medium sized farms. In the case of high-yielding variety of maize, net income showed an increasing trend where it was more than two times on large farms as compared to that on small farms. The local maize did not show any specific trend as the net income was minimum in the first size-group and maximum on medium sized farms. In the case of high-yielding bajra variety, net income showed an increase with an increase in the size-group of farms and a reverse trend was noticed for bajra local.

The cost of production per quintal of grain for the three crops is given in Table X.

TABLE X—COST OF PRODUCTION OF GRAIN PER QUINTAL ON THE BASIS OF DIFFERENT COST CONCEPTS

(in rupees)

Size of farms/ Costs	Crops					
	Wheat H.Y.	Wheat local	Maize H.Y.	Maize local	Bajra H.Y.	Bajra local
Below 2 hectares						
Cost A_1 ..	26.96	37.57	15.98	21.88	15.67	21.12
Cost A_2 ..	26.96	38.55	18.86	21.88	15.80	21.12
Cost B ..	33.55	50.94	30.72	39.59	24.99	31.83
Cost C ..	40.23	54.49	37.19	48.48	29.68	40.71
2—4 hectares						
Cost A_1 ..	25.97	38.44	15.26	23.12	15.64	26.30
Cost A_2 ..	27.84	40.60	17.41	26.64	18.13	31.30
Cost B ..	33.88	52.78	29.43	41.65	24.02	42.72
Cost C ..	39.04	61.72	32.57	47.10	27.58	48.90
4 hectares and above						
Cost A_1 ..	25.32	41.24	14.98	25.08	15.22	28.02
Cost A_2 ..	25.97	43.30	18.05	30.51	18.50	31.02
Cost B ..	27.92	48.73	26.06	41.58	23.20	42.11
Cost C ..	34.83	60.20	29.83	50.13	25.37	50.83
All farms						
Cost A_1 ..	25.75	39.81	15.30	23.58	15.47	23.88
Cost A_2 ..	26.66	41.68	17.96	27.04	17.81	26.37
Cost B ..	33.97	50.18	28.37	41.17	23.88	39.80
Cost C ..	36.83	59.43	35.96	48.55	27.08	47.72

The cost of production per quintal of grain for the high-yielding varieties was less than that for the local varieties for all the crops studied. The cost of high-yielding wheat variety decreased with an increase in the size-group while for local wheat it was high in the second size-group and low in the first size-group. High-yielding varieties of maize and bajra had also a declining trend in Cost C with an increase in the size-group, while local varieties of maize had no specific trend. The cost of production of bajra local showed an increase with an increase in the size of farms.

The bulk-line cost to cover 85 per cent of total production of different crops has been estimated in Table XI.

TABLE XI—BULK-LINE COST OF DIFFERENT CROPS (GRAIN ONLY)

Crops	Bulk-line cost (Rs.)	Per cent coverage of		
		Farms	Area	Production
Wheat H.Y.	37.75	82.25	84.50	85.00
Wheat local	58.25	85.00	78.00	85.00
Maize H.Y.	34.50	78.00	69.00	85.00
Maize local	51.25	81.00	83.00	85.00
Bajra H.Y.	32.50	82.00	77.50	85.00
Bajra local	50.00	81.00	82.00	85.00

The bulk-line cost of high-yielding grain for all crops was much lower than that of the local varieties. The cost per quintal of high-yielding wheat variety was Rs. 37.75 covering 82.25 per cent farms and 84.50 per cent area under the crop. For wheat local 85 per cent production was obtained at Rs. 58.25 per quintal. An important conclusion from the above table may be drawn that there was not much difference in the cost of wheat, maize and bajra. This may not generally hold true because the decline in the yield of maize and bajra due to excessive rainfall in the area was responsible for an increase in the cost per quintal.

SOME ECONOMIC ASPECTS OF HIGH-YIELDING VARIETIES PROGRAMME OF INDORE DISTRICT

J. S. SISODIA*

Department of Agricultural Economics
Agriculture College, Indore
(Madhya Pradesh)

The paper attempts to (*i*) find out the levels of inputs and output in the production of local and Mexican wheats; (*ii*) to study the extent to which recommended practices were adopted; (*iii*) to work out the input needs at the farm, village and district level and (*iv*) to define the problems which hinder the extension of new varieties.

Methodology

Out of 665 villages in the district, Nenod village was selected for the study and the study is confined only to wheat crop taken during 1967-68, because the

* The views expressed by the author are personal and the study was conducted in his personal capacity.