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DRYLAND AGRICULTURAL DEVELOPMENT - PAKISTAN BARANI PROJECT

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ECONOMICS OF WHEAT PRODUCTION  
IN BARANI AREAS OF PUNJAB AND  
NORTHWEST FRONTIER PROVINCES,  
PAKISTAN

by Clarence J. Miller

June 1979

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This report is one of seven summary reports prepared by Experience, Incorporated for Project AID/NE-C-1217, Pakistan Barani. The reports are listed as follows:

- No. 1. Miller, Clarence J., Summary Report of Team Coordinator. September 1, 1976 to May 3, 1979
- No. 2. Miller, Clarence J., Study of Socio-Economic Impact of Barani Project Demonstrations in Punjab and Northwest Frontier Provinces, Pakistan
- No. 3. Miller, Clarence J., Study of Economics of Wheat Production in Barani Areas of Punjab and Northwest Frontier Provinces, Pakistan
- No. 4. McKay, Gerald R., Summary Report of Communications Consultant. September 1 to September 30, 1976 and October 2, 1978 to January 25, 1979
- No. 5. Ulsaker, Lawrence G., Summary Report of Agronomist-Punjab Province. June 28, 1976 to April 3, 1979
- No. 6. Burgess, William D., Jr., Summary Report of Agronomist-Northwest Frontier Province. February 23, 1976 to April 18, 1979
- No. 7. Dilawar Ali Khan, et al, Study of Marketing of Farm Products and Farm Inputs in Barani Areas of Punjab and Northwest Frontier Provinces.

## I. INTRODUCTION

Various research institutes, universities, and ministries have conducted wheat improvement programs in Pakistan which have sometimes included work under barani (rainfed) conditions. However, the major emphasis of this program was, and continues to be, research done under irrigated conditions.

In order to both emphasize rainfed farming conditions, and to use farmers' fields for tests and demonstrations, a cooperative research and demonstration program was organized between CARE and USAID, beginning with the 1973-74 Rabi<sup>1/</sup> season. One thousand seven hundred eighty-four wheat plots of all types were established in that season in the two provinces (Punjab and Northwest Frontier). The CARE program was continued for 1974-75, and the Agricultural Extension Service carried on the program for 1975-76, when over 250 adaptive research and verification trials for Rabi crops were planned in the two provinces. This Barani Project was staffed by USAID, the provinces of Punjab and Northwest Frontier (NWFP) in Pakistan, and Experience, Incorporated. The present report is an attempt to summarize some of the information accumulated since 1973.<sup>2/</sup>

## II. DESCRIPTION OF AREA

Over 4 million acres in farms are classified as rainfed in Punjab, while over 2 million acres in NWFP are in the same category. More than 10 million people live in those areas and depend on the crops produced there for their sustenance. Wheat, Pakistan's principal food grain, is the most important crop.

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<sup>1/</sup> Rabi is the crop season that runs generally from October through March.

<sup>2/</sup> This manuscript was reviewed by Messrs. Hooker, Sulyman, and Jones of USAID/Pakistan Mission.

### A. Size of Farms

The majority of barani farms are small. For Rawalpindi District (Punjab), which is 98 percent barani, the office of the deputy director of agriculture (DDA) in 1975 reported that 30 percent of the district farms were of less than 1 acre, 20 percent of from 1 to 2.5, 19 percent of from 2.5 to 5.0, and 19 percent of from 5 to 12.5.

### B. Importance of Dependable Rainfall

A dependable Rabi rainfall is necessary for a good wheat crop. While Rawalpindi has three times the annual rainfall of Peshawar, they both furnish a 6-12 inch range during Rabi season, which is satisfactory for a crop of average or better size in most years.

Acreages sown to wheat on barani lands are shown in Table 1.

TABLE 1. ACREAGE OF BARANI WHEAT BY ANNUAL RAINFALL CLASS, 1972-73 AND 1973-74 ACREAGES

Over 20 inches	12-20 inches	Under 12 inches	Total by Province
-----millions of acres-----			
			2.31 (Punjab)
			1.00 (NWFP)
			<u>0.79 (Other Areas)</u>
2.8	0.9	0.4	4.10 (TOTAL)

NOTE: Annual average yields for 1970-73 ranged from 3.8 to 6.2. maunds per acre.

SOURCE: Provincial Statistics, Offices of Commissioner, Planning and Development.

### C. Rainfall Variability

Barani wheat production is highly variable from year to year, due primarily to the unreliable rainfall. For instance, during the decade 1964-73, the year of highest production provided 60 percent more wheat than the year of lowest production.<sup>3/</sup> Rainfall variations, both in timing and in amount, cannot be eliminated from any production planning. For instance, when farmers are considering a new technique such as heavy fertilizer application, the formulae needed, and the optimum timing and rates of applications under varying amounts of available soil moisture, must all be considered. In spite of all the experiments showing yield advantages due to fertilizer application, many farmers tend to use it sparingly because they are afraid it will "burn" their crops during a dry season. Here is where trials and demonstrations under farmer conditions are important, because actual conditions of risk and uncertainty have never been included in the experimental designs of the researchers.<sup>4/</sup>

## III. FARM MANAGEMENT

### A. "The Barani Package"

Apart from the influence of rainfall, yields result from the use of a "package" of agricultural practices adapted to each farmer's situation. The typical barani "package" in the past ignored manufactured fertilizers, depended on unimproved varieties, and chose inadequate tillage operations. Experimental evidence over the past 20 years indicates that in the higher rainfall areas, the potential exists to double or even triple cereal crop yields, with improvement possible even in areas of lesser rainfall.

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<sup>3/</sup> H. M. Hepworth and T. G. Zinn, "Barani Wheat Production in Pakistan", 1973.

<sup>4/</sup> D. T. Myren, "The Puebla Project: A Developmental Strategy for Low Income Farmers", 1971.

### B. Factors that Motivate the Farmer

It was estimated by one author that even a demonstrated yield increase, if it is to appeal to farmers, must be at least 100% higher than his traditional yields, and such an increase must obviously be reliable over time.<sup>5/</sup> On the other hand, the farmer can distinguish visually between fields where there may be only a 10 percent difference in yields, and this difference will be enough to cause some farmers to adopt the new variety. Also, the farmer is not satisfied with a large yield increase at any cost. Instead, he is looking for a substantial margin between the added costs of the inputs he uses, and the added market value of the crop he produces; hence, the need for attaching prices to his principal cash inputs (fertilizer and improved seeds) and calculating the value of his wheat, as is done in this report.<sup>6/</sup>

### C. New Practices Needing Experimentation

Besides the tests and demonstrations summarized in this report, there are many improved practices that will be undertaken by the barani program in the future. Tillage methods and implements need to be developed to improve water intake and storage in barani soils. Wheat seed and plant treatment for diseases and insect attacks must be undertaken, as well as weed control including herbicides. A traditional practice to limit weed growth is to plant more wheat seed per acre than is needed to produce a normal crop. Soil conservation must be a long range goal. Crop inter-planting, crop rotations, new crops, changes in dates of planting and harvest, chemical carryover from one season to the next in the soil--all these are important subjects on which there is little experimental evidence presently available in Pakistan.

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<sup>5/</sup> Millard Long "Credit Program for Barani Farmers" (Manuscript).

<sup>6/</sup> A. T. Mosher, "Getting Agriculture Moving", Chapter 2, 1966.

#### IV. COSTS OF WHEAT PRODUCTION

The data in Table 2 have been drawn from many sources, and give the costs required for the typical operations of carrying out a wheat crop. Data from this table will be found useful in calculations for the following tables in this report. It is evident that the amount of increase in yield is crucial, given these costs as fixed. For the most comparisons in this table, the farmer's break-even point must be at about an increase of six maunds per acre.

#### V. EARLY TRIALS ON FARMS

The trials and demonstrations reported on later in this report were all conducted on farmers' fields, and most of them were concerned with fertilizer applications and with improved seed varieties. Table 3 contains reports of two trials conducted several years ago.

Fertilizer trials on farmers' fields were conducted in Rawalpindi (a high rainfall area) for a three-year period (1956-58). Improved local varieties (C591 and C228) of barani wheat were used. The results are in Table 3.

TABLE 2. COSTS OF WHEAT PRODUCTION ON BARANI LAND, 1975-76

	Traditional Desi Wheat	Improved Practices
	--Cost per Acre (Rupees)--	
<u>Land Working and Sowing</u>		
Land Preparation:		
3 plowings (bullocks, 1 day ea.)	45.00	45.00
1 planking (bullocks, 1/2 day)	7.50	7.50
Seed Bed Preparation:		
3 plowings	45.00	45.00
1 planking	7.50	7.50
Seeding:		
Seed, 1 maund	37.00	57.00
Sowing (bullock, 1 day; 1 man added)	25.00	25.00
Harrowing (bullocks, 1 day)	--	15.00
<u>Chemicals</u>		
Fertilizer (2 bags)		140.00
Fertilizer transport to farm		4.00
Fertilizer application (bullocks (1/2 day; 1 man)		12.50
Plant protection chemicals		5.00
<u>Harvesting</u>		
Cutting crop (4-5 days for 1 man)	40.00	50.00
Threshing (1/2-1 day for 1 man, bullocks)	12.50	25.00
Winnowing (1/2-1 day for 1 man)	5.00	10.00
Transport crop to farmer storage (1 - 1-1/2 days)	10.00	15.00
<u>Miscellaneous Expenses</u>		
	<u>10.00</u>	<u>25.00</u>
TOTAL COSTS	244.50	488.50

. . . continued

TABLE 2. COSTS OF WHEAT PRODUCTION . . . (continued)

Yield Increase Per Acre	Increase in Net Benefit Per Acre
(maunds)	(rupees)
2	(162.00)
4	(80.00)
8	84.00
14	330.00
18	494.00

Assume yields of grain of: 1 man-day costs Rs. 10 per maund  
 Desi -8, 12, 16 maunds 1 bullock-day (2 bullocks and  
 Improved-10,20, 30 maunds driver) costs Rs. 15 per maund  
 Bhoosa-same yield as grain

Grain price Rs. 37 per maund  
 Bhoosa Price Rs. 4 per maund

TABLE 3. WHEAT TRIALS IN RAWALPINDI, 1956-58

	N	P	K <u>a/</u>	Wheat Yield	
				Following A Crop	After Fallow
	(pounds per acre)			(maunds per acre)	
Control (no fertilizer)	0	0	0	4.1	9.7
Nitrogen	30	0	0	6.1	11.8
Nitrogen/Phosphate	30	30	0	9.0	14.5
Nitrogen/Phosphate/Potash	30	30	30	10.0	16.7

a/ N= nitrogen, P = phosphate, K = potash

SOURCE: Khan and Chaundry, "Farming Erodable Lands in West Pakistan, 1967.

The Punjab Department of Agriculture also carried out wheat trials at 14 locations in the province in 1969-70, using a "package" of improved practices: (a) deep plowing at the beginning of monsoon rains, (b) shallow cultivation after each rainfall to control weeds and maintain surface mulch, (c) improved wheat varieties, and (d) application of nitrogen/phosphate fertilizer at a 64-40-0 rate at seeding time (see Table 4). Rainfall that season, between heading and maturity, amounted to four to six inches depending on location. (Sandy soils that allow good moisture penetration are usually best for obtaining higher yields.)

TABLE 4. WHEAT TRIALS IN THE PUNJAB, 1969-70

Variety	Average Yield
	(maunds per acre)
Improved Local (C-591)	19.2
Mexi-Pak-65	27.9
Barani-70	29.4

SOURCE: Government of Pakistan, "Fifth Annual Report of the Accelerated Wheat Program", 1971.

#### VI. RECENT VARIETY AND FERTILIZER TRIALS

The data that will be discussed in the report were assembled from farm trials of five Rabi seasons. The trials were of an "adaptive" or "verificational" nature; the simpler demonstrations are not included in this report. In order to be able to compare the data as between years and areas, the same prices were assumed throughout, even though in actual practice there may have been some differences. The price of all improved wheat seed varieties

is assumed to be rupees (Rs.) 57 per maund, while local seed is priced at Rs 37, the same as all wheat sold by the farmer.<sup>7/</sup> Phoosa production is not usually reported, so it has been assumed as equal to grain yield unless reported directly. Nitrogen is priced at Rs. 1.48 per pound.; phosphate at Rs. 1.10 per pound, and potash at Rs. 1.16 per lb. <sup>8/</sup>. The summary table for each set of trials reported takes the increased cost represented by improved seed, fertilizer applied, or both, and compares these costs with the increased net value of the crop due to higher yield. This is identified as the "cost-benefit ratio", which could be defined as the rupees of net added crop value obtained for each rupee expended on the identified farm inputs, (usually fertilizer and high yielding variety seed). The reader may feel that, if appropriate demonstrations and educational material are shown the farmer, he will consider a cost-benefit ratio of 2.00 or less, attractive enough to adopt the practices recommended. Such an assumption may be proven to be true or not, depending on what studies of adoption will show.

The farmer will have additional costs of production of Rs. 84 per acre in addition to cost of the improved seed and fertilizer (see Table 2). The value of increased Bhoosa production is assured to Rs. 4 per maund. (It must be noted that this report is based on secondary data, all reported as simple means, so the raw data was not easily available to consider statistical reliability of the results, or even the dispersion around the means.) In some cases a "control" situation is reported, in which local seed is used and no fertilizer is applied. If there is no "control" reported, then a base was artificially supplied, by using the case with the lowest seeding rate or lowest fertilizer application as

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<sup>7/</sup> However, seed at sowing time may change in price drastically. In many cases, market price may have been higher than government controlled price for all wheat including seed.

<sup>8/</sup> Government subsidies involved in fertilizer prices were not accounted for in any of the following calculations.

the base. This would allow comparisons for various application levels, but should not be considered as a true control situation.

Plots placed on Punjab farmers' fields over a five-year period (1971-72 to 1975-76) are shown in Tables 5, 6, and 7. The data were reported by the Director of the Soil Fertility Survey and Soil Testing Institutes. In Table 5, yields of three improved varieties are shown compared with various application levels of fertilizer and by two ranges of rainfall. Yields increase consistently with each addition of fertilizer, in both low and high rainfall areas.

Calculations in Table 6 are based on data from Table 5, with the lightest level of fertilizer treatment in each group being used as an artificial base for computation purposes only. The cost-benefit ratio is equivalent to the dollars of increased net income (over the base) for each dollar spent on increased fertilizer input. About half of the ratios are larger than 1.5 and this might be a high enough increase to attract a proportion of the farmers, if the results were widely advertised and demonstrated. In both categories, the highest application levels for fertilizer result in lower ratios than some of the lower application levels -- suggesting that knowledgeable farmers may decide to fertilize but will prefer lesser input applications that give them the higher ratios.

In Table 7, data is grouped according to district. Campbellpur is separated because of its different soil requirements for potash. The "control" yield represents no fertilizer application, and local (Desi) seed. The Soil Fertility Survey suggests a "recommended" dose of balanced fertilizer to achieve the yields represented in the table.

TABLE 5. FERTILIZER INPUTS AND YIELD OF IMPROVED WHEAT VARIETIES IN BARANI AREAS OF THE PUNJAB, 1971-72 to 1975-76 <sup>a/</sup>

LOW RAINFALL AREAS (less than 25 inches)

Treatment	Cost (Rupees)				Yield Increase Over Control (maunds per acre)		
	Nitrogen	Phosphate	Potassium	Total <sup>b/</sup>	Mexi-Pak	Barani-70	Potohar
30 -0 -0	44.40	--	--	64.40	5.7	4.2	5.9
30 -30-0	44.40	33	--	97.40	7.5	7.2	7.8
60 -30-0	88.80	33	--	141.80	10.3	9.9	10.6
60 -60-0	88.80	66	--	174.80	12.4	12.3	13.5
60 -60-30	88.80	66	34.80	209.60	13.4	13.6	15.8

HIGH RAINFALL AREAS<sup>c/</sup> (more than 25 inches)

60 -0 - 0	88.80	--	--	108.80	5.9	5.4	
60 -30 -0	88.80	33	--	141.80	8.8	8.3	
60 -60 -0	88.80	66	--	174.80	11.1	10.5	
90 -60 -0	133.20	66	--	218.20	14.3	12.4	
90 -60 -0	133.20	66	69.60	287.80	14.1	14.1	

<sup>a/</sup> Derived from "Fertilizer Requirements of Dwarf Wheats in the Project", October, 1976, Tables 6-7 by Dost Mohammad Malik.

<sup>b/</sup> High rainfall data (1971-72 to 1973-74).

<sup>c/</sup> Including added rupees (Rs.) 20 for improved seed.

TABLE 6. INCREASES IN GROSS AND NET VALUE OF WHEAT IN BARANI AREAS OF PUNJAB (Low Rainfall), 1971-72 to 1975-76<sup>a/</sup>

Treatment	Increase in Gross Value Over Control <sup>b/</sup>			Increase in Net Value			Cost-Benefit Ratio		
	Mexi-Pak	Barani- 70	Potohar	Mexi-Pak	Barani- 70	Potohar	Mexi-Pak	Barani- 70	Potohar
-----Rs. per acre-----									
30-0-0	233.70	172.20	241.90	85.30	23.80	93.50	1.3	0.4	1.4
30-30-0	307.50	295.20	319.80	126.10	113.80	138.40	1.3	1.2	1.4
60-30-0	422.30	405.90	434.60	196.50	180.10	208.80	1.4	1.3	1.5
60-60-0	508.40	504.30	553.50	249.60	245.50	294.70	1.4	1.4	1.7
60-60-30	549.40	557.60	647.80	255.80	264.00	354.20	1.2	1.3	1.7
60-0-0	241.90	221.40	-	49.10	28.60	-	0.4	0.3	-
60-30-0	360.80	340.30	-	102.00	81.50	-	0.7	0.6	-
60-60-0	455.10	430.50	-	196.30	171.70	-	1.1	1.1	-
90-60-0	586.30	508.40	-	284.10	206.20	-	1.3	1.0	-
90-60-60	578.10	573.10	-	206.30	206.30	-	0.7	0.7	-

a/ Based on Table 5.

b/ Includes Bhoosa at same yield as grain, valued at Rs. 4 per maund (this system is used in all tables).

TABLE 7. FERTILIZER APPLICATION ON IMPROVED WHEAT VARIETIES IN BARANI AREAS OF PUNJAB, 1971-72 to 1975-76<sup>a/</sup>

Districts	Yield		Recommended Dose	Increased Fertilizer and Seed Cost <sup>b/</sup>	Increased Yield over Control	Value of Yield Increase over Control		Cost-Benefit Ratio
	Control	With Fertilizer				Gross	Net over Costs	
	(maunds per acre)			(Rs. per acre)	(maunds per acre)	(Rs. per acre)		
<u>LOW RAINFALL AREAS</u> (less than 25 inches)								
Rawalpindi, Jhelum, Gujrat, Sialkot	10.9	21.3	60-60-0	174.80	10.4	426.40	342.40	2.0
Campbellpur	11.8	24.8	60-60-30	192.20	13.0	533.00	449.00	2.3
<u>HIGH RAINFALL AREAS</u> (more than 25 inches)								
Rawalpindi, Jhelum, Gujrat, Sialkot	12.3	25.8	90-60-0	219.20	13.5	553.50	469.50	2.1
Campbellpur	11.7	23.8	90-60-60	254.00	12.1	496.10	412.10	1.6

a/ Derived from "Fertilizer Requirements of Dwarf Wheats in the Punjab", October 1976, Table 10, by Post Mohammad Malik.

b/ Increase in Seed Cost of Rs.20 (used in all tables).

In Table 8, experiments from three areas in the Punjab are recorded for 1973, with two levels of fertilizer application, and the use of improved seed. Increases in net value for the use of improved seed and of fertilizer, vary from Rs. 146 to Rs. 416 per acre.

Data for one level of fertilizer application for 1974-75 in both the Punjab and NWFP are given in Tables 9 and 10, by geographic location. The fertilizer is applied to one improved variety. "Control" here also represents no fertilizer applied, and the local (Desi) variety of seed. Yield increments vary from 5 to 18 maunds, indicating the wide variation in local conditions affecting the wheat. For instance, improved varieties are often very sensitive to amount of moisture at seeding time, and depth at which the seed is planted.

The economic information for both provinces is summarized in Table 11. Net value increase varies from Rs. 129 to over Rs. 660 per acre.

In Table 12, three improved varieties in the Punjab are treated to varying levels of fertilizer application, and there are two levels of rainfall distinguished (1975-76). Yields are noted for both the improved and local varieties. The data is organized in Table 13 in such a way that the effects of the additional fertilizer applications only are shown for each of the improved varieties. This is done by making the lowest treatment level the base, as discussed previously. Increases in net value vary from negative to over Rs. 350 per acre. There are moderately high cost-benefit ratios in both areas. In Table 14, yields from the three improved varieties have been averaged to provide one figure for each treatment, to compare with the yield of the local variety under the same treatment. Increase in net value ranges from Rs. 39 to Rs. 370.

TABLE 8. NET INCREASE OF WHEAT CROP IN THREE BARANI AREAS OF PUNJAB, 1973<sup>a/</sup>

District	IRDP Markaz	Increased Yield Per Acre <sup>b/</sup>		Increased Fertilizer and Seed Cost <sup>c/</sup>		Gross Value Increase		Net Value Increase		Cost- Benefit Ratio	
		Low Level <sup>d/</sup>	High Level <sup>e/</sup>	Low Level	High Level	Low Level	High Level	Low Level	High Level	Low Level	High Level
		(maunds)		(Rs. per acre)		(Rs. per acre)		(Rs. per acre)			
Jhelum	Dhudial	5.6	9.9	99.30	178.60	229.60	405.90	145.60	321.90	1.5	1.8
Campbellpur	Bahatar	6.4	10.6	99.30	178.60	262.40	434.60	178.40	350.60	1.8	2.0
Rawalpindi	Daultala	7.9	12.2	99.30	178.60	323.90	500.20	239.90	416.20	2.4	2.3

<sup>a/</sup> Derived from "Economics of Fertilizer Use in Production of Wheat in the Rainfed Regions of the Punjab", Table 1, by Dr. Riaz Ahmad Khan.

<sup>b/</sup> Increase over Control - local seed, no fertilizer

<sup>c/</sup> Increased Value of Improved Seed added at Rs. 20 per acre, assume 1 maund used per acre.

<sup>d/</sup> Ratio of Nitrogen-Phosphate-Potassium = 35-25-0 (Rs. 79.3).

<sup>e/</sup> Ratio of Nitrogen-Phosphate-Potassium = 70-50-0 (Rs. 158.6).

TABLE 9. SUMMARY OF YIELD DATA OF WHEAT DEMONSTRATION BY MARKAZ, IN PUNJAB PROVINCE, 1974-75<sup>a/</sup>

Markaz	Total No. of Farmers	Total No. of Union Councils	Grain Yield in Maunds per Acre		Incremental Yield
			Control	Barani-70	
Bahtar	47	4	11.39	23.18	11.79
Daultala	41	6	13.88	20.83	6.95
Dhudial	35	5	9.99	21.82	11.83
Choa Saidan Shah	29	3	8.01	14.82	6.81
Chauntra	69	4	12.78	21.24	8.46

<sup>a/</sup> Data from records of USAID. Fertilizer applied: 72 seers Urea per acre; 64 seers DAP per acre. Value of wheat - Rs.37

TABLE 10. SUMMARY OF YIELD DATA OF WHEAT DEMONSTRATIONS, BY MARKAZ, FOR NWFP, 1974-75<sup>a/</sup>

Markaz	Total Number of Farmers	Total Number of Union Councils	Yield <sup>b/</sup>		Incremental Yield
			Control	Barani - 70	
-----maunds per acre-----					
<u>DIVISION: SWAT</u>					
1. Barikot	37	4	16.95	23.60	6.65
<u>DIVISION: PESHAWAR</u>					
2. Kohat	3	3	23.76	28.93	5.17
3. Karak	3	3	16.43	34.62	18.19
4. Gumbat	5	4	12.17	22.35	10.18
5. Hangu	20	6	16.32	30.13	13.81
<u>DIVISION: HAZARA</u>					
1. Battal	2	1	13.14	23.94	10.80

a/ Data from records of USAID.

b/ Fertilizer applied: 72 seers urea per acre; 64 seers DAP per acre, on Barani-70.  
1 seer = approximately 2.1 pounds.

Value of wheat = Rs. 37.

TABLE 11. INCREASES IN YIELD AND NET VALUE OF WHEAT IN BARANI AREAS, BY MARKAZ, 1974-75<sup>a/</sup>

Markaz	Cost of Fertilizer and Seed Increase (Rs. per acre)	Yield Increase- Barani-70 over Local (maunds per acre)	Increase in Gross Value (Rs. per acre)	Increase in Net Value <sup>b/</sup> (Rs. per acre)	Cost-Benefit Ratio <sup>c/</sup>
<u>PUNJAB PROVINCE</u>					
Bahatar	216.00	11.8	433.80	399.80	1.8
Daultala	216.00	7.00	267.00	203.00	0.9
Dhudial	216.00	11.8	433.80	399.80	1.8
Choa Saidan Shah	216.00	5.8	278.80	194.80	0.9
Chauntra	216.00	3.5	343.50	264.50	1.2
<u>NWFP</u>					
Barikot	216.00	6.6	270.60	186.60	0.9
Kohat	216.00	5.2	213.20	129.20	0.6
Karak	216.00	18.2	746.20	662.20	3.1
Gumbat	216.00	10.2	418.20	334.20	1.6
Hangu	216.00	13.8	565.80	481.80	2.2
Battal	216.00	10.8	442.80	358.80	1.7

a/ Data from Tables 9-10.

b/ Rs. 84.00 of added cost associated with application of new seed and fertilizer, and subtracted from gross value (used in all tables where applicable).

c/ Net value divided by costs of fertilizer and added seed cost.

TABLE 12. WHEAT VARIETY AND FERTILIZER EXPERIMENTS IN BARANI AREAS OF PUNJAB, 1975-76<sup>a/</sup>

Variety	Treatment No.			
	1	2	3	4
<u>LOW RAINFALL AREAS</u> <sup>b/</sup> -----yield in maunds per acre-----				
	<u>60 - 30 -0</u>	<u>60 -30 -30</u>	<u>60-60 -0</u>	<u>90-60 -0</u>
Local	22.41	23.88	24.84	25.06
Potohar	28.54	30.15	30.50	30.31
Barani -70	31.82	30.69	33.39	34.27
Yakora	29.33	25.81	31.08	31.98
<u>HIGH RAINFALL AREAS</u> <sup>c/</sup>				
	<u>30 - 30 -0</u>	<u>60 -30 -0</u>	<u>60-60-0</u>	<u>60-60-30</u>
Local	19.18	22.71	21.99	24.66
Potohar	20.61	23.87	29.06	27.98
Barani-70	22.65	30.60	27.81	30.84
Yakora	23.36	30.29	32.69	32.11

<sup>a/</sup> Derived from "Results of Experimental, Verification and Demonstration Plots in Barani Areas, 1975-76 "Annex A, Reported on June 21, 1976, by Rana Mohammad Saleem, Barani (Punjab) Project Director.

<sup>b/</sup> 13 experiments; 88 observations.

<sup>c/</sup> 13 experiments; 48 observations.

TABLE 13. YIELD AND NET VALUE OF IMPROVED WHEATS IN BARANI AREAS OF PUNJAB, 1975-76<sup>a/</sup>

Treatment b/	Seed and Fertilizer Increase over Lowest c/		Yield Increase over Lowest (Hounds/Acre)		Increase in Gross Value (Rs./Acre)		Increase in Net Value over Cost (Rs./Acre)		Cost-Benefit Ratio		
	Barani-70	Yakora	Potohar	Barani-70	Yakora	Potohar	Barani-70	Yakora	Potohar	Barani-70	Yakora
<b>LOW RAINFALL AREAS</b>											
60-30-0	--	--	--	--	--	--	--	--	--	--	--
60-30-30	54.80	6.3	6.8	1.9	254.20	278.80	77.90	170.20	194.80	d/	3.1
60-60-0	53.00	5.7	8.6	6.2	233.70	352.60	254.20	149.70	268.60	234.20	2.8
90-60-0	97.40	5.2	9.2	6.9	213.20	377.20	282.90	129.20	293.20	194.90	1.3
<b>HIGH RAINFALL AREAS</b>											
30-30-0	--	--	--	--	--	--	--	--	--	--	--
60-30-0	64.40	1.2	7.9	7.6	49.20	323.90	311.60	d/	239.90	227.60	d/
60-60-0	97.40	7.1	5.8	10.7	291.10	237.80	438.70	207.10	153.80	354.70	2.1
60-60-30	132.20	3.3	6.2	7.4	135.30	254.20	303.40	51.30	170.20	219.40	d/

a/ Derived from Table 12.

b/ Local treatment in each area is the base.

c/ 30 lbs. Nitrogen = 44.40 rupees; 30 lbs. Phosphate = 33 rupees; 30 lbs. Potassium = 34.80 rupees.

d/ Negative.

TABLE 14. NET VALUE INCREASE OF WHEAT DUE TO IMPROVED VARIETIES IN BARANI AREAS OF PUNJAB, 1975-76<sup>a/</sup>

Local	High Rainfall				Low Rainfall			
	T-1 <sup>c/</sup>		Treatment No. b/		T-1a <sup>d/</sup>		Treatment No. b/	
	T-1	T-2	T-3	T-4	T-2a	T-3a	T-4a	
Yields(mds/acre) 22.4	29.9	28.9	31.7	32.2	29.3	29.8	30.3	
Seed Cost e/ (Rs./acre) 37	57	57	57	57	57	57	57	
Yield Increase (mds/acre)	7.5	6.5	9.3	9.8	9.1	10.6	10.1	
Increase in fertilizer and Seed Cost (Rs./acre)	141.40	176.20	174.40	218.80	121.80	154.80	189.60	
Increase in Gross Value (Rs./acre)	307.50	266.50	331.30	401.80	373.10	434.60	455.10	
Increase in Net Value (Rs./acre)	223.50	182.50	277.30	317.80	289.10	350.60	371.10	
Cost-benefit Ratio <sup>f/</sup>	1.6	1.0	1.7	1.4	2.4	2.3	2.0	

a/ Data from Table 12.

b/ Simple average of three improved varieties, from Table 7.

c/ T-1 = 60-30-0 T-2 = 60-30-30 T-3 = 60-60-0 T-4 = 90-60-0.

d/ T-1 = 30-30-0 T-2a = 60-30-0 T-3a = 60-60-0 T-4a = 60-60-30.

e/ Assume one maund per acre is seeding rate, no fertilizer used on local seed.

f/ Cost Benefit Ratio = Rs. of increase in net value for every rupee increase in seed and fertilizer cost.

In Tables 15 and 16, the data from the Barani Demonstration Plots in the Punjab, for 1975-76 are summarized. Two improved wheat varieties were compared with the local variety, and one level of fertilizer application was compared with no fertilizer. The results are summarized by tehsil and by district, using weighted averages for the one to four tehsils in each district in which plots were established. Three types of results are reported in the tables: (1) increases in yield and net income due to the use of improved seed only, (2) increases in yield and net income due to the application of the specified level of fertilizer only; (3) increases in yield and net income when both improved seed and fertilizer effects are combined together. The net value increase for seed only in both tables varies from Rs. 12 to Rs. 430, and the cost-benefit ratio varies from negative to high, depending on area. The net value increase for fertilizer is usually higher than for seed, but because of the high cost of the fertilizer, its cost-benefit ratio is often less.

The results reported for seed and fertilizer when considered together may be a weighted mean of the results taken separately, or a higher figure in many cases. One might generalize that the separation of these effects is a theoretical exercise; in practice, the farmer is interested in their combination if he can thereby obtain a ratio that is satisfactory.

Table 17 gives the results of different levels of fertilizer application, combined with improved seed, for the fertilizer verification plots in the Punjab in 1975-76. Information is summarized by villages, and average yields of all improved varieties are compared with yields of control (local) varieties. As a result of both the use of improved seed and of added fertilizer, net value per acre increases up to over Rs. 1,000 in a few cases.

TABLE 15 . YIELDS RESULTING FROM USE OF BARANI-70 WHEAT SEED AND APPLICATION OF FERTILIZER TO DEMONSTRATION PLOTS ON BARANI FARMERS' FIELDS IN THE PUNJAB, 1975-76 a/

A. District	Tehsil		Barani-70(Variety)		Local(Variety)	
			70-50 <sup>b/</sup>	0-0	70-50	0-0
(Fertilizer applied)....			(a)	(b)	(a)	(b)
Rawalpindi	Gujarkhan	Y) <u>c/</u>	33.87	24.68	25.81	18.77
		O) <u>d/</u>	(125)	(125)	(125)	(125)
<hr/>						
	Campbellpur	Y)	16.00	11.12	14.11	8.94
		O)	(95)	(95)	(95)	(95)
	Fatehjang	Y)	22.73	15.12	23.29	13.76
		O)	(9)	(9)	(9)	(9)
	Findigheb	Y)	16.10	10.32	11.60	8.59
		O)	(52)	(52)	(52)	(52)
	Talagang	Y)	17.58	12.11	30.20	10.41
		O)	(20)	(20)	(20)	(20)
<u>Campbellpur District</u>		Y)	16.55	11.20	13.73	9.25
		O)	(176)	(176)	(176)	(176)
	Jhelum	Y)	28.96	19.86	20.36	14.21
		O)	(417)	(417)	(417)	(417)
	Pind Dadan Khan	Y)	30.65	21.66	25.66	16.95
		O)	(59)	(59)	(59)	(59)
	Chakwal	Y)	25.61	17.19	21.92	12.59
		O)	(111)	(111)	(111)	(111)
<u>Jhelum District</u>		Y)	28.50	19.54	21.19	14.38
		O)	(587)	(587)	(587)	(587)
<hr/>						
	Gujrat	Y)	29.74	19.85	25.92	17.25
		O)	(242)	(242)	(242)	(242)
	Kharian	Y)	32.48	24.11	26.84	19.36
		O)	(265)	(265)	(265)	(265)
	Phalia	Y)	26.47	14.72	16.62	11.12
		O)	(27)	(27)	(27)	(27)
<u>Gujrat District</u>		Y)	30.93	21.70	25.91	17.99
		O)	(534)	(534)	(534)	(534)
<hr/>						
Mianwali	Mianwali	Y)	16.20	12.31	14.07	11.22
		O)	(234)	(234)	(234)	(234)

. . . continued

TABLE 15. YIELDS . . . (continued)

B. District	Tehsil	Yield Increase			Increase in Gross Value e/		
		Seed Only	Ferti- lizer Only f/	Seed + Fertilizer	(Rs. Per Acre) Seed Only	Ferti lizer Only	Seed + Fertilizer
Rawalpindi	Gujarkhan	5.9	7.0	15.1	241.90	287.00	619.10
	Campbellpur	2.2	5.2	7.1	90.20	213.20	291.10
	Fatehjang	1.4	9.5	9.0	57.40	389.50	369.00
	Findi gheb	1.7	3.0	7.5	69.70	123.00	307.50
	Talagang	1.7	19.8 g/	7.2	69.70	g/	295.20
<u>Campbellpur District</u>		12.0	4.5	7.3	82.00	184.50	303.40
	Jhelum	5.6	6.2	14.8	229.60	254.20	602.70
	Pind Dadan Khan	2.7	6.7	11.7	110.70	274.70	479.70
	Chakwal	4.6	9.3	13.0	188.60	381.30	533.00
<u>Jhelum District</u>		5.2	6.8	14.1	213.20	278.80	582.20
	Gujrat	2.6	8.7	12.5	106.60	356.70	516.60
	Kharian	4.8	7.5	13.1	196.80	307.50	541.20
	Phalia	3.6	5.5	15.4	147.60	225.50	631.40
<u>Gujrat District</u>		3.7	7.9	12.9	151.70	323.90	528.90
Mianwali	Mianwali	1.1	2.8	5.0	45.10	114.80	205.00

. . . continued

TABLE 15. YIELDS. . . (continued)

C. District	Tehsil	Cost Increase		Increase in Net Value (Rs. Per Acre)			Cost-Benefit Ratio			
		Seed Only	Fertilizer Only	Seed + Fertilizer Only	Seed Only	Fertilizer Only	Seed + Fertilizer Only	Seed Only	Fertilizer Only	Seed + Fertilizer Only
Rawalpindi	Gujar Khan	20	109.10	129.10	157.90	203.00	535.10	7.9	1.9	4.1
	Campbellpur	20	109.10	129.10	6.20	129.20	207.10	0.3	1.2	1.6
	Fatehjang	20	109.10	129.10	h/	305.50	285.00	h/	2.8	2.2
	Findigheb	20	109.10	129.10	h/	39.00	223.50	h/	0.4	1.7
	Dalagang	20	109.10	129.10	h/	g/	211.20	h/	g/	1.6
<u>Campbellpur District</u>		20	109.10	129.10	h/	100.50	219.40	h/	0.9	1.7
	Jhelum	20	109.10	129.10	145.60	170.20	518.70	7.3	1.6	4.0
	Pind Dadan Khan	20	109.10	129.10	26.70	190.70	395.70	1.3	1.8	3.1
	Chakwal	20	109.10	129.10	104.60	297.30	449.00	5.2	2.7	3.5
<u>Jhelum District</u>		20	109.10	129.10	129.20	194.80	498.20	6.5	1.8	3.9
	Gujrat	20	109.10	129.10	22.60	272.70	432.60	1.1	2.5	3.4
	Kharian	20	109.10	129.20	112.80	223.50	457.20	5.6	2.0	3.5
	Phalia	20	109.10	129.10	63.60	141.50	547.40	3.2	1.3	4.2
<u>Gujrat District</u>		20	109.10	129.10	67.70	239.90	444.90	3.4	2.2	3.4
	Mianwali	20	109.10	129.10	h/	30.80	121.00	h/	0.3	0.5

- a/ Data from tables presented by the Barani (Punjab) Project Director, January 4, 1977.
- b/ Refers to nitrogen and phosphate used; i.e., 70-50 means 70 lbs. nitrogen and 50 lbs. phosphate.
- c/ Y = yield per acre in maunds
- d/ O = number of observations
- e/ Price = Rs. 37 per maund for wheat.
- f/ With local seed only.
- g/ Probable error.
- h/ Negative.

TABLE 16. YIELDS RESULTING FROM USE OF POTOHAR WHEAT SEED AND APPLICATIONS OF FERTILIZER TO DEMONSTRATION PLOTS ON BARANI FARMERS' FIELDS IN THE PUNJAB, 1975-76<sup>a/</sup>

District	Tehsil	Potohar (Variety)		Local (Variety)	
		70-50 <sup>b/</sup>	0-0	70-50	0-0
Fertilizer Applied		---(a)---	---(b)---	---(a)---	---(b)---
Rawalpindi	Y) <sup>c/</sup>	30.30	22.26	21.13	16.94
	O) <sup>d/</sup>	(101)	(101)	(101)	(101)
Muree	Y)	25.35	22.41	21.94	17.30
	O)	(64)	(64)	(64)	(64)
Kahuta	Y)	18.84	18.01	16.09	16.36
	O)	(92)	(92)	(92)	(92)
Gujar Khan	Y)	38.10	26.80	30.40	22.70
	O)	(225)	(225)	(225)	(225)
<u>Rawalpindi District</u>		Y)	31.10	23.59	24.60
		O)	(482)	(482)	(482)
Campbellpur	Y)	20.07	14.34	17.29	12.66
	O)	(237)	(237)	(237)	(237)
Fatehjang	Y)	23.05	17.27	20.49	15.15
	O)	(237)	(237)	(237)	(237)
Pindigheb	Y)	14.37	10.32	11.06	7.92
	O)	(314)	(314)	(314)	(314)
Talagang	Y)	8.85	6.62	7.92	5.71
	O)	(362)	(362)	(362)	(362)
<u>Campbellpur District</u>		Y)	15.60	11.42	13.30
		O)	(1150)	(1150)	(1150)
Jhelum	Y)	35.93	22.40	26.21	18.85
	O)	(73)	(73)	(73)	(73)
Pind Dadan Khan	Y)	19.67	11.60	15.49	10.28
	O)	(196)	(196)	(196)	(196)
Chakwal	Y)	23.02	15.70	30.02	5.16
	O)	(380)	(380)	(380)	(380)
<u>Jhelum District</u>		Y)	23.46	15.22	25.20
		O)	(649)	(649)	(649)
Gujrat	Gujrat	Y)	26.10	19.06	25.74
		O)	(94)	(94)	(94)
Mianwali	Y)	16.84	11.30	16.40	10.92
	O)	(429)	(429)	(429)	(429)
Isakhel	Y)	17.26	11.56	15.39	10.42
	O)	(331)	(331)	(331)	(331)
<u>Mianwali District</u>		Y)	17.02	11.41	15.96
		O)	(760)	(760)	(760)

. . . continued

TABLE 16. YIELDS RESULTING FROM USE OF POTOHAR WHEAT SEED. . .(continued)

District	Tehsil	Yield Increase			Increase in Gross Value e/ (Rs. Per acre)		
		Seed Only f/	Fertilizer Only g/	Seed + Fertilizer	Seed Only	Fertilizer Only	Seed + Fertilizer
	Rawalpindi	5.3	4.2	13.3	217.30	172.20	545.30
	Murree	5.1	4.6	8.0	209.10	188.60	328.00
	Kahuta	1.6	h/	2.4	65.60	h/	98.40
	Gujar Khan	4.1	7.7	15.4	168.10	315.70	631.40
	<u>Rawalpindi District</u>	4.0	5.0	11.5	164.00	205.00	471.50
	Campbellpur	1.7	4.6	7.4	69.70	188.60	303.40
	Fatehjang	2.1	5.3	7.9	86.10	217.30	323.90
	Findigheb	2.4	3.1	6.4	98.40	127.10	262.40
	Talagang	0.9	2.2	h/	36.90	90.20	127.10
	<u>Campbellpur District</u>	1.7	3.6	h/	69.70	147.00	241.90
	Jhelum	3.6	7.4	17.1	147.60	303.40	701.10
	Pind Dadan Khan	1.3	5.2	9.4	53.30	213.20	385.40
	Chakwal	10.5	24.86 i/	17.8	430.50	i/	729.80
	<u>Jhelum District</u>	7.0	17.0 i/	15.2	287.00	i/	623.20
	Gujrat	0.3	7.0	7.3	12.30	287.00	299.30
	Mianwali	0.4	5.5	5.9	16.40	225.50	241.90
	Isakhel	1.1	5.0	6.8	45.10	205.00	278.80
	<u>Mianwali District</u>	0.7	5.3	6.3	28.70	217.30	258.30

. . . continued

TABLE 16. YIELDS RESULTING FROM USE OF POTOHAR WHEAT SEED. . .(continued)

District Tehsil	Cost Increase (Rs. per acre)			Increase in Net Value (Rs. per acre)			Cost-Benefit Ratio		
	Seed Only	Ferti- lizer Only	Seed+ Ferti- lizer	Seed Only <sup>f/</sup>	Ferti- lizer Only <sup>g/</sup>	Seed + Ferti- lizer	Seed Only	Ferti lizer	Seed+ Ferti- lizer
Rawalpindi	20	109.10	129.10	133.30	88.20	461.30	6.7	0.8	3.6
Murree	20	109.10	129.10	125.10	104.60	244.00	6.3	1.0	1.9
Kanuta	20	109.10	129.10	h/	h/	14.40	h/	h/	0.1
Gujar Khan	20	109.10	129.10	84.10	231.70	547.40	4.2	2.1	4.2
<u>Rawalpindi District</u>	20	109.10	129.10	80.00	121.00	367.50	4.0	1.1	3.0
Campbellpur	20	109.10	129.10	h/	104.60	219.40	h/	1.0	1.7
Fatehjang	20	109.10	129.10	2.10	133.30	239.90	0.1	1.2	1.9
Sindigher	20	109.10	129.10	14.40	43.10	178.40	0.7	0.4	1.4
Salagang	20	109.10	129.10	h/	6.20	43.10	h/	0.1	0.3
<u>Campbellpur District</u>	20	109.10	129.10	h/	63.60	157.90	h/	0.6	1.2
Jhelum	20	109.10	129.10	63.60	219.40	617.10	3.2	2.0	4.8
Pind Dadan Khan	20	109.10	129.10	h/	129.20	301.40	h/	1.2	2.3
Chakwal	20	109.10	129.10	346.50	i/	645.80	17.3	i/	5.0
<u>Jhelum District</u>	20	109.10	129.10	203.00	i/	539.20	10.2	i/	4.2
Gujrat	20	109.10	129.10	h/	203.00	215.30	h/	1.9	1.7
Mianwali	20	109.10	129.10	h/	141.50	157.90	h/	1.3	1.2
Isakhel	20	109.10	129.10	h/	121.00	194.80	h/	1.1	1.5
<u>Mianwali District</u>	20	109.10	129.10	h/	133.30	174.30	h/	1.2	1.4

a/ Derived from tables presented by the Barani (Punjab) Project Director, January 4, 1977.

b/ Refers to nitrogen and phosphate used; i.e., 70-50 means 70 lbs. nitrogen and 50 lbs. phosphate.

c/ Y = yield per acre in maunds.

d/ O = number of observations.

e/ Price = Rs. 37 per maund for wheat.

f/ No fertilizer used.

g/ With local seed only.

h/ Negative.

i/ Probable error.



TABLE 17A. FERTILIZER YIELD RELATIONSHIPS. . . (continued)

District	Name of Village	Average of Controls (maunds/acre)	Increase in Gross Value (Rs. per acre)						Increase in Cost (Rs. per acre) (Seed + Fertilizer)								
			N		K		N K		N		K		N K				
			30-0	0-0	30-30	0-0	60-60	0-0	60-60	0-30	30-0	60-60	0-30	30-0	60-60		
Sialkot	Jeetu Gul	14.3	332.10	414.10	574.00	668.30	733.90	64.40	97.40	141.80	174.80	209.60	64.40	97.40	141.80	174.80	209.60
	Malipor	15.1	184.50	414.10	426.40	574.00	446.90	64.40	97.40	141.80	174.80	209.60	64.40	97.40	141.80	174.80	209.60
	Sodian	9.8	172.20	237.00	262.40	311.60	483.80	64.40	97.40	141.80	174.80	209.60	64.40	97.40	141.80	174.80	209.60
Gujrat	Mangowal Shariki	10.9	127.10	211.90	369.00	631.40	713.40	64.40	97.40	141.80	174.80	209.60	64.40	97.40	141.80	174.80	209.60
	Chak Maroof	11.2	127.10	262.40	426.40	664.20	721.60	64.40	97.40	141.80	174.80	209.60	64.40	97.40	141.80	174.80	209.60
	Bhanowali	10.1	241.90	401.80	688.80	753.50	918.40	64.40	97.40	141.80	174.80	209.60	64.40	97.40	141.80	174.80	209.60
	Khuni Chak	10.9	299.10	344.40	504.30	619.10	840.50	64.40	97.40	141.80	174.80	209.60	64.40	97.40	141.80	174.80	209.60
	Jaliani	11.2	172.20	319.90	377.20	541.20	606.80	64.40	97.40	141.80	174.80	209.60	64.40	97.40	141.80	174.80	209.60
	Gakhari	8.4	205.00	311.60	483.80	549.40	656.00	64.40	97.40	141.80	174.80	209.60	64.40	97.40	141.80	174.80	209.60
	Khuni Chak	6.7	172.20	351.30	426.40	528.90	683.80	64.40	97.40	141.80	174.80	209.60	64.40	97.40	141.80	174.80	209.60
Leither	6.2	352.60	516.60	893.30	1008.60	1098.80	64.40	97.40	141.80	174.80	209.60	64.40	97.40	141.80	174.80	209.60	
Jhelum	Moza Chak Ivorany	13.2	180.40	262.40	422.30	401.80	479.70	64.40	97.40	141.80	174.80	209.60	64.40	97.40	141.80	174.80	209.60
	Chittan	22.7	57.40	205.00	287.00	422.30	528.90	64.40	97.40	141.80	174.80	209.60	64.40	97.40	141.80	174.80	209.60
	Dhoke waddan	21.6	123.00	180.40	479.70	984.00	434.60	64.40	97.40	141.80	174.80	209.60	64.40	97.40	141.80	174.80	209.60
	Dhoke Awan	12.6	262.40	434.60	590.40	606.80	664.20	64.40	97.40	141.80	174.80	209.60	64.40	97.40	141.80	174.80	209.60
	Kauntrila	19.0	795.40	910.20	1184.90	1299.70	1447.30	64.40	97.40	141.80	174.80	209.60	64.40	97.40	141.80	174.80	209.60
	Mohammad Kala Gujran.....	16.8	274.70	401.80	606.80	733.90	873.30	64.40	97.40	141.80	174.80	209.60	64.40	97.40	141.80	174.80	209.60

. . . continued

TABLE 17A. FERTILIZER YIELD RELATIONSHIPS. . . (continued)

Name of District Village	Average of Controls (maunds/acre)	Increase in Net Value (Rs. per Acre)										Cost-Benefit Ratio					
		N		P		K		N P		N K		N P K	N P K	N P K	N P K	N P K	N P K
		30-0-0	0-30-0	30-0-0	0-30-0	30-0-0	0-30-0	30-0-0	0-30-0	30-0-0	0-30-0						
		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
Slalkot	12.3	248.10	330.10	470.00	584.30	647.90	3.8	3.4	3.5	3.3	3.1	3.0	3.0	3.0	3.0	3.0	
Malipur	15.1	100.50	330.10	342.40	470.00	362.90	1.6	3.4	2.4	2.8	1.7	1.7	1.7	1.7	1.7	1.7	
Sodian	9.8	88.20	203.00	178.40	227.60	307.80	1.4	2.1	1.3	1.3	1.3	1.9	1.9	1.9	1.9	1.9	
Gujrat Mangowal Shakki	10.9	43.10	157.90	285.00	547.40	627.40	0.7	1.6	2.0	3.1	3.0	3.0	3.0	3.0	3.0	3.0	
Chak Narooof	11.2	43.10	178.40	342.40	580.20	637.60	0.7	1.8	2.4	3.3	3.0	3.0	3.0	3.0	3.0	3.0	
Bhanowali	10.1	157.90	317.80	604.80	674.50	834.40	2.4	3.3	4.3	3.9	4.0	4.0	4.0	4.0	4.0	4.0	
Khuni Chak	10.9	125.10	260.40	420.30	535.10	756.50	1.9	2.7	3.0	3.1	3.1	3.6	3.6	3.6	3.6	3.6	
Jaliani	11.2	88.20	235.80	273.20	457.20	522.80	1.4	2.4	2.1	2.6	2.5	2.5	2.5	2.5	2.5	2.5	
Gakhari	8.4	121.00	227.60	399.80	465.40	572.00	1.9	2.3	2.8	2.7	2.7	2.7	2.7	2.7	2.7	2.7	
Khuni Chak	6.7	88.20	297.30	342.40	444.90	604.80	1.4	3.0	2.4	2.6	2.9	2.9	2.9	2.9	2.9	2.9	
Leither	6.2	268.60	432.60	809.80	924.60	1014.80	4.2	4.4	5.7	5.3	4.8	4.8	4.8	4.8	4.8	4.8	
Jhelum																	
Moza Chak Morang	13.2	96.40	178.40	338.30	317.80	395.70	1.5	1.8	2.4	1.8	1.9	1.9	1.9	1.9	1.9	1.9	
Chittan	22.7	b/	121.00	203.00	338.30	444.90	b/	1.2	1.4	1.9	2.1	2.1	2.1	2.1	2.1	2.1	
Dhoke Waddan	21.6	39.00	96.40	395.70	900.00	350.60	0.6	1.0	2.8	5.2	1.7	1.7	1.7	1.7	1.7	1.7	
Dhoke Awan	12.6	178.40	350.60	506.40	522.80	530.20	2.8	3.6	3.6	3.0	2.8	2.8	2.8	2.8	2.8	2.8	
Kauntrila	19.0	711.40	526.20	1100.90	1215.70	1363.30	11.0	5.4	7.8	7.0	6.5	6.5	6.5	6.5	6.5	6.5	
Mohammad Kala	16.8	170.70	317.80	522.80	649.90	789.30	3.0	3.3	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	
Gujran																	

a/ Refers to quantities of nitrogen, phosphate, and potassium used; i.e., 60-60-30 means 60 lbs. nitrogen, 60 lbs. phosphate, and 30 lbs. potassium.

b/ negative.

SOURCE: Records of Barani Project for Punjab Province.

TABLE 17B. FERTILIZER YIELD RELATIONSHIPS OF WHEAT IN BARANI AREA VERIFICATION PLOTS, PUNJAB PROVINCE, RABI 1975-76

District	Name of Village	Average of Controls (maunds/acre)	Average Yield of Improved Varieties in Maunds/Acre					Yield Increase over Controls (Hd./Acre)				
			N P K		N P K		N P K		N P K		N P K	
			30-0-0	30-30-0	60-30-0	60-60-0	60-60-0	60-60-30	1	2	3	4
Rawalpindi	Rangu Bahadur	18.2	22.1	19.9	23.2	24.6	25.8	3.9	1.7	5.0	6.4	7.6
	Dhoke Kallian	10.4	12.9	21.0	22.7	25.8	27.4	2.5	10.6	12.3	15.4	17.0
	Buffa Sheikhan	3.9	10.6	14.8	17.6	19.0	20.4	6.7	10.9	13.7	15.1	16.5
	Jobani Bangalow	11.2	14.8	17.4	21.6	26.6	24.6	3.6	6.2	10.4	15.4	17.4
	Jobani Bangalow Sheikhan	2.2	3.4	12.0	14.3	20.7	22.4	1.2	9.8	12.1	18.5	20.2
	Nirala Khurd	10.9	14.6	16.2	17.6	17.9	20.2	3.7	5.3	6.7	7.0	9.3
	Losarmera	5.6	7.0	8.1	9.5	10.9	12.6	1.4	2.5	3.9	5.3	7.0
	Batta	21.0	22.4	22.7	31.1	27.4	23.5	1.4	1.7	10.1	6.4	2.5
	Mera Akko	17.8	18.8	28.0	28.3	31.6	34.4	1.0	10.2	10.5	13.8	16.6
	Mohra Jhanda	9.9	12.9	17.9	19.3	22.0	23.8	3.0	8.0	9.4	12.1	13.9
Campbellpur	Mohra Gandhi	9.5	14.0	16.2	18.2	22.5	24.4	4.5	6.7	8.7	13.0	14.3
	Bucha	7.8	9.8	16.5	17.9	22.1	23.2	2.0	8.7	10.1	14.3	5.4
	Shakaryal	9.0	14.6	16.2	17.4	19.9	21.0	5.6	7.2	8.4	10.9	12.0
	Daultala	13.5	23.6	32.8	25.2	33.6	40.9	10.1	14.3	6.7	15.1	22.4
	Daultala	12.9	21.6	24.6	28.8	35.3	39.2	8.7	11.7	15.9	22.4	26.3
Saharwal	Garh Aseem Khan	13.2	14.8	17.4	18.5	19.3	19.3	1.6	4.2	5.3	6.1	6.1
	Sabar Kal	14.7	14.6	16.5	19.0	20.7	21.8	b/	1.8	4.3	6.0	7.1
	Hastal	13.2	15.1	14.3	19.0	19.6	21.0	1.9	1.1	5.8	6.4	7.8

... continued

TABLE 17B. FERTILIZER YIELD RELATIONSHIPS. . . (continued)

District	Name of Village	Average of Controls (maunds/acre)	Increase in Gross Value (Rs. per acre)										Increase in Cost (Rs. per acre) (seed & fertilizer)									
			N		F		K		NPK		NPK		N		P		K		NPK		NPK	
			30-0-0	0-30-0	30-0-0	0-30-0	30-0-0	0-30-0	30-0-0	0-30-0	30-0-0	0-30-0	30-0-0	0-30-0	30-0-0	0-30-0	30-0-0	0-30-0	30-0-0	0-30-0	30-0-0	0-30-0
			1	2	3	4	5	1	2	3	4	5	1	2	3	4	5					
Rawalpindi	Rangu Bahadur	18.2	159.90	69.70	205.00	262.40	311.60	64.40	97.40	141.80	174.80	209.60	64.40	97.40	141.80	174.80	209.60					
	Dhoke Kalian	10.4	102.50	434.60	504.30	631.40	697.00	64.40	97.40	141.80	174.80	209.60	64.40	97.40	141.80	174.80	209.60					
	Buffa Sheikhan	3.9	274.70	446.90	561.70	619.10	676.50	64.40	97.40	141.80	174.80	209.60	64.40	97.40	141.80	174.80	209.60					
	Jobani Bangalow	11.2	147.60	254.20	426.40	631.40	713.40	64.40	97.40	141.80	174.80	209.60	64.40	97.40	141.80	174.80	209.60					
	Jobani Bangalow Sheikhan.....	2.2	49.20	401.80	496.10	756.50	828.20	64.40	97.40	141.80	174.80	209.60	64.40	97.40	141.80	174.80	209.60					
	Nirala Khurd...	10.9	151.70	217.30	274.70	287.00	381.30	64.40	97.40	141.80	174.80	209.60	64.40	97.40	141.80	174.80	209.60					
	Losarmera	5.6	57.40	102.50	159.90	217.30	287.00	64.40	97.40	141.80	174.80	209.60	64.40	97.40	141.80	174.80	209.60					
	Batta	21.0	57.40	69.70	414.10	262.40	102.50	64.40	97.40	141.80	174.80	209.60	64.40	97.40	141.80	174.80	209.60					
	Mera Akko	17.8	41.00	418.20	430.50	565.80	680.60	64.40	97.40	141.80	174.80	209.60	64.40	97.40	141.80	174.80	209.60					
	Mohra Jhanda	9.9	123.00	328.00	385.40	496.10	569.90	64.40	97.40	141.80	174.80	209.60	64.40	97.40	141.80	174.80	209.60					
	Mohra Gandhi	9.5	184.50	274.70	356.70	533.00	610.90	64.40	97.40	141.80	174.80	209.60	64.40	97.40	141.80	174.80	209.60					
	Bucha	7.8	82.00	356.70	414.10	586.30	221.40	64.40	97.40	141.80	174.80	209.60	64.40	97.40	141.80	174.80	209.60					
	Shakaryl	9.0	229.60	295.20	344.40	446.90	492.00	64.40	97.40	141.80	174.80	209.60	64.40	97.40	141.80	174.80	209.60					
	Daultala 1	18.5	414.10	586.30	274.70	619.10	918.40	64.40	97.40	141.80	174.80	209.60	64.40	97.40	141.80	174.80	209.60					
	Daultala 2	12.9	356.70	479.70	651.90	918.40	1078.30	64.40	97.40	141.80	174.80	209.60	64.40	97.40	141.80	174.80	209.60					
Campbell-Garh	Asecm Khan	13.2	65.60	172.20	217.30	250.10	250.10	64.40	97.40	141.80	174.80	209.60	64.40	97.40	141.80	174.80	209.60					
pur	Sabar Kal	14.7	b/	73.80	176.30	246.00	291.10	64.40	97.40	141.80	174.80	209.60	64.40	97.40	141.80	174.80	209.60					
	Hastal	13.2	77.90	45.10	237.80	262.40	319.80	64.40	97.40	141.80	174.80	209.60	64.40	97.40	141.80	174.80	209.60					

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There has been question as to the advisability of applying more of one ingredient, such as nitrogen, phosphate, or potash, when there is already fertilization at a certain level, as well as when the land is unfertilized. Table 18 presents some answers to this question.

Each fertilizer ingredient is associated with two application levels, one for a high rainfall area, and one for a low rainfall area. In addition, in some cases, the results of the same application of the ingredient are given both when other ingredients are present in a relatively low level, and when they are present in a higher level.

The results of these applications indicate that use of potash under all conditions usually gives a negative net value increase, and that the conditions under which the farmer may get a profitable return by using potash are more limited and more unique than the conditions under which it may pay him to invest in more nitrogen or phosphate.

Tables 19-22 relate increases in crop value to different seeding rates. Tables 19 and 20 give illustrations for the Punjab in 1974-75. Yields of improved varieties at four seeding rates are contained in Table 19. The lowest rate of seeding is used for a base in Table 20, with the three other rates being compared. The net value increases in all cases for the more intense seeding rates, going up to Rs. 442 per acre. The cost-benefit ratio increases with the more intense rates. All ratios (except the negatives) are substantial.

Tables 21 and 22 give illustrations for the NWFP in 1975-76,

TABLE 18. EFFECT OF NITROGEN, PHOSPHORUS, AND POTASH ON NET VALUE OF WHEAT CROP, BARANI AREA OF PUNJAB PROVINCE, 1975-76 a/

NITROGEN (N): HIGH RAINFALL	Cost Increase (Rs./Acre)	Yield Increase (Tounds/Acre)		Gross Value Increase (Rs.)		Net Value Increase (Rs.)		Cost-Benefit Ratio				
		(1) b/ c/	(2) b/ c/	(3) b/ c/	(1) c/	(2) c/	(3) c/	(1) c/	(2) c/	(3) c/		
60-60 -0 to 90-60 -0	44.40	0.9	0.9	36.70	35.70	(1) c/	(2) c/	(1) c/	(2) c/	(3) c/		
NITROGEN(N): LOW RAINFALL												
30- 30 -30 to 60-30 -0	44.40	8.0	7.5	135.30	328.00	307.50	51.30	244.00	223.50	1.2	5.5	5.0
PHOSPHORUS (P): HIGH RAINFALL												
60-30- 0 to 60-60 -0	c/	0.4	2.7	16.40	110.70	217.30	c/	26.70	133.30	c/	0.8	4.0
PHOSPHORUS (P): LOW RAINFALL	33.00	5.2	c/	213.20	c/	73.80	129.20	c/	c/	c/	c/	3.9
POTASH (K): HIGH RAINFALL												
60-30- 0 to 60-30-30	34.80	1.6	c/	65.60	c/	c/	c/	c/	c/	c/	c/	c/
POTASH (K): LOW RAINFALL												
60-60- 0 to 60-60 -30	34.80	c/	3.0	c/	123.00	c/	c/	39.00	c/	c/	1.1	c/

a/ Derived from " Results of Experimental, Verification and Demonstration Plots in Barani Areas, 1975-76" by Rana Mohammad Saleem- Annex a. ( See Table 12, this Report).

b/ (1) = Potohar, (2) = Barani-70, (3) = Yakora.

c/ Negative.

TABLE 19. SUMMARY OF YIELD DATA FOR WHEAT, RATE OF SEEDING TRIALS, BARANI AREAS OF PUNJAB PROVINCE, 1974-75

<u>Markaz</u>	<u>Average Yield of Grain in Maunds Per Acre</u> <sup>a/</sup>				
	Seed Rate in lbs. Per Acre:	58	66	74	82
Daultala		22.0	20.5	24.8	25.9
Chauntra		15.5	19.4	25.5	22.6
Bahtar		14.6	15.7	25.4	21.9
Ikhlas		11.6	13.1	15.8	19.3

<sup>a/</sup> All sub-plots received 72 seers of urea and 64 seers of DAP per acre at a cost of Rs. 196. Yield figures are simple average of all village averages recorded for that markaz.

SOURCE: Data from USAID.

TABLE 20. INCREASE IN VALUE OF WHEAT CROP DUE TO SEEDING RATE IN BARANI AREAS OF PUNJAB PROVINCE, 1974-75<sup>a/</sup>

Markaz	Seed Cost Increase (Rs./acre)			Yield Increase (Maunds/acre)			Gross Value Increase (Rs./acre)			Net Value Increase <sup>c/</sup> (Rs./acre)			Cost-Benefit Ratio			
	Seed Rate	66	74	82	66	74	82	66	74	82	66	74	82	66	74	82
Daultala		5.50	11.00	16.60	c/	2.8	3.9	c/	114.80	159.90	c/	114.80	159.90	c/	10.4	9.6
Chauotra		5.50	11.00	16.60	3.9	10.0	7.1	159.90	410.00	291.10	159.90	410.99	291.10	29.1	37.3	17.5
Bahtar		5.50	11.00	16.60	1.1	10.8	7.3	45.10	442.80	299.30	45.10	442.80	299.30	8.2	40.2	18.0
Ikhlas		5.50	11.00	16.60	1.5	4.2	7.7	61.50	172.20	315.70	61.50	172.20	315.70	11.2	15.6	19.0

a/ Derived from Table 19.

b/ Base is seeding rate of 58 lbs. per acre. Price of improved seed is Rs.57/00 per maund (Rs.0.69 per lb.)

c/ No deductions from gross value for added costs.

c/ Negative.

TABLE 21. RESULTS OF IMPROVED WHEAT SEED TRIALS IN NWFP, 1975-76

Treatment: a/	Yield in Maunds Per Acre			
	I	II	III	IV
<u>SWAT</u>				
Matta	54.4	69.0	57.2	49.0
Barikot	23.3	29.2	29.2	26.3
<u>LIR</u>				
Timargara	13.2	17.5	19.1	14.6
<u>HAZARA</u>				
Abbottabad	29.2	35.0	40.8	40.8
Haripur-I (Darvesh)	13.1	13.2	13.3	16.3
Haripur-II (Talokar)	23.3	30.0	24.7	24.9
Haripur-III (Ghazi)	23.3	35.0	40.8	39.7
Haripur-IV (Hassampur)	23.3	28.0	29.2	29.2
<u>KCHAF</u>				
Billitang	12.1	12.8	16.5	18.5
Hangu	14.6	23.3	14.6	17.5
Doaba	20.1	21.4	18.4	18.0
Karak-I (Sardog)	35.0	35.6	46.7	52.5
Karak-II (Karak)	17.2	19.8	20.5	21.2

Source: Data from Barani Office

a/ Seed rate of :

I = 66 lbs per acre

II = 74 lbs per acre

III = 82 lbs per acre

IV = 91 lbs per acre

One 50 kg. bag of urea and one kg. bag of DAP were applied per acre.

TABLE 22. INCREASE IN NET VALUE OF CROP DUE TO WHEAT SEEDING RATE TRIALS FOR BARANI AREAS IN NWFP, 1975-76 <sup>a/</sup>

Location	Seed Cost <sup>b/</sup>		Yield Increase		Increase in Gross			Increase in Net Value <sup>c/</sup>			Cost-Benefit Ratio				
	Increase		(Maunds/acre)		(Value(Rs./acre)			(Rs./acre)							
	74	82	91	74	82	91	74	82	91	74	82	91	74	82	91
<b>Swat</b>															
Matta	5.50	11.00	16.6	14.6	2.7	d/	598.60	110.70	d/	598.60	110.70	d/	108.8	10.1	d/
Barikot	5.50	11.00	16.6	5.8	5.8	2.9	237.80	237.80	118.90	237.80	237.80	13.3	43.2	21.6	1.1
<b>Dir</b>															
Timargarha	5.50	11.00	16.6	4.2	5.8	1.3	172.20	327.80	53.30	172.20	327.80	53.30	31.3	29.8	3.2
<b>Hazara</b>															
Abbottabad	5.50	11.00	16.6	5.8	11.7	11.7	237.80	479.70	479.70	237.80	479.70	d/	43.2	43.6	28.9
Haripur-I (Darvesh)	5.50	11.00	16.6	0.1	0.2	3.3	4.10	8.20	135.30	4.10	8.20	135.30	0.8	0.8	8.2
Haripur-II (Talokar)	5.50	11.00	16.6	6.6	1.4	1.5	270.60	57.40	61.50	270.60	57.40	61.50	49.2	5.2	3.7
Haripur-III (Ghazi)	5.50	11.00	16.6	11.7	17.5	16.3	479.70	717.50	668.30	479.70	717.50	668.30	87.2	65.2	40.3
Haripur-IV (Hassampur)	5.50	11.00	16.6	4.7	5.8	5.8	192.70	237.80	237.80	192.70	237.80	237.80	35.0	21.6	14.3
<b>Kohat</b>															
Billitang	5.50	11.00	16.6	0.7	4.4	6.4	28.70	180.40	262.40	29.70	180.40	262.40	5.2	16.4	15.8
Hangu	5.50	11.00	16.6	8.8	0	2.9	360.80	0	118.90	360.80	0	118.90	65.6	0	7.2
Doaba	5.50	11.00	16.6	1.4	d/	d/	57.40	d/	d/	57.40	d/	d/	10.4	d/	d/
Karak-I (Sardog)	5.50	11.00	16.6	0.6	11.7	17.5	24.60	479.70	717.50	24.60	d/	717.50	4.5	43.6	43.2
Karak II (Karak)	5.50	11.00	16.6	2.6	3.3	4.00	106.60	135.30	164.00	106.60	135.30	164.00	19.4	12.3	9.9

a/ Data from Table 21. Seed price assumed at Rs. 57 per maund (0.69 per lb.).

b/ "Base" was seeding rate of 66 lbs. per acre. Compared here are the other three rates.

c/ No deduction from gross cost increase for any added costs.

d/ Negative.