BIBLIOGRAPHIC DATA SHEET

1. CONTROL NUMBER
PN-AAH-697

2. SUBJECT CLASSIFICATION (695)
AE30-0000-G730

3. TITLE AND SUBTITLE (240)
Socio-economic impact evaluation for Barani Project demonstrations in Punjab and Northwest Frontier provinces, Pakistan

4. PERSONAL AUTHORS (100)
Miller, C. J.

5. CORPORATE AUTHORS (101)
Experience, Inc.

6. DOCUMENT DATE (110)
1979

7. NUMBER OF PAGES (120)
151p.

8. ARC NUMBER (170)
PK630.72.M647

9. REFERENCE ORGANIZATION (150)
Experience

10. SUPPLEMENTARY NOTES (500)
(In Dryland Agricultural Development - Pakistan Barani Project report no. 2). (Similar reports concerning Dryland Agricultural Development - Pakistan Barani Project, PN-AAH-696 - PN-AAH-701)

11. ABSTRACT (950)

12. DESCRIPTORS (920)
Pakistan
Agricultural information
Socioeconomic development
Dry farming
Technology adoption
Surveys
Data collection
Farmers
Agricultural technology

13. PROJECT NUMBER (150)
391040300

14. CONTRACT NO.(140)
AID/ne-C-1217

15. CONTRACT TYPE (140)

16. TYPE OF DOCUMENT (160)

AID 590-7 (10-79)

PK
630.72
M641

EXPERIENCE, INCORPORATED
RODDIS TOWER • MINNEAPOLIS, MINNESOTA 55402 U.S.A.

PN-AAH-697

REPORT NO. 2

DRYLAND AGRICULTURAL DEVELOPMENT - PAKISTAN BARANI PROJECT

Contract AID/NE-C-1217

SOCIO-ECONOMIC IMPACT EVALUATION FOR BARANI PROJECT DEMONSTRATIONS IN PUNJAB AND NORTHWEST FRONTIER PROVINCES, PAKISTAN

By Clarence J. Miller

June 1979

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 Demonstration 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.

TABLE OF CONTENTS

		Page
I.	INTRODUCTION	1
	A. Objectives and Methodology	1
	B. Statistical Techniques of Analysis	3
	C. Profile of Typical Farmer Interviewed	8
	D. Agroclimatic Description	10
II.	PARTICIPANT PROFILES: SOCIAL CHARACTERISTICS	13
	A. Age	13
	B. Education	15
	C. Family Size	16
	D. Off-Farm Income	17
III.	FARM CHARACTERISTICS	21
	A. Farm Fragments and Farm Size	21
	B. Farmer Tenure	27
	C. Cropping Patterns	28
	D. Mechanization	28
IV.	DATA ON CROP LABOR AND LIVESTOCK	28
	A. Crop Labor	28
	B. Livestock	32
V.	LOCATION OF PARTICIPANTS AND FARMS	32
VI.	THE USE OF DEMONSTRATION PLOTS	34
	A. Selection of Plots	34
	B. Opinions About Demonstration Plots as an Educational Tool	37

TABLE OF CONTENTS (continued)

		Page
	C. Cooperation in Demonstration Plots	39
	D. Benefits Furnished to Demonstrators/Adopters	40
	E. Farmer Observations Concerning Demonstrations and Programs	42
VII.	ADOPTION AND NON-ADOPTION	43
	A. Adoption and Demonstration	43
	B. Multiple Regression Analysis	44
	C. Reasons, Problems, and Limitations in Adoption	47
	D. Information and Its Sources	50
	E. Actual Rates of Adoption	50
VIII.	SUMMARY OF FINDINGS	56
	A. Farmer and Family Characteristics	56
	B. Farm Location and Description	57
	C. Demonstrations	59
	D. Adoption and Non-Adoption	60
	E. Agricultural Information	63
	F. The Agricultural Extension Program	64
IX.	POLICY IMPLICATIONS	66
	A. Farmer and Family Characteristics	66
	B. Farm Location and Description	67
	C. Demonstrations	69
	D. Adoption and Non-Adoption	70
	E. Agricultural Information	72
	F. The Extension Program	73

LIST OF TABLES

		Page
TABLE 1.	PRECIPITATION IN BARANI AREAS	12
TABLE 2.	RAINFALL AND FARMER ADOPTIONS	12
TABLE 3.	AGES OF SAMPLE ADOPTER FARMERS	13
TABLE 4.	COMPARISON OF AGES AND NUMBERS OF SAMPLE FARMERS WITH RURAL MALES (CENSUS)	14
TABLE 5.	EDUCATION OF FARMERS	15
TABLE 6.	SIZES OF FAMILIES	16
TABLE 7.	SIZES OF RURAL BARANI HOUSEHOLDS	18
TABLE 8.	FAMILY MEMBERS EARNING OFF-FARM INCOME	19
TABLE 9.	OFF-FARM INCOMES OF FAMILY MEMBERS	19
TABLE 10.	ADOPTION AND FARM REMITTANCES	20
TABLE 11.	REMITTANCE OF INCOME FROM OFF-FARM SOURCES	21
TABLE 12.	FRAGMENTS OF LAND PER FARM	22
TABLE 13.	FRAGMENTS PER FARM AND ACRES PER FRAGMENT	23
TABLE 14.	ACRES PER FRAGMENT -- ALL DISTRICTS	23
TABLE 15.	BARANI LAND PER FARM	24
TABLE 16.	IRRIGATED LAND ON FARMS	26
TABLE 17.	CUTIVATED LAND PER FARM	26
TABLE 18.	FARMER TENURE	27
TABLE 19.	CROPPING PATTERNS IN BARANI AREAS	29
TABLE 20.	USE OF TRACTORS	30
TABLE 21.	ACRES OF CULTIVATED LAND AND LABOR USED	31
TABLE 22.	DISTANCE TO FERTILIZER DEPOT	33
TABLE 23.	DISTANCE TO MANDI	33
TABLE 24.	DISTANCE TO PUCCA ROAD	34

LIST OF TABLES (continued)

		Page
TABLE 25.	REASONS FOR FARMERS CHOOSING TO HAVE A DEMONSTRATION PLOT	35
TABLE 26.	REASONS FOR FARMERS CHOOSING NOT TO HAVE A DEMONSTRATION PLOT	36
TABLE 27.	PLOTS REPORTED BY FARMERS	38
TABLE 28.	GOVERNMENT COOPERATION IN DEMONSTRATION PLOTS	39
TABLE 29.	FARMER PARTICIPATION IN DEMONSTRATION PLOTS	40
TABLE 30.	WHEAT YIELDS ON CONTROL AND DEMONSTRATION PLOTS	41
TABLE 31.	COSTS OF INCREASED WHEAT YIELD OBTAINED FROM DEMONSTRATIONS	41
TABLE 32.	NET INCOME INCREASES FROM WHEAT DEMONSTRATION PLOTS	42
TABLE 33.	NUMBER OF FARMERS REPORTING DEMONSTRATION PLOTS: ADOPTION OR NON-ADOPTION OF NEW PRACTICES	44
TABLE 34.	SIGNIFICANT REGRESSION RELATIONSHIPS WITH FARMER ADOPTION OF NEW PRACTICES (4 VARIABLES)	45
TABLE 35.	IMPORTANT REASONS FOR LIMITED ADOPTION OR NON-ADOPTION	49
TABLE 36.	TYPES OF INFORMATION THAT FARMERS REPORT THEY RECEIVE	51
TABLE 37.	FARMERS' SOURCES OF AGRICULTURAL INFORMATION	52
TABLE 38.	SOURCES OF FARMER INFORMATION FOR ADOPTERS IN THREE AREAS	53
TABLE 39.	RATES OF ADOPTION OF WHEAT VARIETIES AND FERTILIZERS	54
TABLE 40.	STRAIGHT LINE REGRESSION FACTORS CONSIDERED IN ADOPTION	55
TABLE 41.	ADOPTION OF HYV WHEAT IN IRRIGATED AND BARANI AREAS	55
TABLE 42.	NUTRIENT WEIGHT OF FERTILIZERS APPIED ON HYV WHEAT	56

LIST OF APPENDIXES

APPENDIX A

ADOPTION AND STEPWISE REGRESSION

APPENDIX B

RESULTS OF TESTS OF SIGNIFICANCE BETWEEN MEANS AND OF INDEPENDENCE

APPENDIX C

SELECTED DESCRIPTIVE INFORMATION SAMPLE: ADOPTING BARANI FARMERS

APPENDIX D

SELECTED DESCRIPTIVE INFORMATION SAMPLE: NON-ADOPTING BARANI FARMERS

APPENDIX E

BRIEF REVIEW OF SELECTED IMPACT AND DIFFUSION REPORTS

APPENDIX F

CROP LABOR AT BUSY SEASONS

APPENDIX G

BARANI LIVESTOCK

LIST OF APPENDIXES (continued)

APPENDIX H

FARMER OBSERVATIONS ABOUT DEMONSTRATIONS

APPENDIX I

OPINIONS OF FARMERS HELD ABOUT GOVERNMENT FIELD AGENTS AND FIELD SERVICES FOR AGRICULTURE

APPENDIX J

ADOPTION, NON-ADOPTION AND MAJOR PROBLEMS

I. INTRODUCTION

This is a report on some aspects of the adoption by farmers of improved methods of farming, or advanced technology. According to one writer, the technology of farming means "the way it is done." He says, "It includes the methods by which farmers sow, cultivate and harvest crops and care for livestock. It includes the seeds, fertilizer, pesticides, medicines and the feeds they use, the tools, implements and the sources of power. It includes enterprise combinations by which farmers seek to make the best use of their labor and land. "1/ Even though only a limited number of these matters are covered in the present report, all of them are and have been in the thinking of the staff members of the Barani Project.

A. Objectives and Methodology

Objectives: This impact survey was initiated early in 1978, as a result of a decision to study the effects of the Project after two years of operation. 2/ During the two-year period, demonstration plots illustrating improved farming technology have been set up in the Punjab, the North-West Frontier Province, and the Tribal Areas.

1/ "Survey Report on Spread of New Agricultural Technology to Small Farms in Pakistan", F.M.XVII, October 1969 (Planning Unit, Food and Agriculture Division, Ministry of Agriculture and Works, Government of Pakistan, Islamabad).

2/ Persons in Pakistan who have advised and helped plan and review the study include: A.D. Lundberg, S. Plunkett, D. Alverson, R. Hooker, M. Ashraf, and R. Goldman. Barani Project staff in both provinces reviewed the results. Mr. Ateeque Ahmad did valuable work throughout the study -- in the field survey, in office tabulations, and in liaison work with the Computing Center.

The measurement of progress of the program posed certain questions of which these are examples: (1) What type of farmer is the Project reaching ? (2) What kind of farmers are not being affected by the Project, and why is this so ? (3) What is the extent of direct farmer participation in the Project, and how much participation is indirect? (4) What is the present source of the agricultural information which the farmer receives, and how useful is this information? (5) What has been the degree of adoption of the improved farming techniques which the Project has demonstrated?

In order to obtain new perspectives for planning orientation in the Project, several additional questions were posed by an ad Hoc committee set up to review the questionnaire design: (1) What conditions are necessary in order to encourage farmer adoption of the new techniques? (2) What are farmer opinions about agricultural field agents and the services of field offices, and how does this affect farmer receptivity if information and assistance? (3) What are the key problems faced by Barani farmers, as they see them?

Methodology: For interviewing purposes, three areas in each province were selected, covering a broad range of precipitation, topography, farm sizes, and other important factors related to Barani farm areas. 35 villages were selected in these six areas, and interviewers visited them to obtain informal group interviews concerned with general social, economic and agricultural conditions prevailing. Then lists of farmers were drawn up and sampling was done on a random basis insofar as possible. 248 farmers were interviewed in depth. Information on many Barani crops was obtained, with concentrated attention on wheat, maize and groundnuts. Although the Project has conducted demonstrations on a number of improved techniques of crop production, the decision was made to limit detailed analysis to two: (1) use of new varieties of high-yielding (HYV) seed, and (2) use of chemical fertilizer.

B. Statistical Techniques of Analysis

The hypotheses which are the basis for the various statistical tests that are applied, are drawn from observations and tentative conclusions made by various research and extension personnel as a result of field experience. For instance, it is considered that new technology demands a more labor-intensive regime per acre at certain seasons, although it may release labor at other times. The new technology certainly requires more purchased farm inputs, which entail more outlays in cash or in kind by the farmer than was true with his desi operations. The new technology is accompanied by more risk in the absence of enough general or specific knowledge about the crop, the variety, the weather, and how to use the new farm inputs. Some factors which could be measured or numbered, and which might be expected to reflect the above and other like elements, were selected as variables which would account for the extent of adoption of the new productivity - boosting technology by the sample farmers. Not all suggested explanatory factors could be accommodated in this initial survey.

1. Variables Selected for Correlation Analysis.

a. Adoption of improved agricultural practices was the dependent variable used, and was based on actual change in the farmer's cultural methods.

b. Independent variables used, and hypotheses to be tested through the multiple correlation technique, were:

(1) Rainfall. Higher adoption rates are directly related to higher amounts of rainfall, since the farmer has less risk with more rain.

(2) Age. Older farmers are more traditional and will not choose to make the change to newer methods that younger farmers are willing to make.

(3) Education. Farmers who are more educated will more easily understand how they can benefit from adopting the new techniques.

(4) Mandi. The more distant the farm is located from a Mandi (grain or livestock market), the more difficult the farmer finds it to benefit from improving practices.

(5) Fertilizer Depot. The more distant the farm is from a depot, the harder the farmer finds it to purchase needed new farm inputs.

(6) Pucca Road. The further the farm is located from a Pucca (paved) road, the harder the farmer finds it to receive purchases and ship out products for sale.

(7) Farm Size. The larger the farm, the more resources the farmer will be able to utilize to initiate new practices.

(8) Irrigated Land. The more irrigated land the farmer manages, the more control he will have over soil moisture and the more likely he will be to take chances with new technology.

(9) Small Animals. The more small animals the farmer owns, the less likely he is to be interested in improving crop technology which appears to him to be aimed at less fodder production.

(10) Large Animals. The more draft animals owned by the farmer, the greater the likelihood that he will be able to improve his crop practices and adapt new machines that are needed.

(11) Tractor. If the farmer has access to a tractor, it is likely that he will be interested in adopting new practices, where the tractor and associated machines are well suited to production.

(12) Remittances. The larger the amounts that family members with off-farm positions send back to the farm, the more that the farmer will have available to invest in new technology--inputs, or machines.

(13) Plot Yields. If a farmer knows that a demonstration plot gave a greater yield than a check plot using traditional practices, he is in a better position to decide to adopt the new practices.

(14) Rabi Harvest Labor. If the farmer has more workers available for use in the fields, he will probably be more willing to adopt the new practices which may need more labor per acre.

(15) Kharif Harvest Labor. The same argument may apply as with Rabi labor.

(16) Plot Number. A farmer who has had more demonstration plots on his farm will be more likely to be receptive to improved technology.

(17) Harvest, Thresh, Weigh. On a farm where government agents have been active in participating in the harvest operations, the farmer is more likely to be receptive to adoption of the new practices.

(18) Sow, Fertilize, Weed. Where government agents have been active in participating in the seeding and production operations, the farmer is more likely to be an adopter.

2. Correlation Analysis

a. Simple Linear Correlation

Simple correlation is basically a measure of relationship between two variables, and the larger the absolute value of the correlation coefficient r, through a range from 0 to ±1,

the closer the relationship. The correlation relationship does not tell us whether one factor is dependent on the other.

b. Multivariate Analysis

The multiple correlation coefficient measures the joint relationship between one variable and two or more other variables. In this way, if there is any autocorrelation between the independent variables, the net effect of all independent variables is roughly measured.

c. Dummy Variables.

The use of so-called dummy variables was undertaken when the data were qualitative. For instance, non-adoption was coded arbitrarily as "0", weak adoption as "1", intermediate adoption as "2", and strong adoption as "3" (See Appendix A).

Some independent variables were also converted into dummy form-- use of tractor, farmer knowledge of greater plot yield, whether farmer had had a demonstration plot, and participation of government agents in the various seasonal crop occupations in the field of the farmer. (See: Hubert M. Blalock, Social Statistics (2nd Ed.) 1972, Sec.20.4 "Dummy Variable Analysis".) All these variables were coded as "0" for NO and "1" for YES.

Interpretation of results when both dependent and independent variables are used as dummy variables, must be carefully made. Because of the poor distribution pattern of the dependent variable, the values of the coefficients of correlation must be large in order to be depended upon. A value which is statistically significant but small, is unreliable and should be assumed to be the same as one that is not significant.

The value of a coefficient derived from these variables can be crudely identified as a number representing the probability of happening.

d. Multicollinearity

With the use of multiple regression analysis, one always faces the problem of multicollinearity. It could be expected that there will be some relationship between various independent variables, and in some cases there may be a very strong relationship. Multicollinearity decreases the reliability of some or all of the regression coefficients, and increases the standard errors of the coefficients.

Luckily, the problem does not appear too serious in the present case. The correlation matrix for the combined provinces was observed, and four cases of moderately close variation were identified. No cases gave an *r* as high as 0.90. For all cases together, only the relation of distance to depot to distance to Mandi gave as large an *r* as 0.80. For the demonstration farms only, there was a close relationship between Rabi harvest labor and Kharif harvest labor. Farm size related to RHL with an *r* of 0.86, and to KHL with an *r* of 0.81. RHL and KHL were related by an *r* of 0.82. These few relationships will be recalled when an interpretation of the calculations is made.

It has been suggested that, where there is serious collinearity, factor analysis (principal components analysis) would be applicable. In this process, the correlated variables are combined into single variables, and then an interpretation must be found for the relationship that is uncovered. Unfortunately, this analysis was not included in the SPSS package of programs used by the Islamabad University Computing Center, where the present statistical computations were carried out.

3. Chi Square

This test is used to determine if a certain distribution of data differs from some predetermined theoretical distribution. While this test is useful, it is not as powerful as a regression coefficient because it does not give a quantitative estimate of the influence of one variable on another.

4. Difference of Means

In some cases, groups of data are most easily tested for significant differences by using the t-test in a difference of their two means, especially where the sample is small and the distribution therefore likely to be distorted. If there is a significant difference, then it suggests some underlying factor being responsible. Again, this test is not as powerful as the correlation measures that can be used where such data is measurable.

C. Profile of Typical Farmer Interviewed

The discussion in this section is based primarily on the data shown in Appendix B. A t-test was made of the differences in the means for various variables, and the result reported in Appendix B. Farmer age averaged 44-46 years. His formal education averaged from 3 to 4-1/2 years, with adopters showing a higher number of years of formal schooling than did non-adopters, the difference being statistically significant. Adopting farmers also had slightly significantly more persons in their households (9.5) than did non-adopters (8.2). In respect to nonfarm labor of family members, from 0.9 to 1.1 members worked at nonfarm occupations.

On the average, all farmers had access to one or more tractors. Adopting farmers reported that remittances from members working at nonfarm occupations amounted to Rs. 454 per month, significantly more than the Rs. 239 reported by non-adopters.

Farm location with respect to towns was also measured. Distance to the nearest Mandi averaged 8 miles for adopting farmers and 14 miles for non-adopters. Distance to the nearest depot for farm supplies averaged 11 miles for adopters and 17 miles for non-adopters. Miles to the nearest pucca road averaged approximately 4 miles for both adopters and non-adopters.

The number of nonadjacent pieces of land making up an operating farm unit vary with the area of location, but averaged 7 for adopters and 11 for non-adopters. Acres of Barani land per farm averaged approximately 12.5 for both adopters and non-adopters. Adopters had almost 1.5 acres of irrigated land, while that for non-adopters was negligible. The numbers of buffalo, maintained mostly for milk, averaged over 1 per farm for adopters and only 0.5 for non-adopters. Bullocks for draft purposes averaged 1.5 on adopters' farms and about 1 on non-adopters' farms. Numbers of sheep and goats per farm averaged 6.8 on non-adopters' farms, and only 3.3 on adopters' farms.

In general, the above profile shows small farms comprised of small pieces of land, large families, farms located some distance from town, a variety of livestock, and "surplus" family members earning income away from the farm.

Definitions of "Adoption"

Farmers were divided into adopters and non-adopters--if a farmer had a demonstration plot but did not improve practices on his fields, he was grouped with the non-adopters. As stated above, "adoption" was confined to use of HYV seed and chemical fertilizers.

The adopter group was subdivided into three subclasses: strong; intermediate; and weak. The strong adopters usually used both improved seed and fertilizer. They usually had large increases (over 10%) for at least one year in improved seed and bags of fertilizer used; on small farms an increase of over 1 acre of improved seed and of over 1 bag of fertilizer would be expected (see Appendix C).

The intermediate adopters usually involve farmers who could be classified as strong for one of their inputs, and weak or nil for the other input. The weak adopters would include farmers who (1) adopted a few improved practices only in one year, or (2) increased acres of improved seed or of bags of fertilizer by less than 10%, or (for small farms) by less than 1 acre, or by less than one bag of fertilizer (see Appendix D).

D. Agroclimatic Description

1. Vegetation

The natural plant cover has been altered by cultivation, grazing and livestock trailing. Thorny shrubs have increased at the expense of desirable grasses and shrubs. Vegetation in the Lower Swat Valley is of the bunchgrass-chir pine type. In the Abbottabad area, vegetation changes to the mixed grass-thornbrush type, and in the Kohat area, the bunchgrass-thornbrush.

2. Soil Type

In the Lower Swat Valley, soil types vary from "bad land" to mountain land with shallow colluvial soils. Near Rawalpindi, alluvial and loess soil types vary from "bad land" to gullied land. Near Kohat, soil types vary from shallow residual soils of rock plains, to low mountain land with shallow colluvial soils .

3. Land Use

A part of the land surface has been eaten away by gulley erosion, leaving the rest as table-land; the latter, with some valleys, comprises the principal cultivated area. Due to heavy pressure of human and animal population, soil erosion is a major problem, large areas are subject to landslides, and the clearing of shallow soils on steep slopes for cultivation is compounding the soil problems. In addition, heavy grazing by all animal classes has resulted in the disappearance of the desirable mix of grass, shrubs and trees.[3/]

4. Precipitation

Areas included under the term "Barani" have a wide range in rainfall pattern. Data on precipitation for six Barani weather stations are shown in Table 1, and give a range from 6 to 19 inches for the year. (Even less than 6 inches can produce a good wheat crop if the seasonal distribution is satisfactory).

5. Rainfall and Adoption

In Table 2 are shown the basic data comparing amount of Rabi rainfall with the proportion of the farmers who were classified as adopters-- that is, those who adopted the new practices (in most cases, adopters were classified based on their performance with their wheat crop). A straight-line regression was calculated between amount of precipitation, and % of farmers. The resulting equation is cast in the form $Y=a+bx$.

3/ "Report of the Punjab Barani Commission," 1976.

TABLE 1. PRECIPITATION IN BARANI AREAS

Province	District	Tehsil/Markaz	Reporting Station	Years Used	Annual (inches)	Rabi[a/] (inches)	S.D.
Punjab	Attock	Pindigheb	Pindigheb	1946-60	20.0	6.1	2.8
Punjab	Jhelum	Chakwal	Chakwal	1946-60	21.0	6.2	2.3
Punjab	Rawalpindi	Chauntra	Rawalpindi	1946-60	36.0	9.9	3.4
N.W.F.P	Kohat	Karak	Kohat	1960-74	18.0	7.6	3.2
N.W.F.P.	Abbottabad	Haripur	Haripur	1960-74	37.0	11.0	3.9
N.W.F.P.	Swat	Matta	Oghi [b/]	1960-74	42.0	19.1	3.9
		Khwaza Khela					

NOTE: S.D. means Standard Deviation.

a/ Monthly total from October to March.

b/ Proxy for Lower Swat.

TABLE 2. RAINFALL AND FARMER ADOPTION

Area	Rabi Precipitation (inches)	Sample Farmers who are Adopters (%)
Pindigheb	6.1	38
Chakwal	6.2	50
Kohat	7.6	51
Rawalpindi	9.9	45
Haripur	11.0	78
Swat	19.1	98

NOTE: r = 0.91.

% Adopters = 17.24 plus 4.28 (inches rainfall). The high coefficient of correlation suggests that there is a high relationship. (One must always keep in mind that inter-relation between variables may be obscured when only one factor is tested.)

II. PARTICIPANT PROFILES: SOCIAL CHARACTERISTICS

A. Age

In Table 3, the average ages of the farmers interviewed is given, varying by district from 43 to 50 years. The view has often been expressed that when Barani farmers find they cannot make an adequate living for their families on their farms, they leave to take work in the cities of Pakistan or in foreign countries. The conclusion then drawn is that Barani farms must be managed by old men and by women. Table 4 has then been prepared to compare sample farmers with rural males identified for the comparable areas in the 1972 Census.

TABLE 3. AGES OF SAMPLE ADOPTER FARMERS

District	Average Age	Standard Deviation
Attock	47.2	13.0
Jhelum	47.9	11.9
Rawalpindi	45.2	13.2
Abbottabad	47.8	15.3
Kohat	50.4	12.8
Swat	43.0	10.0
All Farmers	46.1	12.5

TABLE 4. COMPARISON OF AGES AND NUMBERS OF SAMPLE FARMERS WITH RURAL MALES (CENSUS)

Age Group	Swat		Kohat		Rawalpindi		Jhelum		Attock		Abbottabad		All	
	Total Rural Males	Sample Farmers	Total Rural Males	Sample Farmers	Total Rural Males	Sample Farmers	Total Rural Males	Sample Farmers	Total Rural Males	Sample Farmers	Total Rural Males	Sample Farmers	Total Rural Males	Sample Farmers
	Percent													
20-29	27	15	31	3	30	10	27	13	29	13	29	16	28	11
30-39	24	29	22	17	23	27	22	25	23	26	23	21	23	25
40-49	19	26	18	26	18	23	18	25	18	22	18	18	18	24
50-59	13	26	14	26	13	18	14	23	13	18	13	15	13	22
60-69	10	2	9	23	9	13	11	15	10	13	10	18	10	12
70 & over	7	2	7	6	7	10	9	0	7	8	8	13	8	6
	100	100	100[a]	100[a]	100	100[a]	100[a]	100[a]	100	100	100[a]	100[a]	100	100
No. in Sample:		53		35		40		40		40		40		248
No. in Census (thousands)		109		37		76		80		64		207		537

a/ Totals may not sum to 100 because of rounding.

NOTE: Barani farmers in the sample have less men in the 20-29 age group than is true of the census group, and more in every other age group up through the 60s. The farmers who are still active in farming were the group from which the sample was taken. A preponderance of these farmers are obviously in their most productive years of life, regardless of the losses from the lower age groups.

B. Education

The amount of formal education achieved by the sample farmers is shown in Table 5. About half the farmers interviewed had had no formal schooling. About a quarter of them had reached the middle school category, and 10% of them had neared or reached the matric level.[4/]

The proportion of literate farmers in the sample varies by district, with the lowest percent being in Swat and Attock.

4/ Rate of adopters was found to be related to level of education in the survey reported in Appendix E.

TABLE 5. EDUCATION OF FARMERS

District.	Swat	Kohat	Rawalpindi	Jhelum	Attock	Abbottabad	All Groups
No. Interviewed	53	35	40	40	40	40	248
	Percent						
Years of Schooling Completed							
0	67	54	33	43	64	44	52
1-4	5	3	8	0	3	18	6
5-8	13	29	42	40	18	20	26
9-10	4	9	15	10	13	13	10
11-12	4	0	3	3	0	3	2
13-14	0	3	0	5	3	3	2
15 and over	8	3	0	0	0	0	2
Total	100	100 a/	100	100 a/	100 a/	100 a/	100

a/ Totals may not equal 100 because of rounding.

C. Family Size

Families of adopting farmers varied in size from 7.4 in District 5 to 12.2 in District 4. Non-adopting farmers varied from 6.4 in District 3 to 12.8 in District 4. Overall, adopter families were significantly larger than non-adopters.

In Table 6, a comparison is made between the distribution of adopting and non-adopting farmers' family sizes. There is a significant difference in the distribution of family sizes in the two groups. The observed frequencies of adopting farmers are larger than expected for the larger family size classes. One might speculate that the larger families, even when they do not all live on the farm, have more members available to be called home for the busy seasons, particularly for harvesting and threshing. Tests show, however, that this was not the case - significantly less family labor was used by adopters in harvesting than by the non-adopters. The use of family labor for threshing was the same, statistically, for the two groups.

TABLE 6. SIZES OF FAMILIES

No. of Family Members	Adopters		Non-adopters		Total
	O a/ 1	E b/ 1	O a/ 2	E b/ 2	
4 and under	12	15	11	9	23
5-8	57	67	51	41	108
9-12	60	49	19	30	79
13-16	15	14	7	8	22
17-30	8	7	5	5	13
Total	152	152	93	93	245

NOTE: χ^2 = 11.3 - Significant at .02 level. For a discussion and examples of levels of significance, see: Domie and Heath, Basic Statistical Methods, Chapter 14, "Chi Square".

a/ Observed data

b/ Expected distribution

Table 7 with "productive" ages in the family finds 70% of the families having from 3-7 members in the "productive" age category (male and female), with another 15% having 1-2 persons, and 10% having 8-10 persons in this category. If all these adults were available for full-time work on the farm, there would be surplus labor available on the small farms. However, from Table 8 it can be inferred that the majority have 1 and 2 members living away from the farm.

In the "dependent" age categories (0-10, and over 50), the three groups (1-2-3-4, and 5-7) are about equally divided, accounting for about 90% of the total families (Table 7). While a number of the younger children, and of those over 70, cannot provide full field labor, the farm and family assistance provided by the active members of this group, especially where livestock is concerned, can be considerable.

D. Off-Farm Income

Table 8 shows that over 30% of the farmers have no family members earning off-farm income, while 10% of them report either 3 or 4 family members that are earning such incomes. This does support the reports that large numbers of the Barani farm population leave the farms where they cannot earn an adequate living, and find positions elsewhere.

Table 9 addresses another question: What is done with the off-farm income earned by family members? Of the 158 family members earning such income, 92% of them send some of that income back to the Barani families. Approximately 3/4 of these remittances are Rs.500 per month or less. 10% of such remittances are Rs.2000 per month or more, providing a substantial supplement to the on-farm earnings of the Barani families. The other major cash income sources for Barani farms are (1) sale of animals and animal products and (2) sale of cash crops. Any Barani family, especially those on smaller farms, faces the decision each season - how much income to invest in farming operations, and how much to use on family consumption.

TABLE 7. SIZES OF RURAL BARANI HOUSEHOLDS

District	Swat		Kohat		Rawalpindi		Jhelum		Attock		Abbottabad		Total	
No. of Persons	P a/	S b/	P a/	S b/	P a/	S b/	P a/	S b/	P a/	S b/	P a/	S b/	P a/	S b/
	Percent													
0	0	0	0	0	0	5	3	5	0	0	0	0	--	2
1-2	15	19	17	3	13	45	20	43	18	25	5	26	15	27
3-4	34	40	29	24	53	40	25	43	31	33	38	26	35	34
5-7	36	36	29	44	25	5	40	10	31	36	42	32	34	27
8-10	8	6	11	18	10	5	13	0	15	3	13	13	11	7
11-15	6	0	9	9	0	0	0	0	5	3	3	0	4	2
16-20	2	0	6	3	0	0	0	0	0	0	0	3	1	1
Total	100 c/	100 c/	100 c/	100 c/	100 c/	100	100 c/	100 c/	100 c/	100	100 c/	100	100	100
Farmers Reporting:	53		35		40		40		39		40		247	

a/ Persons in the "productive" ages, 11-50.

b/ "Supplementary" workers and dependents, 0-10 and over 50.

c/ Totals may not equal 100 because of rounding.

TABLE 8. FAMILY MEMBERS EARNING OFF-FARM INCOMES

Number of Friends as Laborers	Adopters		Non-Adopters		Total
	O	E	O'	E'	
0	80	79	47	48	127
1-2	34	26	7	15	41
3	15	14	8	9	23
4-5	8	10	8	6	16
Over 5	18	26	23	15	41
Total	155	155	93	93	248

NOTE: $\chi^2 = 14.7$, Significant at .01 level

TABLE 9. OFF-FARM INCOMES OF FAMILY MEMBERS

Number of Friends as Laborers	Adopters		Non-Adopters		Total
	O	E	O'	E'	
	60	66	45	39	105
1-3	36	26	5	15	41
4	17	14	5	8	22
5	12	11	5	6	17
Over 5	30	39	33	24	63
Total	155	155	93	93	248

NOTE: $\chi^2 = 21.3$, Significant at .001 level.

146 farmers reported receiving some income from off-farm sources, whether through the efforts of the farmer himself, or of his family. Table 10 attempts to relate off-farm income to the rate of adoption of new technologies by the farmer. The straight-line regression between % of farmers receiving off-farm income, and adoptions of new practices, gives a correlation coefficient of 0.71. When the % of farmers receiving higher off-farm incomes is related to adoptions, a higher correlation coefficient is calculated. (Swat is not included because of its special characteristics.)

In Table 11, the Chi Square test is used to test whether or not adoption is independent of off-farm income. The test indicates that adoption is not independent of income. The level of significance is indicated in the table, as it will be in other tables where the Chi Square test is used. Adopters receive a larger proportion of the larger remittances than do non-adopters. (In all Chi Square tables in this report, the O represents the actual data and the E represents the theoretical distribution.) The t-test for difference between means also indicated that adopters receive significantly more non-farm income than non-adopters.

TABLE 10. ADOPTION AND FARM REMITTANCES

	Koha	Rawalpindi	Jhelum	Attock	Abbottabad	r for Adopters
% Farmers Adopting New Practices	51	45	50	38	78	
% Receiving off-Farm Income	46	65	65	63	88	0.71
% Receiving over Rs.200 per month of off-farm Income	29	40	38	43	73	0.81

TABLE 11. REMITTANCE OF INCOME FROM OFF-FARM SOURCES

Income (Rs.per month)	Adopters O 1	Adopters E 1	Non-Adopters O 2	Non-Adopters E 2	Total
1-500	58	65	46	38	104
Over 500	34	27	8	16	42
Total	92	92	54	54	146

NOTE: $X^2 = 8.3$, significant at the .005 level.

III. FARM CHARACTERISTICS

A. Farm Fragments and Farm Size

The number of fragments per farm varies from as little as 2.0 in one district to 19.4 in another (Appendixes C and D). There is a distinct difference between provinces, with an average of 3.2 fragments per farm in the N.W.F.P. and of 12.7 in the Punjab. The size of farm, however, is larger in the Punjab than in the N.W.F.P. The result is an average fragment size of 1.1 acres in the Punjab and of 2.4 in the N.W.F.P.

The relation of number of fragments per farm to adoption is shown in Table 12. The value of the test statistic indicates it is highly unlikely that adoption is independent of fragmentation. For farms with 1 to 8 fragments, more farmers favor adoption. For farms with nine fragments or more, more farmers favored non-adoption. It is likely that the farmer with less fragments, other things being equal, has a better farm to manage and has better control of his resources. If this is so, he would be more likely to favor adoption of improved technology.

TABLE 12. FRAGMENTS OF LAND PER FARM

No of Fragments	Adopters		Non-Adopters		Total
	O 1	E 1	O 2	E 2	
1-2	45	40	18	24	63
3-4	44	40	20	24	64
5-6	25	22	10	13	35
7-8	17	13	4	8	21
9-14	9	16	16	10	25
15-20	8	12	12	7	20
Over 20	7	12	13	7	20
Total	155	155	93	93	248

In Table 13 farm fragment number and size are compared for two districts in the N.W.F.P. The comparisons are drawn from a survey done in 1962 as well as the present survey; the latter containing only Barani farms, while the former had irrigated farms also.

There is a drop in average number of fragments for both districts, probably due to the effect of time as increasing family numbers force the reduction in size of farm. Acres per fragment decrease for Kohat but appear larger for Hazara.

In Table 14 the districts are all compared for adopters and non-adopters. In each of the 5 districts that can be compared, the adopters have substantially larger amounts of land per fragment than do the non-adopters. Such a circumstance is likely to have persuaded the adopters to offer an area for a demonstration plot.

TABLE 13. FRAGMENTS PER FARM AND ACRES PER FRAGMENT
(Two Districts in the N.W.F.P.)

District	No. of Fragments				Acres per Fragment			
	Survey I a/	Survey II b/			Survey I a/	Survey II b/		
		A c/	NA d/	All		A c/	NA d/	All
Kohat	5.0	2.9	2.9	2.9	4.1	4.0	3.1	3.6
Hazara	4.0	4.3	2.0	3.8	1.6	2.8	1.2	2.4

a/ Christoph Beringer and Abdul Hadi, "Land Fragmentation and Size of Agricultural Holdings in the Former North-west Frontier Province of West Pakistan", 1962, Board of Economic Enquiry-N.W.F., Peshawar University.

b/ The present Impact Survey.

c/ Adopters

d/ Non-adopters

TABLE 14. ACRES PER FRAGMENT -- ALL DISTRICTS

District	Acres	
	A a/	NA b/
Abbottabad	2.8	1.2
Kohat	4.0	3.1
Swat	1.5	--
Attock	4.2	1.5
Jhelum	1.8	1.1
Rawalpindi	1.2	0.7

a/ Adopters

b/ Non-adopters

Amount of Barani land varies for adopters from 2 acres in one district to 40 acres in another, and for non-adopters from 2-1/2 acres in one district to 17 acres in another. Adopting farmers appear to have more small farms, with large numbers having 1-4 acres of Barani land, while the bulge for non-adopting farmers is in the 9-12 1/2 acre categories 5/ (Tables 15A and B)

5/ The interesting question of how much of the small Barani farms is actually the richer, intensively-cropped 'Lippara' land, other than the 'Maira' land, was not covered in this study.

TABLE 15. BARANI LAND PER FARM

A. All Sizes

Acres	Adopters O	Adopters E	Non-Adopters O	Non-Adopters E	Total
	1	1	1	1	
1-2	40	31	9	19	49
3-4	26	25	12	15	38
5-6	19	19	11	11	30
7-8	17	17	10	10	27
9-10	7	14	16	8	23
11-12	9	12	11	7	20
13-25	22	22	13	13	35
Over 25	15	15	11	10	26
	155	155	93	93	248

NOTE: χ^2 = 18.6 - significant at .01 level.

TABLE 15. BARANI LAND PER FARM . . . . (continued)

B. Small/Large

Acres	Adopters		Non-Adopters		Total
	O 1	E 1	O 2	E 2	
1-8	102	92	42	55	144
9 & Over	53	63	51	38	104
	155	155	93	93	248

NOTE: χ^2 = 12.7 - significant at .001 level.

Adopters reported having an average of slightly over one acre of irrigated land per farm, while non-adopters averaged only one-eighth of an acre. A high proportion of non-adopters reported no irrigated land at all (Table 16), while adopters also reported a large number with over 2 acres irrigated. If a farmer has some irrigated land, he may be more willing to experiment with new techniques. Some adopters reported their interest in new crop varieties that do well under both irrigated and Barani conditions.

The total cultivated land per farm is given in Table 17.

TABLE 16. IRRIGATED LAND ON FARMS

No. of Acres Irrigated	Adopters O 1	Adopters E 1	Non-Adopters O 2	Non-Adopters E 2	Total
0	69	93	80	56	149
1-2	21	19	8	11	29
Over 2	65	43	5	26	70
Total.....	155	155	93	93	248

NOTE: χ^2 = 44.7 - significant at .001 level.

TABLE 17. CULTIVATED LAND PER FARM

No. of Acres (Class)	Adopters O	Adopters E	Non Adopters O	Non Adopters E	Total
1-2	17	16	9	10	26
3-4	32	26	10	16	42
5-6	19	18	10	11	29
7-8	18	18	10	11	28
9-10	17	22	18	13	35
11-12	12	14	10	8	22
13-25	26	25	14	15	40
Over 25	14	16	12	10	26
Total	155	155	93	93	248

NOTE: χ^2 = 8.0 - not significant.

B. Farmer Tenure

As can be seen in Table 18, the sample farmers are very heavily concentrated in the "owner" category, with small numbers of owner/tenants and even fewer of "tenants". 6/ The visibility of owners is probably greater during interviews, and this accounted for some unconscious bias in the sampling process. (If owners are over-represented in the sample, then this bias would be reflected in certain attitudes, such as the farmer reaping the full benefit when he takes a chance on improved technology. He would also be free to make such a decision.)

6/ Farm ownership was found related to rate of adoption as reported in Appendix E.

TABLE 18. FARMER TENURE

	Districts						All Groups
	Swat	Kohat	Rawalpindi	Jhelum	Attock	Abbottabad	
No. Interviewed..	53	55	40	40	40	40	248
	%	%	%	%	%	%	%
Type							
Owner...	92	100	90	85	54	84	85
Owner/Tenant	8	0	10	15	28	8	11
Tenant...	0	0	0	0	18	8	4
Total	100	100	100	100	100	100	100

C. Cropping Patterns

In Table 19, cropping patterns for the different sample areas are compared. It is interesting to note, for example, the relatively high proportion of maize produced in Hazara, and the declining amounts of maize acreage in other districts as Bajra and Jowar increase their proportions. (All three crops are often harvested for fodder if animal feed is scarce and the season is not long enough to mature the crop.)

D. Mechanization

Table 20 gives an index of the mechanization used on farms. It shows that there is significantly more use made of tractors on farms which adopt the new practices. On the other hand, there are not significantly more plows owned by adopters than by non-adopters. (Further research needs to be done on the operating and maintenance costs of various sized tractors compared with bullocks).

IV. DATA ON CROP LABOR AND LIVESTOCK

A. Crop Labor

Appendix F, Tables 1-15 have given much information on the use of the various kinds of labor during the busy Rabi crop seasons of sowing, harvesting and threshing. All the tables are designed with the purpose of finding differences between adopters and non-adopters in the utilization of their labor force. Family labor seems to be utilized in most cases in about the same way, whether the farmer is an adopter or a non-adopter. Labor from relatives is significantly different for adopters than for non-adopters, with adopters often having none or only small numbers of relatives working on their fields.

TABLE 19. CROPPING PATTERNS IN BARANI AREAS

Crop Acres	Hazara District	Kohat District	Rawalpindi District	Attock District	Jhelum District
	%	%	%	%	%
Rabi	100	100	100	100	100
Wheat	86	79	83	87	87
Gram	1	12	4	7	5
Pulses	1	--	1	--	1
Fodder	4	2	7	--	2
Oilseeds	4	4	3	3	4
Vegetables	1	1	1	1	
Other Crops	3	2	1	2	1
Kharif	100	100	100	100	100
Cotton	--	--	3	1	2
Sugarcane	--	1	4	--	--
Rice	4	1	6	--	1
Maize	34	29	10	7	2
Jowar) Bajra)	2	44	38	53	50
Pulses	3	6	7	2	6
Fodder	3	15	24	29	24
Oilseeds	--	2	7	8	14
Vegetables	2	1	1	--	1
Other Crops	2	1	-	--	--

Source: Census of Agriculture, 1972.

TABLE 20. USE OF TRACTORS

Use Reported	Adopters		Non-Adopters		Total
	O 1	E 1	O 2	E 2	
Yes	126	109	48	65	174
No	29	46	45	28	74
Total...	155	155	93	93	248

NOTE: $\chi^2 = 23.6$
Significant at .001 level.

A contrast in the use of hired labor is evident between adopters and non-adopters. Adopters appear to hire significantly more labor, and to hire more labor per farm, than do non-adopters. This suggests the availability among adopters of more resources, both financial and land, than for non-adopters. It may also suggest a more commercial attitude toward farming, with hired labor used when it is financially beneficial. It also suggests that adopters usually are using their labor resources to their utmost limit, and must supplement with hired labor during the busy seasons. When all labor, employed or other, is included, there is not a significant difference between adopters and non-adopters.

Data on busy season crop activity in relation to land resources, are given in Table 21. (It is assumed there that, while not all cultivated land is planted to wheat, wheat acreage reflects the total cultivated acreage, increasing when total acreage increases.) Total seasonal labor has been averaged

and related to acreage of cultivated land. For either threshing or harvesting, approximately twice the labor per acre is used than is the case for sowing; these relationships apply to both adopters and non-adopters. The new technology puts even more pressure on farm labor resources, possibly until the farm becomes fully mechanized.

TABLE 21. ACRES OF CULTIVATED LAND AND LABOR USED

District:	A[a]	NA[b]	A[a]	NA[b]	A[a]	NA[b]
	Abbottabad		Kohat		Swat	
Crop Activity	acres per person					
Sowing Wheat	2.6	1.0	3.0	2.3	1.5	--
Harvesting	1.0	0.8	1.9	1.8	0.6	--
Threshing	1.0	0.7	2.4	2.1	0.4	--
District:	Attock		Jhelum		Rawalpindi	
Sowing Wheat	4.1	1.7	2.4	2.9	2.1	3.1
Harvesting	1.4	0.8	1.1	1.2	1.0	1.1
Threshing	1.8	1.0	1.5	1.1	0.6	0.8
	All Districts					
Sowing Wheat	2.7	2.2				
Harvesting	1.1	1.0				
Threshing	1.0	1.0				

B. Livestock

Reporting farmers averaged one buffalo, one bullock and two cows per farm. (Appendix G). There are also 3-4 goats and sheep per farmer reporting. Animals furnish a bankable asset that can easily be converted into cash if needed, and hence they secure as one proxy for relative wealth or income.

Adopters owned significantly more draft animals (buffalo and bullocks) than did non-adopters. But adopters owned significantly more donkeys, cows, goats and sheep than did non-adopters. Non-adopters may be using animals to increase the earning capacity of their farm, since the investment is small and maintenance is cheap. It is also likely that non-adopters use milk cows as a way of increasing farm income. Also animals act as a ready cash reserve for emergencies, often needed.

V. LOCATION OF PARTICIPANTS AND FARMS

The location of the farm with respect to several places was noted, because such location may be an important consideration of the farmer, as it can determine his access to markets. Adopting farmers were located an average of 11 miles from the nearest fertilizer depot, while non-adopting farmers were located 16.8 miles away. Table 22 shows that adopting farmers were nearer to depots than the non-adopters, with most of the former located less than 10 miles distant, and a large group of the latter located over 30 miles away.

TABLE 22. DISTANCE TO FERTILIZER DEPOT

Miles to Depot	Adopters		Non-Adopters		Total
	O_1	E_1	O_2	E_2	
0-5	79	70	37	46	116
6-10	21	20	12	13	33
Over 10	39	49	41	31	80
	139	139	90	90	229

NOTE: $\chi^2 = 7.7$

Significant at .025 level.

Adopting farmers were an average of 8.2 miles from their Mandi, while non-adopters were 13.5 miles away. Table 23 shows adopters being concentrated in the under-10-mile distances, and non-adopters having much larger numbers in the 11-mile- and over categories.

Adopting farmers were on average of 3.7 miles from a pucca road, while non-adopters were 4.0 miles. (This was not a significant difference. See Table 24).

TABLE 23. DISTANCE TO MANDI

Miles to Mandi	Adopters		Non-Adopters		Total
	O_1	E_1	O_2	E_2	
Under 1	17	13	5	9	22
1-5	66	62	36	40	102
6-10	34	35	23	22	57
Over 10	22	29	26	19	48
Total.....	139	139	90	90	229

NOTE: $\chi^2 = 8.0$

Significant at .05 level.

TABLE 24. DISTANCE TO PUCCA ROAD

Miles to Pucca Road	Adopters	Non-Adopters	Total
Under 1	39	22	61
1-5	73	52	125
6-10	11	8	19
Over 10	16	8	24
Total.....	139	90	229

NOTE: $\chi^2 = 0.97$
Not significant.

VI. THE USE OF DEMONSTRATION PLOTS

A. Selection of Plots

The demonstration plot was selected as a prime tool in the process of educating the farmer in the use of the new technology. A plot should offer typical conditions of the area, and good access to the farmers of the neighborhood. Tables 25-26 present the farmers' view of the selection process. One can only conclude that personal factors did enter into the process, so that a random or objective basis for selection was not completely achieved. In Table 25, half the farmers who had demonstration plots on their farms felt that there were good objective reasons as to why their farm was chosen. In contrast, as shown in Table 26, half the farmers who had no demonstration plot felt that the selection of farm plots was biased and had no relationship to merit of the farm or farmer. Table 27 also lists briefly some farmer views about plots used for education.

TABLE 25. REASONS FOR FARMERS CHOOSING TO HAVE A DEMONSTRATION PLOT

	Swat	Kohat	Rawal-pindi	Jhelum	Attock	Abbot-tabad	All
	%	%	%	%	%	%	%
1. Farmer interested in improved methods: initiated project inquiries; progressive; interested in new seeds; owns tractor and tubewells; educated; cooperative society manager; agent buys his seed	18	27	23	13	20	12	18
2. Farmer only interested in free inputs.					9	2	3
3. Agent requested farmer's cooperation and promised him a plot	8	14	5	10	9	14	10
4. Farmer is good manager, hard worker, has servant; land is good for demonstrations; near roadside; near agent's office; land of high quality; near water.	51	45	51	49	36	48	45
5. Farmer used local influence, he is influential wants plot for prestige; big landlord; on good terms with agricultural officials; has influential friends; threatens to report officials to their superiors.	23	14	21	28	26	24	24
Total(%)	100	100	100	100	100	100	100
No. of Farmers.....	39	22	39	39	65	42	245

TABLE 26. REASONS FOR FARMERS CHOOSING NOT TO HAVE A DEMONSTRATION PLOT

	Swat %	Kohat %	Rawal-pindi %	Jhelum %	Attock %	Abbot-tabad %	All %
1. Farmer's land does not fit demonstration needs; not located alongside the road; only small pieces near road; best lands are irrigated; land not high quality.	20	29	15	64	25	25	28
2. Agent bypassed this farmer because agents work only with large, rich, influential farmers; farmer has no friends among officials; agent promises him a plot for next year or continues to refuse him a plot on some excuse.	72	33	33	23	35	50	41
3. Farmer showed no interest and took no initiative;only a poor farmer should receive free inputs, program information arrived too late or not at all; no time; not ready; inputs too small; does not want to eliminate sarson in wheat; small farmer takes major risk; agents might cause trouble because dishonest; plot needs hard work; farmer not on good terms with agent and finds difficult to approach	8	38	52	13	40	25	27
Total(%)	100	100	100	100	100	100	100
Numbers of Farmers (reporting).....	74	66	27	31	56	56	308

B. Opinions About Demonstration Plots as an Educational Tool 7/

1. Farmers who received demonstration plots thought that they were an excellent method of education.

2. Farmers who had not received demonstration plots, gave two responses:

   a) Some thought they were a good idea and expected to request a plot in the future;

   b) Some did not think they were very useful and would not request a plot.

Since the demonstration plot technique resulted in farmers obtaining free farm inputs from the government, in contrast with other educational methods which did not result in such free inputs. it is difficult for farmers to report that they do not prefer this method.

3. Radio programs were also a popular form of government education about agricultural techniques. Unfortunately, over 90% of the time on agricultural radio programs is taken up with the discussion of techniques on irrigated lands, and very little time is devoted to Barani farming.

7/ See Appendix H.

Table 27 shows the demonstration plots reported by the farmers interviewed. Plots totalled 173, with 83% of those reported for the Rabi season. The largest number of plots were located in Jhelum District, with the next largest number being located in Rawalpindi and Attock Districts, respectively. By seasons, the largest number of plots were reported for 1975-76 and 1976-77, with a slightly lesser number for 1977-78. Farmers did not report much plot activity before the 1975-76 season.

All Rabi plots were wheat; Kharif plots were maize and groundnuts.

TABLE 27. PLOTS REPORTED BY FARMERS

	Swat	Kohat	Rawalpindi	Jhelum	Attock	Abbottabad	Total
	%	%	%	%	%	%	%
1973-74 (Rabi) a/	7	0	17	12	0	0	9
1974 (Kharif) a/	0	0	2	0	0	24	2
1974-75 a/	0	0	2	7	13	8	6
1975 a/	0	0	2	7	0	0	3
1975-76	43	17	10	9	62	15	23
1976	0	17	7	4	0	15	5
1976-77	50	66	30	26	16	23	29
1977	0	0	7	6	6	15	6
1977-78	0	0	23	29	3	0	17
Total(%)	100	100	100	100	100	100	100
Number of Plots (total)	14	6	41	68	31	13	173
Rabi	14	5	33	56	29	6	143
Kharif	0	1	8	12	2	7	30

a/ During these seasons there was a demonstration plot program operated directly by USAID.

C. Cooperation in Demonstration Plots

Of the 88 farmers who cooperated in the plot demonstrations, 66 became adopters of the new practices and 22 became non-adopters. (See Appendix A). Tables 28 and 29 record the extent to which government officials as well as the farmers themselves participated in the various activities necessary for a successful demonstration plot.

A higher proportion of government officials in Table 28 participated in site measurement and crop harvesting for non-adopters, in some cases without the active participation of the farmer.

In Table 29, a higher proportion of adopting farmers participated in site choice, harvesting, threshing and weighing the crop yield. These activities showed that adopting farmers were interested in the results of the demonstration, and hence took an active part.

TABLE 28. GOVERNMENT COOPERATION IN DEMONSTRATION PLOTS

Plot Activity	Adopters(%)	Non-Adopters(%)
Choosing Site	100	100
Measuring Site	79	100
Sowing Crop	38	32
Fertilizing Crop	58	32
Weeding Crop	20	18
Harvesting Crop	42	73
Weighing Yield	45	41
Number of Farmers	66	22

TABLE 29. FARMER PARTICIPATION IN DEMONSTRATION PLOTS

Plot Activity	Adopters(%)	Non-Adopters(%)
Choosing Site	44	14
Measuring Site	67	77
Preparing Plot	100	100
Sowing Crop	97	95
Fertilizing Crop	85	100
Weeding Crop	50	55
Harvesting Crop	98	91
Threshing Crop	97	91
Weighing Yield	85	59
Total Farmers(No.)	66	22

D. Benefits Furnished to Demonstrators/Adopters

The first benefit that comes to the demonstrator is that he is furnished free seed and fertilizer for a part of his crop.

The long-run benefit comes from the increase in yields per acre. Actual yields reported for demonstrations are given in Table 30. Increase in yield varies from 5-17 maunds per acre. (Note that the increase for Rawalpindi compares closely with that reported in a completely separate series of trials carried out by another organization.)

Details of the added costs estimated to obtain the increased yields, are shown in Table 31. Increases in net income are then calculated in Table 32, and appear substantial for all areas except for Kohat.

TABLE 30. WHEAT YIELDS ON CONTROL AND DEMONSTRATION PLOTS

District	No. of Demonstrations Reported a/	Control $\bar{x}$	Control S.D.b/	Demonstration $\bar{x}$	Demonstration S.D.	Increase $\bar{x}$
		----------maunds per acre----------				
Abbottabad	23	13.6	6.2	26.4	10.4	12.8
Attock	28	12.0	4.8	20.0	6.4	8.0
Swat	27	13.6	4.8	24.0	6.4	10.4
Kohat	4	15.2	2.0	20.8	4.0	5.6
Rawalpindi	18	16.8	8.8	33.6	14.4	16.8c/
Jhelum	22	12.8	4.8	24.0	9.6	12.2
All Districts	122	14.0 d/		24.8d/		10.8 d/

a/ Farmer sometimes reports demonstration of his friends

b/ Standard deviation

c/ Rawalpindi also reports 16.49 maunds, given in "Wheat-Results of Fertilizer Demonstrations, Rabi 1975-76", (Progressive Extension Services Report, Karachi)

d/ Unweighted average

TABLE 31. COSTS OF INCREASED WHEAT YIELD OBTAINED FROM DEMONSTRATIONS a/

	Cost(Rs.Per Acre)
Seed Wheat @ 1 maund per acre (price over that of desi)...	25-00
Fertilizer: 1 bag Urea @Rs.75 per bag; 1 bag DAP @Rs.75 per bag } Total	150-00
Fertilizer: Transportation and application..	3-00
Harvesting Costs for heavier yield(over costs for Desi).... ...	50-00
Total Per Acre Added Cost.....	228-00

a/ For basic cost figures, see: "Cost of Production of Major Crops" (Average Leading Farmer, Punjab, in 1975-76), AGR-135, Planning Division, Government of Pakistan, December 1976.

TABLE 32. NET INCOME INCREASES FROM WHEAT DEMONSTRATION PLOTS

District	Yield Increase (Mds/Acre)	Income Increase (Rs./Acre) a/	Cost Added (Rs./Acre)	Net Income Increase (Rs./Acre)
Abbottabad	12.8	473.6	228.0	245.6
Attock	8.0	296.0	228.0	68.0
Swat	10.4	384.8	228.0	156.8
Kohat	5.6	207.2	228.0	-20.8
Rawalpindi	16.8	621.6	228.0	393.6
Jhelum	11.2	415.4	228.0	186.4
All Districts	10.8	399.6	228.0	171.6

a/ Official price of Rs. 37 per maund was used.

E. Farmer Observations Concerning Demonstrations and Programs

Appendixes H and I contain farmer reactions to the results of extension programs and demonstrations which they had either seen or heard about. There is some duplication among the tables, since different questions were often answered in the same way. Appendix H, Tables 1 and 2 are reactions to "successful" demonstrations--those where the demonstration plot had a better appearance than the adjacent control plot. Over a third of the respondents attributed the good results to a good rainfall pattern, in addition to the seed and fertilizer. Another sizeable group pointed out the associated better cultural practices, suggesting that without these, the demonstrations would not have been as successful.

Where the demonstrations were, in the view of the farmer, unsuccessful, there were a number of reasons given. Experimental varieties not adapted to local conditions were often given as a reason -- to this could be added improper cultural practices which suited neither the variety nor the local conditions. Timing and amount of rainfall were

an overwhelming reason in a number of cases. In many cases, farmers did not accept the new varieties as equal to old varieties for consumption either of grain for their families or straw for their livestock.

VII. ADOPTION AND NON-ADOPTION

A. Adoption and Demonstration

The spread effects illustrated here may be due to other initiating factors in addition to the Barani Project. The over-all aspect was considered at all phases of this study, and the general view needed when future programs of farmer education and assistance are planned, was brought in when considered appropriate. By the nature of its primary interest, however, this study emphasises the relationship of Barani farmers to various aspects of the Barani Project, either actual or planned.

In Table 33, for the 248 farmers interviewed, there had been 88 demonstration plots used over the period since Rabi 1972-73, and 155 adoptions of improved practices (a few of them temporary). In fact, adoptions were 63% of the total farmers reporting, far outweighing the non-adopters. However, this over-all adoption rate varied by district, from the 98% rate for the Swat farmers reporting to the 38% of sample farmers in Attock. It should also be noted that the strong adopters were observed primarily in Swat (40%) and Abbottabad (38%), while in the other 4 districts, reported strong adopters dropped as low as the 2% reported in Jhelum. (Adoption is not necessarily related to numbers of demonstration plots, varying from a rate of 3.7 per demonstrator in Swat to 1.1 in Rawalpindi).

TABLE 33. NUMBER OF FARMERS REPORTING DEMONSTRATION PLOTS: ADOPTION OR NON-ADOPTION OF NEW PRACTICES

District	Demonstration Plots (Farmers Reporting)	Adoption				Non-Adoption	%-Adoption	Grand Total
		Strong	Intermediate	Weak	Total			
Swat	14	21	25	6	52	1	98	53
Kohat	6	6	9	4	19	16	54	35
Jhelum	17	3	12	5	20	20	50	40
Rawalpindi	17	4	8	6	18	22	45	40
Attock	20	4	10	1	15	25	38	40
Abbottabad	14	15	11	5	31	9	78	40
Total	88	53	75	27	155	93	63	248

B. Multiple Regression Analysis

Factors which could be measured or put into "yes/no" categories, and were believed to be related in certain ways to adoption of improved technology by the farmers, were subjected to multiple correlation analysis (See "multivariate analysis" in the introduction of this report, as well as Appendix A and Table 34). It is anticipated that knowledge of the true relationships will be useful to future Barani Projects in giving advice to farmers, as well as determining which factors must be ameliorated in order to encourage adoption of the new practices.

1. Farmer Awareness of Greater Yields on Demonstration Plots

Of all the explanatory variables used, this was clearly the single most important variable in accounting for the variation in adoption. The increase in the proportion of the total variance in adoption which was explained by adding this variable was often at least

TABLE 34. SIGNIFICANT REGRESSION RELATIONSHIPS WITH FARMER ADOPTION OF NEW PRACTICES (4 VARIABLES)[a/]

Variable	Punjab and N.W.F.P.	Punjab only	Attock	Jhelum	N.W.F.P. only	Kohat	Abbottabad	Swat
Amount of Rainfall	x				x			
Age of Farmer					x	x		
Farmer Education				x				
Distance for Fertilizer				x				x
Distance to Mandi	x			x		x		x
Farm Size								
Irrigated Land	x	x			x	x	x	
Small Animals					x			x
Large Animals				x				
Tractor Use	x	x			x		x	x
Off-Farm Remittances								
Rabi Harvest Labor						x		
Kharif Harvest Labor							x	x
Greater Plot Yield	x	x	x		x	x	x	x
Number Demonstration Plots								
Government Harvest of Plots								
Government Production/Plots								x

a/ Data from Appendix A.

50% of the total explained variance (R^2), and for some districts it accounted for practically all the explained variance.

2. Rainfall

For all districts combined, the amount of rainfall was the second most important explanatory variable as measured by its Beta coefficient or by the increase in R^2 due to its addition to the regression.

3. Acres of Irrigated Land

This variable was the third most important explanatory variable for all districts combined but the second most important within districts. The acres of irrigated land variable is much less important than knowledge of greater yields on demonstration plots. For example, the addition of the variable to the regression for Punjab province increased R^2 by 5%. It increased R^2 for N.W.F.P. by 10% and both provinces combined by 5%.

4. Distance from Mandi Town

For the whole sample, this variable appears to be the next most important explanatory variable. It explains slightly less of the variance in the adoption variable than does acres of irrigated land and appears less frequently with a significant slope coefficient.

5. Other Variables

The four above variables are the only ones that rather consistantly have significant partial regression coefficients and also relatively high Beta coefficients. A number of the regression coefficients of other variables were significantly different from zero but they explained hardly any of the variance in adoption. For example, the regression coefficient for the "tractor use" variable was significant for all districts combined, with the sample consisting of all non-adopters and all strong adopters, but its addition to the equation changed R^2 by less than 1%.

For the 88 farmers reporting demonstration plots on their farms, further tests were run using all the possible factors listed in Appendix A. For the combined provinces 5 of the factors were the same as with the total farmers-- amount of rainfall, distance to pucca road and to Mandi, amount of irrigated land, and use of tractor. In addition, the demonstrating farmers included as significant: (1) number of large animals, for which they presumably hoped the new practices would provide more feed, (2) number of demonstration plots over the years which would indicate interest in the new methods, (3) government cooperation in production, and in harvesting of the demonstration plots, which would indicate efforts at persuasion of the farmer, and communication of the agent's enthusiasm and increased knowledge about the improved methods.

C. Reasons, Problems, and Limitations in Adoption

Adoption reasons are given in Table 1, Appendix J. A large majority of adopters are impressed with the performance and yield of the new variety, and will attempt to buy it even if it is high-priced.[8/] They are also impressed with the chemical fertilizers, but on a more qualified basis, since (1) its use at recommended rates would be at a high cost, since (2) they are not as sure of the results on an every-season basis, and since (3) the benefit they derive from what fertilizer they use will depend on the future rainfall patterns, which they cannot predict.

Reasons for non-adoption[9/] are given in Table 2 (Appendix J) Roughly a third of the non-adopters think that the old varieties are as good or better (given their consumption attitude) than the new varieties. The fertilizer hazards include the familiar one of uncertain rainfall, plus very high prices, lack of

8/ See also Appendix E.

9/ See also the reasons given by farmers in Appendix E.

knowledge about the fertilizer potential, local availability of manure, and extra care needed to handle it.

Major problems reported by both adopters and non-adopters are given in Table 3 (Appendix J). Input prices (in some cases at black market levels) are considered too high in relation to the income they would generate. Lack of availability of inputs locally is very important. Poor quality of inputs locally combined with poor showing of the new varieties in the field, do not encourage adoption. Lack of infrastructure-- such as farm-to-market roads is a third important factor. Rodents, insects and plant diseases are troublesome, particularly in some areas. More information and more cooperation from agricultural and local officials are needed. Whatever the reason-- and it is observed that in some cases he is not personally to blame-- the Field Agent is criticized by a majority of the farmers for his unsatisfactory performance as the government representative assigned to assist the Barani farmers with their problems. 10/

In Table 35, the two major reasons for farmers not adopting the new practices enthusiastically, or at all, are summarized. (59 "other reasons" for not adopting new practices were also given, but these involve decisions over which the farmer had some control, so they are not pursued.) If these two obstacles could have been removed or lessened, it is assumed that the farmers involved would have adopted improved practices to a large extent. ("Not available" means that the inputs for improved practices were not easily available to the farmer. "Shortage of money" is obvious.) Note that, of 102 intermediate or weak adopters, 72 of them gave one or both reasons for limiting their adoption practices. Of 93 non-adopters, 50 of them gave one or both reasons for not adopting the new practices. (If a farmer gave both reasons for non-adoption or limited adoption in Table 35, each reason was given half-weight.)

10/ See also the farmer complaints about new wheat varieties in Appendix E.

TABLE 35. IMPORTANT REASONS FOR LIMITED ADOPTION OR NON-ADOPTION

District	Strong Adoption	Intermediate and Weak Adoption		Non-Adoption		Totals for Adoption/Non-Adoption	
		Not Available	Shortage of Money	Not Available	Shortage of Money	Not Available	Shortage of Money
Swat	21	16	15	1/2	2/2	16 1/2	15 1/2
Kohat	6	6 1/2	6 1/2	9 1/2	6 1/2	16	13
Jhelum	3	3	6	4	8	11	14
Rawalpindi	4	4	1	3	11	7	12
Attock	4	1/2	2 1/2	-	10	1/2	12 1/2
Abbottabad	15	10 1/2	1/2	2	5	12 1/2	5 1/2
Total	53	40 1/2	31 1/2	19	41	63 1/2	72 1/2

D. Information and Its Sources

In Table 36, farmers report the types of agricultural information they received from various sources. Perhaps because of the Barani Project's emphasis on these two points, sowing seed and fertilizing were reported in almost half of the responses. Use of agricultural chemicals and weeding methods were also given in about a third of the responses. The third large group of responses centered on general cultural methods.

Major sources of information on the new technology are shown in Table 37. The groups are different for adopting farmers than for non-adopters. The official sources-government officials - are larger for adopting farmers. "Other farmers" is the largest source of information for both groups, but about the same size for each group. Radio is surprisingly not as large as expected, perhaps because it tells mostly what the farmer has already heard from his friends, and also because it spends little time on Barani problems. It may also influence farmers at first hand who then tell their neighbours.[11/]

The comparison in Table 38 supports the importance of certain sources, such as friends and neighbors, government agents and dealers. At the same time, the definitions and groupings of sources were somewhat different in the different studies, so it is difficult to make exact comparisons between the different classes.

E. Actual Rates of Adoption

The rate of adoption of the new techniques has been calculated for those farmers identified as adopters. The basic data are shown in Table 39. The straight-line regression equations for different measures

---

11/ In contrast, see Appendix E, where a survey in Attock District gave farmers reporting a strong response to radio programs.

TABLE 36. TYPES OF INFORMATION THAT FARMERS REPORT THEY RECEIVE

No. of Responses	Swat 145	Kohat 67	Rawalpindi 127	Jhelum 146	Attock 214	Abbotta-bad 287	All 986
	(%)	(%)	(%)	(%)	(%)	(%)	(%)
1. Method of land; reconditioning, preparation, cultivation, plowing, dung storage, bund building-	11	10	30	22	7	17	16
2. Information on new Seed Varieties.	-	-	1	-	15	13	7
3. Seeding and Fertilizing: timing and methods-	61	53	50	49	32	24	41
4. Quality and Use of: pesticides, insecticides and herbicides; weeding-methods-	25	28	17	27	42	26	28
5. Methods of well irrigation; fruit tree planting, trimming; vegetable cultivation; keeping livestock, hens, bees, silkworms-	3	9	2	2	4	20	8
Total (%)	100	100	100	100	100	100	100

TABLE 37. FARMERS' SOURCES OF AGRICULTURAL INFORMATION[a/]

Sources	Adopters		Non-Adopters		Total
	O	E	O	E	
IRDP-PM/OA	26	23	10	14	36
AGR-AO/FA	33	24	6	15	39
Coop/Sub-Insp./Beldar	5	11	12	6	17
Other Farmers	76	78	48	47	124
Radio	8	10	8	6	16
Zirat Nama/Nil/Village Aid	8	10	8	6	16
Number of Farmers	155	155	93	93	248

a/ χ^2 test indicates that adoption is not independent of the farmer's source of agricultural information. Only for the first two classes is the observed frequency of adopters greater than expected.

equations for different measures of adoption are given in Table 40. Five factors are considered - old wheat variety acreage for adopters and non-adopters separately, and new variety acreage, nitrogen application and phosphate application for adopter.

For adopters, increases in old wheat acreage and in fertilizer application appear to have reached a temporary plateau in the last year or two of the period, after showing marked increases from low beginning the first year. (It will be noted that the absolute amounts of fertilizer applied per farm are small throughout the period.) Increases from the previous year of HYV seed are phenomenally high in the early years, but taper off later, (Note that there has been a continuous shortage of improved wheat seed varieties available to Barani farmers during recent years). There is a steady

increase in the proportion of new wheat acreage on adopters farms, which will probably reach higher than 50% in another year or two. The equations in Table 40 are of the form (a+bx), where (x) is the year of adoption, beginning with 1972-73. A comparison of the rate of adoption of HYV wheat in irrigated areas is given in Table 41 and it is obvious that these spread faster there than they have in the Barani areas. Table 42 compares total fertilizer used over a period; no strong conclusions can be drawn.

TABLE 38. SOURCES OF FARMER INFORMATION FOR ADOPTERS IN THREE AREAS

Source	Percent of Farmers Reporting		
	Multan District a/	Barani areas	
		Hazara District b/	Six Districts b/
Demonstration Plots and Demonstration farmers		16	-
Government employees and farm supply dealers	8	25	38
Union Councils, Cooperatives, Mandi Stores, Villager Leaders	5	-	3
Neighbors, Friends, Relatives	31	35	49
Self (not aware of external sources)	54		
Mass Media (radio, newspaper) and all other sources	2	24	10
Total:	100	100	100

a/ See Lowdermilk, M.K., "Diffusion of Dwarf Wheat Production Technology in Pakistan's Punjab". Cornell University, May, 1972. Table 1.

b/ See Rochin, Refugio I., "A Micro-Economic Analysis of Small Holder Response to HYV of Wheat in West Pakistan". Ph.D. Thesis, Michigan State University, 1971.

TABLE 39. RATES OF ADOPTION OF WHEAT VARIETIES AND FERTILIZERS

	Adopters						
Rabi	Old Wheat[a] Average acres per farm	New Wheat Average acres per farm	Adoption (Percent new/ total)	Percent increase from previous year	Fertilizer nutrient lbs/farm N	P_2O_5	Non-Adopters Old Wheat Acres/ Farm
1972-73	0.91	0.10	10	-	3.8	3.0	0.96
1973-74	1.40	0.46	25	363	11.1	7.9	1.41
1974-75	4.01	1.21	23	162	20.6	9.5	3.44
1975-76	5.23	2.06	28	70	67.5	43.1	4.16
1976-77	4.91	2.58	34	25	103.6	59.8	4.39
1977-78	4.36	3.33	43	29	101.1	56.5	4.40

a/ A confusing item is the rapid rate of increase of area sown to old wheat varieties, including that sown by non-adopters. Relative price and other factors apparently encouraged the increase in production of all wheat during the period, by all farmers.

TABLE 40. STRAIGHT LINE REGRESSION FACTORS CONSIDERED IN ADOPTION

Factors	Linear Regression & Correlation			
	a(y-intercept)		b (slope)	r^2 variance
Old wheat Varieties: Adopters (Kanals/farm)	(4.57)	+	6.63	0.71
Old wheat Varieties: Non-Adopters (Kanals/farm)	(3.55)	+	6.13	0.86
New Wheat Varieties: Adopters (Kanals/farm)	(-5.67)	+	5.33	1.00
Fertilizer: Elevated Nitrogen (Adopters) (lbs/farm)	(-29.81)	+	23.17	0.92
Fertilizer: Elevated Phosphate (Adopters) (lbs/farm)	(-15.75)	+	13.07	0.88

TABLE 41. ADOPTION OF HYV WHEAT IN IRRIGATED AND BARANI AREAS

Multan District (Punjab) Irrigated Farms a/		Six Barani Areas (Punjab and N.W.F.P. b/	
Rabi	Percent of Total Wheat Acres in HYV Varieties	Rabi	Percent of Total Wheat Acres in HYV Varieties
1966-67	4	1972-73	10
1967-68	28	1973-74	25
1968-69	61	1974-75	23
1969-70	72	1975-76	28
1970-71	73	1976-77	34
-	-	1977-78	43

a/ Source: M.K. Lowdermilk, "Diffusion of Dwarf Wheat Production Technology in Pakistan's Punjab" (Cornell University, May 1972), Table-1

b/ Present Survey, based only on interviews.

TABLE 42. NUTRIENT WEIGHT OF FERTILIZERS APPLIED ON HYV WHEAT

West Pakistan a/			Six Barani Districts b/		
(Rabi)	Tons(N+P)	% Increase over previous year	(Rabi)	Lbs($N+P_2O_5$)	%Increase Over previous year
1967-68	37,000	-	1972-73	1,055	-
1968-69	60,300	63	1973-74	2,951	180
1969-70	103,100	71	1974-75	4,678	59
1970-71	139,100	35	1975-76	17,152	267
-	-	-	Av. (1976-77 & (1977-78)	24,880	45

a/ See Lowdermilk, Table 13
b/ Present Survey, based only on interviews.

VIII. SUMMARY OF FINDINGS AND POLICY IMPLICATIONS

A. Farmer and Family Characteristics

1. Age.

The average age of all sample farms was 45 years. While the average for non-adopters was slightly less than for non-adopters, the difference was not statistically significant.

2. Education.

Half the sample farmers had no formal education and all sample farmers together averaged less than 4 years of schooling. Adopters had received significantly more (50%) schooling than non-adopters.

3. Family Size.

Farmers who adopted improved practices had significantly larger families than non-adopters, with a higher proportion of adult workers.

4. Family Off-Farm Income.

a. 2/3 of the families claim members earning income from off-farm.

b. 3/4 of the families that receive off-farm income report that it amounts to Rs. 500 or less per month. This may be large proportion of the cash income received by many Barani families.

c. Higher off-farm incomes are associated with higher rates of farmer adoption of improved practices.

B. Farm Location and Description

2. Farm and Fragment Size.

a. The average size of each piece of land making up one farm holding, approximates two acres.

b. Farmers who adopt improved practices have larger average sizes of these farm fragments than do non-adopters.

c. Adopters seem to have more small farms than do non-adopters.

2. Large Farmers.

a. Large farmers often have a high social status and political power through caste, tribal and kinship ties. They are placed in an advantageous position to control services offered by government agencies, such as those of the Extension Service.

b. Large farmers can often influence government policy, and receive an undue share of institutional services such as credit facilities, and access to information and knowledge about markets and technology.

3. Irrigation.

a. 40% of the farmers interviewed had some irrigated land on their Barani farms.

b. 55% of the farmers adopting improved practices reported farming some irrigated land; few non-adopters had any irrigation.

4. Location.

a. More adopters are located near a fertilizer outlet than is true of non-adopters.

b. More adopters are located near a Mandi than is true of non-adopters.

5. Precipitation.

Rainfall appears to be directly related to adoption of improved practices, with more rainfall being associated with a high proportion of adopting farmers.

6. Mechanization.

Adopters of improved practices make more use of tractors than do non-adopters.

7. Animals.

Adopters of improved practices appear to own more large animals, but less small animals, than do non-adopters.

8. Crop Labor.

The three crop season activities that require the most intensive activity are sowing, harvesting and threshing. Harvesting or threshing require twice the labor per acre of crop, compared with sowing.

Adopters of improved practices used significantly more Kharif labor (for sowing, harvesting and threshing) than did nonadopters, in Swat, Rawalpindi and Abbottabad Districts. (see Appendix D).

C. Demonstrations

1. Plot Selection.

   a. Some farmers are allocated plots because they are interested in improved methods of farming, have resources to utilize these improved methods, and have farm land in ideal locations for purposes of demonstration.

   b. Some farmers have been allocated plots by the Agricultural field agent because they are influential in their village and own large land-holdings.

   c. Some farmers are not allocated plots, even though they are interested, because they are not personal friends of the field agent, their farm location is not suitable, or the agent has allocated all plots to other farmers.

2. Plot Cooperation and Plots as Educational Tool.

   a. Apparently, more adopting farmers participated in site selection, harvesting, threshing and weighing of crop yield on their demonstration plots than did Government agents (1) cooperated in more plot-production activities on adopters' farms than on farms of . and (2) cooperated in more harvesting activities on adopters farms than on farms of non-adopters. Adopters had more total plots per farm than did non-adopters (over several seasons).

   b. Some farmers thought that plots were an excellent method of education in new techniques, while others were not convinced of their usefulness.

c. The majority of Barani farmers have apparently accepted the general idea of using improved seed and fertilizers, and are now more concerned with how to use them and under what conditions, when the weather is satisfactory.

d. Of the 88 farmers surveyed who cooperated with demonstration plots, 75% became adopters. Of the 182 farmers who did not cooperate with demonstration plots, 49 became adopters.

3. Plot Yields.

a. Farmers attribute increased yields to better seed, use of fertilizer, and timely, sufficient rains. The farmers can see that better cultural practices result in plants that look better in every aspect.

b. Where the demonstration plot resulted in a lower yield, the farmer attributed such a result to (a) poor stand, (b) use of long-season variety unadapted to local conditions, or (c) season was dry, so crop did not ripen properly or it was burned by fertilizer.

c. Average increase in wheat yield was 10.8 maunds, estimated increase in cost was Rs.228 per acre, so increase in net income was Rs.172 per acre.

D. Adoption and Non-Adoption

1. Adoption.

a. 66% of the farmers were adopters. 33% of the adopters were identified as "strong", while another 50% were classified as " intermediate".

b. Some farmers adopt the new techniques when they see a successful demonstration and realize that the new practices do give substantial yield increases.

c. Some farmers become so convinced that the new practices

will be most valuable to them, that they make special efforts to buy the new seed and fertilizer, even under conditions of higher cost or more difficult availability.

2. Non-Adoption.

a. 9% of the non-adopters list unavailability or high cost as the most serious barriers to their acquisition of the new inputs.

b. 31% of the non-adopters find that their old seed of local varieties, plus adequate labor, plus manure give as good or better yields than the new practices.

c. 16% of the non-adopters prefer the taste of old wheat varieties, and of the tender straw from the old taller varieties for their animals.

d. Use of mass media, tenure status, distance from Union Council headquarters, urban orientation, and volume of wheat marketed, were not variables that Lowdermilk 12/ found had much explanatory power in identifying which farmers would be likely to adopt the new practices for wheat. (see Appendix E). Therefore, these factors were not measured in the present study.

3. Limited Adoption.

a. Many adopters and non-adopters emphasize that they would use the new inputs, or would use more of them, if (a) the items were available when the farmer needs them, and (b) the farmer had the necessary money to buy them, or he felt the investment was worthwhile financially.

b. Farmers report that seed and fertilizer are often not available on time, or indeed, at all.

c. Inputs are often reported as too costly, or only available at black market prices.

12/ See Lowdermilk, op cit; and also Appendix E.

d. Lack of rain, or other crop damage due to natural causes and including rodent damage, was often reported. Some farmers use less than the recommended amount of fertilizer because of the uncertainty of adequate rainfall.

e. Lack of quality and quantity control of the new inputs through the market was reported as affecting the farmers' confidence in purchase of these inputs.

f. Farmers reported a lack of infrastructure such as roads and vehicles, government storage and machine rental services, which affected their rate of adoption of the new practices.

g. Dr. Homer Hepworth of CIMMYT[13/] concludes that Barani farmers are eager to accept innovations and new technology, but on the other hand, they resist change because they dare not risk failure due to poor weather or untested crop varieties and practices.

4. Results of Stepwise Regressions.

a. The multiple regressions used take into account a number of the variables that have been considered singly, but weighs them simultaneously. The most noticeable result is the changing relationships as the different geographic areas are considered.

b. For the two provinces together, farmer adoption of the new practices was related principally to six factors. The two most important ones are (a) farmer awareness of greater yields from new varieties and new practices, and (b) the amount of rainfall during the Rabi season. The other three factors are : (a) whether the farmer has some irrigated land, (b) number of miles of

---

13/ Hepworth, H., Zinn, T., "Barani Wheat Production in Pakistan". Oregon State University/USAID.

distance between the farm and the nearest (Market) Mandi (inverse) and (c) farmer use of a tractor.

c. For the N.W.F. Province, adoption is related to seven factors, of which farmer awareness of plot yields, and whether he has some irrigated land, are the two most important. The other factors are (a) amount of Rabi season rainfall, (b) size of farm, (c) numbers of small animals on the farm (inverse), (d) age of farmer, and (e) use of a tractor.

d. For the Punjab Province alone, adoption is related to three factors, of which farmer awareness of plot yields is most important. The other factors are (a) whether the farmer has some irrigated land, and (b) use of a tractor.

e. In addition to the explanatory variables for the two provinces, some districts have variables that are significant. In Swat, adoption decreases as (a) distance to fertilizer depot increases, and also as (b) amount of Kharif season labor used at harvest increases. In Rawalpindi, adoption increases as (a) amount of Rabi season labor used at harvest increases, as (b) education of farmer and as distance to Mandi decreases. In Kohat, adoption increases as (a) amount of off-farm remittances increases. In Jhelum, adoption increases as (a) number of large animals increases.

E. Agricultural Information

1. Types of Information

Major types of information the farmers reported receiving include (a) land preparation and cultivation methods, (b) new seeding, seed and fertilizing methods, (c) weeding, pesticides and insecticides, and (d) well

irrigation, fruit and vegetable cultivation, and maintenance of animals.

2. Source of Information.

Major sources of agricultural information reported by the farmers include (a) other farmers, (b) agricultural extension and other officials, (c) agricultural newspaper and non-agricultural government officials, and (d) radio agricultural programs.

F. The Agricultural Extension Program

1. The Extension System.

a. The operation of the present extension system for farmers-- agricultural extension and other agencies-- results in a low level of knowledge of improved practices among farmers, and a resultant low level of utilization of the recommended practices.

b. There are too many farmers assigned to each extension agent, if he is expected to operate an effective program. In addition, agents are called on by various government authorities for many and varied time-consuming activities which are only peripherally related to what should be their assigned tasks of agricultural education. These include census, survey and tax-related duties (see Appendix I).

2. Extension Staff.

a. Extension personnel are restricted by lack of mobility and of resources, and cannot even perform up to their present capability.

b. Many farmers report that the local field agent is providing unsatisfactory service because of such weaknesses as favoritism, laziness and cheating.

c. Contacts made by extension agents are few, and those

are made mostly among the large, influential farmers.

d. Extension agents have a poor image among most farmers, who report they often do not know the names or office locations of extension personnel.

e. Lowdermilk[14/] reports the field assistant -- the direct extension contact with the farmer-- is ill-trained for giving advice on problems of agricultural modernization. He may get no in-service training of value and receives only meager technical assistance from crop specialists. He has too much paper work and diary-writing. He gets no government-sponsored housing, is given no transport facilities, has little medical assistance, and receives a small salary.

3. Seed Program.

a. HYV seed has increased output, employed more resources and influenced cropping patterns. The relative income position of the adopting Barani farmer has improved. Small size has limited many farmers who would otherwise be interested in the improvement program.

b. Most farmers use the seed they produce, or obtain it from neighboring farmers.

c. Farmers must learn (a) to rogue off-types of plants in the field, and (b) to prevent good varieties from admixture with others either on the harvesting floor or in the godown.

d. There is a lack of growers now assigned to increase and maintain clean, pure seed, and government or commercial sources are not adequate-hopefully, the World Bank program now underway will improve this situation.

14/ Lowdermilk, op cit.

4. Other Innovations.

Each innovation has special properties which are related to its degree of acceptance, adoption and diffusion by farmers. Individual farmers have many different social, personal and economic needs, which affect their response to the innovation.

IX. POLICY IMPLICATIONS

A. Farmer and Family Characteristics

1. A stronger extension program for the future would attempt to attract more attention from Barani farmers under 50 years of age.

2. The new program would have a stronger emphasis on reaching the illiterate farmer. This would involve heavy use of radio and TV, as well as a better utilization of demonstrations.

3. More information needs to be assembled on the relation between family labor and its use on Barani farms. Any new extension program should be very careful about recommending practices which will require additional family labor, until it is certain that such labor will be available with little effort. Women as labor and in farm management must also be considered.

4. An innovation that requires a modest cash investment would not be out of reach of many Barani families, since they receive off-farm income regularly. Any such investment would be in competition with family consumption needs, however.

5. The sample farmers obviously have enough cash income to be concerned with its augmentation. A program to increase home consumption as well as the marketable crop surplus, should meet many needs of the farm family.

B. Farm Location and Description

1. Program: Land, Water, Leaders, Farm Location.

a. Some form of land consolidation, perhaps with multiple ownership but single management, is essential for an extension program for improved practices to have increased impact. An example is ABAD's mechanized farm project. Extension recommendations, meanwhile, must take into account the size of land fragments as well as the distance between the different fragments of each land holding. Sophisticated crop rotations, production of livestock feed, and water harvesting programs will depend on a parallel program of land consolidation.

b. The new program should include elements applicable to supplementary irrigation and to water harvesting, especially as more and more Barani farmers will be adding these activities when they can afford them and when they become available. Although irrigation acreage is small on many Barani farms, it is intensively farmed and contributes to farm income out of proportion to its size, though perhaps in proportion to the inputs utilized.

c. The new program must plan ways to use the large, influential farmers in the community as leaders of innovation, but without allowing these large farmers to obtain all the benefits from the new practices and new government programs. It is possible to do this if a concerted effort is made and if the extension program takes proper precautions to avoid such an end, such as developing a roster of more typical, but progressive, "control" farmers for the extension agent to utilize.

d. A program to persuade farmers to adopt new practices should be able to obtain results more easily if the

farm villages are near a Mandi, a fertilizer outlet, and a pucca road. For farmers that are located far from these amenities, a concerted effort should be made to (1) improve the marketing procedures for the increased crop production, and (b) encourage a program to move some of these amenities nearer to the remote farmers. With such a program making changes in the infrastructure, it will be much easier and more fruitful to persuade Barani farmers to adopt the new practices.

2. Program: Rainfall, Tractors, Animals, Labor.

   a. Since adoption is related to amount of rainfall, this suggests two possibilities in the program: (a) amounts of fertilizer and seed must be adjusted more carefully to the anticipated moisture available, in each area, and (b) more effort must be put into making plans for the package of new practices in the low rainfall areas, since most of the complaints about the present programs come from those areas.

   b. Even the relatively small Barani farmers find that tractors are suitable for certain operations, though not to the exclusion of draft animals for other operations, and an extension program must take these two points of view into account; (1) improving machinery for both types of operation, and (2) planning the field operations with an adjustable package of practices.

   c. Adopters have a deep interest in draft and milk animals, and a crop program should include provision for feeding these animals. Nutritive fodders and crop aftermath, protein from oilseed cakes processed from local crops, silage or hay-- all can be worked into the farm program when it is realized that a substantial portion of farm subsistance and farm income is due to these animals.

d. More information is needed on the seasonal needs for field crop labor, and the present or potential sources of that labor. It appears that all sources including some hired labor are called on for the harvest period. Improved practices will undoubtedly demand more labor unless some labor is displaced with labor-saving practices and with machines. The labor implications of the new package of practices must be worked through carefully before a flat recommendation is made for adoption by all Barani farmers.

C. Demonstrations

1. If it is to be more effective in the future, the selection of plot cooperators must be less biased. A check list of desirable characteristics of both farmer and farm land should be developed and used by the field agents. Where the local agent continues only to favour friends and large influential farmers, intervention by supervisory personnel may be necessary.

2. Plots have not completely fulfilled their potential as an educational tool. Farmers are now too familiar with demonstrations to be impressed with the novelty alone of a plot. Farmers want answers which well-planned adaptive research plots can give them-- the potential of completely new seed releases, of new combinations and different levels of fertilizer application under different climatic and terrain conditions. Other new practices such as new rotations need to be included for the more skilled farmer too. Demonstrations are a tool which must be better utilized and planned than in the past.

3. Both farmer and extension agent must be closely involved with the demonstration throughout the crop season, if adoption is to be effective. Neighbouring farmers should be brought to the plot at various crucial times-- land preparation, sowing, weeding, harvesting-- to help in the operation and see what the crop and plot appearance should be.

4. Plots are needed at more villages, and in good locations, to show the local farmers the importance of such factors as (a) good seedbed preparation, with deep plowing, (b) seedbed levelling, (c) importance of seedbed moisture levels, (d) proper sowing methods and seed rates, and (e) proper local levels of fertilizer application.
5. Plots must be used as true teaching tools. When farmers visit the plot, they should be prepared to ask questions and expect to be given the correct answers.
6. Demonstrations can be a powerful tool, especially in a society where the testimony of witnesses travels so rapidly. Support for such demonstrations must involve (a) accurate, detailed and pertinent research results needed as the basis for a demonstration, (b) the selection of the cooperating farmer on some basis that should indicate value to the village, and (c) the results of the demonstration must be brought vividly to the attention of the local farmers, through various means.
7. A new program should emphasize the increase in grain and bhoosa from improved practices, that a demonstration illustrates. If for some reason the plots show a reduced yield, the field agent must be able to identify the particular cause of such a result.

D. Adoption and Non-Adoption

1. Powerful factors affecting adoption of new practices are the characteristics of the innovation, and the attendant risk and uncertainty-- the latter bearing drastic consequences for the subsistence-level producers, especially. To be adopted, the innovation must show unequivocally a higher profitability than present methods, as well as an ability to fit into present, or easily modified cropping patterns.

2. A successful extension program, after persuading the farmer to adopt the use of the new inputs, must make sure these recommended inputs are available at the time needed on the farm, and in satisfactory quantity, at a fair price. Responsibility for this may be divided between government agencies and the private sector, but it must be done.

3. In Barani areas uncertainty of weather and other natural causes is a fact of life, and if new technology is to be permanently adopted by the farmers, it must be able to adapt to a wide range of climate, soil and past conditions, with drastic changes from one season to the succeeding one.

4. Government control of quality and bagged quantities must be stressed, as the farmer has little influence over these measures. Adoption will also be improved by the continual development of infrastructure, such as farm-to-market roads and electricity, as the marketable surplus of crops increases. The farmer also must have access to the money necessary to make the purchase of the new inputs.

5. Results of the survey can be used to secure better adoption rates in the future, in specific areas. In Swat and Rawalpindi Districts the amount of labor available at harvest time is especially important, and special consideration should be given there to this factor. A program emphasizing its value for the improvement of feeding and use of large animals would be well received in Jhelum District. A program aimed at the less educated farmers would require more effort in Swat District than in some of the other districts, because of the high proportion of illiterates.

E. Agricultural Information

1. All organizations dealing with education of farmers must develop a communication system that will bring the farmers' problems to research centers and development farms to be solved, and carry the new ideas and solutions from the researchers out to the farmers.

2. Farmers at the subsistence level (small Barani farmers) can be expected to obtain the majority of their agricultural information from interpersonal local sources, such as other farmers. An educational system which aims to influence these farmers must use methods which achieve a breakthrough into such a network.

3. Farmers who produce an actual or potential marketable surplus of crops are alert to information distributed by various media, Illiterate farmers, especially, would be a ready audience for information distributed by radio and other urban-oriented channels. The present amount of them offered on the radio for agricultural news is not sufficient at all. Information disseminated on the radio should be accurate, appropriate and timely.

4. To the extent that they make farmer contacts in the course of their work, agronomists, crop specialists, soil scientists, extension workers, IRDP staff, and other specialists may be used to extend information useful to farmers. Government and private fertilizer organizations and future seed merchants can also be used for this purpose.

5. Adopting farmers used the IRDP and agricultural extension staff to a greater extent than did non-adopters to obtain agricultural information. This suggests that field agents must become the primary authorities on agriculture in their areas, as they are in many other countries, before farmers will come to believe in their advice and adopt their recommendations.

6. Other studies have shown that government employees, farm supply dealers, demonstration plots of agricultural agencies, and other farmers were all important sources of agricultural information, and should be utilized to disseminate this information as they are needed. It is obvious that an extension program can use all the present media to dispense agricultural information, building and strengthening what is already there.

F. The Extension Program

1. The Extension System and Staff.

a. A successful extension program would (a) convince farmers that some combination of new practices would be an improvement over their present system, (b) meet their arguments against adoption ofthe new practices, one by one, (c) work out local adaptation of practices that would suit the local climate and farmer habits and traditions, and (d) for specific weaknesses that are discovered, such as the nature of the wheat straw in relation to animal feed, convey the problems back to the crop researchers for them to conduct further research.

b. In recent years, many farmers have begun investing in and using tractors and improved physical inputs on their farms. For these farmers, who are faced with new, complex problems, the need is now for extension advice from better trained extension workers than in the past.

c. Training improvement and close direction of the activities of field agents must be central to improvement

of the extension organization. There must be fewer farmers for each agent to contact personally, yet the agent must contact those assigned to him, frequently and for a purpose. There must be less favoritism, and more logistic support. The program under which the agent operates must be fixed, yet flexible, and it is essential that many of the superfluous assigments the agent now is requested to perform must be transferred to other agencies. There must be incentives to encourage good agents, and alternatives provided for agents that are not effective. Above all, the agent must be thoroughly trained in Barani agriculture, preferably being recruited from Barani areas and intending to do his work in Barani areas.

d. Extension workers have a role in educating farmers to understand the value of a pure, good quality seed, even if it is usually difficult to locate. In addition to the agronomic characteristics they are incorporating, wheat botanists should continue to strive for (a)improved taste and bread making qualities, (2) good seedling emergence even when seed is planted to 6-inch depth (a characteristic now available in some popular varieties), (3) wheat straw that is more palatable for livestock than that of some of the presently popular HYV varieties. (4) Improvement of triticale, produced for both fodder and grain.

e. Drastic changes must be made in the system for selection, training, supervision and upgrading of the field agent. Selection and promotion must be on a merit basis, and his field assignments should be on the basis of ability, not on the basis of his need for punishment. Training and upgrading programs must be commonly available to willing participants.

2. Innovations and Extension Support.

a. The program to increase Barani wheat production must depend on technicians and extension personnel trained and experienced with dryland wheat and dryland agriculture, of which there are at present very few, if any. Wheat varieties must still be developed to take full advantage of Barani conditions, and to reduce the extreme variability in season-to-season yields. New varieties that can offer higher yields, shorter growing periods, good flavor, and copious and easily-consumed fodder for livestock, will be readily adopted by the farmers.

b. Water is so essential in Barani areas that any good extension program should initiate elements of a water harvesting program, cooperating with the Soil Conservation Service. A framework for this type of program would include (a) the physical components, (b) the agronomic components, (c) economic and research-cum-demonstration activities, and (d) technical and institutional support for the program.[17/]

c. To support a stronger extension effort, government intervention will be needed to: (a) continue to procure and increase an adequate supply of HYV seed varieties of known quality; (b) continue to improve and expand the fertilizer distribution system; (c) provide appropriate price incentive to encourage increased crop production; and (d) begin to effectively operate centers of modern adaptive research for Barani agriculture, and set up close coordination procedures between the researchers and extension specialists in the Barani areas; (e) allocate adequate funds; and (f) insure more training in country and abroad.

17/ See: "A Water Harvesting Plan for Barani Lands of Pakistan", USAID Mission in Pakistan. September, 1972.

d. To support the extension effort, more farm supply centers must be established in remote areas to furnish improved seed, fertilizer, insecticides, farm implements and machinery, and tractor servicing.

e. Agricultural credit must be furnished through an improved system to support the extension recommendations, especially in buying the short-term or medium-term inputs--fertilizer, plant protection chemicals, seed and farm implements, draft animals, tractors and wells. This will be especially important for the small farmer, where his production- and -consumption family needs, including short-term needs resulting from a one-season crop failure, must be considered.

f. Adaptive research is also needed to support the extension effort in order to identify types of farming, crop and livestock combinations, crop varieties, levels of capital and labor input, which are needed in order for the Barani farmer to utilize his present and potential land, water and labor resources most effectively. Extension programs can be no more useful than the research programs that supply their technical information.

APPENDIX A

ADOPTION AND STEPWISE REGRESSION

ADOPTION AND STEPWISE REGRESSION

In order to help explain the rates of adoption of improved practices under varying circumstances, the decision was made to use a stepwise regression analysis of some of the major factors that could be measured. Dummy variables were used so that "non-adoption " was coded as "0", "weak adoption" was coded as "1", "intermediate adoption "was coded as "2" and "strong adoption" was coded as "3". A check regression was also run in which only non-adoption and strong adoption were included.

Independent Variables

1. Inches of Rainfall. Assured to be uniform within each survey area. Derived for periods of 15 years or more, from monthly data for the Rabi season, defined as October to March.

2. Age of Farmer.

3. Education of Farmer. Years of formal schooling.

4. Miles to Mandi. Distance from farm to nearest market.

5. Miles to Fertilizer Depot. Distance from farm to nearest outlet selling fertilizer and improved seed.

6. Miles to Pucca Road. Distance from farm to nearest metalled road.

7. Farm Size. Size of farmland operated.

8. Irrigated Land. Amount of irrigated land operated, in addition to the Barani land of the farm.

9. Small Animals. Number of donkeys, sheep and goats on the farm

10. Large Animals. Number of buffalo, bullocks, cows and camels on the farm.

11. Tractor Use. Farmer use of a tractor.

12. Remittances. Rupees received by the farm family per month from family members working away from the farm.

13. Rabi Harvest Labor. Total number of workers (including family) used for the Rabi harvest.

14. Greater Plot Yield. Farmer knowledge that a demonstration plot gave a greater yield than a check plot using normal local practices.

15. Kharif Harvest Labor. Total number of workers (including family) used for the Kharif harvest.

Variables Added for Demonstration Farms

16. Demonstration Plot. Indicate whether farmer ever had a demonstration plot.

17. Number of Plots. Total number of demonstration plots farmer had had.

18. Harvest, Thresh, Weigh. Participation of Government agents in the plot activities associated with harvesting the crop.

19. Sow, Fertilize Weed. Participation of Government agents in the plot activities associated with plot preparation, seeding, and production of the crop. The stepwise regression computer program selects variables roughly in the order of their importance to the multiple correlation coefficient, starting with the most important ones. The rule adopted in this report has been to stop including variables when the last one adds less than 1% to the change in R^2. A key word is used to identify each variable included in each table.

The variables listed in Table 1 are in various ways related to adoption or non-adoption, but a direct causal relationship must not automatically be assumed. Farmer awareness of the greater yield of demonstration plots over fields

with normal farmer production practices, is shown here as the most important factor. An inclination and ability to mechanize, by using a tractor, is shown as the second most important factor in this area. Kharif labor indicates ability to mobilize resources at a crucial season of the year. Irrigation resources allow the farmer to be more adventurous in adopting new practices, because he has some control over the vital water supply and also is not dependent on one crop.

In Table 1, the b's or slopes of the straight-line partial regressions, the F-ratios, and the significance as measured by the F-ratios are also included. Based on the F-tests, the other factors initially included are not significant, even though they were important enough to reduce the total variance. Two factors are shown to have a possible negative or inverse relationship, but are not significant in this table1/ (Even if a factor tests as significant based on its F-ratio, it is classed as "not significant" if its b is below 0.01, thus indicating unimportance).

Abbottabad Demonstrators

There are 14 farmers in this category. In addition to some of the factors discussed previously, additional factors that are important in this regression are : (1) miles to market (2) number of small animals (3) farm size (4) amount of remittances (5) government plot production (6) government harvesting (7) number of plots of each farmer. (Government activities associated with demonstration plots were stated previously, with production being associated with selection of plot, sowing, fertilizing and weeding, and harvesting with threshing and weighing the yield (Demon. Multiple R= 0.99).

1. The reader can always assume a relationship is positive or direct, unless it is stated otherwise.

Abbottabad District

Table 1. Abbottabad

Variable	Change in R^2	b. (slope)	F. Statistic	Significance[a/]
Plot Yield	0.24	1.04	10.84	Significant
Tractor Use	0.10	0.86	7.33	Significant
Kharif Labor	0.07	0.13	4.46	Significant
Rabi Labor	0.04	-0.02	1.90	not significant
Irrigation	0.04	0.06	4.78	Significant
Large Animals	0.02	-0.10	1.42	not significant
Farmer Age	0.01	0.01	1.45	not significant
Education	0.02	0.05	1.22	not significant

Multiple R: 0.73

Variation explained: 54%

Constant.....-0.14

a/ At 5% level

N = 40

Attock District

Farmer awareness of the greater yield from plots demonstrating new varieties and use of fertilizers, is by far the most important factor. Farm size, which also indicates ability to assemble resources for new programs, is the second most important. Irrigation resources are not significant here.

When only non-adopters and strong adopters are used in the analysis, two more factors appear important. They are (1) off-farm family remittances, which give the family some security and also resources that may be used in farming, and (2) number of large animals, a partial proxy for wealth or income.

Table 2. Attock

Variable	Change in R^2	b.	F.	Significance a/
Plot Yield	0.66	1.61	55.83	Significant
Farm Size	0.05	0.00074	8.05	Not significant
Irrigation	0.01	0.02	1.62	Not significant

Multiple R: 0.85
Variation explained: 73%
Constant = -0.16 N= 40

a/ At 5% level

Attock Demonstrators

There are 20 farmers in this category. In addition to some of the factors discussed for this district previously, important factors showing up in this regression are: (1) Distance to pucca road (negative) (2) Education (3) Age of farmer and (4) government plot harvesting. (Multiple R=0.87)

Jhelum District

Significant factors appear to be: distance from Mandi (though not negative in this), distance from depot (negative), education, remittances (negative in this case), and number of large animals, a partial proxy for wealth or income. Even though yield and distance to a pucca road appear to be the most important factors, and have the proper signs, they do not test as statistically significant in this case; neither do the other 5 factors included.

When only non-adopters and strong adopters are used in analysis, Rabi harvest labor (negative) also appears as a factor; both this and Kharif labor indicate ability of the farmer to amass resources that are crucial seasonally.

Table 3. Jhelum

Variable	Change in R^2	b.	F.	Significance a/
Plot Yield	0.29	0.44	1.73	Significant
Pucca Road	0.04	-0.39	1.80	Significant
Farmer Age	0.03	0.02	2.03	Significant
Mandi	0.03	0.28	15.28	Significant
Depot	0.09	-0.11	14.03	Significant
Kharif Labor	0.04	0.01	0.90	Not significant
Education	0.02	0.08	4.66	Significant
Remittances	0.03	-0.00046	3.87	Not significant
Large Animals	0.03	0.16	3.17	Significant
Small Animals	0.02	-0.02	0.68	Not significant
Tractor Use	0.01	0.61	1.77	Not significant
Irrigation	0.01	0.14	0.98	Not significant

Multiple R: 0.79
Variation explained: 63%
Constant = -1.95

N=40

a/ At 5% level.

Jhelum Demonstrators

There are 17 farmers in this category. In addition to some of the factors discussed previously, additional important factors in this regression are : (1) number of this farmer's plot (2) Rabi harvest labor (3) Kharif harvest labor (4) farm size (5) government plot production (6) government plot harvesting. (Multiple R=0.96)

Kohat District

Irrigation in this district is by far the most important factor. The second most important is farmer awareness of greater plot yield. Then come distance to Mandi, age of the farmer, amount of remittances to the farm, and amount of Rabi harvest labor. All are significant factors.

When only non-adopters and strong adopters are used in analysis, distance to a good road also appears as a factor.

Table 4. Kohat

Variable	Change in R	b.	F.	Significance a/
Irrigation	0.47	0.03	9.07	Significant
Plot Yield	0.11	1.39	17.06	Significant
Mandi	0.08	-0.20	8.09	Significant
Farmer Age	0.03	0.02	4.26	Significant
Remittances	0.02	0.0015	2.90	Not significant
Rabi Labor	0.03	0.12	2.72	Significant

Multiple R: 0.86

Variation explained: 74%

Constant = -1.10 N=35

a/ At 5% level

Kohat Demonstrators

There are only 6 farmers in this category. In addition to some of the factors discussed previously, important factors in this regression are: (1) small animal numbers (2) large animal numbers (3) distance to pucca road (negative) and (4) Kharif harvest labor. (Multiple R= 0.99)

Rawalpindi District

Irrigation is the most important factor, followed by Rabi labor, Distance to road comes next, followed by distance to market which may be quite important. Amount of Kharif harvest labor follows.

Amount of Rabi labor unexpectedly shows a negative relationship, while the other two factors are not significant in this case.

When only non-adopters and strong adopters are used in analysis, three other factors are shown to be important: (1) farmer awareness of greater plot yield, (2) number of large animals (negative) and (3) number of small animals (negative).

Table 5. Rawalpindi

Variable	Change in R^2	b	F.	Significance[a/]
Irrigation	0.39	0.03	8.91	Significant
Rabi Labor	0.09	0.05	6.81	Significant
Education	0.04	0.02	0.24	Not significant
Road Pucca	0.02	0.27	17.12	Significant
Mandi	0.12	0.25	14.51	Significant
Kharif Labor	0.02	0.06	3.12	Significant
Tractor Use	0.02	0.40	1.88	Not significant

....

Multiple R: 0.84

Variation explained: 70%

Constant = 9.38 N = 40

a/ At 5% level

Rawalpindi Demonstrators

There are 17 farmers in this category. In addition to some of the factors discussed previously, important factors in this regression are : (1) farm size (2) farmer age (3) distance to depot (negative) (4) amount of remittances. (Multiple R = 0.98)

Swat District

The most important factor is farmer awareness of the greater plot yield from the new variaties and fertilizer. Number of small animals is the next most important factor in indicating adoption, and it is negative; use of tractor and distance to depot and to mandi are all factors of about equal importance.

Table 6. Swat

Variable	Change in R^2	b.	F.	Significance[a/]
Plot Yield	0.38	0.65	23.52	Significant
	0.12	-0.01	5.56	Significant
Tractor Use	0.04	0.53	7.22	Significant
Depot	0.05	-0.83	9.60	Significant
Mandi	0.04	0.70	7.54	Significant
Kharif Labor	0.02	0.04	2.46	Significant

Multiple R= 0.81
Variation explained:65%

Constant = 1.57

N = 53

a/ At 5% level

Swat Demonstrators

There are 14 farmers in this category. In addition to the factors discussed previously, important factors in this regression are: (1) Rabi harvest labor (2) number of large animals (3) amount of remittances (negative) (4) age (5) education (6) distance to pucca road (negative) and (7) government plot harvesting. (Multiple R = 0.98.)

PUNJAB PROVINCE

This combines Attock, Jhelum and Rawalpindi. Once again, the most important factor is farmer awareness of greater plot yield. Next comes irrigation, followed by tractor use and farm size. The final factor, distance to the fertilizer depot, is not significant.

When only non-adopters and strong adopters are used in analysis, two factors are added: (1) numbers of large animals, and (2) education of farmer.

Table 7 Punjab

Variable	Change in R^2	b	F	Significance[a/]
Plot Yield	0.35	0.98	33.36	Significant
Irrigation	0.05	1.02	12.46	Significant
Tractor Use	0.02	0.42	5.17	Significant
Farm Size	0.02	0.00035	3.34	Not significant
Depot	0.01	-0.0048	2.22	Not significant

Multiple R= 0.67

Variation explained: 45%

a/ At 5% level

Punjab Demonstrators

There are 54 farmers in this category. In addition to some of the factors discussed previously, important factors in this regression are : (1) number of large animals (2) number of this farmer's plots (3) government plot harvesting (4) Rainfall (5) government plot production. (Multiple R= 0.77)

North-West Frontier Province

This combines Abbottabad, Kohat and Swat. Again, the most important factor is farmer awareness of greater plot yields, followed by irrigation as an important second factor. For the first time, rainfall appears as a factor--it was not possible for this to show up in the individual district analyses, since all farms in each district had the same coded rainfall. Also, the spread in amount of rain between districts is substantially more in N.W.F.P. than in Punjab. Other factors that show up are farm size, numbers of small animals, farmer age and tractor use, all significant.

When only non-adopters and strong adopters are used in analysis, the two additional factors of Kharif harvest labor and of Rabi harvest labor, also appear.

Table 8. N.W.F.P.

Variable	Change in R^2	b.	F.	Significance a/
Plot Yield	0.29	0.88	28.49	Significant
Irrigation	0.10	0.02	10.47	Significant
Rainfall	0.03	0.05	10.22	Significant
Farm Size	0.03	0.0013	5.24	Not significant
Small Animals	0.02	-0.015	4.13	Significant
Farmer Age	0.01	0.010	4.05	Significant
Tractor Use	0.01	0.29	2.74	Significant

Multiple R: 0.70

Variation explained: 49%

a. At 5% level

N.W.F.P Demonstrators

There are 34 farmers in this category. In addition to some of the factors discussed previously, important factors in this regression are : (1) Kharif harvest labor (2) distance to pucca road (3) number of farmer's plots (negative) (4) Rabi harvest labor (5) distance to depot (6) government plot harvesting (negative) (7) education (8) number of large animals (9) amount of remittances (negative). (Multiple R = 0.83.)

N.W.F.P. and the Punjab

When all six districts are combined, analysis produces the following results. Farmer awareness of greater plot yields, and rainfall are almost equally important factors. Irrigation and miles to the market, are the two next most important. Tractor use and distance to a pucca road, are the final factors. All 6 factors are significant.

When only non-adopters and strong adopters are used in analysis, one additional factor appears--size of remittances to the farm.

Table 9. N.W.F.P. and Punjab

Variable	Change in R^2	b.	F.	Significance a/
Plot Yield	0.21	0.92	65.45	Significant
Rainfall	0.17	0.07	32.63	Significant
Irrigation	0.05	0.02	20.18	Significant
Mandi	0.04	-0.02	25.86	Significant
Tractor Use	0.02	0.52	14.80	Significant
Pucca Road	0.02	0.02	8.02	Significant

Multiple R: 0.71
Variation explained: 51%

a/ At 5% level

N.W.F.P. and Punjab Demonstrators

There are 88 farmers in this category. In addition to some of the factors discussed previously, important factors in this regression are: (1) government plot harvesting (2) number of large animals (3) number of each farmer's plots (4) government plot production (negative) (5) farm size. (Multiple R = 9.91.)

N. W. F. P. and Punjab Strong Adopters

Table 10.
Strong Adopters and Non-Adopters

Variable	b (slope)	Beta Coefficient	F Statistic	Significance
Plot Yield	.413	.42	49.8	Significant
Rainfall	.031	.28	20.4	Significant
Irrigated Area	.008	.26	19.4	Significant
Distance from Mandi	-.007	.23	17.0	Significant
R^2 = .61		N =146		

Table 10 shows the first four variables entered by the step-wise regression program for the sample containing all non-adopters and all strong adopters for the two provinces. Of the 13 independent variables entered, only 4 had significant slope coefficients, and each of these also accounted for more than 2% of the variance in adoption (as measured by their respective beta coefficients).

APPENDIX B

RESULTS OF TESTS OF SIGNIFICANCE BETWEEN MEANS AND OF INDEPENDENCE

TABLE B-1. SUMMARY OF TESTS OF SIGNIFICANCE BETWEEN MEANS AND OF INDEPENDENCE

Variable a/	Mean: Adopter	Mean: Non-Adopter	Value of t	Chi Square b/ test of Independence: Chi Square	Chi Square b/ test of Independence: Degrees of Freedom	Observed Adopter frequency greater than expected for:
1. Age of farmer, years	46.1	43.5	1.51	4.6	5	--
2. Education, years	4.4	2.9	2.57 c/	7.5 d/	3	more years
3. Miles from Mandi	8.2	13.5	-2.77 e/	8.0 c/	3	smaller distances
4. Miles from Depot	11.0	16.8	-2.79 e/	7.7 c/	2	smaller distances
5. Miles from pucca Road	3.7	4.0	-0.27	1.0	3	--
6. Acres of Cultivated land	13.9	12.8	0.45	8.0	7	--
7. Acres of Irrigated land	1.4	0.2	5.63 e/	44.7 e/	2	larger acreage
8. Acres of Barani land	12.5	12.6	-0.04	18.6 e/ f/	7	smaller acreage
9. Number Fragments/Farm	7.2	11.0	-1.90	25.7 e/	6	smaller numbers
10. Use of tractors:	.81	.52	5.19 e/	23.6 e/	1	greater tractor use
11. Number Bullocks	1.5	1.1	2.59 e/	17.7 e/	3	larger numbers
" Donkeys	0.7	1.0	-2.76 e/	16.7 e/	2	smaller numbers
12. Number Buffalo	1.2	0.5	4.69 e/	25.9 e/	2	larger numbers
13. Number Cows	1.9	2.3	-1.91	18.1 e/	4	smaller numbers
14. Number Goats	2.2	4.2	-2.06 c/	14.4 e/	4	smaller numbers
15. Number Sheep	1.1	2.6	-2.43 c/	7.9 c/	2	smaller numbers
16. Number in Household	9.5	8.2	2.10 c/	11.3 c/	4	larger number
17. Gross non-Farm Income (Rs)	911.0	473	2.39 c/	13.2 e/	3	larger income
18. Remittances, Rs/Mo.	454.0	239	2.20 c/	8.5 c/	2	larger remittances
19. No. members receiving outside income	1.1	0.9	1.13	2.3	3	
Family Labor for Rabi						
- Sowing	2.0	2.5	-2.89 e/	6.1	4	
- Harvesting	2.8	4.0	-4.72 e/	22.6 e/	4	smaller numbers
- Threshing	2.3	2.6	-1.59	3.7	4	
20. Relatives' Labor for Rabi:						
- Sowing	1.3	2.4	-2.82 e/	14.6 c/	5	smaller numbers
- Harvesting	3.6	5.6	-2.17 c/	13.6 c/	5	smaller numbers
- Threshing	5.6	8.2	-2.58 c/	18.9 e/	4	smaller numbers
21. Friends' Labor for Rabi:						
- Sowing	0.7	0.8	-0.33	4.0	3	
- Harvesting	3.4	2.2	1.15	14.7 e/	4	smaller numbers
- Threshing	4.2	1.9	2.36 c/	21.3 e/	4	smaller numbers
22. Hired Laborers for Rabi:						
- Sowing	1.2	0.1	1.77	25.3 e/	1	larger numbers
- Harvesting	2.6	0.7	2.05 c/	35.7 e/	2	larger numbers
- Threshing	1.6	0.1	3.00 e/	33.7 e/	2	larger numbers
23. Total Labor for Rabi:						
- Sowing	5.2	5.7	-0.56	3.8	4	--
- Harvesting	12.4	12.3	0.05	5.7	5	--
- Threshing	13.6	12.8	0.50	8.61	5	--

a/ N for adopters = 155, N for Non-adopters = 93; Total N = 248.

b/ Chi square is also referred to as χ^2.

c/ Significant at the 5% level.

d/ Signficiant at the 10% level.

e/ Signfiicant at the 1% level.

f/ Two size classes-- 1-2 acres and 9-10 acres, account for almost all the χ^2. For the two largest size classes, observed and expected frequencies are the same

TABLE B-2. CHARACTERISTICS OF 66 ADOPTING FARMERS WHO HAD DEMONSTRATORS ON THEIR FARMS

Characteristics	$\bar{x}$	Standard Deviation
Age	46.0	12.5
Education	4.5	4.7
Miles to Mandi	9.7	13.8
Miles to Depot	13.4	15.5
Miles to Pucca Road	4.4	9.8
Persons in Family	8.8	3.6
No. Fragments in Farm	10.6	24.8
Acres cultivated land in farm	21.3	28.8
Acres irrigated land in farm	1.2	1.8
Acres barani land in farm	20.1	29.3
No. buffalo per farm	1.1	1.3
No. bullocks per farm	1.8	1.3
No. cows per farm	2.0	2.0
No. Donkeys per farm	0.8	0.7
No. Goats per farm	2.6	4.5
No. Sheep per farm	1.7	5.4
No. tractors available	1.2	0.4
No. plows owned per farm	1.4	0.7
No. members of family earning off-farm income	1.1	1.0
Remittances per month (Rs)	500	900

APPENDIX C

SELECTED DESCRIPTIVE INFORMATION

SAMPLE ADOPTING BARANI FARMERS

TABLE C-1. SELECTED DESCRIPTIVE INFORMATION - SAMPLE ADOPTING BARANI FARMERS

District Mean & Standard Deviation:	North-West Frontier Province									Punjab									Total 6 Districts	
	Abbottabad			Kohat			Swat			Attock			Jhelum			Rawalpindi				
	$\bar{X}$	N	σ	$\bar{X}$	N	σ	$\bar{X}$	N	σ	$\bar{X}$	N	σ	$\bar{X}$	N	σ	$\bar{X}$	N	σ	$\bar{X}$	σ
Age of Farmer	47.8	31	15.3	50.4	18	12.8	43.0	52	10.0	47.2	15	13.0	47.9	20	11.9	45.2	19	13.2	46.1	12.5
Years Education of Farmer	4.6		4.4	3.7		4.0	3.4		5.4	4.5		4.5	4.6		4.3	6.8		3.8	4.4	4.7
Miles to Mandi	3.7		3.1	0.9		1.4	2.1		1.7	7.6		9.1	6.9		2.7	41.2		3.7	8.2	13.1
Miles to Depot	16.2		16.4	0.9		1.4	2.2		1.6	5.6		4.0	10.5		6.6	41.2		3.7	11.0	14.9
Miles to Pucca Road	12.2		16.3	1.3		1.4	0.6		0.5	0.4		0.5	0.6		0.5	6.2		3.7	3.7	6.7
Persons in Household	10.5		4.8	12.2		6.1	8.9		4.3	9.9		4.6	8.3		3.1	7.4		3.3	9.5	4.6
No. Farm Fragments	4.3		2.7	2.9		1.9	2.9		1.6	11.7		9.3	10.4		-	9.9		5.6	7.2	16.0
Acres Cultivated Land	12.0		19.0	11.5		8.1	4.2		2.9	49.6		34.8	19.2		28.6	11.6		8.5	13.9	[illegible]
Acres Irrigated Land	0.5		0.8	1.6		2.2	2.2		2.2	0.7		1.3	0.1		0.2	2.1		2.6	1.4	[illegible]
Acres Barani Land	11.5		19.1	10.9		7.4	2.0		1.0	48.9		35.5	18.6		28.8	9.5		7.6	12.5	[illegible]
No. Buffalo	3.3		1.3	0.1		0.5	1.8		1.2	1.3		1.7	0.4		0.8	1.3		1.0	1.2	1.3

. . . continued

TABLE C-1. SELECTED DESCRIPTIVE INFORMATION - SAMPLE ADOPTING BARANI FARMERS . . . (continued)

	North-West Frontier Province						Punjab							
	Abbottabad		Kohat		Swat		Attock		Jhelum		Rawalpindi		Total 6 Districts	
	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ
No. Bullocks	1.4	1.0	0.6	0.9	1.8	0.7	2.7	1.9	1.4	1.1	0.7	0.9	1.5	1.1
No. Cows	1.1	1.4	2.7	1.4	1.3	1.3	3.8	2.6	2.7	1.5	1.5	1.2	1.9	1.7
No. Donkeys	0.5	0.6	0.4	0.9	0.04	0.2	1.3	0.8	1.0	0.2	0.7	0.6	0.5	0.7
No. Horses	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.05	0.2	0.05	0.2	0.02	0.1
No. Camels	0.0	0.0	0.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.03	0.2
No. Goats	0.7	0.8	6.8	4.5	0.6	1.7	6.8	7.4	1.6	2.3	1.5	1.6	2.2	3.9
No. Sheep	0.8	3.3	1.4	1.7	0.3	2.1	4.6	9.6	0.4	1.1	1.2	4.6	1.1	4.0
No. Tractors	1.5	0.5	1.1	0.3	1.2	0.4	1.2	0.4	1.0	0.2	1.1	0.2	1.2	0.4
No. Plows	0.9	0.5	1.4	0.5	1.4	0.5	1.6	0.7	1.4	0.7	1.1	0.8	1.3	0.6
No. With Outside Income	1.6	1.1	1.0	0.7	0.5	0.8	1.7	1.0	1.2	1.0	1.3	1.1	1.1	1.0
Total Income per Farmer (RS)	1727	1922	518	546	396	862	1700	2322	866	1651	788	1436	911	1839
Remittance/Farmer (Rs)	949	1305	180	162	158	316	856	1102	347	777	511	981	454	873
Rabi Sowing/ Family Labor	1.7	0.9	3.4	1.4	1.4	0.9	2.7	1.4	2.0	1.1	2.1	1.1	2.0	1.2

. . . continued

TABLE C-1. SELECTED DESCRIPTIVE INFORMATION - SAMPLE ADOPTING BARANI FARMERS . . . (continued)

	North-West Frontier Province						Punjab							
	Abbottabad		Kohat		Swat		Attock		Jhelum		Rawalpindi		Total 6 Districts	
	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ
Rabi Sowing/ Relatives	1.7	1.9	0.1	0.5	0.1	0.4	4.3	7.4	1.2	1.5	2.9	1.7	1.3	2.9
Rabi Sowing/ Friends	0.7	1.2	0.0	0.0	0.2	0.6	4.3	6.6	0.4	0.8	0.6	1.3	0.7	2.5
Rabi Sowing/ Laborers	0.4	0.8	0.3	0.8	1.2	1.1	0.9	1.4	4.3	16.4	0.0	0.0	1.2	6.0
Total Rabi Sowing	4.6	2.9	3.8	1.3	2.9	1.5	12.1	13.5	8.0	15.8	5.6	2.7	5.2	7.7
Rabi Harvest/ Family	2.3	1.5	5.1	1.9	1.4	1.0	4.1	1.5	3.7	1.8	3.6	1.8	2.8	1.9
Rabi Harvest/ Relatives	2.4	3.6	0.3	0.8	0.9	1.2	12.2	12.0	5.5	5.0	7.5	7.5	3.6	6.3
Rabi Harvest/ Friends	4.2	16.1	0.0	0.0	1.8	1.2	17.5	12.7	0.6	1.9	1.2	2.2	3.4	9.5
Rabi Harvest/ Labor	3.3	4.7	0.7	2.1	2.3	1.9	1.5	2.4	7.4	22.8	0.0	0.0	2.6	8.7
Total Rabi Harvest	12.1	19.3	6.0	1.7	6.5	2.3	35.2	19.6	17.2	25.6	12.2	8.6	12.4	16.4
Rabi Thresh/Family	2.1	1.2	3.7	1.6	1.6	1.1	3.4	1.5	2.8	1.1	2.0	1.1	2.3	1.4

. . . continued

TABLE C-1. SELECTED DESCRIPTIVE INFORMATION - SAMPLE ADOPTING BARANI FARMERS . . . . (continued)

	North-West Frontier Province						Punjab							
	Abbottabad		Kohat		Swat		Attock		Jhelum		Rawalpindi		Total 6 Districts	
	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ
Rabi/ Thresh/ Relatives	3.9	3.4	0.1	0.2	3.3	1.3	8.9	7.5	5.8	7.0	17.2	11.1	5.6	7.2
Rabi Thresh/ Friends	5.0	16.2	0.6	2.0	4.3	2.1	14.4	11.6	1.0	2.3	1.1	1.9	4.2	9.0
Rabi Thresh/ Labor	1.0	3.6	0.3	1.0	2.2	1.7	0.9	1.4	3.6	12.0	0.0	0.0	1.6	4.8
Total Rabi Thresh	12.0	21.0	4.7	2.4	11.3	3.5	27.7	15.9	13.2	12.0	20.3	12.4	13.6	13.6
N. Wheat Kharif '72-3	0.0		0.0		0.0		0.0		0.0		6.5		0.8	
73-4	0.0		0.0		0.0		20.0		2.3		12.0		3.7	
74-5	0.0		0.0		0.0		61.2		16.8		13.3		9.7	
75-6	13.0		0.0		2.4		108.4		2.0		18.8		16.5	
76-7	16.2		9.0		6.6		118.6		4.6		17.0		20.6	
77-8	21.5		10.0		8.9		151.3		6.0		22.7		26.6	

. . . continued

TABLE C-1. SELECTED DESCRIPTIVE INFORMATION - SAMPLE ADOPTING BARANI FARMERS. . . (continued)

		North-West Frontier Province						Punjab							
		Abbottabad		Kohat		Swat		Attock		Jhelum		Rawalpindi		Total 6 Districts	
		$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ
O.Wheat Kharif	'72-3	0.0		0.0		0.0		0.0		39.0		18.2		7.3	
	73-4	1.4		0.0		0.6		20.0		49.8		19.1		11.2	
	74-5	2.7		0.0		8.6		201.5		50.8		21.0		32.1	
	75-6	14.1		35.3		11.7		187.5		72.4		28.5		41.8	
	76-7	12.2		29.8		10.2		184.7		72.7		22.2		39.3	
	77-8	7.1		30.8		9.6		155.0		68.9		23.2		34.9	
Nitrate	72-73	0.0		0.0		0.0		0.0		17.8		12.7		3.8	
Phosphate	72-73	0.0		0.0		0.0		0.0		12.8		10.7		3.0	
N.	73-74	0.0		0.0		0.0		0.0		59.9		27.8		11.1	
P.	73-74	0.0		0.0		0.0		0.0		35.7		26.8		7.9	
N.	74-75	0.6		0.0		21.4		0.0		54.8		51.1		20.6	
P.	74-75	1.6		0.0		2.0		0.0		35.7		32.2		9.5	
N.	75-76	75.7		0.0		84.2		49.4		71.8		82.2		67.5	
P.	75-76	67.6		0.0		44.1		30.6		43.4		51.0		43.1	
N.	76-77	114.7		90.4		111.1		75.0		126.9		75.5		103.6	
P.	76-77	83.4		28.3		61.8		61.2		76.5		26.8		59.8	
N.	77-78	102.0		105.9		125.0		52.9		99.3		70.0		101.1	
P.	77-78	88.0		19.6		71.6		43.5		49.7		16.1		56.5	

APPENDIX D

SELECTED DESCRIPTIVE INFORMATION

SAMPLE NON-ADOPTING BARANI FARMERS

TABLE D-1. SELECTED DESCRIPTIVE INFORMATION - SAMPLE NON-ADOPTING BARANI FARMERS

District: Mean and Standard Deviation:	North-West Frontier Province									Punjab									Total 6 Districts	
	Abbottabad			Kohat			Swat[a/]			Attock			Jhelum			Rawalpindi				
	$\bar{x}$	N	σ	$\bar{x}$	N	σ	$\bar{x}$	N	σ	$\bar{x}$	N	σ	$\bar{x}$	N	σ	$\bar{x}$	N	σ	$\bar{x}$	σ
Age of Farmer	49.6	9	21.0	46.3	17	11.0	65.0	1	0.0	44.8	25	15.6	38.5	20	11.2	41.0	21	13.0	43.5	14.2
Years Education of Farmer	1.4		2.2	3.2		4.7	0.0		0.0	1.9		3.8	4.3		4.7	3.3		3.5	2.9	4.0
Miles to Mandi	3.1		3.7	2.5		2.0	5.0		0.0	5.3		3.9	6.3		3.2	43.9		2.9	13.5	16.8
Miles to Depot	24.2		17.6	2.5		2.0	5.0		0.0	5.3		3.9	12.3		7.9	43.9		2.9	16.8	17.3
Miles to Pucca Road	19.3		18.6	1.6		1.6	1.0		0.0	1.3		1.2	0.6		0.5	5.8		3.2	4.0	7.9
Persons in Household	7.0		2.2	12.8		7.9	13.0		0.0	7.6		4.3	6.4		1.6	7.0		3.0	8.2	4.9
No. Farm Fragments	2.0		1.1	2.9		1.2	2.0		0.0	11.2		12.5	13.4		12.7	19.4		13.0	11.0	12.2
Acres Cultivated Land	2.5		2.2	8.9		6.2	2.5		0	17.2		14.4	14.6		10.4	13.6		14.4	12.8	12.2
Acres Irrigated Land	0		0	0.1		0.3	0		0	0.4		0.9	0		0	0.2		0.6	0.2	0.6
Acres Barani Land	2.5		2.2	8.8		6.2	2.5		0	16.8		14.8	14.8		10.4	13.4		14.4	12.6	12.2
No. Buffalo	0.7		0.7	0.0		0.0	4.0		0.0	0.5		0.7	0.4		0.8	0.6		0.7	0.5	0.8

. . . continued

TABLE D-1. SELECTED DESCRIPTIVE INFORMATION - SAMPLE NON-ADOPTING BARANI FARMERS . . . (continued)

	North-West Frontier Province						Punjab							
	Abbottabad		Kohat		Swat[a/]		Attock		Jhelum		Rawalpindi		Total 6 Districts	
	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ
No. Bullocks	1.0	1.4	0.4	0.6	2.0	0.0	1.6	1.5	1.2	1.3	1.0	1.2	1.1	1.3
No. Cows	1.0	0.9	2.5	1.1	3.0	0.0	2.2	1.3	2.6	1.7	2.7	1.5	2.3	1.4
No. Donkeys	0.2	0.4	0.6	0.8	3.0	0.0	0.8	0.5	1.3	1.6	0.8	0.4	0.8	1.0
No. Horses	0.0	0.0	0.0	0.0	4.0	0.0	0.1	0.4	0.0	0.0	0.1	0.3	0.9	0.5
No. Camels	0.0	0.0	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.05	0.2	0.04	0.2
No. Goats	0.7	0.9	7.3	7.7	99.0	0.0	2.7	3.8	2.9	3.7	1.9	2.2	4.2	11.0
No. of Sheep	2.2	6.7	1.8	3.4	0.0	0.0	2.9	5.0	2.6	6.7	3.2	6.9	2.6	5.7
No. Tractors	1.9	0.3	1.2	0.4	2.0	0.0	1.8	0.4	1.3	0.5	1.3	0.5	1.5	0.5
No. Plows	1.0	0.5	1.2	0.5	2.0	0.0	1.2	0.6	1.3	0.7	1.4	0.6	1.3	0.6
No. With Outside Income	1.2	0.4	0.8	1.0	0.0	0.0	1.0	1.2	1.0	1.0	0.7	0.7	0.9	0.9
Total Income Per Farmer (Rs.)	376	172	242	292	0.0	0.0	710	1734	705	1388	219	263	473	1127

continued

TABLE D-1. SELECTED DESCRIPTIVE INFORMATION - SAMPLE NON-ADOPTING BARANI FARMERS . . . (continued)

	North-West Frontier Province						Punjab							
	Abbottabad		Kohat		Swat[a/]		Attock		Jhelum		Rawalpindi		Total 6 Districts	
	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ
Remittance/Farmer (Rs.)	314	162	138	166	0.0	0.0	313	663	324	529	129	145	239	439
Rabi Sowing Family/Labor	1.7	1.0	3.8	1.8	2.0	0.0	2.5	1.5	2.6	1.3	1.6	0.9	2.5	1.5
Rabi Sowing/Relatives	0.6	0.7	0.0	0.0	0.0	0.0	4.6	4.4	2.2	2.0	2.8	1.9	2.4	3.1
Rabi Sowing/Friends	0.3	0.7	0.0	0.0	0.0	0.0	2.7	3.0	0.2	0.7	0.0	0.0	0.8	2.0
Rabi Sowing/Laborers	0.0	0.0	0.0	0.0	1.0	0.0	0.2	0.6	0.2	0.4	0.0	0.0	0.1	0.4
Total Rabi Sowing	2.6	1.0	3.8	1.8	3.0	0.0	10.0	7.7	5.1	2.2	4.4	2.2	5.7	5.0
Rabi Harvest/Family	2.1	1.4	4.8	1.9	2.0	0.0	4.0	2.3	3.7	1.6	4.4	2.1	4.0	2.0
Rabi Harvest/Relatives	0.7	1.0	0.0	0.0	0.0	0.0	8.5	11.7	7.6	6.8	7.0	6.1	5.6	8.1
Rabi Harvest/Friends	0.6	1.3	0.0	0.0	3.0	0.0	7.4	5.2	0.1	0.4	0.3	1.2	2.2	4.2
Rabi Harvest/Labor	0.0	0.0	0.0	0.0	4.0	0.0	1.8	4.6	0.4	0.8	0.2	0.9	0.7	2.6

TABLE D-1. SELECTED DESCRIPTIVE INFORMATION - SAMPLE NON-ADOPTING BARANI FARMERS . . . (continued)

	North-West Frontier Province						Punjab						Total 6 Districts	
	Abbottabad		Kohat		Swat[a/]		Attock		Jhelum		Rawalpindi			
	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ
Thresh Rabi Harvest	3.3	2.2	4.8	1.9	9.0	0.0	21.6	17.5	11.8	6.6	12.0	5.3	12.3	11.8
Rabi Thresh/Family	1.8	1.0	4.0	1.6	2.0	0.0	2.6	1.3	2.7	1.6	1.8	0.9	2.6	1.5
Rabi Thresh/Relatives	1.4	1.3	0.0	0.0	3.0	0.0	7.8	7.8	10.6	7.6	16.2	6.8	8.2	8.4
Rabi Thresh/Friends	0.4	1.3	0.2	0.7	8.0	0.0	6.2	3.7	0.1	0.4	0.1	0.7	1.9	3.4
Rabi/Thresh/Labor	0.0	0.0	0.0	0.0	5.0	0.0	0.2	0.6	0.2	0.4	0.0	0.0	0.1	0.6
Total Rabi Thresh	3.7	2.2	4.2	1.9	18.0	0.0	16.8	10.9	13.5	7.7	18.1	6.8	12.8	9.4
N. Wheat Kharif 72-3	0.0		0.0		0.0		0.0		0.0		0.0		0.0	
73-4	0.0		0.0		0.0		0.0		0.0		0.0		0.0	
74-5	0.0		0.0		0.0		0.0		0.0		0.0		0.0	
75-6	0.0		0.0		0.0		0.0		0.0		0.0		0.0	
76-7	0.0		0.0		0.0		0.0		0.0		0.0		0.0	
77-8	0.0		0.0		0.0		0.0		0.0		0.0		0.0	

. . . continued

TABLE D-1. SELECTED DESCRIPTIVE INFORMATION - SAMPLE NON-ADOPTING BARANI FARMERS . . . (continued)

		North-West Frontier Province						Punjab						Total 6 Districts	
		Abbottabad		Kohat		Swat[a]		Attock		Jhelum		Rawalpindi			
		$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ
O. Wheat Kharif	'72-3	0.0		0.0		0.0		0.0		32.6		3.0		7.7	
	73-4	0.0		0.0		0.0		0.0		46.4		5.7		11.3	
	74-5	0.0		0.0		0.0		20.6		49.2		50.6		27.5	
	75-6	0.0		25.5		10.0		22.6		53.0		49.0		33.3	
	76-7	2.8		25.8		10.0		22.4		52.2		56.6		35.1	
	77-8	3.1		29.0		10.0		22.7		52.2		53.7		35.2	
Nitrate	72-73	0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Phosphate	72-73	0.0		0.0		0.0		0.0		0.0		0.0		0.0	
N.	73-74	0.0		0.0		0.0		0.0		0.0		0.0		0.0	
P.	73-74	0.0		0.0		0.0		0.0		0.0		0.0		0.0	
N.	74-75	0.0		0.0		0.0		0.0		0.0		0.0		0.0	
P.	74-75	0.0		0.0		0.0		0.0		0.0		0.0		0.0	
N.	75-76	0.0		0.0		0.0		0.0		0.0		0.0		0.0	
P.	75-76	0.0		0.0		0.0		0.0		0.0		0.0		0.0	
N.	76-77	0.0		0.0		0.0		0.0		0.0		0.0		0.0	
P.	76-77	0.0		0.0		0.0		0.0		0.0		0.0		0.0	
N.	77-78	0.0		0.0		0.0		0.0		0.0		0.0		0.0	
P.	77-78	0.0		0.0		0.0		0.0		0.0		0.0		0.0	

[a] One farmer only.

APPENDIX E

BRIEF REVIEW OF SELECTED IMPACT AND DIFFUSION REPORTS

Brief Review of Selected Impact and Diffusion Reports

Several publications appear to shed some light, both on the framework within which this study might operate, as well as some data and conclusions which offer comparisons with data obtained in the present survey. A theoretical framework is set by Wolf, who describes the assessment of social impact as (1) assessing the effectiveness of an on-going program in achieving its objectives, and (2)aiming at program improvement through a modification of current operations.[1/]

Diffusion and Rate of Adoption

Next to be described is "diffusion", the "process by which innovations spread to the members of the social system".[2/] Since the diffusion process takes time to complete, there is always a lag between its initiation and complete acceptance. Any measure of social change found in the system will be the direct consequence of actions taken by the change agents responsible for initiating the process. To be very successful, change agents must be thoroughly client-oriented, and they will then (1) be more feedback-minded, (2) have close rapport and high credibility with their clients, and (3) base their program of change on their clients' needs.[3/]

Five attributes of innovations are most important in explaining the rate of adoption. (1) Relative advantage is the degree to which an innovation is perceived as better than the idea it supersedes. (2)Compatibility is the degree to which an innovation is perceived as being consistent with existing values, experiences and needs of recipients. (3) Complexity is the degree to which an

---

1/ Wolf,C.P.,Ed.,"Social Impact Assessment" (Environmental Design Research Association, Inc., 1974),p.14.

2/ Rogers, Everett M.,with Shoemaker, F.Floyd, "Communication of Innovations", 2nd Ed. (Free Press,New York, 1971),pp.12-18.

3/ Rogers and Shoemaker,p.237.

innovation is perceived as difficult to understand and use. (4) Trialability is the degree to which an innovation may be experimented with on a limited basis. (5) Observability is the degree to which the results of an innovation are visible to others. The rate of adoption of an innovation will increase to the extent that this new technology has a relative advantage, is compatible, simple (not complex), trialable, and observable.4/

An example of diffusion at work is the rapid rate of adoption of High Yield Varieties (HYV) of wheat seed by irrigated farmers in Multan District, in the Punjab area of Pakistan. This seed innovation was (1) highly visible to farmers, (2) highly compatible with their traditional cropping systems and management practices, and (3) its use, even alone, offered a substantial advantage over desi seed. Other associated innovations which were a part of the "package" of improved practices, did not diffuse so rapidly through the farm population.5/

Another example of rapid adoption is found among barani farmers in Hazara District, NWFP, Pakistan. In 1966-67, there was an adoption ratio of only 0.9%, but by 1969-70, the ratio had risen to 66% for both HYV seed wheat and for fertilizer. HYV seed was adopted rapidly because (1) it gave better yields than desi seed, (2) it fit the existing cropping pattern, (3) it had a shorter growth period than desi wheat, (4) it did not require complex planting or cultivating procedures, (5) it had other positive features, such as beards that reduced bird attacks, and (6) while it furnished less bhoosa in some cases than did desi wheat, this was counter-balanced by the higher yield of grain.6/

4/ Rogers and Shoemaker, pp.22-23.

5/ Lowdermilk, Max Kearns, "Diffusion of Dwarf Wheat Production Technology in Pakistan's Punjab" (Cornell University, May 1972).

6/ Rochin, Refugio I., A Microeconomic Analysis of Small-Holder Response to HYV of Wheat in West Pakistan, Michigan State University, 1971. p. 159.

Awareness and Adoption of Innovations

Early farmer awareness of an innovation is prized by change agents, because awareness must come before innovative action is taken. Variables classed as either economic or communication variables, are both necessary for awareness as well as for innovation, and are highly inter-dependent. Correlations carried out in the Rochin study showed that a higher innovation awareness was found among farmers who:

(1) owned their own land
(2) had larger families
(3) listened to the radio more frequently
(4) had more interpersonal cosmopolite contacts (such as government agents and farm input sales representatives).

It is probable that migration does lead to increased awareness.[7/]

A companion correlation series found that farmers are more likely to adopt innovations early after exposure. if they:

(1) own 5 acres of land or more
(2) have large families
(3) have a relatively high income
(4) score high on awareness of innovations
(5) have numerous interpersonal cosmopolite contacts.

According to the correlation test, the following factors seemed to have little influence on innovative behavior: (1)income per capita per farm, (2) use of mass media channels (radio), (3) use of demonstration plots, (4) migration, and (5) off-farm remittances.[8/]

7/ Rochin, p. 162.

8/ Rochin, p. 163.

Rate of Adoption

Rate was measured in two ways -- over-time, and as a proportion of total farmers for one time period. With the rate measured as wheat acreage adopted over the time period, statistically significant correlations were identified with:

Positively	Negatively
Wheat acreage (farm size)	Miles to market
Credit availability	Tenure Status
Education of farmer	

The regression coefficients were not significant for: (1) farmer's age, or (2) miles to paved road. 9/

A slightly different result was obtained when the adoption of HYV wheat was correlated for Rabi 1969-70 with the independent factors, resulting in the following significant relationships:

Positively	Negatively
Wheat acreage (farm size	Miles to paved road
Miles to Union Council	
Education of farmer	
Recent wheat volume marketed	

At the same time, there was no significant correlation with: (1) credit availability, (2) tenure status, or (3) number of agricultural extension contacts. 10/

A third correlation was run for a recent year with adoption of nitrogen fertilizer as the dependent variable. Significant correlation was found with :

9/ Lowdermilk, pp. 21-29.

10/ Lowdermilk, pp. 29-34.

Positively	Negatively
Wheat acreage (farm size)	Distance to fertilizer outlet
Credit availability	
Number of trips to town	

Other independent factors considered were: (1) distance to Union Council, (2) number of extension contacts, or (3) water availability, (4) radio listening index, and (5) farm management knowledge. 11/

Findings on Migration

Migrants are typically adult males from small farms with extended families. There is a large cash flow from the urban places of employment of these migrants back to the (Barani) villages. Correlation of these remittances with actual innovation shows little statistical significance, but such income can give the Barani farmer some risk insurance against the failure of any technical innovation on his farm. Lack of credit did not appear to be a serious constraint on the ability of Barani farmers to adopt the new technology, as many of them had income derived from local employment and from migrant remittances. 12/

Risk and Uncertainty

If a modern technique is considered by the farmer to be more risky than traditional methods, he will underinvest in such techniques. In many cases, recommendations suitable for certain classes of farmers are applied to all of them, and may actually decrease average profits for many. For

11/ Lowdermilk, pp. 40-52

12/ Rochin, pp. 163-64.

instance, farmers in India continue to grow wheat mixed with mustard even though agronomists advise against it. There may actually be less variation in the two-crop output year after year, and the mean income may be greater by cropping as farmers do it, because of such indirect effects as more effective disease control.[13] Although it is easy to show cases of significantly higher yields on barani farms through fertilizer and tillage improvements, it is more difficult to evaluate the increased risk resulting from the higher variance in yield coupled with the uncertainty of quantity and timing of rainfall.[14]

Complaints About New Wheats

Farmers in Multan who had no complaint about (1) straw quality, or (2) taste or breadmaking qualities, reported consistently higher adoption of HYV varieties than did the farmers who had such complaints. Following are the farmers' reported reactions[15]:

Farmers had no complaints	33%
HYV had poor straw quality, difficult for animals to eat	33%
HYV had poor taste or bread-baking qualities	20%
Additional water was needed for HYV compared with desi types	10%
Added fertilizer was needed for HYV; other complaints	5%
	100%

13/ Roumasset, J.A., "Risk and Uncertainty in Agricultural Development " (Agricultural Development Council, New York, Oct. 1977).

14/ "A Water Harvesting Plan for Barani Lands of Pakistan",USAID Mission to Pakistan, September 1972.

15/ Lowdermilk pp. 35-6.

Complaints About Fertilizer

There were three common complaints about fertilizer availability in the Multan area: 16/

Fertilizer price was too high	95% of farmers
Farmer had lack of funds for purchasing	75%
Farmer unable to get needed fertilizer on time	76%

Extension Programs 17/

A survey was conducted in 1974 which included a small sample of Barani farmers in Campbellpur District, and which compared extension education by radio and by extension agents. Unfortunately, only 6% of the farmers knew there was a demonstration plot in their Union Council, and only half of these attended the plot field days regularly. Only 8% of the farmers reported that they had attended a showing of agricultural films within the past 6 months. 92% of the farmers listened to agricultural programs on the radio, and 64% of the farmers owned radios.

56-61% of the farmers obtained the information they needed and adopted improved seeds and use of manure / fertilizer, from the advice of the Field Assistant only. 33-36% of the farmers reported that they obtained such information from both radio programs and the Field Assistant.

16/ Lowdermilk, pp. 43-44.

17/ Qazi, Z. I., Grooming the Punjab Farmers for a Green Revolution, Punjab Board of Economic Inquiry, Lahore, 1975. Publication No. 158.

Fertilizer adoption[18/]

Over 230 Barani farmers were included in this survey. There was no significant difference either among farm size categories, or among tenure classes, in the percent of Barani farmers using fertilizer. Age and literacy were not related to fertilizer use, and neither were location on a Katcha or Pucca road.

As expected, there was a significant difference between use of fertilizer by irrigated and by Barani farmers; the former reported a higher percent of use. Fertilizer use was related directly to availability, but not the amount of fertilizer used. Barani wheat farmers reported the tendency of large farmers to use phosphate fertilizer to a greater extent than was true for small farmers; on the other hand, small farmers used significantly more nitrogen fertilizer per acre than larger farmers.

Sources of information for Barani farmers about fertilizer included: the agricultural extension service, 6%; radio, 21%; other farmers, 38%; relatives, 29%; newspapers and other sources, 6%. 23% of the Barani farmers used credit to buy fertilizer; 17% of this was from non-institutional sources.

Reasons given by Barani farmers who did not use fertilizer were: had insufficient water, 33%; use of fertilizer too expensive, 25%; lack of funds, 10%; fertilizer sales outlet too distant, 12%; lack of knowledge about fertilizer, 7%; fertilizer unavailable or other reasons, 12%.

18/ General Farmers Investigation Survey: Distribution and Use of Fertilizer in Pakistan, National Fertilizer Corporation of Pakistan, Ltd., 1977.

APPENDIX F

CROP LABOR AT BUSY SEASONS

Crop Labor at Busy Seasons

During the Rabi season, the wheat crop takes precedence over all other farming operations, and the need for labor at critical times of the season is most noticeable. For this reason, it was thougnt that adopters might differ in their use of labor from non-adopters, and the following tables have been set up to make such comparisons:

Family Labor. Tables 1-3 give the amount of family labor used in sowing, harvesting and threshing, respectively. Of the three operations, only harvesting exhibits a significant difference, in which adopters appear to have a majority of the smaller family groups working in the fields.

Table 1

Rabi Sowing : Family Labor

Number of Family Labors	Adopters		Non-Adopters		Total
	O	E	O'	E'	
0-1	63	59	32	36	95
2	51	48	25	29	76
3	20	20	12	12	32
4	14	19	16	11	30
Over 4	7	9	8	6	15
Total	155	155	93	93	248

$\chi^2 = 6.1$

Not significant at .10 level.

Table 2

Rabi Harvesting: Family Labor

Number of Family Laborers	Adopters		Non-Adopters		Total
	O	E	O'	E'	
0-1	47	34	7	20	54
2	30	33	23	20	53
3	28	26	14	16	42
4	19	19	12	12	31
Over 4	31	43	37	25	68
Total	155	155	93	93	248

$\chi^2 = 22.6$

Significant at .001 level.

Table 3

Rabi Threshing: Family as Laborers

Number of Family Laborers	Adopters		Non-Adopters		Total
	O	E	O'	E'	
0-1	53	49	26	30	79
2	42	42	25	25	67
3	31	29	16	18	47
4	17	21	17	13	34
Over 4	12	13	9	8	21
Total	155	155	93	93	248

$\chi^2 = 3.7$

Not Significant at .10 level.

Labor from Relatives. Tables 4-6 give the amount of labor furnished by relatives of the farm family for sowing, harvesting and threshing the crops. All three operations exhibit significant differences between adopters and non-adopters. Adopters average fewer relatives used as labor than do non-adopters.

Table 4

Rabi Sowing: Relatives as Labor

Number of Relatives as Laborers	Adopters		Non-Adopters		Total
	O	E	O'	E'	
0	98	84	37	51	135
1	11	11	7	7	18
2	13	15	11	9	24
3	14	17	13	10	27
4	7	8	6	5	13
Over 4	12	19	19	12	31
Total	155	155	93	93	248

$\chi^2 = 14.6$

Significant at .02 level.

Table 5

Rabi Harvesting: Relatives as Labor

Number of Relatives as Laborers	Adopters		Non-Adopters		Total
	O	E	O'	E'	
0	68	61	30	37	98
1	24	21	9	12	33
2	18	19	13	12	31
3	13	11	5	7	18
4	5	9	9	5	14
Over 4	27	34	27	20	54
Total	155	155	93	93	248

$\chi^2 = 13.6$

Significant at .02 level

Table 6

Rabi Threshing: Relatives as Laborers

Number of Relatives as Laborers	Adopters		Non-Adopters		Total
	O	E	O'	E'	
0	30	33	22	20	52
1-2	22	19	9	12	31
3	25	19	6	12	31
4	25	19	5	11	30
Over 4	53	65	51	39	104
Total	155	155	93	93	248

$\chi^2 = 18.9$

Significant at .001 level.

Labor from Friends. Tables 7-9 give the amount of labor furnished by friends of the farm family for sowing, harvesting and threshing of the crop. While adopters and non-adopters show as significant difference for sowing, they do show significant differences for harvesting and threshing. Adopters seem to have more friends in the small-number groups while non-adopters have more friends in the large-number groups.

Table 7

Rabi Sowing: Friends as Laborers

Number of Friends as Laborers	Adopters		Non Adopters		Total
	O	E	O'	E'	
0	122	121	71	72	193
1	14	12	5	7	19
2	9	9	5	5	14
Over 2	10	14	12	8	22
Total	155	155	93	93	248

$\chi^2 = 4.0$

Net Significant at .10 level.

Table 8

Rabi Harvesting: Friends as Laborers

Number of Friends as Laborers	Adopters		Non-Adopters		Total
	O	E	O'	E'	
0	80	79	47	48	127
1-2	34	26	7	15	41
3	15	14	8	9	23
4-5	8	10	8	6	16
Over 5	18	26	23	15	41
Total	155	155	93	93	248

$\chi^2 = 14.7$

Significant at .01 level

Table 9

Rabi Threshing: Friends as Laborers

Number of Friends as Laborers	Adopters		Non-Adopters		Total
	O	E	O'	E	
0	60	66	45	39	105
1-3	36	26	5	15	41
4	17	14	5	8	22
5	12	11	5	6	17
Over 5	30	39	33	24	63
Total	155	155	93	93	248

$\chi^2 = 21.3$

Significant at .001 level.

Labor Hired. Tables 10-12 give the amount of crop labor furnished by hired laborers, and the differences between adopters and non-adopters is significant in all three cases. Adopters appear to hire more labor and to hire in larger numbers per farm than do non-adopters.

Table 10

Rabi Sowing: Laborers Hired

Number of Laborers Hired.	Adopters		Non-Adopters		Total
	O	E	O'	E'	
	96	113	85	68	181
1.00 or more	59	42	8	25	67
Total	155	155	93	93	248

$\chi^2 = 25.3$

Significant at .001 level

Table 11

Rabi Harvesting: Laborers Hired

Number of Laborers Hired.	Adopters		Non-Adopters		Total
	O	E	O'	E'	
0	77	98	80	59	157
1-2	33	24	6	15	39
Over 2	45	33	7	20	50
Total	155	155	93	93	248

$\chi^2 = 35.7$

Significant at .001 level.

Table 12

Rabi Threshing: Laborers Hired

Number of Laborers Hired	Adopters		Non Adopters		Total
	O	E	O'	E'	
0	92	111	86	67	178
1 or more	63	44	7	26	70
Total	155	155	93	93	248

$\chi^2 = 33.7$

Significant at .001 level.

All Rabi Labor for Sowing, Harvesting and Threshing.

Tables 13-15 give the amount of labor furnished from all sources for crops on the farms for sowing, harvesting and threshing operations. In none of the three cases is the difference significant.

Table 13

Rabi Sowing: All Labor Used

Number of Laborers Used	Adopters		Non-Adopters		Total
	O	E	O'	E'	
0	80	81	49	48	129
1	30	26	12	16	42
2	22	21	11	12	33
3	10	11	8	7	18
Over 3	13	16	13	10	26
Total	155	155	93	93	248

$\chi^2 = 3.8$

Not Significant

Table-14

Rabi Harvesting: Total Labor Used

Number of Laborers Used	Adopters		Non-Adopters		Total
	O	E	O'	E'	
0	60	62	39	36	98
1	19	15	4	8	23
2	20	17	9	12	29
3	18	19	9	8	27
4	12	11	5	6	17
Over 4	26	31	27	22	53
Total	155	155	93	93	248

$\chi^2 = 5.7$

Not Significant

Table-15

Rabi Threshing: Total Labor Used

Number of Laborers Used	Adopters		Non-Adopters		Total
	O	E	O	E'	
0	47	54	39	32	86
1	19	17	8	10	27
2	22	19	9	12	31
3	20	16	6	10	26
4	18	16	7	9	25
Over 4	29	33	24	20	53
Total	155	155	93	93	248

$\chi^2 = 8.6$

Not Significant

APPENDIX G

BARANI LIVESTOCK

Barani Livestock

Barani farmers make full use of animals to the extent the farms can support them through cropping all grass and weeds, production of fodders and bhoosa, and some purchase of oilcakes. Reporting farmers averaged one buffalo, one bullock and two cows per farm. Horses and camels were negligible on a per-farm basis. The relation of adopting and non-adopting farmers to numbers of animals owned is shown in Tables 1-6.

Goats and sheep averaged three to four per farm. Many animals serve multiple purpose for the farmer, furnishing milk, wool, skins, draft power, and a bankable asset that can be easily converted into cash.

All categories of animals show a significant difference between adopters and non-adopters. Adopters have larger numbers of buffalo and bullocks than non-adopters. Non-adopters have larger numbers of cows, donkeys, sheep and goats than do adopters. It appears that the use and availability of draft animals is related to adoption, while the use of animals for transport (donkeys) and to produce milk and meat and wool (except buffalo) is adversely related to adoption rates. Buffalo are particularly important in four of the districts, among adopters.

Over half the farmers have one or more large animals. Only about half the farmers reported owning donkeys, with the majority of those reporting, only listing one animal. Over half the farmers reported sheep and goats, with flocks of various sizes, but the largest group only owned one animal.

Table 1

Buffaloes Per Farm

Number of Buffalo	Adopters		Non-adopters		Total
	O	E	O'	E'	
0	57	74	62	45	119
1	45	41	21	25	66
Over 1	53	39	10	24	63
Total	155	155	93	93	248

$\chi^2 = 25.9$

Significant at .001 level

Table 2

Bullocks Per Farm

Number of Bullocks	Adopters		Non-Adopters		Total
	O	E	O'	E'	
0	37	47	38	28	75
1	34	39	28	23	62
2	66	52	17	31	83
Over 2	18	18	10	11	28
Total	155	155	93	93	248

$\chi^2 = 17.7$

Significant at .001 level.

Table 3

Cows Per Farm

Number of Cows	Adopters		Non-Adopters		Total
	O	E	O'	E'	
0	28	23	8	14	36
1	53	43	16	26	69
2	33	40	31	24	64
3-4	29	38	32	23	61
Over 4	12	11	6	7	18
Total	155	155	93	93	248

$\chi^2 = 18.1$

Significant at .01 level.

Table 4

Donkeys Per Farm

Number of Donkeys	Adopters		Non-Adopters		Total
	O	E	O'	E'	
0	89	73	29	44	117
1	56	71	57	42	113
Over 1	10	11	7	6	17
Total	155	155	93	93	248

$\chi^2 = 16.7$

Significant at .001 level.

Table-5

Sheep Per Farm

Number of Sheep	Adopters		Non-Adopters		Total
	O	E	O'	E'	
0	111	102	52	61	163
1	23	24	15	14	38
Over 1	21	29	26	18	47
Total	155	155	93	93	248

$\chi^2 = 7.9$

Significant at .02 level

Table-6

Goats Per Farm

Number of Goats	Adopters		Non-Adopters		Total
	O	E	O'	E'	
0	74	61	23	36	97
1	30	35	26	21	56
2	12	15	12	9	24
3-4	17	19	13	11	30
Over 4	22	26	19	15	41
Total	155	155	93	93	248

$\chi^2 = 14.4$

Significant at .01 level.

APPENDIX H

FARMER OBSERVATIONS ABOUT DEMONSTRATIONS

Table 1

Reasons Farmer Gives for Higher Yield of Demonstration Plot

	Swat	Kohat	Rawal-pindi	Jhelum	Attock	Abbotta-bad	All
Number of Responses:	84	31	22	19	60	93	309
	%	%	%	%	%	%	%
1. Increased Yield;better Seed-	52	12	-	5	20	5	16
2. Seed,Fertilizer,Timely and Sufficient Rains-	-	-	86	95	37	58	36
3. Methods of cultivation: Land Preparation,Sowing Tractor-	--	--	14	--	23	17	11
4. Better Land for Plot: Lowland,Silty,Moisture-retaining-	-	-	-	-	7	20	7
5. Better Plants:taller (Maize) or Shorter(Wheat) as much straw as desi, longer ears, more ears per plant, larger grains-	44	45	-	-	13	-	19
6. Equivocal responses: but less straw,harder stalks that cattle can't eat, grains fall off in wind-	24	42	-	-	-	-	11
Total %:	100	100	100	100	100	100	100

Table 2

Farmer Comments Concerning Demonstrations about which they know (when demonstration plot was better)

	Swat	Kohat	Rawal-pindi	Jhelum	Attock	Abbotta-bad	All
No. of Responses:	283	198	17	21	154	60	733
	%	%	%	%	%	%	%
1. Fertile, Moist Land or unique plot give high yield	--	--	6	24	3	--	2
2. Seed and Cultural Practices somewhat better: higher yield noted without explanation-	19	22	70	57	19	30	23
3. Seed, Fertilizer and timely rains give high yield; land preparation, hard work and sowing methods-	35	30	24	19	38	30	33
4. Crop looks better; well taken care of; rows look good and weed easily; wheat plants shorter; millet, maize plants taller; strong plants with thick stalks; larger or longer ears; more grains per ear; more ears per plant-	46	48	--	--	40	40	42
Total(%)	100	100	100	100	100	100	100

Table 3

Reasons Farmer Gives for Lower Yield of Demonstration Plot

	Swat	Kohat	Rawal-pindi	Jhelum	Attock	Abbotta-bad	All
Number of Responses:	46	32	2	0	9	36	125
	(%)	(%)	(%)	(%)	(%)	(%)	(%)
1. Lower yields; grain falls in wind; heavy rains and erosion-	11	3	50	-	11	3	7
2. Dry weather effects; no rain during sowing, ears shooting, ripening; crop dries up; fertilizer destroys-	20	38	50	-	78	14	27
3. Long season variety stays green; attacked by birds and cattle-	69	59	-	-	11	3	43
4. Jowar only: wind breaks stalks and grains drop off; long ripening period so cut for fodder; fertilizer burns crop-	-	-	-	-	-	80	23
Total %	100	100	100	0	100	100	100

Table 4

Farmer Comments Concerning Demonstrations About Which They Know

(when lower yield appeared likely)

	Swat	Kohat	Rawal-pindi	Jhelum	Attock	Abbotta-bad	All
Number of Responses:	222	183	11	11	95	62	584
	(%)	(%)	(%)	(%)	(%)	(%)	(%)
1. Desi yields better with equal labor and fertilizer; prefers Mexi-Pak; lower yield noted without explanation-	16	7	9	--	12	13	12
2. Poor land; lack of rain or poor timing; less straw; thin stand and rows far apart; grains drop off in wind; crop dries and yellows before ripening stage; fertilizer burns when rain lacking; plants lodge; stiff straw no good for animals; poor seed, sowing and cultivation; few grains per ear-	61	72	--	9	64	45	62
3. Late variety or resown, will not ripen; attacked by birds, cattle, people (for forage)-	23	19	--	--	20	40	22
4. Groundnuts hard to dig and unsuccessful; farmer has requested but not received a demonstration plot; he has demanded seed from agent, and requested information about seed and land preparation-	--	--	91	91	4	2	4
Total(%)	100	100	100	100	100	100	100

APPENDIX I

OPINIONS OF FARMERS HELD ABOUT GOVERNMENT FIELD AGENTS AND FIELD SERVICES FOR AGRICULTURE

Opinions of Farmers Held about Government Field Agents and Field Services for Agriculture

Tehsil Karak

IRDP and Agricultural Extension offices are located in Karak and Thatti Nasratti, with the former serving Tippi Kerk and Grosi, and the latter serving Kas and Khoda Banda.

1. Agents in Karak are not well known, and are not doing any serious work.
2. Farmers know they can go to the agent offices for agricultural information, particularly to find out about new seed.
3. Those farmers who have irrigated land can find out about fertilizer.
4. Farmers in all villages reported that agents did not give good advice.
5. Farmers in all villages reported that agents preferred to give plots to their friends, and worked only with rich farmers.

Tehsil Chakwal

Union Council[a] office in Chak Malok serving Behkary and Chak Norang; in Chak Omra serving Dhok Wadan; in Siral serving Sirkal Kaser.

1. The D.A. comes to the villages only to select plots, or at harvest time.
2. Agent does not give good advice to farmers.
3. Siral and Sirkal Kaser farmers usually go to the Dudial office--5 to 10 miles distant--when they need agricultural information.

---

a/ Several villages make up a Union Council, and several Union Councils make up a Markaz.

4. Agent prefers to work with rich farmers.
5. One progressive farmer from Sirkal Kaser often goes to meetings with the DA, and brings back agricultural information for the farmers in his village.

Markaz Chauntra

Union Council offices in Chauntra, serving Gagan; in Paryal, serving Dhok Gujri and Jara.

1. Farmers believe the two IRDP agents act fairly in giving out the demonstration plots.
2. The agent in Paryal is usually not found in his office.
3. The Agricultural Extension Beldar serving Paryal, Jara and Dhok Gujri, in lieu of agent, has little agricultural knowledge, especially about pesticides.

Note: The transfer of good IRDP agents to poor farming areas is in progress, but is not reflected in the comments here.

Tehsils Matta and Khwazakhela

There are agent offices in Matta, serving Bedara; in Lower Dureshkhela, serving Upper Dureshkhela in Khwazakhela, serving Bandai, Chalyar, Fatehpur and Furhatabad. Matta also serves Pirkalei and Sumbat.

1. All villages reported that agents gave poor advice to farmers.
2. All villages reported that agents preferred to work with rich farmers.
3. Farmers know they can visit the agent in his office to obtain information; they also know it is difficult to find him in his office.
4. A number of farmers do not know the field agents.
5. Where the Annual Farmer's Day is held, farmers know they can receive informative lectures and seed.

Tehsil Pindi Gheb

Mianwali and Ahmadal each have their own union councils. Shahbazpur and Lungrial are served by Dandi, and Nangawali is served by the union council at Ikhlas.

1. The D.A. is remembered in one village for .... laying out many plots in one year, and for locating one plot 10 miles from the road.
2. D.A. and F.A. are reported by farmers in several villages as looking after the plots very well, and in general being very cooperative.
3. Agents are reported to have given the correct amount of seed and fertilizer for the plots, and furnishing good agricultural information when farmers visit their offices with questions.
4. On the other hand, the D.A. is reported by some farmers to work only with a few rich, influential farmers in each village.
5. Farmers report that the F.A. seldom visits their village, does not give good advice, and takes no action on complaints.
6. F.A. does not provide seeds or pesticides to farmers, but does furnish pesticides to shopkeepers.
7. Agents visit farmers and villages near the road but not far away; they don't furnish adequate quantities of inputs for plots; they have no supplies or facilities with which to assist farmers
8. Field agents cannot make decisions because their supervisors do; cover too many plots (especially at sowing) so they cannot take care of them properly.
9. Individual farmers report such problems (obstructed by agent) as attempted rental of a drilling rig, and attempted request for permission to plant trees on their private land, without success.
10. In general, the IRDP office is thought to be doing a better job than Agricultural Extension. The Extension agents are considered to be doing a poor job for most farmers, and the two organizations appear to be duplicating each other's work.

Tehsils Abbottabad and Haripur

Village Lora has its own union council. The Phallah Union Council serves Rupper, Ghazi Union Council serves Hasanpur, Brila Union Council serves Mang, and Panyan Union Council serves Gheryan.

1. A few farmers report that the agent cooperates fully with them.
2. Farmers complain that agent works only with rich, influential farmers, relatives and friends; that he rarely appears in the village but stays near his office.
3. Agent has no authority, no supplies, and in general seems ineffective in his job.

APPENDIX J

ADOPTION, NON-ADOPTION AND MAJOR PROBLEMS

Table 1

Reasons Given by Farmers for their Adoption of Improved Practices.

	Swat	Kohat	Rawal-pindi	Jhelum	Attock	Abbotta-bad	All
Number of Responses:	2	14	22	19	58	167	282
	%	%	%	%	%	%	%
1. Will cultivate new seed after seeing demonstration; higher yields; likes new varieties-uses new seed but hard to find-	100	86	9	--	33	35	34
2. Plants same variety on Barani and irrigated, after several years, new variety adapted for fodder and grain---	--	14	--	--	21	--	5
3. Uses less fertilizer than recommended--lack of money, lack of rain plenty of dung, land will not take, not adequate supply locally, buys early and stores, or buys what is available--	--	--	45	32	24	23	24
4. Prefers certain kinds of fertilizer; uses on both barani and irrigated-	--	--	5	5	--	25	15
5. Uses fertilizer or will increase after seeing demonstration; impressed with other farmer fields; will use when farm has more moisture than usual-	--	--	27	52	--	3	7
6. Higher yield and good for crops; gives distinct crop appearance; land used to it; buys in spite of high cost-	--	--	14	11	22	14	15
Total(%)	100	100	100	100	100	100	100

Reasons Given by Farmers for their Non-adoption of Improved Practices.

	Swat	Kohat	Rawalpindi	Jhelum	Attock	Abbottabad	All
Number of Responses:	47	29	51	58	306	111	602
	(%)	(%)	(%)	(%)	(%)	(%)	(%)
1. New seed not available when needed; not in good condition; too expensive; can't find; depots only in cities; officials give to friends-	2	3	16	16	2	12	6
2. Old seed plus labor gives better yield; desi seed better for weak land; Mexi-Pak and C-591 are adapted and have good yield and taste-							
3. New varieties give less straw or poor quality for cattle feed; can't keep new seed separated from old; bird damage; wind blows off grains; has disease; loses seed cost if no rain-	9	7	10	13	18	7	16
4. Fertilizer needs more rain than usual; too much risk; costly and money shortage; black market price high; prefers abundant cheap manure-	9	--	38	37	25	12	24
5. If less rain, fertilizer destroys crop; needs timely application; adequate manure best and long-lasting-	-	--	2	--	20	12	12
6. Not easily available; no depot nearby; transport costly; landlord does not supply; crop doesn't return cost of fertilizer-		--	10	--	2	8	3
7. Good only for one crop, or on cold, wet land; not good-	--	--	--	--	8	7	6
8. Farmer has no desire to adopt; prefers manure and desi seed, or not available; will not risk, lack of rain-	6	10	12	5	--	--	2
Total (%):	100	100	100	100	100	100	100

Table 3

Major Problems Reported by Barani Farmers

	Swat	Kohat	Rawal-pindi	Jhelum	Attock	Abbotta-bad	All
Number of Responses:	92	65	124	39	465	198	983
	%	%	%	%	%	%	%
1. Inputs too costly; can't afford seed or fertilizer; won't pay black market prices; crop will not return cost-	40	5	5	35	6	11	11
2. Seed or fertilizer not available on time, or not easily available, or at all; irrigated farmers buy all; no pesticide or fertilizer depot; depot sells to friends; agents get no inputs-	44	23	12	31	11	36	20
3. Poor quality and quantity of inputs; open market seed not trusted; seed needs testing under Barani conditions; fertilizer aged, or bags not full or adulterated with sand; pesticides impure; new wheats show poor emergence, lodge, grains fall off, late season attracts birds; if cut for fodder, wheat does not regrow-							
4. Lack of rain; fertilizer dries up crop; urea and Nitro-ñhos especially drying; Natural damages of weeks, insects, erosion, windstorms, freezing--	-						
5. Lack of infrastructure; roads and vehicles needed-- now use tongas and animals; depot far away; crop market far away; village prices low; no government storage; bank loans difficult; inputs needed located at each Union Council office, Machinery: low rentals for tractors; minitractors; low spare part tractor service; low-rental bull-dozers; need harvesters, threshers, well-drilling rigs-	1	11	78	10	12	16	20

(Table-3-contd.)

	Swat (%)	Kohat (%)	Rawal-pindi (%)	Jhelum (%)	Attock (%)	Abbotta-bad (%)	All (%)
•Other needs;more cheap open wells for good drinking water;more tubewells; interest-free bank loans; more labor;more agents to present Barani Project results;more information on fruits/vegetables; official cooperation on tree planting on waste land;radio program for Barani farmers;activities to use staff of SCS-	12	58	1	--	10	1	10
•Rat problems;numbers increase when groundnuts grown;destroy land and growing crops;poisons not available or not effective; officials ignore-	--	--	--	--	25	5	13
•Field Agent unsatisfactory: gives poor advice;doesn't do much work;works only with rich farmers or close friends;appears in distant villages rarely;falsely marks good fields as demonstration plots;makes false promises of help; can supply no inputs;has no authority and no facilities;farmers unaware of any Agriculture field activities;cheats on inputs he is given for farmers;agent must mediate between farmers and officials			2	8	26	16	16
Total (%)	100	100	100	100	100	100	100