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ABSTRACT

A MICRO-ECONOMIC ANALYSIS OF SMALLHOLDER RESPONSE
TO HIGH-YIELDING VARIETIES OF WHEAT IN WEST PAKISTAN

by

Refugio I. Rochin

From 1964-65 to 1969-70, high-yielding varieties of wheat, characterized by dwarfness and the ability to use water and fertilizer more efficiently than traditional (desi) varieties of wheat, spread from almost zero to forty-four percent of the wheat acreage (15 million acres) in West Pakistan. Over the same span of time, the average annual wheat yield for West Pakistan rose by 35 percent to a new record for 1969-70 of 12.9 maunds per acre, a remarkable achievement commonly called the Green Revolution.

According to government estimates, dwarf wheats have not spread significantly to barani (rainfed) areas which have large numbers of farmers with smallholdings. In 1968-69, the latest year of official recorded figures, dwarf wheats were found on only 0.16 million acres of the 3.8 million acres of barani land. With modest wheat research on barani land and practically no knowledge of barani farming and conditions, it was presumed that barani smallholders would be unable to participate in the benefits of the Green Revolution, accentuating the socio-economic problems of the country.

Field surveys and interviews with 226 farmers were conducted in Hazara District, a district with about 90 percent of its 1.5 million people living on small farms (averaging 5 acres in size) and producing wheat on barani land primarily for subsistence consumption. Compared

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to other barani areas, Hazara receives relatively higher rainfall, between 30 to 60 inches annually, with most falling during the summer monsoon.

The principle objective of the surveys was to determine the extent of dwarf wheat adoption in Hazara District. In the survey locations, it was found that there has been rapid diffusion of the new varieties and chemical fertilizer by farmer to farmer exchanges. Analysis of the pattern of dwarf wheat adoption shows that, overall, smallholder barani farmers are responsive to profitable innovations and will make rapid economic adjustments in resource allocation with high-yielding varieties of seed. The findings indicate that smallholders will rarely sow more than 30 percent of their acreage with a new variety during the initial year of experimentation.

Analysis of the "extended family," the pattern of off-farm migration and non-farm employment lead to the conclusion that the lack of credit does not appear to be a limiting constraint on the ability of the smallholders to adopt high-yielding seed, since they have other sources of farm income and migrant remittances which enable them to experiment with "risky" innovations.

Respondents in Hazara adopted dwarf wheats because they (1) gave consistently better yields over desi varieties, (2) fit the cropping pattern of the farmer and grew in a faster time than desi varieties, (3) were subject to experimentation on a small scale, (4) were not complex in relation to desi wheat with respect to the way they were planted and cared for, and (5) had other positive features such as beards which protected grain against birds. All of these factors, shown in order of descending importance suggest the major characteristics that new varieties must have before they will be readily adopted by smallholders.

Communication variables were also important in diffusing the new varieties, namely, mass media channels, interpersonal channels, and demonstration plots. The survey findings show that: (1) The farmers who become aware of innovations before others in their communities will be those who: (a) listen to the radio more often than others and who have more contacts with extension agents and fertilizer sales representatives, (b) own most of their land and have comparatively larger extended families (12 to 15 members), and (c) own medium size farms (4 to 5 acres). Wealth (the combination of farm area and cash income) is not a major determinant of early awareness of innovations. (2) The farmers to adopt innovations earlier than others in their communities will be those who: (a) score high on awareness and interpersonal cosmopolite contacts, (b) own farms of 5 acres or more, have large families, and (c) are generally wealthier than others in their vicinity.

Measurement of the economic impact of dwarf wheats (by way of Cobb-Douglas production functions and budgetary analysis) on smallholder barani farms has shown that: (1) Smallholders with dwarf wheats are producing on a new production function with noticeable changes being made in the factor proportions such that (2) more output is forthcoming and more labor, fertilizer, and seed is used with dwarf varieties. Also significant is the finding that the marginal product of labor is zero for both types of wheat production, desi and dwarf. (3) Those who grew dwarf wheat in 1969/70 earned approximately three times more per acre than those who grew only desi wheat. (4) Partial budgeting analysis indicated that the relative profitability with dwarf wheats (compared to desi wheats) was virtually unchanged when the price of fertilizer was in

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increased by 25 percent, in one case, and when the yield of dwarfs (and straw) was reduced by 20 percent, in another case, all other factors held constant. Overall, the analysis showed that the relative income position of barani smallholders improved for those who were able to use the new dwarf varieties. It also showed the potential for barani smallholders to finance agricultural improvements themselves.

These findings suggest that government should design food-grain improvement programs to include farmers with barani smallholdings. The response to a program to diffuse high-yielding varieties should be significant enough to control for increasing disparities in rural income between farmers with irrigated holdings and farmers with small unirrigated plots of land. By increasing food production per capita in rural barani areas, the need to leave the farm (for the many migrants that are already doing so) should be less great, given the present growth in population. Furthermore, information on the relative importance of various types of communication channels and their impact on different categories of farmers are useful for implementing programs designed to diffuse new varieties to similar economic settings.

A MICRO-ECONOMIC ANALYSIS OF SMALLHOLDER RESPONSE TO HIGH-YIELDING VARIETIES OF WHEAT IN WEST PAKISTAN

By

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A THESIS

Submitted To
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Agricultural Economics

1971

ACKNOWLEDGEMENTS

Sincere gratitude is acknowledged to the many persons of Pakistan and, in particular, to the many farmers of Hazara District who made this study possible. In addition, the author acknowledges the cooperation received from Mr. Malik Fazel Dad Khan, Director of Agriculture Extension and Research, Dr. Abdul Matin, Chief Economist of the Planning and Development Department and Dr. C.M. Sharif, Economist of the Pakistan Academy for Rural Development, in the North West Frontier Province. Special gratitude goes to my companion and interpreter, Mr. Mohammed Siddiq of Village Malot Sattian, who as a barani farm migrant himself, contributed as much insight into the lives and manners of his fellow barani smallholders as into their agriculture.

General acknowledgement is due The Ford Foundation for making it possible for me and my family to live in Islamabad, Pakistan, where I worked as a Training Associate in Agricultural Economics, from November, 1969 through May, 1971. I am greatly indebted for the encouragement and questionning interests of Messrs. Robert Edwards and Robert D. Havener, Representative and former Agriculture Program Advisor, respectively, of The Ford Foundation in Pakistan. To Havener goes my earnest thanks for educating me on Pakistan's agriculture. In no way, however, are The Ford Foundation, Edwards or Havener responsible for any errors of fact, logic or recommendations which enter into this thesis. The author alone is responsible for any of the views and contents presented.

A very special acknowledgement goes to Dr. Lawrence W. Witt for his patience and "long distance" guidance via letters from the U.S. with detailed and valuable comments pertaining to the formulation of this thesis. Moreover, I am grateful for his kind enthusiasm shown while serving as academic advisor during my graduate study at Michigan State University.

At Michigan State University, I am also sincerely indebted to others: to Dr. Carl K. Eicher for his suggestions which helped considerably in editing a first draft of the dissertation, and to Drs. Warren Vincent, Everett M. Rogers, and William Haley who read preliminary chapters of the study and made insightful comments.

Last but not least, loving appreciation is due my wife, Isaura, for her patience during the year of the thesis and help in editing, and Chaguita, my daughter, who kept me cheerful even during the most rigorous writing days.

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CHAPTER I

SETTING AND PROBLEM INVESTIGATED

Setting

Wheat is the most widely consumed and cultivated crop in West Pakistan affecting nearly all its people. On the average, West Pakistanis obtain 60 percent of their caloric intake from wheat products.[1/] Wheat is regularly grown during the winter months from October to May on 14 to 15 million acres of land which comprises nearly 60 percent of the season's total cropped acreage. Of the wheat acreage, 70 percent is irrigated and 30 percent is rainfed or barani.[2/] Up to 42 percent of the wheat is sown on farms with 12.5 or less cropped acres, commonly referred to as smallholder farms. In addition, 65 percent of West Pakistan's 6 million farms engage in wheat production.

From the time of Independence in 1947 until 1967, wheat yields averaged around 8.8 maunds per acre in West Pakistan, according to official estimates.[3/] However, the rate of change in wheat

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1/ Estimates of per capita cereal consumption are found in: Hufbauer, G.C. "Cereal Consumption, Production, and Prices in West Pakistan: The Pakistan Development Review, Summer 1968; pp. 288-306.

2/ Barani translated from Urdu means "depending on rainfall." The term is commonly used among agriculturalists in West Pakistan. This is discussed in Chapter II of this volume.

3/ Government of Pakistan, Ministry of Agriculture & Works, Agricultural Statistics of Pakistan, and Government of West Pakistan, Season and Crop Reports. (The glossary in the appendix provides the conversions for the measurements used in this study).

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acreage,[4/] fell below the rate of increase in population (which was increasing at about 2.8 percent per annum) during the last two decades.[5/] To meet deficits in food-grain supplies, West Pakistan imported 3.3 million tons of wheat from 1955-56 to 1959-60 (over the First Plan), 7.0 million tons of wheat from 1960-61 to 1964-65 (over the Second Plan), and approximately 5.3 million tons of wheat from 1965-66 to 1969-70 (over the Third Plan).[6/] To make matters apparently worse, drought conditions in 1965 and 1966 lowered acreage and wheat yields in West Pakistan. This heightened the dire forecasts[7/] that it would be increasingly difficult to close the food-population gap without massive imports of food-grains. At the same time, however, the imported dwarf wheats were providing higher yields in test plots and offered hope that Pakistan's desire to remove dependence on food-grain imports could be achieved.

"Dwarf wheats" refers to the new, high-yielding varieties of wheat which were developed in Mexico and imported and multiplied in

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4/ Eckert, Jerry Bruce. The Impact of Dwarf Wheats on Resource Productivity in West Pakistan's Punjab. Unpublished Ph.D. dissertation, Michigan State University, 1970; pp. 26-31.

5/ Stern, Joseph J. and Walter P. Falcon. Growth and Developments in Pakistan: 1955-1969. Harvard University, Center for International Affairs, Occasional Paper Number 23, April 1970; pp. 8-13.

6/ Government of Pakistan Ministry of Agriculture & Works, Agricultural Statistics of Pakistan. It should be noted that West Pakistan essentially achieved self-sufficiency in wheat production by 1968-69. However, limited supplies were still imported to meet deficit conditions in East Pakistan. In 1969-70, West Pakistan exported wheat to East Pakistan but later turned around and imported approximately 200,000 tons of wheat to maintain a small wheat reserve.

7/ President's Science Advisory Committee, The World Food Problem, The White House, Volume II, May 1967.

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West Pakistan. Dwarf wheats are characterized by: (1) relatively short genetic height (30-35 inches) which enables the plant to absorb heavy applications of fertilizer without lodging from excessive vegetative growth, (2) high tillering with stiff stems which adds to the sturdiness of the plant, helps it to fight wind and heavy rain damage and at the same time facilitates harvesting, and (3) erect leaves which maximize the leaf area exposed to sunlight hence enhancing photosynthesis. Notably, the same structural characteristics were used in developing Gaines, the wheat variety which holds the world's record yield of 216 bushels per acre (about 162 maunds per acre). At the time dwarf wheats were introduced, no traditional (desi) variety of wheat in Pakistan had these high-yielding genetic characteristics.[8/]

Food Self-Sufficiency Program

In an attempt to bolster food production in West Pakistan, the Food Self-Sufficiency Program (initiated in 1967) had as its main focus the achievement of self-sufficiency in wheat production based on the cultivation of imported varieties of dwarf wheat on irrigated holdings (refer to Table 1).

8/ The general agronomical and morphological characteristics of the desi varieties are documented in a paper by S.A. Anwar Abidi, "The Development of New Wheat Varieties in Pakistan." Conference on Food Production Increase in West Pakistan: Problems and Effects. Pakistan Academy for Rural Development, Peshawar, April 22-23, 1970. The more common varieties referred to as desi are C-591, Dirk and C-273.

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The specific strategy called for a combination of factors, heretofore untried in West Pakistan history. Point by point it stipulated:[9/]

(a) Bringing 4 million acres (out of the present total irrigated wheat acreage of about 8 million acres) under Mexican wheat, giving it an average fertilizer application of 4 bags per acre in terms of ammonium sulphate and providing each acre one to two additional waterings (average increase in water delta of 33%).

(b) Providing additional fertilizer for two million irrigated acres under indigenous wheat at the rate of one bag per acre in terms of ammonium sulphate.

(c) Increasing irrigated wheat acreage by 1.5 million acres.

(d) Making organizational changes, increasing credit availability and devising a system of incentives and subsidies to ensure that input targets provided above are in fact met.

(e) Allocating funds in A.D.P. for water and agricultural program of third plan on a priority basis, specially encouraging schemes linked to wheat self-sufficiency.

Furthermore, production targets were set for an annual three percent increase in wheat production in the districts of the Indus Plains which are largely irrigated.[10/]

In a period of five years, beginning in 1964-65 to 1969-70, dwarf wheats spread from almost zero to forty-four percent of the wheat acreage in West Pakistan. Over the same span of time, the

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9/ Government of West Pakistan, Planning and Development Department of (Project Wing), Implementation Plan for the West Pakistan Food Self-Sufficiency Programme, Printed by the Superintendent, Government Printing Lahore, West Pakistan. August 1967, Chapter I (underlined by the author). A.D.P. apparently stands for Agricultural Development Program.

10/ The districts are namely: Sargodha, Lyallpur, Gujrat, Jhang, Muzaffargarh, Sheikhupura, Sialkot, Gujranwala, Multan, Sahiwal, Lahore, Bahawalpur, Rahimyar Khan, Bahawalnagar, Khaipur and Nawabshah Districts.

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average annual wheat yield for West Pakistan rose by 35 percent to a new record for 1969-70 of 12.9 maunds per acre. This record of events, as shown in Table 1, is commonly called the Green Revolution.[11/]

The Problem

According to official releases, rainfed (barani) wheat areas have been unable to substantially adopt the high-yielding dwarf wheats. In 1968-69, the latest year of official recorded figures, dwarf wheats were found on only 0.16 million acres of the 3.8 million acres of barani wheat land.[12/]

Most conclusions about the inability to diffuse dwarf wheats on barani acreage were drawn from speculative reasoning based on limited knowledge about the farmers who cultivate barani land and their resource endowment. In the words of a noted national planner:[13/]

11/ More complete treatment of the diffusion of dwarf wheats in the Indus Plains of West Pakistan is found in: Eckert, Jerry B. The Impact of Dwarf Wheats on Resource Productivity in West Pakistan's Punjab. Op. Cit. Chapter II; pp. 12-36.

12/ Source: Government of West Pakistan, Planning and Development Department, Bureau of Statistics, Rabi 1969-69 Crop Acreage of West Pakistan: By Districts and Tehsils, Table I. This is the only known publication, which is compiled by the village revenue collectors (Patwaris), that gives an estimate of irrigated and barani acreage covered by dwarf wheat. In addition, The Fifth Annual Technical Report: Accelerated Wheat Improvement Program in Sind, Punjab & N.W.F.P. 1969-70, (by Munshi, et. al.) states that no more than 0.2 million acres were covered with Mexipak and other short varieties during 1969-70; p. 11, Table 2. As of June 1, 1970, West Pakistan was sub-divided into four Provinces: The Punjab, The Sind, Baluchistan, and the North West Frontier (N.W.F.P.) This break-up of the one unit temporarily curtailed official releases on crop acreage and production. At the time of the writing, no further reports were available on the spread of dwarf wheats in West Pakistan.

13/ Aziz, Sartaj. "Problems and Prospects of the Green Revolution." The Planning Commission, Mimeographed, May, 1970. Islamabad, West Pakistan.

TABLE I CHRONOLOGY OF DWARF WHEAT DIFFUSION IN WEST PAKISTAN: 1962-1969

			Estimated Acreage	Dwarf Wheat Area	Average
Seed	Quantity Imported	Crop	Covered with Dwarf	As Percent of	Wheat Yield

TABLE I CHRONOLOGY OF DWARF WHEAT DIFFUSION IN WEST PAKISTAN: 1962-1969

Seed Year	Quantity Imported from Mexico	Crop Year	Estimated Acreage Covered with Dwarf Wheat	Dwarf Wheat Area As Percent of Total Wheat Area	Average Wheat Yield (mds/acre)*
1962	Experiment Samples (grams)	1962/63	nil	nil	9.00
1963	Experiment Samples (200 kilos)	1963/64	nil	nil	8.99
1964	-	1964/65	10	nil	9.36
1965	350 metric tons	1965/66	12,000	0.1	8.24
1966	50 metric tons	1966/67	250,000	0.2	8.80
1967	41,750 metric tons	1967/68	2,365,000	16.0	11.63
1968	-	1968/69	5,892,000	39.0	11.65
1969	-	1969/70	6,840,000	44.0	12.95

Sources: J.B. Eckert, op. cit.; p. 23, Table 2.1 and p. 27, Table 2.2.

International Maize and Wheat Improvement Center CIMMYT REPORT 1967-68: On Progress Toward Increasing Yields of Maize and Wheat, Mexico 6, D.F. Mexico.

* One maund = 82.286 lbs. and approximately 27,224 maunds = one ton (2,240 lbs.)

> There is as yet no conclusive evidence but the facts pertaining to distribution of cultivable areas between small and large farms and the ready access of large and medium farms to tubewells, and other inputs, support the contention that the bulk of additional incomes generated by the green revolution and supported by liberal government subsidies has gone to a relatively small number of big and medium sized farmers. Again, even geographically, the green revolution is concentrated in a few irrigated areas, and has not yet reached over 70 per cent of total holdings consisting of small farms below 12 acres [the barani smallholders]. Unless a conscious and vigorous effort is made to extend the new technology to smaller farms and to reduce the benefit of subsidies to large farms, the green revolution will only accentuate the burning social and political problems of the country and fail to improve the life of the vast majority of the rural population.

Looking back, it is clear that there was no conclusive evidence that barani farmers were able and willing to use the new dwarf varieties of wheat. This stemmed from two weaknesses of research on the barani, namely that there was only a modest wheat research effort on barani land,[14/] and that little research was available on the socio-economic characteristics and farming practices of barani smallholders. In more detail:

(1) With a limited wheat research base to draw on, it was not possible to know what varieties would be particularly suited to the barani areas. Furthermore, dwarf wheats called for an apparently

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14/ Details of the available wheat research are found in; Munshi et. al. op. cit. In addition, there is only one known study which examines the influence of rainfall on barani wheat acreage and production in the Districts of Rawalpindi, Jhelum and Campbellpur. Namely: Qureshi, Sarfraz Khan. "Rainfall, Acreage and Wheat Production in West Pakistan: A Statistical Analysis" Pakistan Development Review, Volume III, Winter 1963, No. 4. Karachi, Pakistan, pp. 566-593.

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rigid set of critical requirements to achieve high yields over traditional varieties; shallower sowing, later sowing, more fertilizer, and timely irrigation.[15/]

Nearly everything that was written about the critical requirements (pertaining to the use of seed, fertilizer and water) of the new dwarf wheats suggested that the physical environment conducive to their growth, aside from experienced farm managers, must be one with controlled supplies of water (which allow for heavy doses of fertilizer), ideal temperatures and soils, and a place where wheat fits neatly into the farmer's cropping pattern. All these factors hold for the well-irrigated portions of Pakistan's Indus Plains. On the other hand, with scant research on dwarf wheats on barani lands, it is nearly impossible to make practical recommendations to the barani farmer on sowing time, seed rates, fertilizer applications, rainfall ranges conducive to high yield with dwarf wheats, etc.

(2) There was a dearth of research on the socio-economic characteristics and farming practices of barani smallholders, and what was available suggested that barani farmers, as such, would be slow and perhaps unwilling adopters of new technology. Two examples, one American,[16/] and the other Pakistani,[17/] make similar comments.

15/ For a complete run-down on these requirements see: Bill G. Wright. "Critical Requirements of New Dwarf Wheat for Maximum Production." Paper presented at FAO/Rockefeller Foundation International Seminar on Wheat Improvement and Production, Ayub Agricultural Research Institute, Lyallpur, Pakistan. March 26, 1968.

16/ U.S. Department of Agriculture in Cooperation with U.S. Agency for International Development, Watershed Management Team, Resource Management for the Rainfed Region of West Pakistan: Final Draft Report. Volume II: General Background and Analysis of Specific Problem Areas, May 1968-February 1969; p. 47.

17/ Sharif, C.M. Farmer's Attitudes Toward Self-Help, Pakistan Academy for Rural Development, Peshawar, 1965, p. 18.

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The American study states that:

> Resistence to change remains strong throughout the Barani area. Efforts of most government agencies have been concentrated on increasing food and fiber production from the irrigated plains. Another potent cause, however, is the too frequent absence of adequate educational efforts by officials responsible for carrying out specific programs.

The Pakistani research also suggests that resistence to change is part of the attitude of the people of the northern region of Pakistan:

> ...most of the villagers (in the rural areas studied) are continuing in the farming business in spite of small, marginal and non-profitable holdings because it carries certain prestige over other occupations in the village social order and also because alternate choices for making respectable living are not readily available to them.

By the end of 1969 policy analysts concluded that barani wheat-growing areas of West Pakistan would experience adverse development effects by the general inability to sow dwarf wheats. As such, policy-makers in drawing up the Fourth Five Year Plan were concerned with devising new strategies aimed specifically at the barani farmers:[18/]

> Not all farmers are able to adopt the new technologies like the use of large quantities of fertilizer and have access to the greater water supplies needed. Thus the larger and irrigated farms are more able to respond and gain economically as compared with those dependent upon rainfall or inadequate canal water. For the farmer left behind because his resource base cannot productively use the new technology, the alternatives described here may mean nothing except lower prices and higher costs. Perhaps he will benefit by shifting to another crop perhaps he can work off his farm helping others collect their larger harvest, but these are small consolations and provide little additional income. Hence, as the economic issues on production goals are resolved, the next issue needing thought and programs is to help those

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18/ Planning Commission, Government of Pakistan, The Fourth Five Year Plan, 1970-75. July 1970; p. 262.

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> farmers unfavorably affected. Clearly for most of them high prices have limited impact, since they have only small quantities to sell; the task is to devise new programs which may also involve and benefit these farmers during the process of agricultural development. Such programs will be difficult to devise and even more difficult to operate, but social justice requires that the effort be made. Studies and surveys for the purpose are needed which will be taken up during the Fourth Plan.

Hence, one main objective of the agricultural development program for the Fourth Plan based on this reasoning was: "to broaden the distribution of farm income and to provide the farmers with more amenities for better living."[19/]

Research Agenda

Objectives

The issues of the Green Revolution and the barani smallholder raise a number of questions pertaining to the development strategy of the Fourth Five Year Period. Should the government seek to devise new programs and agricultural strategies for barani areas? What are the opportunities and possibilities for diffusing new improved varieties of seed along with a package of complementary inputs to barani smallholders? How can barani smallholders be informed of new and different production alternatives so that they may eventually try them? What quantifiable differences can be expected with the adoption of dwarf varieties of wheat and complementary inputs? How will barani smallholders and their farm incomes be affected by the changes that occur?

The questions, while difficult to answer, provide important

19/ *Ibid.*, p. 261.

guidelines for required research on the barani areas of West Pakistan. If we find that these relatively poorer farmers cannot benefit from the agricultural strategies that assist farmers with larger irrigated holdings--leading to a spread in the gap between the "haves" and the "have nots"--then new strategies may be required. Furthermore, knowledge of the process of diffusing innovations is crucial in promoting new agricultural strategies which are based on the introduction of improved seeds and other complementary production inputs. Within this context, it is important to know how we can reduce the time lag between the release of new varieties from experimental farms and their adoption at the farm level. Basic input/output data on the new varieties will provide useful information for (i) extension personnel and farmers who are interested in the marginal returns to such inputs as chemical fertilizer and seed rates and (ii) policy makers involved in a wide range of decisions, including pricing policies, modifications in credit institutions etc.

The specific and operational objectives of this thesis are to:

(1) determine to what extent barani smallholders are using the new dwarf varieties of wheat;

(2) determine what communication variables make it possible for barani farmers to learn about dwarf wheats and other improved varieties and to assess the types of factors which influence the farmers to adopt dwarf wheats;

(3) analyze off-farm migration from barani areas and relate this to the family make-up and income situation of the barani smallholder;

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(4) estimate the input/output relationships applied to dwarf and traditional (desi) wheat production and derive comparative estimates of net profits with dwarf varieties and desi wheat on barani land; and

(5) indicate the policy recommendations of the study.

Chapter Brief

The lack of descriptive material about the barani areas required that this research begin by describing and analyzing the salient aspects of West Pakistan's barani agriculture. Chapter II is designed for this purpose. The discussion therein is drawn from the available literature and complemented by the observations made during field surveys throughout the barani areas in 1970.

Primary data used in this study were collected in Hazara District of the North West Frontier Province. Since the characteristics of the District have bearing on the results that were found, it is described separately in Chapter III.

Chapter IV reviews the method of data collection, discusses the problems encountered and the measures taken to avoid them. The end result is a sample of 226 farmers whose characteristics and environment are briefly described at the end of the chapter.

Dwarf wheats were extensively grown in the barani areas that were surveyed. After going into an analysis of the adoption pattern that prevailed and the extent to which farmers were using the variety, Chapter V documents the influence of the communication channels which were instrumental in dwarf wheat diffusion. The rest of the chapter

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analyzes the characteristics of the dwarf wheats that prompted their adoption, the risk and uncertainty attached to the varieties and the input/output combinations.

One important finding of the field surveys was a high rate of off-farm migration from the sampled locations to urban centers in response to the pressing needs of the area. Chapter VI analyzes off-farm migration and the influence of remittances from migrants on the decision-making behavior of barani smallholders.

Cobb-Douglas production functions are applied to the input/output data collected for the study to quantify the economic impact that dwarf wheats are having on barani land; changes in marginal physical products and wheat production are spelled out in Chapter VII. From this analysis, an attempt is made to determine the optimum levels of inputs for the average barani farm producing both dwarf and desi wheats. Then, budgetary analysis is employed to evaluate the net returns to producing a maund of either wheat on barani land.

In Chapter VIII, the summary and policy recommendations are presented.

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CHAPTER II

SALIENT ASPECTS OF WEST PAKISTAN'S BARANI AGRICULTURE AND WHEAT PRODUCTION 1/

Introduction

Since nearly 50 percent of Pakistan's GNP comes from agriculture, the agriculture sector holds a prominent position in the country's development. In the preceding, we have seen that the irrigated areas were selected as prime movers of agriculture in West Pakistan. The strategy outlined above was based on the belief that farmers with adequate and certain water resources can adjust and make changes in cropping patterns in response to relative profits and new technical possibilities, can sow a wider range of crops and are less subject to the vagaries of nature relative to farmers with water limitations.

The barani farmer fits into a different set of environmental and operational constraints. However, little is really known about the conditions and constraints within which he performs. As such, planners and policy-makers are left with a void in practical alternatives for dealing with the barani farmer and find it difficult to make decisions which can increase his agricultural output.

This chapter describes major features of the environment within which the barani farmer works. Particular focus is on the major

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1/ In the following discussion barani agriculture refers to farm areas dependent upon direct rainfall for crop production and is distinguished from farm area irrigated by man-made constructions that control water supply and flow.

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agricultural characteristics of the "barani area" with contrasts made, where possible, with the agriculture of the rest of West Pakistan. In addition, the performance of wheat crops on barani land is discussed and a general hypothesis is stated regarding the nature of low productivity of rainfed acreage.

"The Barani"[2/]

West Pakistan borders with Iran, Afghanistan, Russia, China, India and the Arabian Sea. It contains a wide and diversified relief throughout its 198.6 million acres out of which some 25 percent is cultivated annually. Its principal barani area, frequently referred to as "the Barani", spans the Northern territory between 33° to 35° North Latitude and 71° to 74° East Longitude. This area is affected by the summer monsoons and enters into the Himalayan foothills of West Pakistan.

Physical Environment

In this general region, barani agriculture is largely found in the Districts of Hazara, Mardan, Kohat (in the North West Frontier Province), Cambellpur, Rawalpindi, Jhelum and Gujrat (in the Punjab Province). For the purpose of analysis, "the barani" can be divided into the three geo-physically locked areas which combine climate, elevation and topography in slightly different ways making it possible to view them separately.

1. Potwar Plateau and Pabbi Areas

The Potwar Plateau of Rawalpindi, Jhelum and Cambellpur Districts

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[2/] Only a brief coverage can be presented here. More information is found in: U.S. Department of Agriculture and U.S. Agency for International Development. Resource Management for the Rainfed Region of West Pakistan. Vol. Two: General Background and Analysis of Specific Problem Areas, May 1968-February 1969, prepared by USDA-AID Watershed Management Team under the leadership of Richard A. Wilcox.

and the submountainous and Pabbi areas of Gujrat District sit between 1,000 to 2,500 feet above sea level. They are geologically characterized by gentle undulating tablelands which are extensively cultivated. The same area, however, is subject to devastating erosion caused by water run-off over the denuded land which forms part of the drainage system of the upper areas. Furthermore, this area experiences a mean rainfall varying between 18 to 35 inches per annum (plus or minus 5 inches) with highest precipitation falling during June-September with the summer monsoon.

2. Himalayan Foothills and Valley Areas

Directly North and Northwest of the Potwar Plateau and largely into Hazara District with portions of Murree Hills and Swat Valley the topography changes from relatively flat eroded surfaces to steep and rugged mountainous terrain with deep narrow gorges, some spacious valleys, and steep surrounding slopes of the Himalayan Foothills. Elevation rises from 2,500 to 10,000 feet above sea level. These upper reaches hold the headwater of the Indus and Jhelum rivers. Many valleys formed by the Haro, Daur and Siran rivers, cut through the mountains to form large barani tracts of land which are intensively cultivated.

Average annual precipitation varies from 30 to around 60 inches where these highland barani conditions prevail. Most occurs during the monsoon season between June-October with only 30 to 35 percent falling in winter. Winter precipitation is largely from snow with accumulations attaining several feet at some places in some winters.

3. The Peshawar Vale and Kohat Range

The Peshawar Vale and Kohat Range are located to the West of the two aforementioned barani areas. Peshawar Vale notably includes the

lower Kabul valley and the small Indus River valley to the East. The Kohat Range extends South from Peshawar Vale to the Salt Range and lies West of the Indus river.

Though this area usually receives less than 20 inches of rainfall annually, both Peshawar Vale and Kohat Range have large areas which are dry farmed. Barani agriculture of Peshawar Vale is found on the outer fringes of the Kabul and Indus River valleys and in all the hill-tracts.

Unlike the Potwar Plateau and Pabbi areas and the Himalayan foot-hills and Valley areas, the Western portions of Peshawar Vale receive proportionally more rainfall in winter than in summer.

Kohat is rough and hilly in character and is composed of a series of parallel-trending ridges, averaging 3,000-4,000 feet which extend in an East-West direction from the Kurram Valley to the Indus. Fifty percent of the annual precipitation falls between June-September in Kohat.

Extent of Irrigation

The major unifying characteristic in all three barani areas viewed above is their limited extent of irrigated acreage. Table 2.1 shows that the Districts of Hazara, Mardan (in Peshawar Vale), Kohat, Cambell-pur, Rawalpindi, Jhelum and Gujrat comprise 10.6 percent of West Pak-istan's (47.6 million acres) cultivated acres. But only 22 percent of the Districts' five million cultivated acres are irrigated compared with 65 percent for all West Pakistan. Crop production is, thus, largely barani.

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TABLE 2.1 CULTIVATED ACREAGE, AREA IRRIGATED, AND PERCENT OF CULTIVATED IRRIGATED ACREAGE - 1967-68

West Pakistan and "Barani" Districts	Cultivated Acreage (000 acres)	Area Irrigated (000 acres)	Percent Cultivated Acreage Irrigated
(1)	(2)	(3)	(4) = (3)/(2) x 100
West Pakistan	47,594	30,874	65
In Peshawar Division			
Hazara	596	88	15
Mardan	502	283	56
Kohat	426	60	14
In Rawalpindi Division			
Cambellpur	1,062	60	7
Rawalpindi	687	26	4
Jhelum	713	34	5
Gujrat	1,079	569	53
Total	5,065	1,120	22

Source: Season and Crop Report, Government of West Pakistan, 1967/68

Data, however, are not available which would permit separation of the barani areas from the irrigated sections within the aforementioned area. In addition, it is difficult to separate the data on the Districts of Hazara, Mardan, Kohat, (in Peshawar Division), Rawalpindi, Cambellpur, Jhelum and Gujrat (in Rawalpindi Division) from the data on the Divisions.[3/] Thus, the information provided below

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[3/] Actually all of Rawalpindi Division is represented. For Peshawar Division we are dropping Peshawar District (since 96 percent of the District's 480 thousand cultivated acres are irrigated), the former tribal agencies of Mohmand, Khyber, and Kurram (whose 62 thousand cultivated acres are over 80 percent irrigated), and the dry desert and dust storm areas of Southern and Western Peshawar Division because they are out of the monsoon area and rely almost entirely on irrigation for significant crop production.

covers mostly the data for the Divisions of Peshawar and Rawalpindi, taken as aggregates.

People, Farms and Tenure

Primarily because it was naturally supplied with monsoon rainfall, the barani area encouraged earlier settlement of large numbers of people before other areas in West Pakistan. However, early settlement in "the Barani" has resulted in extreme man-land pressure. Today it is coping with many people who are mostly concentrated in small inhabited pockets of cultivated land.

According to the 1961 Population Census, the Divisions of Rawalpindi and Peshawar held 10.4 million or 24 percent of West Pakistan's 43 million people. By 1974, the Divisions are expected to have 13 million people (about 2 rural people per cultivated acre) compared to West Pakistan's 69 million.[4/] Over the same span of time, the number of people living on barani holdings in the two Divisions is expected to increase from 6.1 million (in 1961) to around 6.8 million by 1974.

Furthermore, Peshawar and Rawalpindi Divisions hold the majority of West Pakistan's small farms.[5/] The average farm size and area cultivated, respectively, according to the 1960 Agriculture Census, was 5.5 and 3.2 acres in Peshawar Division and 6.7 and 4.2 acres in Rawalpindi Division.

4/ Bussink, H.C.F. "Population Estimates by Province and Districts in West Pakistan, 1970-80." Mimeograph, Harvard Advisory Group, Lahore West Pakistan, May, 1970.

5/ The 1960 Census recorded 4.9 million farms in West Pakistan. Nearly 49 percent of the farms were less than five acres in size and accounted for only 10 percent of the agricultural area. On the other hand, 8 percent of the farms were 25 acres or more but covered 42 percent of the total farm area.

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Moreover, the percent of owner operators appears to be somewhat higher in the barani areas. Slightly more than 50 percent are owners and another fourth are owner-cum-tenants who both rent and own land; barani agriculture appears to be associated with a lower degree of tenancy than other agricultural areas of West Pakistan.

Land Use

The barani area of West Pakistan has been farmed for years 6/ but land use has shifted during the last three to five centuries from predominantly nomadic livestock production -- which still exists in the upper portions of the barani area -- to crop production.

In all areas, the intensity of land use has been modified by the terrain. Level highlands, surrounded by steep-sided ridges and gullies have the best rainfed farming. But the high level places are limited. Population pressure has pushed cultivation on to marginal, droughty, steep, and thin soils. Alternatives for land use in these soils are few from the techno-physical standpoint. Terracing and cultivation of steep slopes with grain crops has become an accepted way of life.

Cropping Patterns and Practices

West Pakistan has two basic cropping seasons: winter (rabi) and summer (kharif). Irrigated agricultural areas of West Pakistan can produce during both seasons in succession without leaving land fallow. Barani farmers, on the other hand, with rain as a limiting factor, normally grow two crops during one year and leave the same land

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6/ Charred remains of wheat kernels have been found in the Taxila Excavations which date back more than 2,000 years.

fallow for at least one season, all in an apparent attempt to conserve moisture and to redevelop soils depleted of nutrients during the growing period.

The divergence in cropping intensities between rainfed and irrigated zones is clearly shown in Figures 2.1 and 2.2.[7/] Notably the typical cropping intensity in the well-irrigated Punjab is 50 percent greater than that of "the barani." In addition, the northern rainfed zone produces mostly grain whereas the irrigated Punjab of the Indus Plains has a much more diversified cropping pattern.

The usual rotation in the barani area is to grow wheat in rabi[8/] and maize, sorghum, and/or millets in kharif. Wheat is normally sown from October to mid-December depending on the autumn rains and harvested during April or May.[9/] Kharif crops are sown in July or August depending on the monsoon and harvested in October. Seasonal labor demands are greatest during the short harvest and sowing period between kharif and rabi seasons. The typical rotation has local variations, however. Land around habitations which receives farm yard manure is usually sown year round with wheat, then maize, sorghum

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[7/] The figures are taken from: Gotsch, Carl H., and Falcon, Walter P. Agricultural Price Policy and the Development of West Pakistan. Vol. I Final Report AID/OSTI Contract No. NESA 403. Cambridge, Mass. January 1970, pp. 2.8 and 2.9 Figures 114 and 115.

[8/] In the higher cooler elevations some barley and oilseeds are grown to a limited extent on barani lands during rabi. At the highest cultivable elevations, potatoes are sown during the kharif and sold almost exclusively for winter seed to farmers at lower elevations.

[9/] There are exceptions. To quote from a village study: "Generally, the village people do not wait for the first winter rain, but begin planting between mid-October and mid-November. So acutely important is rainfall to people of this village that, if it should happen to rain during the sowing season and certain pieces of land are not seeded and ploughed, they will sow the seeds first in order to take advantage of moisture and then plough them in later on." David Dichter, The North West Frontier of West Pakistan: A Study in Regional Geography, Clarendon Press, Oxford, England 1967, p. 100.


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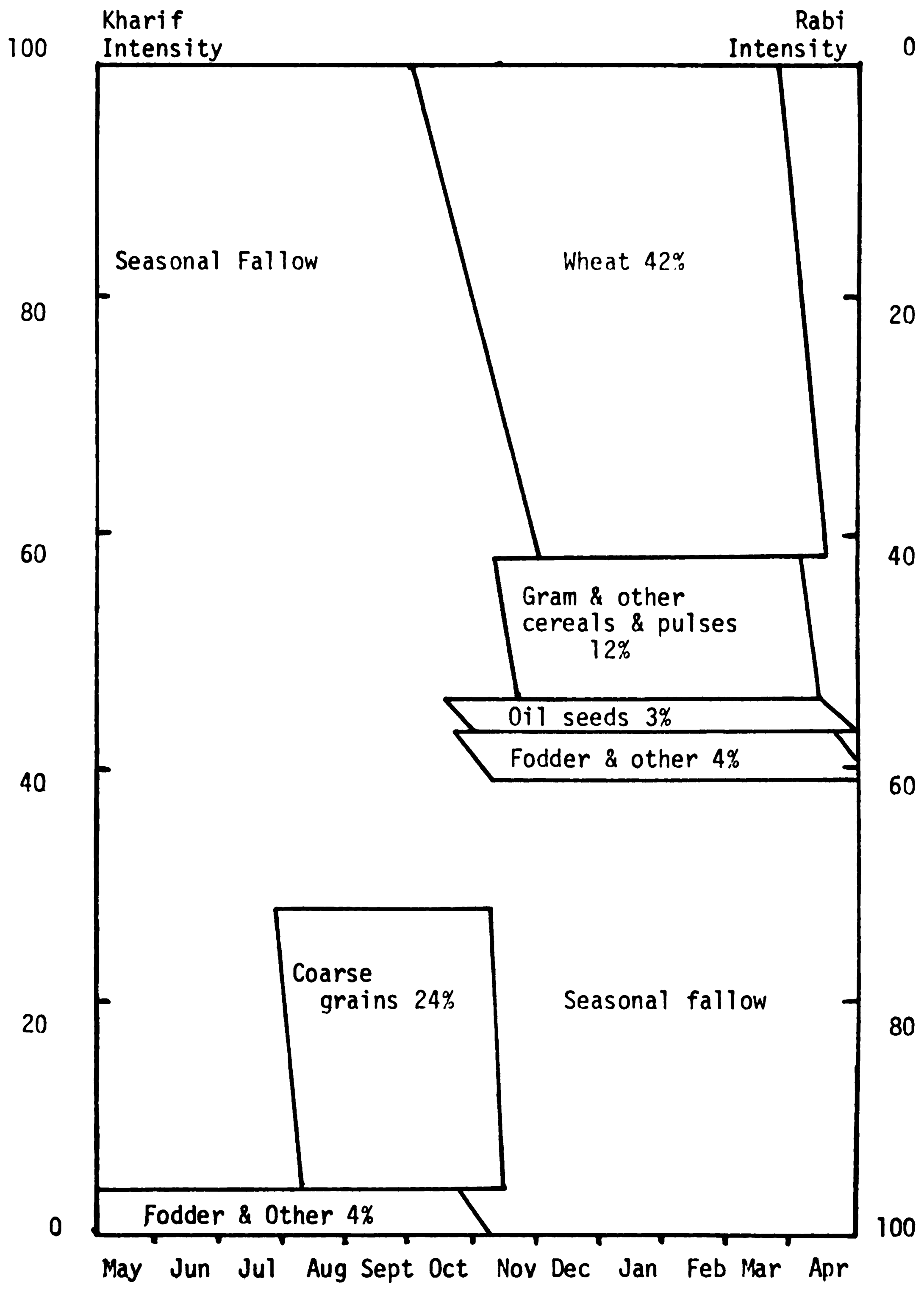

Figure 2.1 TYPICAL CROPPING PATTERN, NORTHERN ZONE
RAINFED AREA: OVERALL CROPPING INTENSITY - 92%

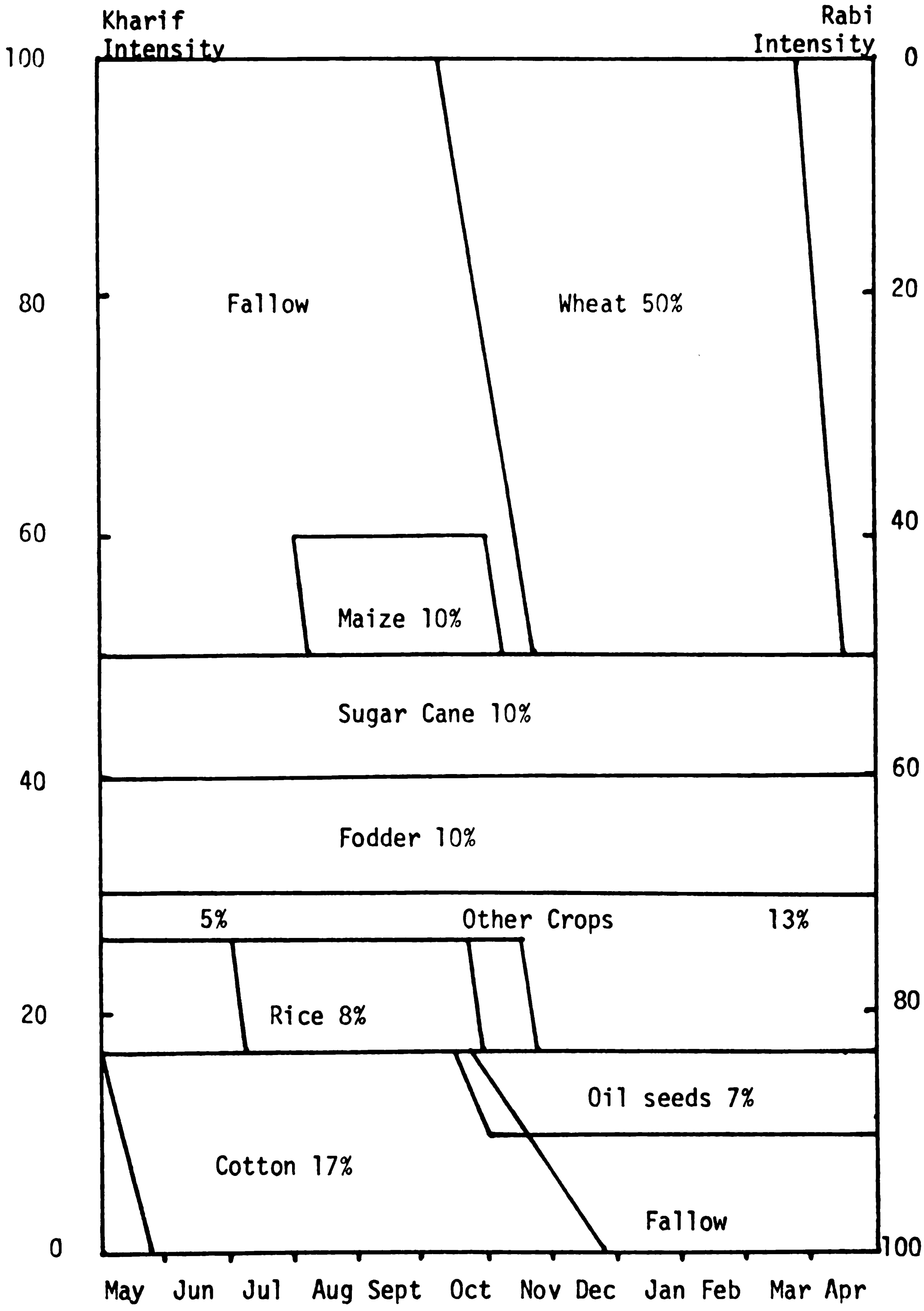

Figure 2.2 TYPICAL CROPPING PATTERN, CENTRAL PUNJAB
CANAL PLUS TUBEWELL: OVERALL CROPPING INTENSITY - 150%

and/or millets, then wheat again, and is not left fallow for long. Almost all sowing is broadcast (and so is fertilizer application) but a few farmers with level land are accepting the practice of line sowing by either the kera method of dribbling the seed by hand into the furrow or the pora method of dropping the seed through a funnel which is attached to the plow.

Efforts to introduce commercial crops other than the local traditional crops have to take into consideration the importance of maintaining the barani farmer's livestock herd. Most barani farmers have a pair of bullocks (for draft) and a buffalo or goat (for dairy products) on their farms which are fed crop forage. Without the traditional food-grain crops, roughage for the livestock would be a considerable problem. Concomitantly, pasture grasses are generally not included in the rotations. Uncultivated grasses which grow on the steep slopes and bunds presently produce more roughage in shorter time than commonly known cultivated grasses and are harvested for hay during the month of October. This, in turn, adds to the seasonal demand for labor. But livestock numbers are apparently exceeding available forage. Over-grazing is common, resulting in severe erosion, the destruction of thousands of grassland acres and the reduction of productivity of the barani acreage through loss of rich top-soil from unchecked water run-off.

As a result of the inter-play of forces, it has been stated in a recent study on similar environs that dryland farming is underpowered, due, in part, to the poor quality of draft animals which are weak because of the seasonality of fodder production and the low

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economic resources of the farmers.[10/] As such, power poses a severe constraint on full utilization of land during the land preparation period. In particular, after the monsoon starts, several days are often required to prepare seed-beds with low-quality bullocks.

Even considering the above, farming is mostly with bullocks and only a small area is under tractor cultivation in the barani area.[11/] Fallow land is tilled on the average of once a month to destroy weeds and conserve moisture. The bullock-drawn wooden plough with a spiked metal tip penetrates just a few inches below the soil surface. As such, it is less than a plow and more than a cultivator. Due to continued use of this plough a hard pan is created underneath which limits the penetration of rainwater to moisture holding levels. The hard pan also leads to greater surface erosion of precious topsoil needed for crop production. Crops are harvested by hand close to the ground; stubble is short and little is left in the soil to preserve its structure or to act as mulch for moisture conservation. Furthermore, barani farmers are not in the habit of developing compost. Thus, organic matter is not returned to the soil and the moisture-holding capacity of the soils is not improved.

Barani farmers plank their fields with wooden logs. The effect of planking on production has not been studied but it is hypothesized

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[10/] Johnson, A.A. Indian Agriculture Into the 1970's -- Components of Modernization, The Ford Foundation, New Delhi, India, June 1970.

[11/] According to the Farm Mechanization Committee Report there were 18,909 tractors in operation at the end of 1968 in all West Pakistan. Ninety-two percent of the tractors were concentrated on irrigated land and 80 percent were with farmers operating 50 plus acres of land. Government of Pakistan, Ministry of Agriculture and Works, Farm Mechanization in West Pakistan: Report of the Farm Mechanization Committee, March 1970. pp. ix and 387.

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in one report[12/] that it makes the top-soil powdery and compact and thus helps the soil moisture to come up to the surface by capillary action. That, in turn, raises the rate of evapotranspiration and weakens moisture--holding capacity of barani soil.

Development Alternatives

Overall, "the barani" holds a large number of Pakistan's rural people, living under intense man-to-land pressure. Low incomes and apparently few prospects for improved conditions makes the barani a formidable challenge. The barani terrain is rough and uneven, also making it costly to build effective water-ways for efficient utilization.

In many ways productivity could perhaps be doubled and tripled by modern land management practices and tractor cultivation which conserves moisture and restrains soil deterioration. For this type of development, the prospects appear best for the relatively low rainfall areas where the land are fairly level. However, development through tractor mechanization, in particular, may be expensive, in terms of costs to society, if many are left unemployed in the process. On the other hand, the marginal lands, which abound in the barani area, show potential for fruit and nut tree expansion. Tied to this possibility, the development of forestry and orchards serve as a means to conserve eroding soil and preserve moisture for the dams and reservoirs to water the Indus Plains. Rainfall, however, appears adequate for good crop production in the barani area. In this light, the use of new and improved production inputs of seed, fertilizer and simple implements offer another

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12/ Rana Tractors & Equipment Ltd., "Report on Dryland Wheat Production with Massey-Ferguson System"/ Rana Tractors and Equipment Ltd., Lahore 1969.

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way to increase barani agricultural productivity, a development alternative we give further attention to in the pages that follow.

Wheat Performance in "the Barani"

Approximately 30 percent or 3.8 million acres of West Pakistan's wheat is sown on barani land each year. But barani wheat acreage supplies only 11 percent of West Pakistan's 7 million tons of wheat. The Divisions of Peshawar and Rawalpindi alone, with large portions of barani wheat, supply about 10 percent of West Pakistan's wheat grain but have 20 percent of its wheat acreage.

TABLE 2.2 WHEAT AREA AND YIELDS FOR IRRIGATED AND BARANI WHEAT IN WEST PAKISTAN

Years	All West Pakistan Wheat Area (000 Acres)	Wheat Yields (in Mds/Acre)*		
		All West Pakistan	Irrigated	Barani
1964-65	13,140	9.4	11.3	5.7
1965-66	12,738	8.2	10.1	4.2
1966-67	13,205	8.8	10.9	3.9
1967-68	14,785	11.6	13.9	6.2
1968-69	15,221	11.6	14.1	4.5
1969-70	15,089	12.9	17.2	4.4

Source: Former Government of West Pakistan, Lahore -- Season and Crop Reports for respective years.

*One maund = 82.286 lbs. and approximately 27.224 maunds = one ton (2,240 lbs.). Note: Barani wheat yield statistics refer to the average for all West Pakistan including Peshawar and Rawalpindi Divisions.

In Table 2.2, it is evident that yields are invariably lower on barani acreage as compared to irrigated acreage in West Pakistan and there has been little positive change in the barani wheat yield statistic. One of the problems confronting barani wheat farmers is

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the risk and uncertainty factor. Yields are reduced when rains are untimely and insufficient. In Kohat, for example, the most acute physical problem is aridity. "It is so arid, except where irrigated, that crop production is hazardous. Average wheat yields are low despite an occasional bumper crop in good rainfall years. Crops are a near failure in bad years occurring all too frequently".[13/]

Though there is little research on barani wheat cultivation, it is hypothesized that barani yields are comparatively lower than those attained on irrigated land, even in times of adequate rainfall, for two main reasons:

(i) Lower seed rate per acre: The amount of residual moisture, added by the monsoons, affects wheat seed germination. Farmers add seed according to tradition and experience over a number of good and bad years. They usually plan for their worst experience with rainfall. Barani farmers know that high plant population densities result in crowding and insufficient moisture for all plants to thrive. Thus they invariably use lower seed rates on barani lands.

(ii) Lower fertilizer application: Residual moisture also determines the effectiveness of fertilizer on barani wheat. Heavy doses of it relative to available moisture or directly in contact with the seed can result in poor germination or burned seedlings. Hence, barani farmers use chemical fertilizer sparingly and at times in less than optimum yield-giving proportions.

Taken together, the general hypothesis is suggested that barani farmers, who are forced to plan their farming operations under conditions of gross uncertainty, learn to allocate their resources conservatively.

[13/] USDA-AID Watershed Management Team, op. cit. Vol. II, p. 196

In such circumstances, their principal objective is to grow crops which afford greatest certainty in producing enough grain to feed themselves and their families. Moreover, the uncertainty in yield tends to reduce the potential marketable surplus from the area.

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CHAPTER III

BACKGROUND DESCRIPTION OF HAZARA DISTRICT AND SURVEY LOCATIONS

Introduction

Data on barani farming are rather limited at best and do not provide a base from which to draw significant conclusions and policies. Thus, it is necessary to rely almost entirely on information from the field. This chapter describes the major characteristics of Hazara District and the reasons for selecting Hazara for this study. A brief comparison is also made between the two thanas of Hazara which were surveyed and their average yearly rainfalls.

District Selection

It has been pointed out that there are three geophysically tied barani areas in the northern portion of West Pakistan: (1) The Potwar Plateau and Pabbi Areas, (2) The Himalayan Foothills and Valley areas, and (3) The Peshawar Vale and Kohat Range. The dilemma that arose was either to select one of the three areas for research and analysis or to sample in all three areas in order to get comparative cross sectional data. Based on the author's familiarity with "the barani" and knowledge of the problems confronting barani agriculture and its people, Hazara District of the North West Frontier Province (N.W.F.P.), which is largely representative of the Himalayan Foothills and Valley areas, was selected for the field survey work of this study.

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Several considerations led to the selection of Hazara: (1) The break-up of West Pakistan into four provinces with separate Departments of Agriculture pointed out the need to work with one government unit of administration which would be in a better position to implement some of the practical recommendations of such a study. (2) It was quite evident that the Potwar Plateau and Pabbi areas, which are primarily in the Punjab, are more favorably located to become recipients of irrigation from new dams that are planned and presently under construction. Tarbela Dam, in particular, which will be the world's largest earth filled structure, will soon provide much needed irrigation for both the Punjab and Sind Provinces. While the actual allocation of water has not yet been decided, it is quite possible that much of the "barani" of the Potwar Plateau and Pabbi areas will become irrigated; hence, no longer "barani" per se. (3) Although the Peshawar Vale and Kohat Range are located in the N.W.F.P., they were excluded from the present study because they are relatively unpopulated. Moreover, the comparative advantage for this area lies more in the production of ground nuts, a crop for which the government is allocating more funds toward its improvement. (4) On the other hand, Hazara District is notably coping with problems on two fronts, one, a dence and rapidly expanding population and two, a wide spectrum of poverty. Moreover, there is practically nothing written of Hazara's agriculture. It has long been a district void of research and analysis since much of its territory was, until recently, "unsettled"; that is to say, it was generally under the administration of tribal authorities in charge of the affairs of the people. On top of all this, Hazara has general characteristics similar to the Himalayan portions of the Punjab and Azad Kashmir. Generalizations from the observations of this study appear appropriate for the other Himalayan areas as well as for Hazara.

Major Characteristics of Hazara District

Hazara's characteristics are well worth reviewing, for the information contained offers insights into the survey findings that follow:

(1) Hazara's agriculture is almost exclusively barani. The District has a total of four million acres making it the 14th largest district out of a total of 52 in West Pakistan. Yet because of its broken and mountainous terrain, only 600 thousand acres are cultivated annually and of that, approximately 85 percent is barani. With its rough geographic conditions, tractor mechanization and irrigations schemes have hardly penetrated the District.[1/] As a result, bullock drawn plows and rainfall will probably continue to be the major factors in Hazara's crop production.

(2) Man-to-land pressures and small farms are extant throughout Hazara.

Approximately 93 percent of the inhabitants live in rural areas. The urban population can be found in the Districts' three main cities, Abbottabad (the District Headquarters), Haripur, and Mansehra. There are also three main administrative units,[2/] or tehsils, named after each

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[1/] An indication of this is that there is no service sector for tractors, tubewells or low lift pumps in Hazara. During my many visits to Hazara, I have only seen three tractors in use in Hazara. These were in the lowlands plains areas around Haripur.

[2/] A fourth tehsil was recently constituted out of the former "unsettled" area of Battagram, north of Mansehra Tehsil. As yet, though, this area has not been studied nor is there available data on its characteristics.

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of the three main cities in Hazara.

In 1901, Hazara district had a total cultivated area of about 410 thousand acres. By 1969, the cultivated area had increased to 600 thousand acres. Notably, the gains in cultivated area have not kept pace with the near 2.5 annual increase in population. In 1961 approximately 1.38 million populated the District. Today there might be more than 1.6 million people and an average density of between 2 to 3 people per cultivated acre. However, the population is unevenly distributed. The northern tehsil of Mansehra has 75 percent of the total area and 26 percent of the population. Abbottabad and Haripur tehsils are more heavily populated with equal densities of people. Yet, the figures can be deceiving since much of the territory of Mansehra includes the high snow-capped peaks of Hazara and most population is settled in the small areas of cultivated acreage.

The overwhelming majority of Hazara's farms are small, individually owned and cultivated. According to the 1960 Agriculture Census, Hazara has at least 268 thousand farms; approximately 77 percent of the farms are five acres or less in size and account for 38 percent of the cultivated area. Two percent of the farms are larger than 25 acres and have 10 percent of the cultivated area. According to the Census figures on tenure, 62 percent are 'owned' farms, 23 percent are tenant farms and the rest (15 percent) are categorized owner-cum-tenant farms.

Since it has been difficult to increase productivity and cultivable area in Hazara, population pressures on the cultivable acreage have made it increasingly difficult to live there. For instance, between 1961-70 approximately 38,000 people were estimated to have left the District; the highest recorded out-migration from any district in

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West Pakistan.[3/] The movement is significant and as we will note in Chapter VI, has bearing on the livelihood of Hazara's occupants.

(3) Hazara is a transition zone, both physically and culturally, between the Frontier and the Punjab. Culturally, both Pushto and Hindko (related to Punjabi) are spoken there. Physically it is the only frontier district which lies to the east of the Indus River. Roughly 85 percent of the people speak Hindko and most Hindko-speakers live in the southern portions of Hazara, in Abbottabad and Haripur tehsils. Those who speak Pushto, about 25 percent of the population, are located primarily in Mansehra tehsil. Of course, a number of people speak both languages in Hazara plus the national language, Urdu, and to a minor extent, English.

The district is inhabited by people of various tribes as shown in Table 3.1. Nearly all are Muslims belonging to the Sunni Sect. Knowledge of these ethnic and religious characteristics of the people is important when one realizes the mobility these people have in moving from one part of the country to another.

TABLE 3.1 TRIBAL BREAKDOWN AND LANGUAGES SPOKEN*

Hindko Speakers		Pushto Speakers
Sayid	Jadun	Swathi
Turk	Tanaoli +	Mishwani
Awan	Tarin	Tarkheli +
Gujar	Dilazek	Tanaoli +
Gakhar	Punjabi	Utmanzai
Dhund	Tarkheli +	
Karral	Abbassi	

+ Speaking both

*Source: Dichter, David, The North West Frontier of West Pakistan, Clarendon Press, Oxford, 1967

Note: Pushto speakers are more commonly called Pathans.

3/ For more detail see: M. Ahmad Khan. "Population and Migration Pattern N.W.F.P. and Adjoining Tribal Areas". Paper prepared for the Project office, Regional Development Plan, University of Peshawar, Jan. 1971.

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(4) Wheat and Maize are primarily subsistence crops for the majority of Hazara's occupants. Table 3.2 gives the percentage of cropped area under various crops during the kharif (summer) and rabi (winter) seasons. It indicates to some extent that rainfall and climate both bear on the diversity of cropping patterns and crops grown in Hazara. Notably, maize and wheat predominant the two seasons with proportionately more wheat grown in Haripur tehsil and proportionately more maize grown in Abbottabad and Mansehra for the respective seasons. Some commercial crops -- chiefly tobacco and oilseeds -- are grown, but commercial trade is limited at best to the local markets.

TABLE 3.2 PERCENTAGE OF TOTAL AREA UNDER CROP BY TEHSIL AND SEASON IN HAZARA DISTRICT

Season	.............Tehsils	....		Total
+ Crop	Haripur	Abbottabad	Mansehra	District
Kharif:	38	69	64	57
Maize	29	56	47	45
Rice	-	2	5	3
Pulses	3	7	3	4
Rabi:	62	31	36	43
Wheat	44	18	26	29
Oilseeds	4	2	3	3
Total Cropped Area	186,081	187,284	249,096	623,061

Source: Pakistan Census of Agriculture, 1960

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Approximately 30 percent (200 thousand acres) of the District's cropped area is sown with wheat during rabi (winter); 88 percent of the wheat crop is barani. During kharif (summer), 290 thousand acres are sown with maize. Maize takes up 45 percent of the annual cropped area of Hazara and 88 percent of the maize is grown on barani land. The District's share of West Pakistan production and acreage for wheat and maize (1969-70) is shown in Table 3.3 Like other Districts which are largely rainfed, the share of West Pakistan production is relatively below the share of acreage used for wheat production, an indication of below average productivity. Maize production, on the other hand, approaches the norm for the whole of West Pakistan.

TABLE 3.3 HAZARA DISTRICT'S SHARE OF WHEAT AND MAIZE PRODUCTION IN WEST PAKISTAN: 1969-70

Commodity	Number of (000) Acres	Share of Nation (percentage)	Number of (000) Tons	Share of Nation (percentage)
Wheat	200	1.3	51.0	0.7
Maize	292	18.0	113.0	17.2

Source: Crop and Season Report, 1969-70, unpublished

According to official statistics of the Ministry of Agriculture and Works, little has happened in the rural areas of Hazara with wheat and maize over the last two decades. Wheat acreage grew at about 1.5 percent annually between 1954-55 and 1969-70, while yields increased annually at about 0.9 percent. The combined effect was a 2.4 percent annual increase in production over the time period, below the rate of growth in population.

Maize production did comparatively better than wheat and grew at about 2.9 percent per annum between 1954-55 and 1969-70. An annual 1.5 percent increase in acreage and 1.4 percent increase in yield account for the increase in production.

Survey Locations

Lora and Oghi Thanas[4/]

It was found that a widespread area, such as a thana in the hilly and broken terrain of Hazara, gives the field researcher the needed space to gather a large cross-section of data on a variety of subjects and still provides a unit of reference for the people interviewed. There was no other appropriate unit with these characteristics. Because there is literally no research available on the barani of Hazara, it seemed imperative to select two areas instead of one to account for inter-District variability in the findings. Hence, the sample of respondents were chosen from two different thanas in Hazara, Lora and Oghi.

The two thanas are a hundred miles apart and hold a number of interesting contrasts and similarities; Lora is in Abbottabad tehsil and Oghi is in Mansehra tehsil. Their rough terrains are similar in appearance yet different with respect to soil quality and moisture-holding capacity. Oghi has rich forested acres. Lora is practically deforested and, as such, is subject to extensive erosion and soil deterioration. Oghi city sits 3,890 feet above sea level and Lora city is a little lower at around 3,250 feet. At these altitudes, both

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[4/] "Thana" is defined in the glossary in the Appendix.

Lora and Oghi areas grow primarily rabi wheat and kharif maize under strictly rainfed conditions. Both crops are grown on small terraced plots of land that have been carved out of the mountains. Some kharif rice is grown near water flows on a few of the many terraces farmed by the small farmers. To add to the contrasts, Lora area is mostly settled by Hindko-speaking Abbassis and Gugars. Oghi, on the other hand, has a large settlement of Pushto-speaking Swathis and Tanoalis. Hence, culturally speaking, Lora and Oghi are also different from one another in terms of the people that farm the land.

Note on Rainfall

Rainfall is measured in Lora (in village Barkot) and Oghi (Oghi proper) thanas by rain gauge recorders installed and owned by the Surface Water Hydrology Department of the Water and Power Development Authority (WAPDA). Figure 3.1 shows the average annual precipitation of the two areas over the last decade. Rainfall has averaged 52 inches per annum in Lora and 45 inches in Oghi.

Both areas experience heaviest precipitation during the combined periods of July-September and February-April. Between August 1, 1969 and July 31, 1970, which covers the wheat production period under investigation, rainfall was about the same in the two areas, around 36 inches. A breakdown of these critical months is shown in Figure 3.2. In both areas, rainfall was above normal during October 1969. October is the period when residual moisture for the presowing period is needed. During March and April, however, rainfall was below normal in both Lora and Oghi. Rainfall during these months affects wheat grain development. Since rainfall was above normal during the former period, we could expect fertilizer applications to be readily applied to dwarf wheat. On the other hand, since rainfall was below normal during the heading period of wheat growth, yields may be biased downward.[5/]

[5/] The "Fifth Annual Technical Report: Accelerated Wheat Improvement Program, 1969-70", concluded that the "barani" crop was quite normal during the period studied, p. 4, March 10, 1971. (Distributed by the Coordinator Wheat Improvement Project, Lahore, West Pakistan).


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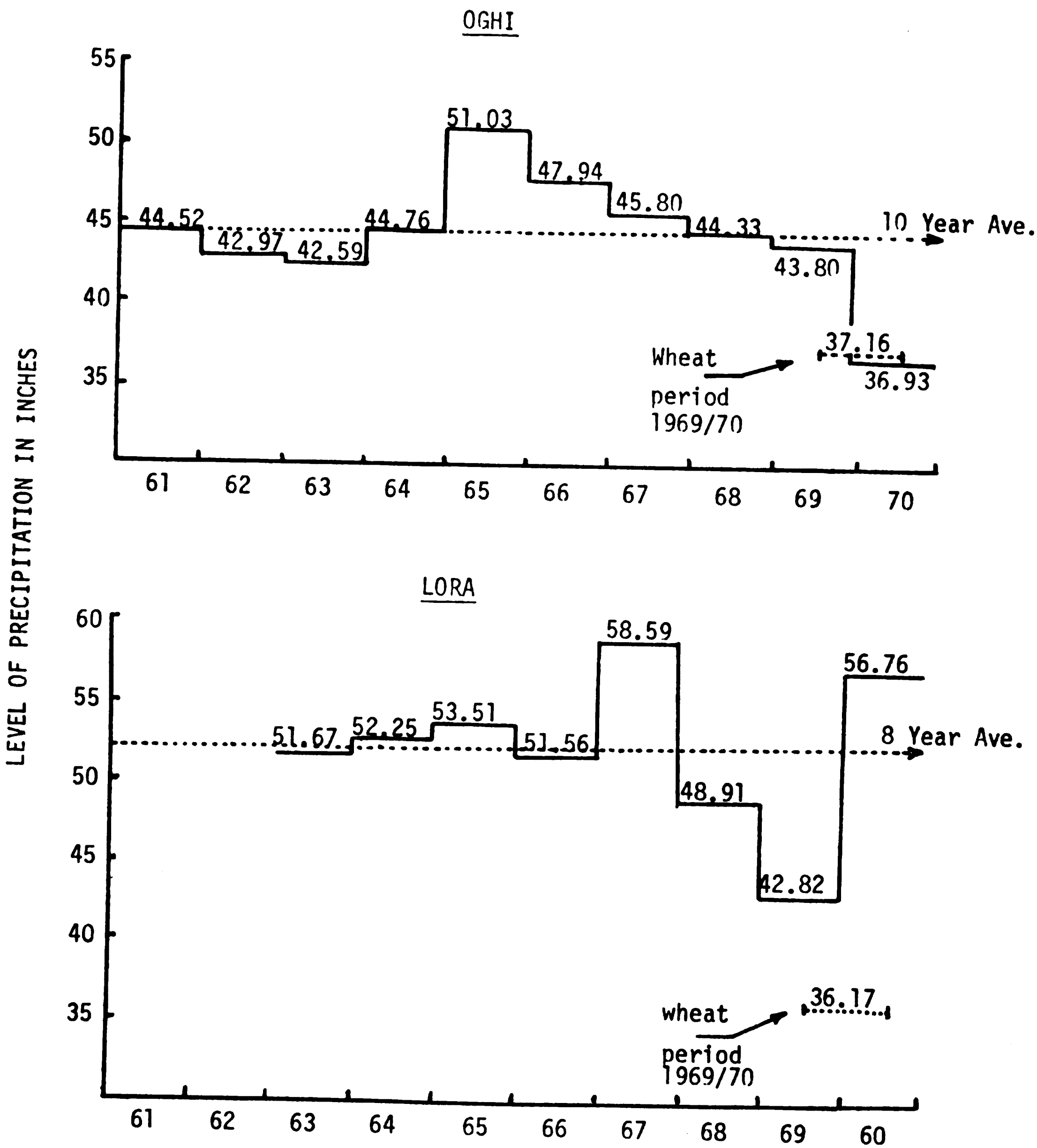

FIGURE 3.1 VARIATION IN ANNUAL PRECIPITATION: LORA AND OGHI, HAZARA DISTRICT, 1961-1970.

Average Monthly Precipitation in Inches

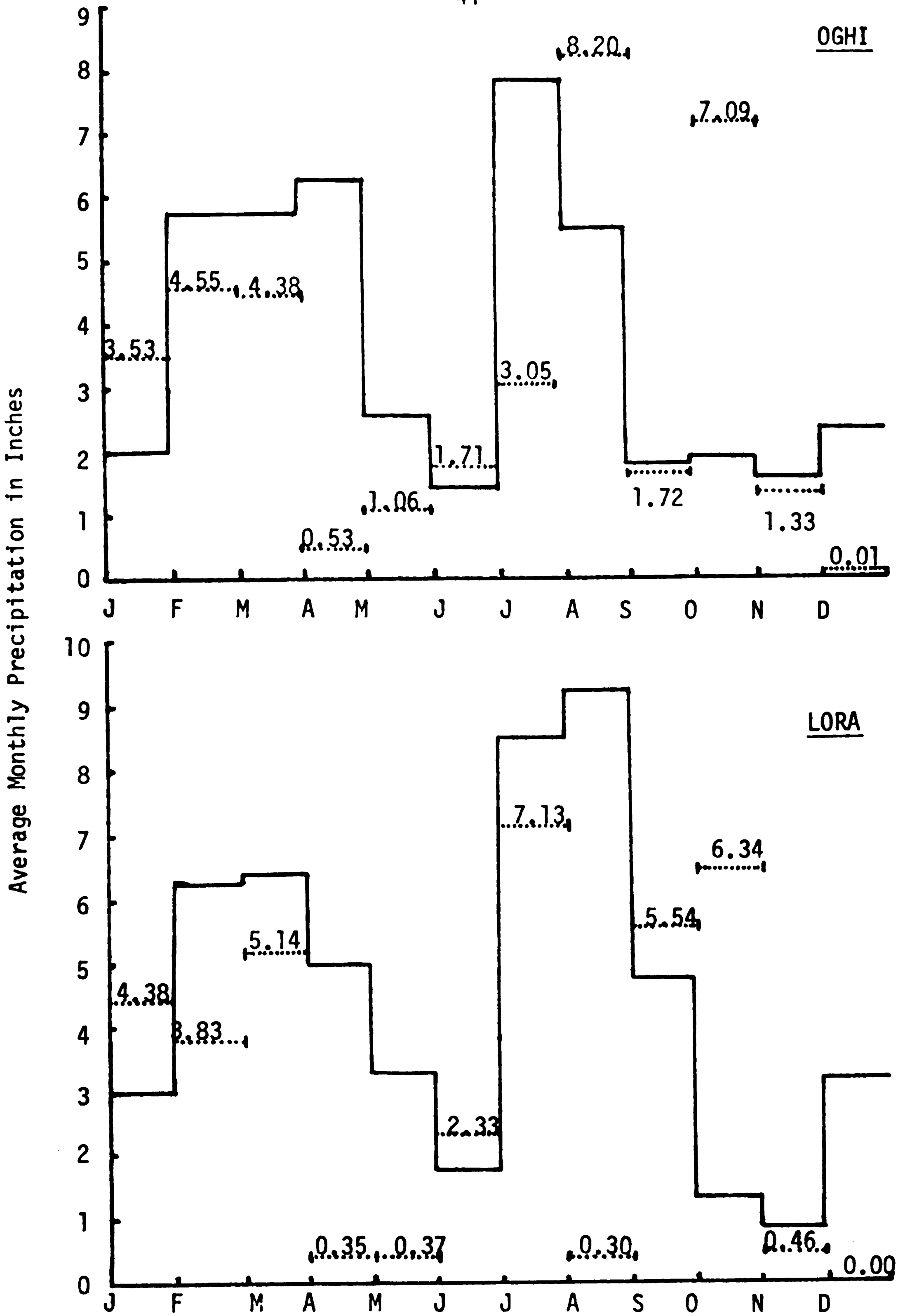

FIGURE 3.2 AVERAGE MONTHLY PRECIPITATION FOR 1961-67 (in solid lines) AND AUG. 1, 1969 TO JULY 31, 1970 (in broken lines): LORA AND OGHI, HAZARA DISTRICT

CHAPTER IV

METHOD OF DATA COLLECTION AND THE GENERAL CHARACTERISTICS OF HAZARA'S FARMS

Introduction

The central purpose of thise chapter is to discuss the method of data collection and the precautionary measures which were taken to encourage reliable answers from the sample of respondents who were interviewed. The sampling technique which was employed and the way the survey was implemented are also covered in this chapter. The final portion of this chapter depicts the general characteristics of Hazara's farms.

Method of Data Collection

Interviewing and data collection on the micro-level in Pakistan is an art in itself, involving new and different terrains and socio-cultural factors from one place to another. Eckert, in his recent study on the impact of dwarf wheats in the Punjab of West Pakistan found problems with: (1) eliciting "straight" answers to direct questions, (2) dealing with the intricacies of Punjab agriculture, (3) learning to question farmers who had difficulty recalling and measuring inputs and outputs and (4) finding the "right respondent" in a society which tends to make spokesmen of the better informed and wealthier farmers.[1/]

Such difficulties emphasize the need for well planned and executed

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1/ J.B. Eckert, op. cit., pp. 37-46. Eckert refers to the "right respondent" as the farmer who actually worked the land and managed the farm operations, whether an owner or tenant.

methods of data collection. They also stress the importance of knowing the culture well enough to conduct survey work on a proper footing. In Hazara, for example, village muslim women practice purdah, which means that they conceal themselves against all outsiders and sometimes against local villagers after having reached puberty. Purdah was said to have originated with the prophet Muhammed and continues strongly to this day in both the urban and rural areas of West Pakistan. However, the practice of purdah makes it difficult for the outsider or foreigner to move about freely in and around village communities until the women have been warned and/or rushed into their quarters. Getting around the problem requires someone familiar with the area to make an announcement within the village that a visitor is coming. This is easily done by telling male adults or children that the village will be entered. Failure to understand this custom can make interviewing in a Hazara community rather difficult and uncomfortable. However, once one gets by the formality, movement within the village is unrestricted.

Another custom that prevails throughout Hazara is household courtesy. Most visitors will be invited into a house for a cup of tea. "Distinguished" visitors or burra sahibs will in most cases be given a complete dinner. Often the interviewing team went through as many as 15 cups of tea a day. Acceptance of a cup of tea is an important way of showing respect and easing the relationship between the guest and the host. It does, however, take time and one must be prepared to sit for an hour or more if necessary.

Therefore, the survey method of collecting data had to be adapted to fit the socio-cultural context of Hazara. Since data collection is a major component of research of the type presented here, it is worthwhile revi

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reviewing the precautionary measures that were taken for the implementation of the field survey.

Precautionary Measures

Before any interviews were conducted, all of the above caveats were taken into consideration. In addition, the author consulted with members of the Pakistan Academy for Rural Development in Peshawar who have field research experience in and around the North West Frontier Province. They advised the author on problems that could be encountered in local field surveys and ways to get around them. All things considered, it seemed imperative that one of the first musts would be to find ways to avoid being mistaken for a revenue collector, a policeman or a government official with the intent of seizing land, for example. In short, special measures called for ways of reducing heterophily between the interviewers and the prospective respondents in order to gain cooperation and possibly reliable and valid data.

Heterophily is defined as the degree to which two or more people who interact are different in certain attributes such as beliefs, values, education, or social status. The more different two people are, the more heterophilous. Previous field experience in villages has shown that communication between individuals is less effective when a high degree of heterophily is present.[2/] "Less effective" here means that it is difficult to get clear-cut answers to the interviewer's questions and to have the respondents' full attention and cooperation. Measures

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[2/] Rogers, Everett M. Modernization Among Peasants: The Impact of Communication. Holt, Rinehart and Winston, Inc. 1969, pp. 182, 202, 233-237, 241, 264.

were thus taken to reduce heterophily by way of (1) pretesting the interview schedules, (2) conforming the manner and dress of the interviewing team to local customs and (3) explaining the interviewers' intent. In more detail:

(1) Pretesting Interview Schedules

Having a clear and concise interview schedule can serve to reduce heterophily between the interviewer and the respondent. A complex and ambiguous schedule, on the other hand, is indicated by a large number of refusals to answer questions, or rather obvious wrong or inconsistent answers from farmer to farmer. The usual result is to have a confused and perhaps embarrassed respondent.

Two interview schedules were used in this study and are reproduced in the appendix. Both schedules were pretested within two weeks of the main interviews, in areas near Lora and Oghi Thanas but outside the sampled thanas. Ten farmers were interviewed with each of the two pretest interview schedules.

The results proved helpful; useless and time consuming questions were eliminated, some questions were clarified, the interview schedule was reorganized in order to get continuity and flow in the answers. At all times an attempt was made to structure the interview in such a way that the interviewer would answer the easier "yes" and "no" questions before more difficult questions were asked.

The pretest interviews also helped to enhance the finesse of the interview team. In addition, both pretests came out with large variability in the crop production and input data which suggested that we would need to draw from as large a sample as possible.

(2) Conformity of the Interviewing Team

All interviews were conducted by the author with the aid of an interpreter. The interpreter, Siddiq, was born and raised on a barani farm of Murree Hills which has conditions quite similar to Lora and Oghi. Siddiq could not only speak the farmers' language but he was highly respected as a Muslim follower; his neatly kept beard was a strong sign that he practiced his religion faithfully. The author, on the other hand, was often mistaken for a local because of his looks and compliance with local customs at community gatherings.

Personal appearances of interviewers can have imposing effects on respondents. A man in a suit, for example, commands respect and special courtesies, aside from being rather obvious in a rural setting. In this study, both interviewers wore the native shalwar-kameez at all times in the village areas. Furthermore, the interview team stayed in the village areas, eating, sleeping, and participating in some local activities. The generous hospitality and many invitations to have dinner and discuss farming were signs of reduced heterophily.

(3) Explaining Interviewer's Intent

Explaining interviewer's intent is a very important step towards reducing heterophily. Rogers[3/] writes that:

> In one Latin American community local rumors were spread that the researchers conducting the field interviews were really looking for farm children to send to a sausage factory. In the case of the Colombian study, an increase in local property taxes was announced by the Government during the data collection. The farmers were asked as part of our interviews, how many animals they owned and how many acres they operated. Naturally, they assumed a direct causal link between the information they were giving and the tax increase. Interviewing was brought to a halt by

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[3/] Rogers, ibid., p. 367.

> noncooperation until the community leaders, who fortunately understood the nature of the investigation, had an opportunity to explain the situation to their neighbors.

Subsistence crop production occupies by far most of the barani smallholders' time and energy. They are thus indeed concerned with anything which affects their farm management decisions and practices. Hence, each and every respondent was told (1) that the interviewers were interested in learning all they could about barani crop cultivation, (2) that we were not working for the Government of Pakistan, (3) that the information obtained would be instrumental in helping to improve barani agriculture, and (4) that we had the welfare of the Hazarans in mind at all times. We were never asked if we had ulterior motives and seemingly had full cooperation.

Sampling Technique and Respondent Selection

Three sampling techniques were considered before a fourth modified technique was chosen for the survey. The first consideration was to draw random samples of farmers from village land records which are held by the patwaris or revenue collectors. Such a sampling technique proved unsuitable for obvious reasons: (1) it would have involved using revenue records and perhaps giving the wrong impression of interviewer's intent, (2) the sample would have included owners of land to the exclusion of tenants, and (3) it would have been difficult to locate selected farmers in the very mountainous area of Lora and Oghi since many homes are widely scattered. The sheer physical feat of reaching the right respondent would have been enormous.

Second consideration was given to registering all cultivators in a village and drawing random lots from those registered. This sampling technique had the following drawbacks: (1) just going into villages would have taken time and numbers of interviewers and, hence, would have made the survey work costlier, and (2) it was believed that dwarf wheat diffusion would be location specific. Namely, some villages would be saturated with the wheat variety and other areas would not. And as noted above, a large geographic area like the thana was required in order to get an idea of the spread of the new variety.

Third, using maps from which to draw sample villages was not possible because none were available. Then again, the broken terrain with its insurmountable obstacles to traverse would have made it a formidable task to reach a number of villages.

The sampling technique which was relied upon involved the following steps in selecting respondents: (1) Equipped with a Land Rover, the interviewing team would drive to an area at random without notifying the villagers in advance and would stop at places within sight of a village or a group of homes, (2) the interview team thus walked to the homes or village and whenever a farmer was encountered, usually in the field or on the trail, we asked him the following questions which formed the criteria for an interview: (i) whether or not the man grew wheat (during the first round) or maize (during the second round), (ii) whether or not the man actually cultivated and worked the crop, and (iii) whether or not the man had ten minutes to spare for general discussions on the crop. If the man answered affirmatively to all three questions and agreed to be interviewed, then the interviewer's intent was stated before we proceeded with the actual interview. After the first interview we'd ask the farmer to take us into the village. In those cases where we did not encounter an adult male on the trail, we would ask local children to take us into the village to the headman's home which is the general receiving area. These latter precautions were strictly adhered to in order to avoid the problem of interferring with the practice of purdah.

Such a selection procedure is subject to some bias (1) if there are a large number of refusals, and (2) if the interview team consciously selects "better looking" respondents out of a group. In answer to the first part, there were no refusals from those who fit the criteria. As to the second part, attempts were made to interview as many of the farmers that we encountered, one by one. During some encounters there were at most 3 or 4 farmers to deal with at a time. Those listening in at the interview and not directly interviewed were asked to refrain from making side comments during the interview. This request was respected by all and none seemed embarrassed by being asked to sit silent until their turn. It should also be noted that there did not appear to be a "parrot effect" involved whereby those waiting to be interviewed repeat the same answers as those already interviewed. On the contrary, farmers were clear in pointing out when they did some things differently from others who were interviewed in their presence.

Overall, the selection procedure appeared to work exceptionally well. Farmers were cooperative and seemingly interested in the questions. Some even commented that the questions made them think more about their present farming practices. Furthermore, the high response to the questions asked gives reason to believe that the farmers attempted to answer all questions to the best of their ability. In some cases, farmers said they weren't sure about their answers. This seemingly indicated a desire to avoid giving just any answer as a courtesy to the interviewing team.

Survey Implementation

Two field surveys were conducted during two time periods in order to coincide with the post-harvest periods for wheat and maize; May/June and October/November, respectively.[4/] The interview schedule used during the first period was aimed specifically at questions on Mexipak[5/] wheat adoption and impact. In addition a number of questions on communication, farm size, resource use in wheat production, family size, and non-farm income were asked. The second period interview schedules focused on maize production and resource use, and further questions on dwarf wheat adoption. It was also designed to get information on farmers' use of fertilizer and off-farm employment.

The second round of interviews created a problem for the interview team. Namely, should those interviewed during the first period be interviewed again to round out the information dealing with the same farm units? Or should we work with a sample drawn randomly as before and accept the possibility of interviewing some of the respondents interviewed earlier? Because of the extreme difficulty in relocating farmers, added cost, and the limited time available to the interview team, the second alternative was taken.

In the first round of interviews, the heads of household represented a cross-section of 45 villages spread throughout Lora and Oghi areas -- 71 villagers represented 27 villages in Oghi and 72 villagers represented 18 villages in Lora. In all, the first sample was composed of 143 respondents.

In the second round, 98 farmers were interviewed -- 50 villagers represented 26 villages in Oghi and 48 villagers represented 13 villages

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4/ Both interview schedules are reproduced in the Appendix.

5/ Mexipak is the common term used for all dwarf wheats in Hazara. Few farmers are able to distinguish the differences in the new dwarf varieties.

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in Lora. Portions of one farmer's answers to the questions on production had to be dropped from the sample in Oghi because all his land was farmed by tenants. However, the rest of this interview schedule was retained to add to the information on the questions dealing with off-farm employment and family size.

Handling First and Second Round Interviews

As it turned out, there was indeed some overlap of farmers during the second round who were also interviewed during the first round. In Oghi thana, two farmers were interviewed both times and in Lora thana, thirteen. Handling the overlap presented another problem in compiling and organizing the data, but it also presented a way of checking the reliability of the data since some questions were repeated. For example, both the first and second interview schedules had the same questions on total farm area owned by the respondents, the farm area cultivated and the size of family. Given the nature of these questions we would generally presume that the answers would be the same during both interviews. However, some farmers gave apparently different answers in every case. Out of the 15 who were interviewed twice, there were only 4 farmers who answered that they owned the same amount of land. Only 3 farmers repeated the same answer on cultivated area and surprisingly, only 8 farmers mentioned the same family size. Thus, it became imperative that a test be made to see whether the two answers between first and second interviews were significantly different, and what the implications would be for the reliability of the survey data.

The procedure involved taking second period answers and subtracting them from first period answers for each of the 15 respondents. The null hypothesis tested by the Students-t was that the mean value of the answers given during the first period interview were equal to the mean value of the answers given during the second interview in response to the same questions asked on "owned land", "cultivated land" and "family size". Table 4.1 illustrates the results of the test. Notable are the rather large standard deviations which are shown in parenthesis; area owned per respondent ranged from 0 acre (in the case of one tenant farmer) to 35 acres. Area cultivated ranged accordingly. Families ranged from 4 to 18 members per respondents. Also evident, however, is that there is no significant difference with any of the mean values. The levels of significance are the same for "owned land" and "family size". The mean value of the area cultivated apparently changed the most. One possible explanation may be that farmers associated the area cultivated with the area they had just harvested. Since wheat was just harvested at the time of the first interview and since it occupies proportionately less land than the summer crops, farmers may have had easier recall of that land they just tended and correspongingly gave a smaller number for cultivated acreage. On the other hand, the second interview was taken after the maize harvest which occupies proportionately more land. Even with the apparent descrepancies, the data appears to be fairly reliable. The noticeable errors associated with the variance of answers between interviews indicates that they are equally distributed about the mean. Thus, with a larger sample, we should not be too concerned that farmers could not recall information precisely since the mean values of the observations appear to be without significant bias.

TABLE 4.1 COMPARISON OF MEAN VALUES OF ANSWERS TO THE SAME QUESTIONS ASKED DURING FIRST AND SECOND ROUND INTERVIEWS, HAZARA, 1970.

(n = 15)

Number of:	Mean Value of Answers From: First Interview (May/June)	Mean Value of Answers From: Second Interview (Oct/Nov)	Ho: $U_1 = U_2$ No Significant Difference With:
Acres Owned/Farm	10.18 (11.14)	10.68 (11.56)	$\alpha = 0.50$
Acres Cultivated/Farm	3.61 (2.65)	4.28 (4.87)	$\alpha = 0.30$
Family Members/Farm	9.53 (3.64)	8.93 (2.99)	$\alpha = 0.50$

Combining Lora and Oghi Samples

In the analysis that follows, the data from Lora and Oghi will be combined in order to develop a representative sample for Hazara District and the Himalayan barani. No attempt is made to compare the production functions and decision environment between Lora and Oghi. Instead, generalizations will be made about the population of Hazara District's agricultural sector on the basis of the data drawn from the two samples. Since the two interview schedules adduced a number of different issues, the reader is cautioned against thinking that the sample size is uniform for a number of the relationships that are tested herein. For instance, in the first round of 143 interviews, questions were asked on the communication factors which alerted the farmers to dwarf wheats. Thus, the sample size is 143. During both interviews, questions were asked on aspects of off-farm migration so the sample size is larger. For the farmers who were interviewed twice, information is averaged on the per

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pertinent questions, in order to adjust for the discrepancies in answers noted above.

General Characteristics of Hazara's Farms

Table 4.2 below shows that approximately 95 percent of the sample of respondents cultivate less than 15 acres; 87 percent cultivate less than ten and 64 percent less than five. About 82 percent of the respondents own their land, 4 percent both own and rent land and the rest are tenants. However, 34 percent of all the respondents cultivate less than 2.5 acres (not shown in table) and 97 percent of the tenants cultivate less than 10 acres.

TABLE 4.2 DISTRIBUTION OF SAMPLE, BY TENURE AND SIZE OR AREA CULTIVATED, 1970: HAZARA DISTRICT

	TENURE			
Cultivated Area (acres)	Owner (n = 185) %	Owner-cum-Tenant (n = 10) %	Tenant (n = 30) %	All Farms (n = 225) %
<5	59.47	70.00	90.00	64.01
5<10	25.95	30.00	6.67	23.57
10<15	9.18	0	3.33	8.00
15<20	2.70	0	0	2.21
20>	2.70	0	0	2.21
Total	100.00	100.00	100.00	100.00

The average size of holding that is cultivated by 225 interviewees is about 5 acres; 97 percent of this cultivated acreage is barani. What little is irrigated is sown with rice during the summer season. Water for irrigation,however, is not perennial; it too comes from melting snow and monsoon rains and is channeled long distances around the mountains. Nearly all of the farmers struggle with small and widely separated plots that multiply the difficulties of efficient use of production factors.[6/] Each plot averages around a quarter of an acre in size and farmers cultivate on the average as many as 15 individual and separate pieces of land that are generally terraced and scattered. Government attempts, however, to consolidate holdings have met with little success.[7/]

Most families live humbly in homes made of rock covered over with hand-molded mud. The average family has a few trees spotted around the house, a buffalo and/or goat for dairy products, some chickens, a dog, and a pair of bullocks for plowing. Some homes have a private well for drinking water or a nearby well shared by village neighbors; none of the village homes have indoor plumbing.

Village homes are without electricity; the kerosene lamp is now replacing the candle. Wood and fuel oil are used for heating and cooking. Latrines are not to be found. Few homes are located near an all weather road. They are generally nestled against protective mountainsides and provisions and building materials are carried by hand, sometimes by rented donkey for a small carrying fee.

6/ Fragmentation is notably a function of family size and inheritance practices. Muslim families continue the tradition of dividing farm land among sons and daughters; usually in the proportion of 2 pieces per male to 1 piece per female. The more off-spring there are the more fragments that develop. In some cases, off-spring pool their resources as farms become unproductive in terms of feeding all family members, male members decide who will farm and the others will leave to seek employment elsewhere. The remittances from off-farm employment are sometimes pooled in the family income. Evidence of this is discussed in Chapter VI.

7/ Rizvi, S.M.A., et.al. Consolidation of Holdings: A Study of the Process of Consolidation of Agricultural Holdings in Selected Villages in Peshawar District, Pakistan Academy for Rural Development, Peshawar, West Pakistan, January 1965.

The heads of household interviewed in the survey were about 47 years of age. Forty-five percent said they were literate. However, they appeared to read with considerable difficulty. More and more the younger males are sent to rudimentary primary schools, mostly in anticipation of leaving the farm by the time they reach 20 years of age (discussed in Chapter VI).

The extended families which live in one household, average between ten and eleven people; about 2 to 3 per cropped acre. Most families have a relation employed outside the village area, often working in Karachi city, a thousand miles away, but keeping their wives and children on the farm.

The typical family's total income is about $235 a year.[8/] About $150 is the value of the farm-produced crops: wheat, maize, a little rice, with their straw and hay cut from the surrounding hills. Another $25 is earned by the farmer at other jobs in the village. The rest of the income, $60, comes from relations employed away from the village who send either money orders or cash to the family on the farm. Little of the grain produced reaches the market. If a farmer sells any, it is only when debts fall due or when cash is needed to cover costs of medicine or wedding ceremonies. The poorest families consume practically nothing besides the grain they produce.

Overall, these barani smallholders of Hazara District do not appear to be likely candidates to adopt innovations. They simply cannot afford huge losses in their crop production. Yet without agricultural advances

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[8/] Estimated on the basis of the international exchange rate of ten rupees per U.S. dollar.

and with a continuing growth in population, Hazarans will have no alternative but to add to the mainstream of people joining urban concentrations, a prospect the country can ill afford.

CHAPTER V

DIFFUSION AND ADOPTION OF DWARF WHEATS IN HAZARA DISTRICT

Introduction

The main purpose of this chapter is to examine and analyze the process of dwarf wheat diffusion and adoption as experienced by a sample of smallholder farmers in Hazara District. Particular concern will be with (1) the extent to which barani smallholders are using the new technology and (2) those factors involved in prompting barani smallholders to substitute a new technology (a new variety of wheat) for one with which they are familiar. Concomitantly, at the root of this investigation lie the following questions: Do barani smallholders represent an economically inert peasantry or do they represent farmers responsive to economic incentives? Will they make rapid economic adjustments in resource allocation with high-yielding varieties of wheat (and maize) which are neutral to scale, labor intensive and suitable to barani farming practices and conditions? Where do farmers obtain their first information on new varieties? What variables correlate significantly with the decision to try a new variety? What factors facilitate the diffusion and adoption process? How can new agricultural practices be put into practice as quickly as possible?

In this study, an innovation is defined as the introduction of a new factor of production or agricultural practice. The innovator -- the farmer who is earlier than others in his community to apply the innovation -- must be willing to take the risks involved in trying an innovation. In many cases the risks are high, especially when much more is involved, such as the accompanying use of fertilizer with a new variety. By obtaining needed information regarding the actual performance of the innovation, the innovator plays a vital social role. With a proper understanding of the human communication that follows early adoption and the complex social and economic interactions of farmers in a barani environment, we move closer to knowing why some people change and how social systems can be made dynamic. Furthermore, by focusing on these particular aspects of change, it may be possible to answer important questions raised in recent discussions on the relative usefulness of the mass media, extension services and other channels of communication as they serve to diffuse new technology.[1/] Information on these points would be important for implementing programs designed to diffuse new varieties to similar economic settings.

After a look at the historical antecedents of dwarf wheats in Hazara, the latter portions of this chapter are divided into three main sections:

Section I includes a general overview of the findings dealing with the magnitude of dwarf wheat diffusion and adoption. It should be noted that during the first round of interviews, questions were asked primarily on the use of dwarf wheats. As farmers were interviewed it became evident that fertilizer was also being used by many in the sample for the first time. In order to incorporate information on this innovation, fertilizer, farmers were asked questions during the second

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[1/] See Part III, "Food Production Increase and Role of Administrative and Extension Services" in Sharif, C.M. (ed.), Food Production Increase in West Pakistan: Problems and Effects, Pakistan Academy for Rural Development, Peshawar, June, 1970, pp. 179-239.

round of interviews on when they first started using both chemical fertilizer and dwarf wheats. The answers provide an interesting parallel with those of dwarf wheats. However, due to the relative smallness of the sample included in the second round of interviews, the information gathered on fertilizer use will be incorporated as supplementary material to that on dwarf wheat adoption.

Section II will cover the reasons behind dwarf wheat adoption, such as, the unique characteristics of dwarf wheats which were singled out by the farmers interviewed and the average yields with desi and dwarf wheats. In addition, some attention is given to the risk and uncertainty associated with the new varieties of wheat and the new factor proportions employed.

Section III presents the channels of communication most instrumental in informing barani smallholders about dwarf wheats for the first time. For the major part of this section, zero order correlation and multiple correlation analyses are utilized to analyze the empirical relationships between several "economic" and "communication" variables related to the adoption of dwarf wheats.[2/]

Historical Antecedents[3/]

Sources of Dwarf Wheats in Hazara

The first dwarf wheats to enter Hazara District were used by the field staff of the Regional Department of Agriculture, the Agricultural Development Corporation, and some individual farmers.

[2/] Those unfamiliar with correlational analysis should refer to Appendix B.

[3/] Historical coverage of dwarf wheats in West Pakistan is found in: Eckert, Jerry B., The Impact of Dwarf Wheats on Resource Productivity in West Pakistan's Punjab, op. cit., Chapter II, pp. 12-36.

(1) The Department of Agriculture and the Agricultural Development Corporation (ADC).

According to the Extra Assistant Director of Agriculture of Hazara District, 1966/67 was the first year that dwarf wheats entered the District under the auspices of the Regional Department of Agriculture. The first inshipment of 400 maunds (enough for at least 400 acres) was distributed to different areas of the District for both commercial sales and to some extent to be sown by the field extension staff on a number of controlled and carefully selected "demonstration plots." Twelve maunds of the first shipment were distributed in Mansehra (where Oghi is situated), twenty maunds in Abbottabad (where Lora is situated) and the rest in Haripur (the area with most of Hazara's irrigated farmland). At that time, each bag of dwarf wheat cost the government Rs. 54 per maund, compared to Rs. 20 per maund for the best desi varieties.

In 1967/68, nine thousand maunds of dwarf wheat were commercially available to the farmers through the Agricultural Development Corporation. The price per maund dropped to Rs. 36 but this price was still far above the price of desi varieties.

By 1968/69, dwarf wheat seed reached a significant number of the farmers' fields. The Agricultural Development Corporation (ADC) sold a smaller amount (5,500 maunds) than the year before and at a lower price of Rs. 22 per maund.

In 1969/70, the year of this survey, enough seed was apparently trading hands from farmer to farmer and relatively little was sold by the ADC.

(2) Individual Farmers

It's extremely difficult to estimate the number of individual farmers who brought dwarf wheat seed into Hazara District. However, one person was encountered in Oghi who brought dwarf seed to his farm in 1966/67.

Mr. Khan read about Indus 66 in the English newspaper and learned of its tremendous yields over desi varieties grown under similar conditions. In 1966/67 he was able to purchase enough seed (through his personal contacts) for 6 acres of strictly rainfed land. Khan harvested 32 maunds per acre, a record never before witnessed in Oghi area.

The same year that he purchased his Indus 66 happened to be Mr. Khan's first year as a full-time farmer. Before then he was a lawyer in Lahore. What prompted his turn to farming was his dissatisfaction with the legal profession and the restoration of some 200 acres of his land that was originally held in abeyance by the Land Reform Movement of West Pakistan.

This serendipitous group of events revolving around Khan's decision to farm produced one of the major demonstration effects in Oghi thana. The following year, according to Mr. Khan, several farmers approached him for some of his seed which he willingly exchanged for an equal amount of desi wheat, since he preferred the taste of the latter.

Mr. Khan's first experience with dwarf wheats should not be passed over lightly. Under similar circumstances, Huke and Duncan[4/] conclude from a recent field study in the Philippines that:

[4/] Huke, R.E. and J. Duncan, "Spatial Aspects of HYV Diffusion," mimeo, International Rice Research Institute, The Philippines, Summer, 1970.

> The pattern of spread of high-yielding varieties in Gapan owes much to the fact that three major landowners had sufficient political or economic power to secure IR8 seeds (rice seed from IRRI) in July 1966. These three landlords caused the seed to be planted by selected tenants in barrios (villages) close to poblacion (major cities) . From this modest beginning, the use of high-yielding varieties spread unevenly but with great speed to all corners of the municipality.

Clarification of Intent

The "Mr. Khans" located in the agricultural sector of West Pakistan tend to be more advanced and wealthier than the majority who farm the land. With all other things equal, such individuals, in turn, would serve as important conduits of output-increasing innovations in more progressive areas. But in Hazara and other parts of West Pakistan, all other things are not equal. Land is unevenly distributed with major proportions of the acreage held in a few hands and with large numbers of smallholders holding proportionately smaller fractions of the cultivable acreage (see Table 5.1). Wealth, as well, is also unevenly distributed between large and small farmers. Considering these differences in equality and due to the "chance" circumstances of Mr. Khan's success, his exceptional education and relatively large farm (even in today's context), he is not included in the analysis that follows. Strict analysis of the aspects of change exclusively among smallholders serves to select variables which identify their characteristics the best. From this focus, we seek to recommend strategies of change which can be implemented with some assurance of access to smallholder barani farmers.

TABLE 5.1 DISTRIBUTION OF FARM SIZE IN WEST PAKISTAN

Area (acres)		No. Farms (000)	Percent
	<1	742	15
1	<2 1/2	856	18
2 1/2	<5	806	16
5	<7 1/2	581	12
7 1/2	<12 1/2	759	16
12 1/2	<25	729	15
25	<50	286	6
50	<150	88	2
150	>	14	<.5

Source: 1960 Pakistan Census of Agriculture

Section I. Survey Results: General Overview

Magnitude of Diffusion and Adoption

In the sampled areas of Hazara it was found that change is taking place at a very rapid rate with the diffusion and adoption of new dwarf wheats. The pattern of change is recorded in two ways: (1) the number of dwarf wheat users over a period of time and (2) the area sown with dwarf wheats over a period of time.

(1) Dwarf Wheat and Fertilizer Users Over Time

Research on the diffusion of innovations among agricultural producers indicates that typically the innovation is accepted slowly at first.[5/] Gradually, the rate of acceptance begins to speed up until

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[5/] Rogers, Everett M., Diffusion of Innovations, New York, Free Press of Glencoe, 1962.

a large proportion of farmers have accepted the innovation. After widespread acceptance, the number of potential adopters is much less and the rate of adoption begins to decline. Plotting this pattern of acceptance against time gives an "S" shaped curve of the normal distribution.

Table 5.2 shows the number of respondents who were using dwarf wheats and chemical fertilizer for the first time. A different pattern of use if discernible between the two innovations. In line with the observations made in many research studies dealing with the diffusion of innovations, Table 5.2 shows that initially, in 1966/67, less than one percent of the sampled barani smallholders were using dwarf wheats. During the same year, a slightly larger fraction of farmers used chemical fertilizer. In subsequent years, looking at the data from 1967/68 to 1969/70, more and more farmers used both dwarf wheats and chemical fertilizers. However, dwarf wheat use noticeably surpassed the use of chemical fertilizer. During 1969/70, the rate of change in both cases began to slacken as the majority of barani smallholders had already tried dwarf wheats and fertilizer for the first time.

TABLE 5.2 DWARF WHEAT AND CHEMICAL FERTILIZER USED FOR THE FIRST TIME PER RESPONDENT BY YEAR: HAZARA DISTRICT, 1970.

	DWARF WHEAT [b/] (n = 226)			CHEMICAL FERTILIZER [c/] (n = 95)		
Growing Period for Wheat	No. of New Users Each Year	Cumulative Number	Cumulative % of "n"	No. of New Users Each Year	Cumulative Number	Cumulative % of "n"
1966/67	2	2	0.88	3	3	3.16
1967/68	28	30	13.26	5	8	8.42
1968/69	45	75	33.17	20	28	29.47
1969/70	75	150	66.35	30	58	61.05
1970/71 [a/]	50	200	88.47	11	69	72.63

[a/] Respondents' anticipated use.

[b/] Data collected from first and second surveys.

[c/] Data collected from second survey.

Why do patterns of acceptance of an innovation generally show an "S" shaped surve of the normal distribution? It is often thought that if acceptance were essentially in response to economic profitability of the innovation, then the diffusion curve would be expected to take the shape of a vertical straight line. The main reason for expecting an "S" shaped curve is attributed to the network of interpersonal communication which influences the potential adopters. Havens and Rogers state:[6/]

[6/] Havens, Eugene A. and Everett M. Rogers, "Adoption of Hybrid Corn: Profitability and Interaction Effect," Rural Sociology, Vol. 26, No. 4, December, 1961, pp. 410-11 (underline added).

> It is our contention that once an innovation has fulfilled minimum considerations of profitability, it is largely the amount of interaction between individuals who have or have not adopted the innovation that determines the rate of adoption for individual farmers.....The interaction effect is the process through which individuals in a social system who have adopted an innovation influence those who have not yet adopted.

However, it is clearly evident that there were also shortages in the availability of new seed during the first two years of diffusion in Hazara. Hence, it is difficult to separate the "interaction effect" between individuals from the "economic response" of farmers to adopt higher-yielding varieties. This issue deserves special consideration and in Section III an attempt is made to separate the two by way of multiple correlation analysis.

By focusing on the use of dwarf wheats for the moment, it is quite plausible to believe that as more and more farmers adopt an improved variety of seed, they become active agents in demonstrating the outcome of their decision. Festinger's dissonance theory lends support to the possible interaction effect.[7/] It generally states that once people have made a decision to either accept or reject an innovation they go out of their way (1) to make sure they have made the right decision, (2) to learn more about the innovation and perhaps unconsciously, to selectively expose themselves to further messages which were consistent with their decision. Simultaneously, they may (3) try to block out negative responses to their decision and (4) try to get more people to follow their decision. In line with the last statement is

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7/ Leon Festinger, "Behavioral Support for Opinion Change," Public Opinion Quarterly, 1964, 28: 404-18.

the finding that some farmers were persuaded to adopt dwarf varieties even though they never saw the wheat in the field before trying it for the first time.

The pattern of fertilizer acceptance looks similar to that for dwarf wheats. In actuality, it is more difficult to interpret. Table 5.3 shows the use of chemical fertilizer on dwarf and desi wheats. According to the respondents, nearly 19 percent were using chemical fertilizer before they experimented with dwarf wheats. They started fertilizer before dwarf wheats were generally available. Another 39 percent tried fertilizer and dwarf wheats together for the first time for each. Another 9 percent were using dwarf wheats but had never used chemical fertilizer. On the other hand, about 9 percent of the sample were using only desi wheat and fertilizer. A larger proportion (nearly 14 percent) who were using the traditional variety exclusively have never used fertilizer.

These findings are consistent with a number of possible explanations: (i) dwarf wheats may do well without fertilizer, (ii) farmers cannot afford fertilizer but want to experiment with new varieties, (iii) farmers experiment with chemical fertilizer on desi varieties before switching to dwarfs, and (iv) farmers believe that fertilizer must accompany dwarf varieties. Though some of the propositions look contradictory, there is little supporting evidence to test them out. On balance, though, it looks as if different farmers have reacted differently to the use of dwarf wheats and fertilizer and that adjustment to these innovations is still taking place. Another indication is that farmers have not yet decided, one way or the other, what to do about fertilizer.

TABLE 5.3 COMPARISON BETWEEN THE USE OF DWARF AND DESI WHEAT WITH FERTILIZER USAGE, 1969/70* (n = 95).

	Percentage of Farmers Who Used Chemical Fertilizer for the First Time:			Percentage of Farmers Who Have Not Used Chemical Fertilizer
Percentage of Respondents:	Before Using Dwarf Wheat	Same Time as Dwarf Wheat	After Using Dwarf Wheat	
Using Dwarf Wheat	18.95	38.95	9.47	9.47
Using Only Desi Wheat	9.47	Not Applicable	Not Applicable	13.68

*Figures are in terms of percentage of "n".

(2) Dwarf Wheat Acreage Over Time

Table 5.4 gives the average area sown with dwarf wheat and the percentage of total wheat area per farm in the Lora and Oghi areas. In 1966/67, less than one acre was sown with dwarf wheat by two farmers in the sample. From a modest beginning, barani smallholders began to sow more and more of their area with dwarfs. In following years other farmers went through a period of experimentation and acquaintance with the variety. Few, if any, sowed 100 percent of their wheat area to the new variety during the first two years. Between 1968/69 and 1969/70 growing periods, more farmers with smaller holdings began to use dwarf wheats. But due to the increasing proportion of smaller farms among the users, dwarf wheat area as a percentage of total wheat area did not increase substantially. For 1970/71, the respondents anticipate sowing

72 percent of their wheat area to dwarfs. Corresponding to the above, the average area sown with dwarfs has increased on each farm.

TABLE 5.4 DWARF WHEAT AREA SOWN AND PERCENTAGE OF TOTAL WHEAT AREA BY YEAR IN HAZARA DISTRICT: 1966/67 - 1970/71

Growing Period	Cumulative No. of New Users Each Year	Average Number of Dwarf Wheat Acres per Farm	Average Intensity of Adoption c/
1966/67 a/	2	0.375	30.00
1967/68	30	0.775	34.02
1968/69	75	1.375	65.04
1969/70	150	1.412	65.90
1970/71 b/	200	1.725	72.10

a/ Unreliable figures for comparative purposes due to small number of respondents.

b/ Anticipated area.

c/ Ratio of dwarf wheat area to total wheat area.

Out of the total number of dwarf wheat users, only one farmer tried dwarf wheats (in 1968/69) and did not use them the following year (1969/70). The stated reason for this rejection was the "bad taste and quality" of the unleavened bread (chapatti) made from the new wheat; he had a variety with a red-grain which is considered inferior to white-grain. However, the same farmer said he saw some white-grain types (Mexipak-65) in the village and would attempt to acquire enough seed to sow his entire wheat acreage with it. In the group of respondents, two farmers said they had never heard of Mexipak until the time of the interview. Their numbers represent less than two percent of the sample. They do, however, point out the need to know more about the way other farmers became aware of the dwarf varieties of wheat (discussed in Section III).

Overall, findings on the micro-level are significant enough to show widespread use of dwarf wheats in the unirrigated portions of Hazara District. This leads one to suspect the validity of the official estimates regarding the actual spread and adoption of dwarf wheat to barani areas, at least in those areas where rainfall appears to be adequate. In addition, it is believed that the impact of the dwarf wheats would have been much greater had the rainfed areas been treated equally in the initial food-grain self-sufficiency program which was primarily directed to attaining dwarf wheat adoption on irrigated farms.

Section II. Why Dwarf Wheats Were Adopted And The Risks Involved

The dominant failure in programs aimed at diffusing technologically improved varieties has been the lack of understanding about (1) the important characteristics of the innovation and (2) "the relationship between the expected variability in yields using current varieties and practices; the expected variability of yields using new varieties and practices; and the relationship of these to the absolute levels of living of the farmer."[8/]

The first point should be of more concern to those who develop new varieties for diffusion and the second point is generally of concern to the farmer confronting a possible innovation.

Characteristics of Dwarf Wheats as Perceived by Farmers

Aside from the relatively higher yield achieved with dwarf varieties (discussed below), farmers frequently named a few other important characteristics which influenced their adoption behavior. Namely, it was found that:

(1) Dwarf wheats fit the cropping pattern of the farmer and grow in a faster time than desi wheats. Respondents mentioned that desi wheats would not do well if sown after November. On the other hand, they said that dwarf wheats still performed well if sown before the end of December. This is crucial since late rains result in late sowing. With dwarf wheats the farmers have a longer decision period to work with. In addition, dwarf wheats generally mature 10 to 20 days faster than desi wheats, thus giving the farmer time to clear the field for maize. Longer-growing desi wheat varieties interfere with multiple cropping and the collection of residual moisture; much land is frequently left fallow as a result of late maturation.

[8/] Wharton, Clifton R., "Risk, Uncertainty and the Subsistence Farmer", War on Hunger: A Report from the Agency for International Development, May 1969, p. 15.

(2) Dwarf wheats are not complex in relation to desi wheat and are subject to experimentation by individual farmers. A number of tasks are still done in the same way for both desi and dwarf wheats: ground preparation, broadcast sowing, weeding, harvesting and winnowing. The only new difference is the addition of fertilizer and, as we have seen above, both growers and non-growers of dwarf wheats are using it. Dwarf wheats are neutral to scale meaning that any size farm can use them. It is evident that barani smallholders initially experimented with handfuls of seed, saw good results with their own experiments and increased the area sown with dwarf wheats the following year. Without this neutrality, it is doubtful that smallholders would have experimented and adopted the variety so willingly.

(3) Some respondents liked the bearded features of dwarf wheats because the beard gave some protection against birds. Other respondents stated that they liked the taste of the white variety (Mexipak-65).

(4) In addition to the above, and perhaps the most important characteristic, is the ability to see the differences between old and new innovations. Dwarf wheats are short-statured, with high tillering, and dark green compared to desi varieties; the physical contrasts between dwarf and desi wheats are very noticeable. During the second round of interviews, farmers were interviewed right next to demonstration plots with new, high-yielding varieties of maize and asked if they had ever heard of or seen any improved varieties of maize in the area. Surprisingly, many said no, even though a field of maize, which gave thirty percent more yield, was sitting in front of the respondents. What this illustrates is that new varieties need something to attract

attention, whether a visible symbol or a visible characteristic such as dwarfness.

One complaint, however, was that dwarf wheat gave less fodder. However, barani smallholders appeared willing to substitute less fodder for a higher grain yield.

Overall, the barani smallholders' perceptions about dwarf wheats indicate the need for a careful consideration of the characteristics built into a new variety. Such a consideration of the characteristics requires that due weight be given to the communicable variables involved. It should be clear that technological improvement alone, vital though it is, can only go so far in attaining widespread adoption of a new variety. In general, the innovation, in order to be usefully applied to barani agriculture, should be suitably modified to satisfy the interests of potential adopters.

Dwarf and Desi Wheat Yields

All farmers in the sample know the size of their cultivated acreage and measure grain that has been sun dried on the threshing floor with a wodi (a wooden or metal measuring bowl). Wodis, which are treated like heirlooms, are fairly uniform in size and are filled until grain spills over the sides. Each farmer knows how much wheat, maize and rice weigh in his wodi in terms of seers.[9/] In addition to counting the number of wodis of each harvested crop, barani smallholders seem capable of

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[9/] One seer equals 2.057 lbs. of 1/40th of a maund. One maund equals 82.286 lbs. One wodi holds approximately 5 1/2 seers of wheat grain.

recalling production for at least three years. Customarily, they frequently discuss production over the hukka (smoking pipe) in casual gatherings. Thus, the yield data appear to be reliable.

Table 5.5 gives comparative yields on a per acre basis between desi and dwarf wheats. It can be seen that for each and every year dwarf wheats out-yielded desi wheats by a consistently wide margin, nearly 100 percent on the three year average from 1967/68 to 1969/70 (the first year, 1966/67, has been deleted because of the small number of growers). 1967/68 is considered one of the best years for wheat in West Pakistan; both temperature and rainfall were within the range conducive to good yields with the dwarf wheats. This seems in line with the exceptional dwarf wheat yields reported in Hazara for that year. In subsequent years, dwarf wheats were grown on more and more acreage which apparently included a mix of factors resulting in reduced yields: (i) poorer land under dwarfs, (ii) poorer farm managers growing the new varieties, (iii) less ideal weather, and (iv) less fertilizer per acre on dwarfs. Yet, dwarf wheats yielded comparatively more than desi in all periods.

Pertinent at this juncture is a comparison of wheat performance on irrigated holdings. A year before this study, J.B. Eckert conducted a study of 115 farmers (from which he obtained 86 useable interview schedules) for making yield and input comparisons between dwarf and desi wheats.[10/] Among Eckert's respondents, dwarf wheats averaged 22.80 maunds per acre and desi wheats 16.20. That is, dwarf wheat

[10/] Eckert, op. cit., p. 72.

TABLE 5.5 COMPARATIVE YIELDS FOR DESI AND DWARF WHEAT ON BARANI LAND, HAZARA DISTRICT*

Year	Dwarf Wheat Number of Growers Questioned	Dwarf Wheat Yield/ Acre (mds)	Desi Wheat Number of Growers Questioned	Desi Wheat Yield/ Acre (mds)	Yield Differ-ential (3)-(5)	Col.(6) as % of Col.(5)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1967/68	26	23.92	17	9.08	14.84	163.4
1968/69	60	17.52	28	10.24	7.28	71.1
1969/70	98	15.12	62	8.48	6.64	78.3
3 Year Ave. 67/68 -69/70	61	18.85	39	9.27	9.58	103.3

* Table 5.5 reflects the structure of the interview schedule and should not be interpreted to mean that the number of desi wheat users is increasing.

averaged 40 percent more than desi wheat on the larger well-irrigated farms. Another study of 502 farmers conducted during the year of this study by Mushtaq Hussain found similar results between desi and dwarf wheats in districts of the Sind and Punjab where dwarf wheats averaged around 23 maunds per acre and desi wheats around 16.5 maunds per acre.[11/]

11/ Hussain, Sayed Mushtaq: "Price Incentives for the Production of High-Yielding Mexican Varieties of Wheat", The Pakistan Development Review, Vol. X., Winter 1970, pp. 448-468.

Notably, yield differentials between dwarf and desi wheats were reportedly greatest in the Sind and Rawalpindi District of the Punjab.

Comparatively speaking from this small body of research results, Hazara's farmers experienced the greatest percentage increase in yields over desi varieties in West Pakistan. But in absolute terms, irrigated land out-performed barani land in both dwarf and desi wheat yield averages; an indication that barani smallholders still have a long way to go to increase their relatively lower levels of output.

Risk and Uncertainty With Dwarfs

Wharton has studied the interaction of risk, uncertainty and subsistence on technological innovation and states that:[12/]

> When the subsistence farmer confronts a possible innovation, he will be concerned with two questions: (1) Will the new method, taking its probable costs into account, produce an expected yield appreciably higher than his old method? (2) Is there a reasonable probability that something will go wrong, and that the new method will result in a net yield below his minimum subsistence level? Even if the answer to (1) is yes, he will not change his method unless he can also answer (2) in the negative.

The closer a smallholder's current output is to his minimum subsistence level, defined as just enough to feed his family over good and bad years combined, the more conservative he is likely to be. But, "if he can be convinced that the new method is not only better but

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12/ Clifton R. Wharton, Jr. "Risk, Uncertainty, and the Subsistence Farmer", Development Digest, Vol. VII, No. 2, Agency for International Development, U.S. Department of State, Washington, D.C., April 1969, p. 7. Excerpted from "Risk, Uncertainty and the Subsistence Farmer: Technological Innovation and Resistence to Change in the Context of Survival," a paper presented at the Joint Session of the American Economic Association and the Association for Comparative Economics, Chicago, 28 December, 1968.

reliably so, and that is probable negative variability (in terms of worst possible yield) will still leave him better off than he was before, then he is most likely to make the change."[13/]

It is clearly evident to the respondents that dwarf yields are greater than desi yields. Respondents also claimed that there is less risk and more certainty in sowing dwarfs, they at least "got their seed back." On the other hand, farmers said that many times they had to feed their desi wheat as fodder to the animals, they "got no seed back."

How close the farmers were to describing the relative amount of risk involved is illustrated by the contrasts in Table 5.6. It should be pointed out that the data comes from 71 farmers who grew only dwarf wheats and 35 farmers who grew exclusively desi wheat. Those who grew dwarf wheat obviously experienced the greatest variability in yield as indicated by a range in output from 6.5 to 26.6 maunds per acre. Desi growers, on the other hand, who have grown their traditional wheat for several years, experienced a range in output from 4 to 13 maunds per acre. A farmer who shifted entirely to dwarf wheats would, by all indications, run some risk of getting lower than average yields usually obtained for desi varieties. Looking at the positive side of the spectrum, given all the favorable input combinations, a high of 26 maunds per acre could be expected with the new varieties. This helps to explain part of the reason behind dwarf wheat adoption.

[13/] Wharton, Ibid., p. 7.

TABLE 5.6 YIELDS OF DWARF AND DESI WHEAT VARIETIES IN HAZARA DISTRICT, 1969/70

Type of Wheat	Negative Standard Deviation	Average Yield (mds/acre)	Positive Standard Deviation	Sample Size (n)
Dwarf	6.50	16.56	26.62	71
Desi	4.07	8.54	13.01	35

Some risk is evident with dwarf wheats and one should look more closely to the intensity of dwarf wheat adoption; the ratio of dwarf wheat area to total wheat area per farm. An analysis of the intensity of adoption is essentially a study of farmer's decision-making under risk and uncertainty, for the ratio indicates how cautiously farmers move from experimentation to full use of the new variety.

The comparisons shown in Table 5.7 are drawn up from the data collected during the first round of interviews. Farmers who began using dwarf wheats between 1966/68 got the highest yields among the respondents in 1969/70. Their mean value of adoption intensity was 89.7 percent. Those who began using dwarf wheats in 1968/69, had lower yields, similar standard deviation and similar intensity of adoption with dwarf wheats in 1969/70.

TABLE 5.7 AVERAGE YIELDS AND INTENSITY OF ADOPTION, HAZARA DISTRICT

Year of Adoption	Number of Growers (n)	Average Yield, 1969/70 (mds/acre)		Average [c] Intensity of Adoption, 1969/70 (%)
		Mean	S.D.	
1966/68[a]	30	18.48	10.24	89.7
1968/69	45	16.43	10.60	89.3
1969/70	75	14.17	7.13	79.0
1970/71[b]	50	--	--	31.7

[a] 1966/67 and 1967/68 are combined to increase "n". [b] Anticipated

[c] Ratio of dwarf wheat area to total wheat area.

Finally, those who grew dwarf wheats during the year of the survey, began by sowing nearly 80 percent of their wheat acreage with the new varieties. Their yield (and standard deviation) dipped lower than those of earlier adopters. Farmers who anticipate growing dwarf wheats for the first time in 1970/71 indicate a desire to sow 32 percent of their wheat fields with dwarfs.

A New Production Function

Variability in yields reveal only a portion of the risks involved with the new varieties. Farmers' decisions have both a risk and uncertainty dimension which relates to year by year variability (i) in costs of production, determined by the factor proportions required for production, and (ii) in price of the product. The former is more important than the latter among subsistence farmers who market little or nothing of their total product. Table 5.8 clearly shows that factor proportions have changed to a considerable extent with the use of dwarf wheats. In essence, the farmers have shifted from one production function to another, and in the process of change the dimensions of risk and uncertainty also change.

TABLE 5.8 REPORTED INPUT LEVELS FOR DWARF AND DESI WHEATS IN HAZARA DISTRICT, 1969/70

Input	(A) Dwarf Wheat (n=71)		(B) Native Wheat (n=35)		$H_0: X_A = X_B$* Rejected with Less than:
	Mean	S.D.	Mean	S.D.	
Man-Hours/Acre	106.8	123.2	68.4	38.3	.01
Seed Rate (Seers/Acre)	36.5	8.4	32.2	9.1	.01
Pounds of Nitrogen/Acre	40.7	44.2	6.0	19.1	.001
Pounds of Phosphate/Acre	28.7	46.3	8.3	23.1	.01
Yield (mds/Acre)	16.6	10.1	8.5	4.5	.001

* A test for the difference in mean values was made with the Student t. The figures shown indicate the probability of making a Type I error.

The costs and returns deserve much more attention than given in this chapter. A section is devoted to examining expected changes in net profits associated with cost variability in Chapter VII.

Three important points should be drawn from the above: (1) The variability in dwarf wheat yield is relatively large vis-a-vis the variability in desi yields. More attention should be given to finding ways to help barani smallholders move towards the optimum allocation of resources used to produce dwarf wheats in order to reduce the yield variability. (2) Stemming from the first observation is the fact that barani smallholders are still not committing their full wheat acreage to the new wheat because they are apparently experimenting under their own farm conditions. (3) If the supply imperfections and distribution defects are uniform for all smallholders in Hazara, why do some farmers tend to be relatively quicker than others in introducing an innovation? This last point is a basic question underlying Section III.

Section III. Communication and Economic Variables Associated With Dwarf Wheat Diffusion and Adoption

In this section of the chapter an examination is made of the communication and economic variables (which will be defined below) associated with dwarf wheat diffusion and adoption among barani smallholders. The section is divided into two parts. First, an overall perspective is presented with regard to the way farmers were first made aware of dwarf wheats, namely, the channels of communication. Second, zero-order and multiple correlational analysis is used to deal with a number of questions so far left unanswered: What factors are most important at the farm level in creating awareness and adoption? What farmers are the first to become aware of and adopt innovations in a smallholder setting? What relative importance can be attached to economic and communication variables in motivating smallholders to adopt innovations? Finally, knowing that a dynamic agricultural sector is identified by its rate of change, what variables can "best" promote change? For the government of West Pakistan, which has direct control over some communication and economic variables, answers to these questions are of paramount importance. In addition, there is practical usefulness for agricultural extension agents if they can identify potential innovators among smallholders, and then use different strategies of change with different categories of smallholders.

Channels of Communication

During the first round of interviews, respondents were asked to name the first source of information telling them of the new dwarf wheats. Generally, there are two main channels of communication, interpersonal and mass media channels.[14/] Frequently mentioned, however, was the demonstration plot. Because of its importance as a media for information and because it has been used in Pakistan for years by the Department of Agriculture, a separate sub-heading has been made for the demonstration plot. In particular, it has been grouped with the category for interpersonal channels since demonstration plots serve primarily as topics

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[14/] Both channels function in different ways and their effectiveness also differs according to the way they are used. Their more distinguishing characteristics are discussed in: Rogers with Svenning (1969) p. 125.

for discussion between farmers.

In the following, a brief overview will be presented on the channels of communication which first informed respondents of dwarf wheats. The findings are shown in Table 5.9. More detail is explained below.

TABLE 5.9 CHANNELS OF COMMUNICATION WHICH FIRST INFORMED RESPONDENTS OF DWARF WHEATS, HAZARA, 1969/70.

Channels	Number of Respondents	Percent of Total Respondents
Mass Media	33	23.78
Magazine (in Urdu)	1	0.70
Radio	32	23.08
Interpersonal	108	74.82
Localite	54	35.66
Cosmopolite	33	22.38
Demonstration Plot	21	16.78
Not Aware of Dwarfs*	2	1.40
TOTAL	143	100.00

* Not aware at the time of interview.

(1) Mass Media Channels

Mass media channels refer to the radio, television, film, newspaper, magazines -- anything with a capacity to reach large audiences quickly over great distances. Agricultural programs are broadcast daily over the radio in West Pakistan. Many are coordinated with the Bureau of Agricultural Information as a part of an Education Extension component. In addition, the Bureau publishes a monthly calendar of the radio programs for their respective areas. Radio programs are presently beamed from Lahore, Rawalpindi and Peshawar. The first two stations broadcast in Urdu/Punjabi and the third in Pushto.

It was found that the radio was the most effective mass media channel to inform the smallholders of dwarf wheat performance and availability. As shown above in Table 5.9, 23 percent of the respondents interviewed during the first round became aware of dwarf wheats over the radio. But 56 respondents out of the 143 (39 percent) owned radios. Ten people (7 percent) who did not own radios stated that they were first made aware of the dwarf wheats over this media. This tends to indicate that even families without radios were as apt to listen to the radio as much as owners in Hazara's rural areas.[15/]

Altogether, only one farmer learned of Mexipak from written media, a magazine written in Urdu. No other type of mass media channel was mentioned by the respondents as a first source of information on the new wheat varieties.

(2) Interpersonal Channels

There are essentially three types of interpersonal channels which informed the barani smallholder of dwarf wheat yields:

(i) interpersonal localite or those originating within the social system of the receiver, i.e. the neighbors, village shopkeepers, etc.

(ii) demonstration plots or localite visual field displays of agricultural innovations that lead to some discussion among farmers. Both Lora and Oghi areas had the same number of demonstration plots installed on farmers' fields by the Field Assistants; six plots in each area in 1967/68 and

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15/ It was often said that the war with India in 1965 created a tremendous surge in the demand for radios. Furthermore, Hazara is relatively near to the trade routes for contraband radios which come in from Afghanistan and it should not be too surprising that the smallholders possess radios.

five plots in the following two years. For 1970/71, the number has been reduced to one each. Their locations have all been near the market centers of Lora and Oghi.

(iii) interpersonal cosmopolite or those channels which have their origins outside the immediate social system, i.e. agricultural extension personnel and distributors of farm supplies. It should be noted that both Lora and Oghi cities have offices of the Department of Agriculture, each headed by an Agricultural Assistant (usually a man in his 30's, with a bachelor's degree in agriculture from Peshawar University). Each Agricultural Assistant, in turn, supervises 3 or 4 Field Assistants (usually men in their late 20's who matriculated in second or third division and who completed a one-year certificate course in the Agricultural Training Institute in Peshawar). "A Field Assistant is expected to be the Government's principal contact with farmers in the area of one or two Unions, which means 10-20 villages, or 10,000-25,000 people."16/

The interpersonal localite channels had the largest impact on the farmers. Approximately 35 percent of those who know about dwarf wheats (Mexipak) first heard of them from interpersonal localite channels (shown in Table 5.9). Another 17 percent of the respondents said they first saw dwarf wheats in demonstration plots and later asked the farmers growing the variety about the crop. Overall the findings show that interpersonal exchanges between barani smallholders carry the most messages and that the dwarf wheat demonstration plots (which showed striking differences next to desi plots) were effective transmitters of the dwarf yield message.

Approximately 22 percent of the respondents heard the message initially from interpersonal cosmopolite sources such as the Government extension people, the ADC agents, and other fertilizer dealers. It

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16/ Davy, Dorcey, F., "Improving the Training of Field Assistants in the Agricultural Training Institutes of West Pakistan," mimeo, The Ford Foundation, March, 1967, p. 4.

should be noted that Field Assistants (lowest level extension agents of the AGriculture Department) were very instrumental in diffusing dwarf wheat varieties. Aside from personally informing farmers of dwarf wheat potential, they were responsible for the installation of many of the demonstration plots on farmers' fields which, in turn, were catalysts in dwarf wheat diffusion.[17]

Correlation Analysis

Dependent Variables

The dependent variables in this section of analysis are "awareness" and "innovativeness." Awareness is defined as the degree to which a barani smallholder first hears of or sees dwarf wheats. The following operational numbers are used to measure the degree of awareness among smallholders, i.e., those with a number of 6 were the first to become aware of dwarf wheats among the sample of respondents.

Operational Numbers	Explanation	Sample Size
6	First heard of or saw dwarf wheats in either 1965/66 or 1966/67	27
5	First heard of or saw dwarf wheats in 1967/68	71
4	First heard of or saw dwarf wheats in 1968/69	41
3	First heard of or saw dwarf wheats in 1969/70	2
2	First heard of dwarf wheats at time of interview, 1970	2

[17] Since 1966, a group of 155 farms located in Lagana Province of the Philippines have been surveyed annually to observe the changes taking place with the introduction of new, high-yielding rice varieties. One observation was that "Over 50 percent of the farmers surveyed reported that the extension worker was the major source of their information regarding new varieties. The second most important was the neighboring farmers." The International Rice Research Institute, Annual Report, Los Banos, The Philippines, 1968, p. 311.

Innovativeness is defined as the degree to which a barani smallholder is relatively earlier than others in his social system to adopt dwarf wheats. The following operational numbers are used to measure the degree of innovativeness. Notably, the larger the number the higher the degree of farmer innovativeness.

Operational Numbers	Explanation	Sample Size
6	Began using dwarf wheats in 1966/67	2
5	Began using dwarf wheats in 1967/68	28
4	Began using dwarf wheats in 1968/69	45
3	Began using dwarf wheats in 1969/70	75
2	Anticipates using dwarf wheats in 1970/71	50
1	Has not yet decided to try dwarf wheats	26

For the analysis presented below, operational numbers 3 and 2 of awareness will be combined as will operational numbers 6 and 5, under innovativeness, in order to increase the size of sample for these categories for farmers.

Independent Variables

Awareness and innovativeness are hypothesized to depend on several independent variables. A summary of the independent variables are presented in the following paradigm. Each, in turn, is identified by a code name as shown. Since awareness precedes innovativeness, it too becomes an independent variable of innovativeness in this particular instance.

PARADIGM OF CORE VARIABLES RELATED TO
AWARENESS AND INNOVATIVENESS

Dependent Variables (Yi)	Independent Variables (Xi)	Code Name
	I. Economic Variables	
	a. Total area cultivated per farm (acres)	AREA
	b. Percentage of area owned by respondent (%)	OWNER
	c. Size of family on the farm	FAMILY
	d. Cash earned in the village (rupees/year)	CASH
	e. Total cash income (CASH + MREMIT)	INCOME
	f. Income per capita (INCOME ÷ FAMILY)	Y/CAP
1. AWARENESS	g. Dwarf wheat yield per acre	YIELD
2. INNOVATIVENESS	II. Communication Variables	
	a. Awareness	AWARE
	b. Mass Media Contact	MMC
	c. Interpersonal Localite Contact	ILC
	d. Interpersonal Cosmopolite Contact	ICC
	e. Demonstration Plot	DEMO
	III. Intervening Variables	
	a. Migrant remittances	MREMIT
	b. Absence of male family member	MIGRANT

A few things should be noted with regard to the independent variables and Tables 5.10 and 5.11:

(1) Some barani smallholders earn cash in the village by selling milk, butter and eggs. Others have odd jobs like carting packages and bundles. A large percentage of the farmers interviewed receive military pensions. This last source of income in further explained in the next chapter. Altogether, these forms of income constitute CASH.

(2) All of the communication variables, save that of AWARE, are mutually exclusive. For example, a farmer either became aware of dwarfs by MMC, ILC, ICC, or DEMO, but not any two. For each farmer interviewed, the value of one is given to the first source of information on dwarfs

and a value of zero for the rest. The number of observations on these variables are 143. Hence, under the awareness component the mean values for each category of farmers sums to 100. Under the innovativeness component the sum is less than 100 since the observations of 143 farmers are spread over 226 respondents.

(3) The variable, MIGRANT, also enters as a zero-one variable. The value of one is given to each family that has at least one family member working away from the farm, and zero for all other families. Concomitantly, the last set of families receive no migrant remittances. Chapter VI clarifies the definitions for "migrant" and "migrant remittances." Both variables are "intervening" because migrants serve as sources of information and income simultaneously.

(4) It should be explained that YIELD represents the actual yield per acre with dwarfs in 1969/70. Conceptually, this variable is inserted as a proxy for the joint effect of two variables which are ordinarily difficult to measure: (i) It is a proxy for "management" in that the best farm managers are usually distinguished from the worst managers by their higher levels of farm output per unit of input. Such farmers may be expected to be more efficient and innovative than others and we would expect to find a high correlation coefficient between a measure of innovativeness and management. (ii) It is a proxy for land quality. It is felt that the best farm managers also have the best land in terms of location, amount of farm yard manure applied and nutrient content of the soil (or soil fertility).

(5) Tables 5.10 and 5.11 are drawn up expressly for the purpose of showing (i) the zero-order correlation coefficients between "awareness" (or "innovativeness") and each of the identified independent variables and (ii) whether or not the correlation is linear or not. For example, on Table 5.10, the correlation coefficient between FAMILY and "awareness" is 22.82 percent and the relationship is statistically significant at the 0.02 level. If we concentrate on FAMILY for the time being, Table 5.10 also shows that during 1965/67, twenty-seven farmers out of 143 became aware of dwarf wheats for the first time. The same farmers had an average of 15.1 family members living in their households. In 1967/68, seventy-one farmers became aware of dwarfs and the size of their extended families averaged 12.4 persons per household. Forty-one farmers learned of dwarf wheats in 1968/69 and their families averaged 10.2 persons. Four farmers out of 143 first heard of dwarfs in 1969/70 and their families numbered 8.3 persons on the average. Scanning the data once more, it can be seen that family size decreases from 15.1 to 12.4 to 10.2 to 8.3 over the years from 1965/67 to 1969/70. Clearly, the relationship is linear and highly significant.

Correlates of Awareness

The dependent variable "awareness" was correlated across 143 respondents with most of the variables shown in the paradigm. Table 5.10 presents the results. Of the economic variables, farmers who owned most of th

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TABLE 5.1

Independe
Variables

ECONOMIC
AREA (a
OWNER (
FAMILY
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MMC (%
ILC (%
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DEMO (

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most of their land and those with large families were relatively sooner than others in becoming aware of dwarf wheats. The mean values indicate linear relationships for these two variables and each is significantly correlated with "awareness."

TABLE 5.10 CORRELATES AND MEAN VALUES OF INDEPENDENT VARIABLES (BY TIME PERIOD) ASSOCIATED WITH AWARENESS (N = 143)

Independent Variables	MEAN VALUES OF VARIABLES AND TIME OF AWARENESS 1965/67 (n=27)	1967/68 (n=71)	1968/69 (n=41)	1969/70 (n=4) b/	ZERO-ORDER Correlation Coefficient (Percent)
ECONOMIC					
AREA (acres)	7.0	5.2	4.5	8.1	12.17
OWNER (%)	93.59	91.93	79.68	77.25	19.17***
FAMILY (No.)	15.1	12.4	10.2	8.3	22.82**
CASH (Rs)	1,149	862	812	165	11.02
INCOME (Rs)	1,913	1,822	1,645	920	7.85
Y/CAP (Rs)	145	159	163	124	-1.53
COMMUNICATION					
MMC (%) a/	30	26	15	0	15.77****
ILC (%) a/	11	37	56	100	-37.21*
ICC (%) a/	44	24	10	0	28.33*
DEMO (%) a/	15	13	19	0	-1.18
INTERVENING					
MIGRANT (%) a/	63	61	61	75	-0.42
MREMIT (Rs.)	764	960	833	765	0.46

a/ Figures shown are percentages of the respective values of n.

b/ Unreliable sub-sample figures due to small number.

* Statistically significant at the .01 level.

** Statistically significant at the .02 level.

*** Statistically significant at the .05 level.

**** Statistically significant at the .10 level.

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None of the other economic variables are significantly correlated with awareness. However, the variable AREA is obviously non-linear and to some extent it appears that farmers with medium size farms score relatively higher in terms of awareness than farmers with large farms. Though the mean values for INCOME and CASH show linear relationships with awareness, they are not significantly correlated since the actual observations record rather large standard deviations from the mean values (not shown in the table). Judging from the zero-order correlation coefficients, it is quite probable that "wealth" (the combination of farm area and income) in a smallholder environment does not have a significant association with awareness.

Two variables under the heading of communication are significantly correlated with awareness at the .01 level, and one variable at the .10 level of significance. Namely, both interpersonal cosmopolite (ICC) and mass media contacts (MMC) were important for creating awareness among smallholders. Those farmers who scored low on awareness became informed of innovations primarily through interpersonal localite contacts (ILC); a very significant association.

The correlation coefficients for migrants (MIGRANT) and migrant remittances (MREMIT) are not significantly different from zero. However, the mean values for migrant remittances show a curvilinear relationship over time. Since the percentages shown for migrants are uniform over time, we should not expect to find any significant correlation. However, it is apparent that many respondents have family members working outside the village community (the subject matter of Chapter VI).

In sum, it can be seen that farmers who become aware of innovations before others are generally those who own most of their land, have large families, frequently listen to the radio and have more contact with change agents and sales representatives of farm inputs (the interpersonal cosmopolite channels of communication).

Correlates of Innovativeness

"Innovativeness" was correlated across 226 respondents with all of the variables shown in the paradigm. It should be remembered that YIELD represents, conceptually, a proxy for land quality and a proxy for "management" in that the best farm managers are distinguished by their higher levels of productivity with dwarfs. As such, we would expect to find a significant correlation with innovativeness. As seen in Table 5.11, this is the case and the relationship between YIELD and "innovativeness" turns out to be the strongest among all the variables considered.

Most of the other variables which are significantly correlated with innovativeness do not need particular explanation except to say that the economic variables predominate in explaining innovativeness. Judged by the correlation coefficients, income per capita, mass media channels, demonstration plots, percentage of migrants and migrant remittances seem to have the least influence on farmers' innovative behavior. Respondents with an average size farm of 5 acres and above, large families, and relatively higher incomes are more innovative than others. Similarly, farmers who score high on awareness and interpersonal cosmopolite contacts are more likely to adopt innovations before others in their community.

Finally, it should be pointed out, that all of the variables which were

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were significantly correlated with innovativeness show linear relationships among the mean values. As such, the zero-order correlation coefficients appear to be fairly reliable indicators of the relationships between the variables identified.

TABLE 5.11 CORRELATES AND MEAN VALUES OF INDEPENDENT VARIABLES (BY TIME PERIOD) ASSOCIATED WITH INNOVATIVENESS (N = 226)

Independent Variables	MEAN VALUES OF VARIABLES AND TIME OF INNOVATIVENESS					ZERO-ORDER Correlation Coefficient (Percent)
	1966/68 (n=30)	1968/69 (n=45)	1969/70 (n=75)	1970/71a/ (n=50)	Noneb/ (n=26)	
ECONOMIC						
AREA(acres)	8.5	5.6	4.2	4.6	3.1	24.48**
OWNER (%)	95.13	86.67	88.00	80.68	69.58	10.63
FAMILY (No.)	17.8	12.1	10.4	9.1	8.3	33.54*
CASH (Rs)	1,691	765	854	533	408	24.85**
INCOME (Rs)	2,965	1,548	1,537	1,206	995	27.03*
Y/CAP (Rs)	171	155	148	148	130	5.22
YIELD (Mds)	18.48	16.43	14.17	NA	NA	56.63*
COMMUNICATION						
AWARE (Score)	4.8	3.7	3.0	2.8	0.5	46.33*
MMC (%)	20	27	9	16	0	8.16
ILC (%)	10	16	37	30	12	-35.57
ICC (%)	40	24	8	6	4	29.07*
DEMO (%)	17	9	12	8	0	4.73
INTERVENING						
MIGRANT (%)	70	40	59	64	58	-3.58
MREMIT (Rs)	1,274	783	683	673	587	12.32

a/ Anticipated use of dwarfs.

b/ Have not yet decided to try dwarfs.

* Statistically significant at the .01 level.

** Statistically significant at the .02 level.

NA = not applicable.

Multiple Correlation Analyais

The zero-order correlation analysis made it possible to detect strong associations between "innovativeness" and several economic and communication variables. Earlier in the chapter we mentioned the possibility of separating the influence of the economic and communication variables in order to see which sets of variables explain innovative behavior the best. For this purpose, multiple correlation analysis has been employed.

To explore this possibility, the variables highly correlated with innovativeness were used as independent variables in two different models.[18/] In the first model, innovativeness is a function of YIELD, AREA, FAMILY, OWNER, INCOME and AWARE. In the second model, innovativeness is a function of YIELD, AREA, OWNER, INCOME, AWARE, MMC, ILC, and ICC. Inadvertently, FAMILY was not included in the second model. The exclusion, however, does not alter the results in any significant way. Purposely, only three communication variables are added to the second model and DEMO is not included in order to avoid a singular matrix problem in the computer calculations. Although inextricable, the constant term holds some of the variation in the dependent variable which can be attributed to the DEMO variable.

Table 5.12 presents the results of the multiple correlation analysis. In the first model, 47 percent of the variation in the

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[18/] Description of the model is in Appendix B. Ordinary Least Squares techniques were used to estimate the functional relationships between variables.

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dependent variable is explained by the variation in the identified independent variables, i.e., R^2 = .47.[19/] Analysis of variance for the model as a whole indicates that the regression is highly significant at the 0.0005 level. The regression coefficients for YIELD and AWARE are statistically significant at the 0.0005 level (shown in column 4). The regression coefficient for FAMILY is also significantly different from zero at the 0.029 level. The reader should note that the same variables contributing to the explanation of "innovativeness" in the multiple correlation are the same as those found significantly related in the zero-order correlation tests. On the other hand, the variables for income, ownership of land and cultivable area appear less significant in explaining innovativeness.

Attention should be focused on columns (5) and (6) of Table 5.12. Column (5) shows that R^2 which would be obtained if Xi were deleted from the least squares equation and the equation were recalculated. In more precise terms, R^2 delete i, "is the proportion of the sum of the squared deviations from the mean of the independent variable which can be accounted for by all of the independent variables [including the constant variable (mean of the dependent variable)] except variable Xi."[20/]

Column (6) shows the difference between each value shown in column (5) and the R^2 for the regression model. Quite clearly, column (6)

19/ The explained variance compares favorably with other studies of a similar nature dealing with innovativeness and multiple correlation analysis. For a concise summary of other studies see: Rogers, Everett M. Modernization Among Peasants: The Impact of Communication, op. cit., pp. 302-303, Table 13.4.

20/ Ruble, William L., Donald Kiel, and Mary E. Fafter, "Calculation of Least Squares (Regression) Problems on the Least Squares Routine," Agricultural Experiment Station, Michigan State University, November, 1969, p. 38.

TABLE 5.

Independ
Code Nam (1)
Constant
ECONOMIC
YIELD
AREA
FAMILY
OWNER
INCOME
COMMUNIC
AWARE

Independ
Code Na (1)
Constan
ECONOMI
YIELD
AREA
OWNER
INCOM
COMMUNI
AWARE
MMC
ILC
ICC

TABLE 5.12 EXPLAINING INNOVATIVENESS--MULTIPLE CORRELATION (N = 143)

Model No. 1

Independent Variables — $R^2 = .472$; $\bar{R}^2 = .448$; Sig. < 0.0005

Code Names (1)	Reg.Coef. (2)	Std-Dev. (3)	Sig.= α (4)	R^2 Deletes (5)	R^2-R^2 Deletes (6)
Constant	0.4713	0.4482	0.295	--	--
ECONOMIC					
YIELD	0.0469	0.0069	<0.0005	0.293	0.179
AREA	0.0118	0.0168	0.486	0.470	0.002
FAMILY	0.0232	0.0105	0.029	0.453	0.019
OWNER	-0.0023	0.0024	0.348	0.468	0.004
INCOME	0.0000	0.0000	0.217	0.466	0.006
COMMUNICATION					
AWARE	0.4309	0.0933	<0.0005	0.389	0.083

Model No. 2

Independent Variables — $R^2 = .465$; $\bar{R}^2 = .433$; Sig. < 0.0005

Code Names (1)	Reg.Coef (2)	Std-Dev (3)	Sig. = α (4)	R^2 Deletes (5)	R^2-R^2 Deletes (6)
Constant	0.8522	0.5202	0.104	--	--
ECONOMIC					
YIELD	0.0459	0.0071	<0.0005	0.297	0.168
AREA	0.0233	0.0160	0.148	0.456	0.009
OWNER	-0.0016	0.0024	0.506	0.463	0.002
INCOME	0.0000	0.0000	0.132	0.456	0.009
COMMUNICATION					
AWARE	0.4063	0.1004	<0.0005	0.399	0.066
MMC	-0.0616	0.2372	0.796	0.465	0.000
ILC	-0.2718	0.2189	0.217	0.459	0.006
ICC	0.0573	0.2448	0.815	0.465	0.000

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shows that if the economic variable YIELD were excluded from Model No. 1, R^2 would be reduced by .179. Furthermore, if AWARE were dropped, R^2 would be reduced by .083. The deletion of any other variable does not alter the value of R^2 substantially. Relative to the other variables, the economic variable YIELD and the communication variable AWARE add more to explaining innovativeness than any other variable in the first model.

Model 2 should be fairly self-explanatory. Of importance, however, is the insignificance of the three variables MMC, ILV, and ICC in explaining innovativeness. Columns (5) and (6) highlight this assertion. As in Model 1, YIELD and AWARE explain most of the variation in the dependent variable, "innovativeness."

In sum, there is evidence that multiple correlation methods using economic and communication variables can be used to explain the variability in innovativeness. An R^2 of over .45 was obtained by each of the two models. The analysis, however, draws some rather simple conclusions: (1) Those farmers who were characterized by a relatively high yield with dwarf wheats in 1969/70, are more likely to be innovators than others in their community. The same farmers, in turn, may be identified as the best farm managers with better quality land, vis-a-vis the other smallholders. (2) The sooner farmers become aware of yield increasing innovations which are neutral to scale, the faster they may adopt the innovation. (3) If we accept the first two points, then it becomes evident that any program designed to diffuse innovations must first concentrate on creating awareness among smallholders. Aside from the important role that the radio can have in diffusing innovations, it behooves the extension staff to select those smallholder farmers, who exemplify

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exemplify the "best" farm management practices, to serve as demonstrators of further innovations. (4) Finally, it does not appear possible to separate with any success the relative importance of economic and communication variables catalyzing the process of diffusion and adoption. Furthermore, it does not appear to be a useful argument to pursue; that one set of variables is more important than another. The two are interdependent and sequentially different from one another.

CHAPTER VI

A PRELIMINARY VIEW OF NON-FARM EMPLOYMENT AND MIGRATION OF HAZARANS

Introduction

The purpose of this chapter is to summarize the findings from the two surveys on the salient aspects of off-farm migration and non-farm employment. The surveys of Hazara's smallholders sought answers to the following questions: (1) What importance do prior familial ties in the rural areas and in the urban areas of destination have on where a person migrates, and what steps does the migrant take to make his decision reversible if things don't work out for him? (2) What are the particular characteristics of the off-farm migrant, family and the village farm that they leave? (3) What are the important country and zonal differences in rural-to-urban migration -- is the migration one way between two points or two ways, a back and forth movement from village to city? Or, is off-farm migration taken as a once-and-for-all movement to the large towns? (4) How well are migrants from various source areas with different characteristics prepared for employment, i.e. what jobs do they take, how do they maintain themselves? (5) Does the rural-urban migration typically lead to a transfer of unemployment from traditional agriculture to traditional services in the cities? (6) Is there a return-flow of cash and goods from urban areas to rural areas -- is this economically significant, how does it affect farming decisions of those family members who remain in agriculture?

Answers to the above questions come from respondents in Lora and Oghi thanas who were asked about the family members who had left the farm to work outside the village community. Information provided was on age and years of schooling, ability to speak Urdu and/or English, place of employment, length of employment, why people left the farm and a few other questions. Overall, the answers come from 226 respondents.

In the following, some basic considerations on the prospects for employment in the Northwest Frontier Province will be presented. Next, some attention will be given to defining the extended family that seems to influence the pattern of migration that occurs. Then, the findings of the survey will be reported as a set of propositions regarding the salient aspects of off-farm migration. This is done with the feeling that more research is needed on this subject and that the findings are preliminary in nature. As such, the propositions serve as reference points for further enquiry and analysis. In the last section of this chapter, the implications of migration will be presented.

Basic Considerations

According to official estimates, the North West Frontier Province (N.W.F.P.) is a net contributor to the labor force in the rest of West Pakistan. Moreover, the magnitude of outmigration from the N.W.F.P. is reported large:

(1) In 1951, the population of Peshawar Division and the adjoining tribal areas was 4.9 million. By 1961, the population had increased to 6.4 million -- an increase of 28.2 percent for the ten year period. During the

same period, 1951-1961, there was also a net out-migration[1/] of 77 thousand people from the same area.

(2) It is estimated that the population in the same area for 1970 is 7.9 million people. Assuming the rate of out-migration to continue from 1961 to 1970 at the same rate as between 1951-1961, the net exodus is estimated at 86 thousand for the period.[2/]

What makes the estimates particularly revealing is that the prospect for absorbing labor into the industrial sector of the N.W.F.P. does not look too promising. With a limited industrial base of 115 registered factories in the N.W.F.P.--compared to 1,890 factories in Karachi and a balance of 4,240 units in the rest of West Pakistan--it has been estimated that the industrial sector of the N.W.F.P. does not even hold 2 percent of the labor force (of about 3 million persons) in the area.[3/] In addition, it does not appear that the large manpower exodus adversely affects the industrial labor supply in the northern Province. On the contrary, one of the Frontier's major resources appears to be labor.

1/ Net out-migration refers to the difference between the number of persons "born outside-counted in Peshawar Division" and "born in Peshawar Division/counted outside" as recorded in the 1951 and 1961 Census of Population. For a summary of the Census data, the reader is referred to: Matin, Abdul, et. al., Resource Base and Economic Progress of the Peshawar Valley, Study conducted by the Department of Economics, University of Peshawar, June 1970.

2/ Khan, M. Ahmad, "Population and Migration Pattern: N.W.F.P. and Adjoining Tribal Areas". Paper prepared for the Project Office, Regional Development Plan, University of Peshawar, North West Frontier Province, January 1971.

3/ Matin, Abdul, Industrialization of the N.W.F.P., Board of Economic Enquiry, July 1970, See Chapters 1 and 2 for a general description of industrialization and labor resources in the N.W.F.P.

The Family

"Family" Defined

"Family" is defined differently among societies and arises primarily out of the many complex sets of alternative marital arrangements that can be made. In Hazara District, where most persons are Muslims of the Sunni Sect, the villagers adhere to the "prescriptive" principle, that is they indicate whom a person shall marry. The most widely practiced arrangement of this kind is known as "cross-cousin marriage" which is illustrated in the following paradigm.[4/] If the prescriptive principle, coupled with the practice of cross-cousin marriages, is followed closely -- and it usually is -- no marriages will take place between tribes. In turn, it is common to find whole villages or areas made up of one tribe, such as the Abbasis or Gujars, etc., with extremely close and hence closed relationships.

The nature of the relationship between a villager interviewed and the villager working outside the village helps to explain what the composition of a family is in a Pakistani society. The greatest proportion, or 56 percent, of those working outside were sons of those interviewed. The next largest group, or 30 percent of those working outside were brothers. The rest were nephews (8 percent), cousins (2 percent), fathers (1.7 percent) and uncles (.4 percent).

[4/] Terminology and definitions for this discussion are taken from Felix M. Keesing, Cultural Anthropology: The Science of Custom, Holt, Reinhart and Winston, New York, May 1963, pp. 255-286.

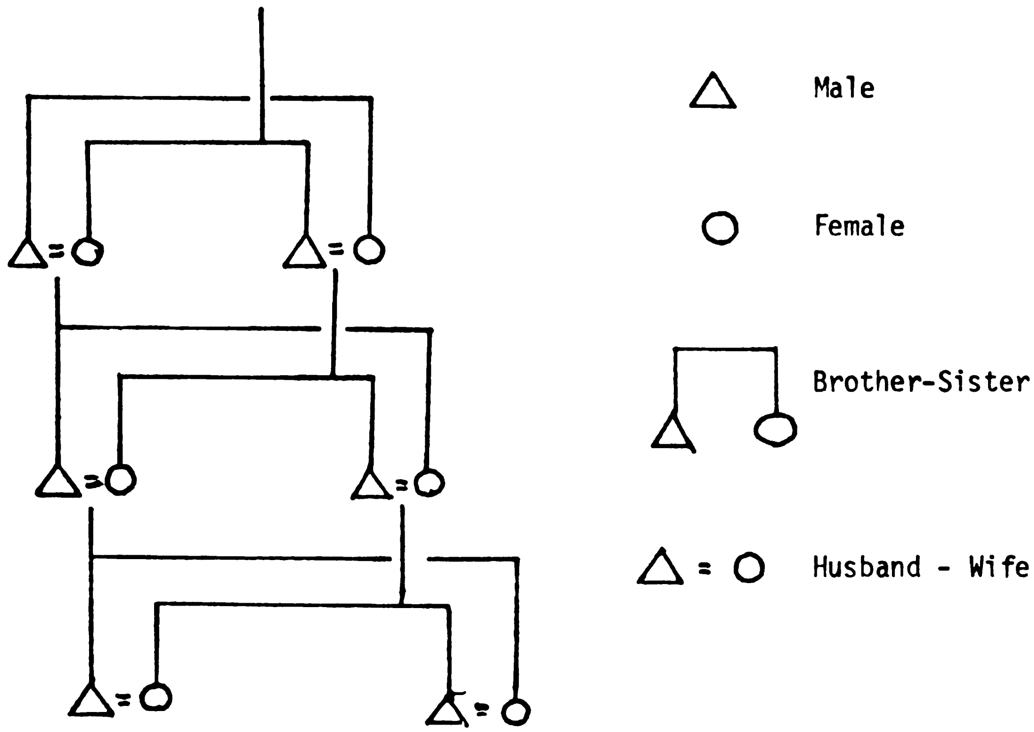

Figure 6.1 ILLUSTRATION OF CROSS-COUSIN MARRIAGE

The type shown is a symmetrical or double one. By following the lines of relationship and the marriage unions it will be seen that a man, in marrying his mother's brother's daughter, is also marrying his father's sister's daughter. Note that lines indicate blood relationships, and equal signs indicate marriages.

Source: F.M. Keesing, ibid, p. 259.

Locality and residence in marriage also defines the family. The most common practice in Hazara District is for the bride to go live with, or in the same locality as, the husband's people, so-called patrilocal ("father-place") residence. But present day land pressure, as found in the sampled areas, may require a home apart from the parents of both, so-called neolocal ("new place") residence, which is rare but can be expected to increase in the not too distant future for the people of Hazara District as the man to land ratio rises.

The Pakistani family is a consanguineal type of family in which ties of "blood", or descent, dominate. The "family" is thus an extended family with ties running across and among cousins, to grandchildren, to anyone associated by a blood tie. This strong bond among members is sometimes loosened to include close adult friends who are called uncle and auntie (in the local language) in front of the children. This treatment of friends tends to reinforce the familiness of the Pakistani culture. It also serves as a way for female members of the family - practicing purdah[5/] - to know non-family members as part of the family without breaking traditional family ties and practice of purdah. However, the number of non-family friends introduced to the whole household is rather limited. Many male friends can spend a lifetime together and never see each other's wives.

"Family" Influence

With such large extended family groupings there are meticulous definitions and rules governing the behavior of individuals. Men and women fit into well-defined divisions of labor where the common household chores are divided among young and old. Sometimes the work allocations appear skewed in favor of the men as the women work during all moments of the day. They are the first to rise and the last to sleep. They do most of the cooking - except during large wedding feasts when professional village cooks

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5/ "Purdah" is the practice of female seclusion. The word purdah literally means veil or curtain.

prepare the meal - make the butter in seemingly secret fashion, wake the men, feed and clothe the children, weed the fields of greens which they feed to the animals, collect the fire wood, get the water, etc. The men manage the house, prepare the fields, harvest, go to the market, handle the cash, and smoke the hukka (water pipe) most of the evening while exchanging words with the neighbours.

Young parents take their place among the number of persons working collectively, and are subject to the direction of elders. A man may not be the head of his household as his father, uncle, or older brother can "command" the roles of his family. In certain respects, there is no personal freedom and initiative, little privacy, and slight authority over their own children if an elder lives with the family. On the other hand, the extended family system shows unity of effort in economic matters and creates an umbrella of security for all to share. At times of crisis, such as sickness, death and indebtedness (easily brought on by marriage and the "bride-fee"), the situation is likely to be met by all members of the family with little fuss and fumbling, for such events are common and there are many hands to help. The extended family also has a continuity of life. As the old people die off, the young take their place. Everyone experiences a change in role with age; they gain authority, responsibility, and prestige which everyone looks forward to and receives in turn.

Most often, family males make the economic decisions in a Pakistani household and determine the destiny of the family. Indirect questioning, without an interview schedule, revealed that family males decide which member (or members) will continue farming and which members will seek off-farm employment. The family elder, of course, has the final word. Those who remain to farm are responsible not only for the operations of the farm but the welfare of the whole family. Old males are almost certain to stay and a younger male (or males) may also stay to do the hard labor.

It is believed that those who leave go to places where other family members or village members are present. These forerunners of outmigration serve as the contacts for the newer arrivals. How the first outmigrants of a family adjust to off-farm work and conditions is a question largely unanswered.

Propositions Derived From Survey Findings

(1) Migrants[6/] are generally young men with some schooling and they are usually from small farms with "medium size" extended families.

Table 6.1 provides a general overview of migrant characteristics. Those who have migrated presently average about 28 years of age. On the average, most have been working away from the farm about 6.7 years. The difference between the two indicates that migrants leave the farm at about 21 years of age. When they leave the village they have approximately 4.9 years of village schooling, some ability to read and write Urdu. It should be noted, however, that there is some variability in the data since some migrants are much older and cannot read or write. But we can generally expect these characteristics to be representative of most of Hazara's migrants.

[6/] The word migrant is used rather loosely in the following discussion. Broadly, it refers to those who have permanent jobs (or seek such jobs) outside the village community and who reside in a house away from the village family.

TABLE 6.1 - MIGRANT CHARACTERISTICS

	Average Age (1970)	Average Number of Years Working Outside the Village	Average Age At Time of Migration	Years of Schooling
Lora	27.29	6.06	21.23	5.13
Oghi	29.46	7.33	22.13	4.66
Both	28.38	6.70	21.68	4.90

Table 6.2 indicates that all migrants are from farms which have less than 20 cultivated acres. Ninety-six percent of the migrants are from farms with less than 15 cultivated acres, 88 percent from those with less than 10, and nearly 57 percent from 5-acre farms. This suggests linear relationship between farm size and out migrants directly, at least at this level of aggregation.

TABLE 6.2 - DISTRIBUTION OF MIGRANTS BY SIZE OF CULTIVATED ACREAGE ON "THE FARM"

Average Cultivated Area (acres)	Number of Migrants from:			Percentage of Both	
	Lora	Oghi	Both	%	Cumm. %
< 5	90	46	136	56.90	56.90
5 < 10	23	52	75	31.38	88.28
10 < 15	7	13	20	8.37	96.65
15 < 20	1	7	8	3.35	100.00
Total	121	118	239	100.00	-

Table 6.3 shows that the size of extended family varies to some extent from less than 5 family members living in the same household to more than 40. The majority (54%) of the migrants is from extended families with 6 to 13 members. In families with 5 or fewer members (which probably means only one adult male) the men and children are apparently needed to manage the farm and cannot be released for outside jobs. However, not much can be said at this time as to why some larger families do not have any migrants. A cursory look at the data suggest, though, that large families are found on large farms.

TABLE 6.3 - SIZE OF EXTENDED FAMILY OF MIGRANT LABOR

Size of Extended Family	Number of Migrants From			Percentage of Both	
	Lora	Oghi	Both	%	Cumm. %
5 or less	15	12	27	11.30	11.30
6 - 9	43	21	64	26.78	38.08
10 - 13	32	33	65	27.20	65.28
14 - 17	10	19	29	12.13	77.41
18 - 29	16	21	47	15.48	92.89
30 and more	5	12	17	7.11	100.00
Total	121	118	239	100.00	-

All of the above, however, pertains to those families with off-farm migrants. Table 6.4 compares the mean values of families with migrants with those families who have no relation working outside the village. In brief, compared to families with migrants, families without migrants are smaller, earn more cash in the village, sow more acreage with wheat, have slightly larger farms (though not significantly larger) but have lower incomes per capita, primarily because they do not receive any migrant remittances. With smaller families, they seemingly do not have males of working age and in excess (over the labor required) to leave the farm. Families with migrants, on the other hand, with comparatively more people in the household, can "afford" to send family members to urban centers in search of jobs.

TABLE 6.4 MEAN VALUES OF FACTORS FOR FAMILIES WITH MIGRANTS AND FOR FAMILIES WITHOUT MIGRANTS: HAZARA, 1970.*

Factors	Families With Migrants (n=130)		Families Without Migrants (n=96)	
	Mean	Std. Dev.	Mean	Std. Dev.
Percentage of Land Owned (%)	88.346	30.434	80.333	39.056
Dwarf Wheat Area (Acres)	0.919	1.084	1.407	2.106
Total Wheat Area (acres)	1.559	1.201	1.978	2.164
Total Cultivated Area (acres)	4.865	4.521	5.215	6.054
Cash Earned In Village/yr.(Rs)	593.72	1,037.93	1,227.63	1,489.87
Migrant Remittances per yr. (Rs)	1,269.42	1,521.34	0.00	0.00
Total Cash Income per yr. (Rs)	1,863.14	1,861.91	1,227.63	1,489.87
Size of Family (#)	12.13	7.74	9.90	7.53
Income per Capita (Rs)	188.05	199.57	130.15	140.70

*The factors in this table are not normally distributed since the mean value minus one standard deviation for some observations are negative. This suggests that the largest proportion of the farmers under study fall below the norm indicated by the mean value.

(2) Mostly adult males leave the village family. Married men usually stay away from their family for a year or more while they work in other places.

Table 6.5 shows the marital status of family members working outside the village. Of the 239 males working away, 73 (31%) were single and 166 (69%) were married. Of the married ones, 137 (57%) had their immediate family (wife and children) living in the village under the custody of the extended family. The rest, 29 (12%), of the married men were reported to have their family with them in the designated place of employment - in other words, living outside the village.

Persons interviewed were asked how often the family members working outside the village visited the village. The majority of those outside (65%) visited their family in the village only once a year. There appears to be, as one might expect, a strong relationship between the distance from village to place of employment with the number of village visits per year. This will become evident when we examine the distance to the places of employment for most Lora and Oghi villagers below.

TABLE 6.5 - MARITAL STATUS OF FAMILY MEMBERS WORKING OUTSIDE THE VILLAGE: OGHI AND LORA THANAS, JUNE 1970

MARITAL STATUS*

	Single	Married with Family in Village	Married with Family in Place of Employment	Total
Lora	46 (.380)	67 (.554)	8 (.066)	121 (1.000)
Oghi	27 (.229)	70 (.593)	21 (.178)	118 (1.000)
Both	73 (.306)	137 (.573)	29 (.121)	239 (1.000)

*Figures in parenthesis show proportion of total.
Total number of villagers interviewed who have relations working outside the village = 130
Lora (63) + Oghi (67) thanas

(3) <u>Male family members go to such far-off places as Karachi to find various forms of employment</u>.

One-third of the family migrants were employed within a 200 mile radius of their village; mostly within Peshawar and Rawalpindi Districts. However, approximately 50% were working in Karachi, about 1,000 miles away from either Lora or Oghi thanas. The actual distribution for the distance travelled by the migrants is shown in Table 6.6.

TABLE 6.6 PERCENTAGE BREAKDOWN BY DISTANCE OF EMPLOYMENT FROM VILLAGE OF VILLAGERS WORKING OUTSIDE THE VILLAGE, JUNE 1970

Approximate Distance from Village to Place of Employment (miles)	Number of Villagers Working Outside the Village From:			Percentage Distribution of Total
	Lora*	Oghi	Total	
1 - 100	22	36	58	24.26
101 - 200	8	14	22	9.20
201 - 300	6	9	15	6.28
301 - 400	4	3	7	2.93
401 - 500	0	0	0	0
501 - 600	3	4	7	2.93
601 - 700	0	0	0	0
701 - 800	0	0	0	0
801 - 900	0	0	0	0
901 - 1000	75	51	126	52.72
1001 - 2000	0	2	2	0.84
on the road*	2	0	2	0.84
Total	120	119	239	100.00

*Two persons were reported working and sleeping in the one truck that they drove between Lora and Karachi. They visited their own village and families in Lora only once every three months according to the villager interviewed.

Table 6.7 gives a breakdown of the major cities employing Hazara's migrants. It indicates again that the overwhelming proportion of migrants ends up in Karachi. However, an apparently large number is in the Rawalpindi/Islamabad area which is particularly close to Lora. In addition, it is important to note that Islamabad, the national capital of Pakistan, has shown a remarkable growth in populace and buildings in the last decade. In the future, it may well attract increasingly larger numbers of migrants than indicated by the present data.

TABLE 6.7 - PLACES OF MIGRANT EMPLOYMENT AND DISTANCE TO VILLAGE

Major City of Employment	Approximate Distance to: (in miles)		Number of Migrants	
	Lora	Oghi	Lora	Oghi
Rawalpindi/Islamabad	40	80	21	4
Peshawar	120	110	6	8
Lahore	215	290	9	3
Karachi	1,000	1,090	49	71

Most villagers travel by bus or train to their place of employment. It is not known whether any travel by air also. A one-way trip from Rawalpindi to Karachi takes 26 hours and costs anywhere from Rs.30 to Rs.170. This is relatively inexpensive travel even by Pakistani standards.

Two things are noteworthy:

(i) Karachi is the largest cosmopolitan city in Pakistan with the largest centralized industrial base. Wages are notably higher than in other cities with jobs available in a variety of fields.

(ii) Lahore is also large and industrialized, within approximately 250 miles of the sampled thanas, yet relatively few villagers were reported to be working there. The reasons, for which there are no immediate answers, may be:

a. Lahore's wage rate structure may be relatively lower than that of Karachi's due to any number of factors like large numbers of available laborers, relative to the number of jobs; skilled or semi-skilled jobs for which members of Lora and Oghi thanas are not qualified to take; etc.

b. Lahore is the center of the Punjab and the members of Lora and Oghi belong to the N.W.F.P. The people of Oghi, in particular, speak Pushto and have closer ties with their Pushto speaking brethren. Punjabi and Pathan cultures have historically not mixed comfortably. But the villagers of Lora, for all practical purposes, speak Punjabi and look and act much more like Punjabis than the people of Oghi. Yet, they have a small number of villagers working in Lahore. Karachi, on the other hand, being more cosmopolitan, has a great diversity of people, languages and traditions with which a great many people can identify. Hence, it might be an easier place for migrants with culturally different traditions to settle in.

c. It could simply be that the people of Lora and Oghi have had more contacts over longer periods of time in Karachi. This may be perpetuated by common-law leases on particular jobs which certain families seem to hold.

With regard to the last possibility, it was found that 65 (28%) of those interviewed had two or more family members working outside the village at the time of the interview. As shown in Table 6.8, 77 percent of the 65 were working in the same city. And, out of 65, about 44 percent were working together in the same job. Hence, there is reason to believe that kinship ties are important for finding jobs off the farm.

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TABLE 6.8 - LOCATION OF MIGRANTS FROM FAMILIES WITH TWO OR MORE FAMILY MEMBERS OFF THE FARM

Village	In Same City			In Different Cities	Total Number of Families With Two or More Migrants
	Sub-Total	In Same Job	In Different Jobs		
Lora	24	19	5	11	35
Oghi	26	10	16	4	30
Both	50	29	21	15	65
Total	76.92	44.62	32.30	23.08	100.00

(4) <u>Jobs taken by barani smallholders are varied but the general job is low-paying and manual.</u>

Conventional wisdom has it that a village outmigrant from the N.W.F.P. is limited in the types of jobs he takes; namely, most are thought to be chowkidars (night watchmen) and simple traders in the city markets. However, Table 6.9 indicates no such stereotype. The sample survey revealed that a wide range of jobs are taken outside the village by Hazara District villagers. Such jobs have been classified in six separate groupings in the table below with an extra group for those unemployed. Some of the job skills were arbitrarily included in a certain classification. For example, all drivers were classified as "business or household servants". In one known case, the driver was the owner of his own car and could easily be classified in the "self-employed" group. The notes to the table will help the reader do his own reshuffling of the jobs included under the various classifications.

TABLE 6.9 - EMPLOYMENT STATUS AND JOBS HELD BY MIGRANTS FROM HAZARA DISTRICT, 1970

Village Locale	Un-Employed (1)	EMPLOYED WITH OR AS: National Military (2)	Government or Public Sector (3)	Textile Mill (4)	Laborer (5)	Self-Employed or Private Sector (6)	Household or Business Servant (7)	Total (8)
Lora	6	18	23	13	2	32	27	121
Oghi	7	10	29	20	6	20	26	118
Both	13	28	52	33	8	52	53	239
Percent	.0544	.1171	.2176	.1381	.0335	.2176	.2217	1.0000

* Notes on columns (figures in parenthesis pertain to actual numbers in each category where Lora = L and Oghi = 0):

(1) Unemployed: People who have left the village for outside employment and do not have jobs. In all cases of unemployed, the villager interviewed did not know the state of his relatives' employment. All but four (from Lora) were out of the village for the first time and had only left the village within four months of the interview date.

(2) National Military: Refers to those either in the Pakistan Army, Airforce, or Navy (no distinction made as to which).

(3) Government or Public Sector: Refers to those employed with Pakistan International Airlines (3-0, 6-L), border police (8-0), police (4-0, 5-L), railway workers (2-0), telephone and telegraph linemen (1-0, 2-L), Survey of Pakistan (5-L), school teachers (3-0, 1-L), librarian (1-0), Department of Agriculture - Field Assistant (1-0), electric company (1-0, 2-L), range manager (2-0), Forest Department - Guard and Nursery Attendant (1-0, 2-L), Public Works Department - Peon (1-0), University clerk (1-0).

TABLE 6.9 - (continued)

TABLE 6.9 - (continued)

(4) Textile Mill: Refers to those working in textile mills which are mostly located in Karachi.

(5) Laborer: Refers to those doing manual tasks in construction (1-0), packing (1-L), gardening (1-0), dairy firm (1-0), oil company (1-L), pipe factory (1-0) and other (2-0).

(6) Self Employed or Private Sector: Refers to those who work in miscellaneous set of jobs either for themselves or for others of the private sector; baker (5-L), gas station attendant (2-0, 2-L), peon (1-0), ice dealer (1-0), resident engineer power house (1-L), timber dealer (1-L), utensil polisher (1-L), clerk (5-0, 9-L), machine operator (1-0), employee Dalda Co. (1-0), building contractor (3-L) mechanic (1-0), tea-stall owner (4-L), tailor (2-0), trader of bags (2-L), blacksmith (1-0), sales manager (2-0), bank manager (1-0), shopkeeper (4-L), barber (1-0), workshop apprentice (1-0).

(7) Household or Business Servants: Refers to those working for others in the following jobs: Bearers (1-0, 9-L), drivers (17-0, 9-L), household servant (1-0, 2-L), hospital attendant (1-0, 1-L), washer-boy (1-0), night watchmen (5-0, 1-L), hotel servant (4-L), vehicle cleaner (1-L).

included under the various classifications.

Table 6.9 should be self-explanatory. A few highlights are worth pointing out, however:

(a) The largest number of relations working outside the village (22%) were either household or business servants. But almost as many were in each category labelled for those "employed with the government" and those "self-employed or in the private sector."

(b) The smallest classification was the "laborer" group with only 3.3 percent of the migrants. The next smallest number were "unemployed." In all cases, the person interviewed stated that the unemployed relation had left the village within a few months of the interview. In two cases, the respondents weren't sure whether or not the relation had landed a job or not. It has been found, however, that when a man cannot find employment he usually returns to the farm after a short period of time. Hence, we shouldn't expect the category of unemployed to be too great for the migrants from Hazara.

Reviewing the notes to the above table will show that few jobs are related to agriculture. Except for the Agriculture Department field assistant, there is no evidence that the skills being learned would enhance the productivity of the laborer should he return to the village to farm.

(5) <u>There is a large cash flow from the places of outside employment to the needy villagers in the mountains.</u>

Even though those working outside the village seldom return to the village during a year, there is a continuous flow of capital going to the village on a monthly basis. Nearly everyone working outside sends either a money order through the mail or cash with a fellow villager who is returning to the village for his annual leave. Averaging both Lora and Oghi, Rs.62.43 per month is sent to the village per relation working outside (see Table 6.10). This represents a large cash flow from the places of employment to the needy villages in the mountains. It has even been reported from a mailman to this researcher that as much as Rs.50,000 reaches the Oghi area monthly. How much cash reaches the other parts of Hazara District is unknown. But in all cases, since off-farm migration is widespread, the amount should have significant economic repercussions in the area.

TABLE 6.10 - CASH INFLOW TO VILLAGER INTERVIEWED FROM RELATION WORKING OUTSIDE THE VILLAGE

Thana	Number of Villagers Interviewed (1)	Number of Relations Working Outside (2)	Total Cash Inflow/Month Reported by Interviewees (3)	Average Amount Sent by Relation/Month (3) ÷ (2)
Lora	107	121	Rs. 8,126.00	Rs.67.16
Oghi	119	118	Rs. 6,795.20	Rs.57.57
Both	226	239	Rs.14,921.20	Rs.62.43

Most remittances to the villages from off-farm migrants are in the form of cash. To some extent, cloth is sent to family members. It is usually thought that one of the first items purchased by an off-farm migrant is a radio. However, there is a weak relationship between families with radios and families with some relation working outside the village. As a matter of fact, many of those families who had no relation employed elsewhere were apt to have a radio.

Cash inflow goes primarily to meet fixed cash needs for food and debt obligations. Barani smallholders of Hazara District are net purchasers of food-grain. Production is characteristically below minimum consumption needs. Families are large and productivity is relatively low as we have seen. Furthermore, nearly everyone interviewed was indebted. Nearly all debts were incurred for weddings and household construction; generally for building another room onto the house for a family member. Those owed money were generally relations or shopkeepers. Only one farmer out of the total sample was indebted to the Agricultural Development Bank for money used to purchase land.

Some Implications

Understanding the form and pattern of out-migration from Hazara District gives us some ideas regarding the seriousness of off-farm migration for the urban centers. The first implication is that the village migrants may add less in the near future than might be expected[7/] to the urban chaos because, (a) they leave their families in the village, (b) they apparently team up with other family members to share housing, food and expenses in the urban areas, (c) they apparently find employment in a wide range of fields mostly attributed to their family contacts, (d) they hold strong family ties in the rural areas and (e) they keep their farm both as a retreat and as security against unemployment. In addition, the village farms are used to raise and educate children until they are old enough to migrate, about 21. Also, it is common for migrants to return to the village to retire. Many of the farmers interviewed in the village had worked some time or other outside the village.

[7/] Other opinion is expressed in D'a Shaw, Robert "Jobs and Agricultural Development: A Study of the Effects of a New Agricultural Technology on Employment in Poor Nations," Overseas Development Council, Monograph No. 3 Washington, D.C., 1970, pp. 4-6.

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The second implication stemming from the above is that the barani smallholders who live in Hazara, will have to be prepared to educate an increasing number of people who will work in other parts of West Pakistan. It could be that the educational system is not giving the potential off-farm migrant the tools he needs to move beyond the present types of jobs found in the cities. One hypothesis, that is not tested as yet, is that jobs and job salaries correlate with levels of education, i.e., more rural schooling is met with progressively higher incomes in the urban areas. Another similar hypothesis is that educational attainment is relatively low in Hazara District, hence the large number of service sector employees. It may also be that the type of education received adds little to their ability to perform skills for which there is a higher value job market. More research to test these hypotheses would prove valuable.

A third implication is that it is perhaps unwise to attempt to hold back the flow of off-farm migrants by government legal measures. Given that they move to where the opportunities are greater indicates the efficiency of the economy to adjust its resources in the direction that optimizes national product. Off-farm migration, especially that generated by the forces that push one to migrate, gives many opportunities for development. It means a removal of the younger generations from the family origins to the locus of their active participation in the economic system. Eventually, it may lead to a detachment of the individual from the family when he sets up his neolocal residence, although there is yet little substantiation of this. It could be that in the future the ability to move will facilitate the adjustment to and selection of economic opportunities by means of objective tests of performance rather than on the basis of family

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The fourth implication is that off-farm migration and non-farm employment serve to reduce the disparities within Pakistan conditioned by differential rates of natural increase in the population and between the income earned by the many different groups which serve the country. It should be made clear that there is an income generating effect going on with the free flow of labor from the N.W.F.P. Namely, the poor people of Hazara District are able to work in order to feed their poor families. The work they do fills needed positions in Karachi and other large centers. The money earned in turn goes to purchase grain from the Punjab and keeps the more productive farm workers of the Punjab employed by an effective demand for Punjabi goods. Break any link in this chain and more problems are created to deal with. In certain respects, the N.W.F.P. should be concerned with the employment situation in other areas holding large numbers of its migrants until such time that the Province can develop its own productive capacity to employ more people.

Remunerations back to the farm have apparently aided some barani smallholders to be rapid adopters of the new, high-yielding varieties of wheat. They probably wouldn't have adopted without off-farm sources of income. In essence, the extended family provides some degree of "risk insurance" against penalties from crop loss due to innovation; especially, when family members have some assurance of non-farm employment.

The fifth implication is that migration opens the rural areas to outside information. Horizons are widened and aspirations enhanced. Farmers become more cosmopolitan (worldly) and experienced in ways which can move them to greater opportunities.

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CHAPTER VII

THE ECONOMICS OF WHEAT PRODUCTION ON BARANI LAND IN HAZARA DISTRICT

Introduction

This chapter is divided into two sections. In Section I, production relationships between inputs and outputs for dwarf and desi wheat varieties are specified with the Cobb-Douglas production function.[1/] Comparisons between the estimated regression coefficients and marginal productivities are made in order to depict the economic impact of dwarf wheats on resource productivity on Hazara's barani land. In Section II, the costs and returns of dwarf and desi wheat production are analyzed with partial budgeting analysis in order to assess whether or not the relative income position of barani smallholders has been able to improve for those who use the new high-yielding varieties of wheat.

Section I. The Impact of Dwarf Wheats on Resource Use

Model of Wheat Production

Specification of Functional Form

The objective in fitting the Cobb-Douglas production function to the set of cross-section data (discussed below) is to obtain estimates of the marginal contribution of each input to output of either dwarf or desi wheat. Such estimates make it possible to evaluate the performance

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1/ The term production function refers to the physical relation between a farm's inputs of resources and its output of a particular commodity per unit of time, exclusive of prices.

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of the sample of barani farms and to compare the productivity of inputs used with dwarf or desi varieties. Moreover, the common use of the Cobb-Douglas production function in many studies of a similar nature partially attests for its general usefulness as a tool in applied economics.[2/] By following past experience, the results contained in this study may lend themselves to comparative analysis with other studies. The function has the general form:

$$Y_j = AX_{1_j}^{b_1} X_{2_j}^{b_2} \ldots X_{i_j}^{b_i} U_j \quad ,$$

is converted to linear logarithmic form, and is fitted by ordinary least squares procedures. In the function,

Y_j = output of farm j,

A = some constant,

X_{ij} = amount of input i used by farm j,

b_i = the elasticity of production of input i,

U_j = a stochastic term.

The estimates with the above functional form are notably subject to a variety of possible errors which have been discussed and analyzed elsewhere.[3/] The major limitations of our specified model are that:

2/ For example, see a more recent study and its references: Yotopoulos, Pan A., Laurence J. Lau and Kuttu Somel "Labor Intensity and Relative Efficiency in Indian Agriculture", Food Research Institute Studies in Agricultural Economics, Trade and Development, Vol. IX, No. 1, 1970, pp. 43-55.

3/ Massell, Benton F. and R.W.M. Johnson, Economics of Smallholder Farming in Rhodesia: A Cross-Section Analysis of Two Areas. Food Research Institute, Stanford University, 1968, Chapter 7, "Problems of Statistical Estimation", pp. 38-44.

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(1) we have a single equation model of production; (2) some variables will undoubtedly be missing and others will be unqualified, such as the flow of capital and the quality of soil; and (3) some sample variables are zero for some farmers, i.e., chemical fertilizer.[4/]

But for our purposes, these errors should not present any major limitations on the analysis of the functional relationships and the results should be useful in explaining the general pattern of resource use. The results should also be useful in identifying inputs which promise the largest increase in output from greater or lesser employment.

Sample Size

The first round of interviews during May/June, 1970, collected the raw data for the production function specified above. Out of the 143 farmers who were interviewed, 71 exclusively grew dwarf wheat, 35 desi wheat and the rest of the sample grew both dwarf and desi varieties. Those growing both varieties are excluded from the production function analysis below. Due to the restrictions placed by a small sample, no attempt is made to compare the production functions of Lora and Oghi. The data are combined in order to serve as a sample of representative observations on Hazara District as a whole. Although four outliers appeared in the dwarf wheat sample of respondents and two in the desi wheat sample, all observations are kept intact.

[4/] The reader is referred to: Johnson, S.R. and Gordon C. Rausser. "Effects of Misspecifications of Log Linear Functions When Sample Values are Zero or Negative". American Journal of Agricultural Economics, Vol. 53, No. 1 February 1970, pp. 120-124.

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Production Variables

Six production variables are considered in this study: output (the dependent variable), land, labor, seed rate, nitrogen and phosphate (the inputs).

Output (Y_j)

The dependent variable, output, is measured in terms of maunds harvested; one maund equals 82.286 lbs. Conversions were made from the village unit of measurement, the wodi, to the maund during the interview period.[5/]

Land (X_1)

Land is measured in terms of acres planted with each wheat variety during 1969/70. The standard village unit of measurement for land is the kanal. Eight kanals equal one acre and the conversion was made accordingly.

The quality of land is subject to some variation. Barani smallholders can distinguish between bunjar (or rakkar), very poor pebbly soil, and maira, improved soil near the home which customarily receives farm yard manure. In almost all cases, wheat was sown on maira land. No further attempt was made to qualify land in the sample.

Labor Utilization (X_2)

Labor utilization is measured in terms of man-hours used for field preparation and sowing. Since each pair of bullocks used to prepare the land needs one driver, man-hours were derived by asking the

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[5/] The wodi is described in Chapter V along with a statement regarding the reliability of the data on yield.

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respondent: (i) how many times each wheat field was plowed, including the time for sowing, (ii) the number of bullock-pairs employed, (iii) the number of days it took to plow the wheat fields one time using X number of bullock pairs and (iv) the approximate number of hours spent in the field plowing each day. From answers to these questions, it was possible to estimate the number of man-hours used per farm.

Family males are charged with all aspects of wheat production. Information on labor input -- both hired and family labor -- was recorded separately in the course of the interviews. The overwhelming majority of the respondents hired no labor for any aspect of the field preparation and wheat processing. Of the 143 farmers who were interviewed with regard to wheat production, only two hired labor. This presents a problem for valuing labor as we will note in the cost and returns section of this chapter.

Seed Rate (X_3)

"Seed rate" is measured in terms of total seers applied to wheat acreage per farm. One seer is equivalent to 2.057 lbs. and 40 seers equal one maund. In a barani environment, high plant populations use proportionately more residual moisture. Hence, it is thought that "seed rate" should contribute to yield variability; it is, in essence, a measure of response to drought stress.

Nitrogen (X_4) and Phosphate (X_5) Fertilizers

Nitrogen (N) and Phosphate (P_2O_5) are measured in pounds applied to wheat acreage per farm. Since fertilizer use is relatively new to the farmers, they can easily remember at least two or three characteristics of the type applied; i.e., bag weight, price, color, place of purchase. Any two of these can be used to identify the type and amount of fertilizer used.

Farm yard manure could not be measured nor included in the inputs because: (i) size of livestock herd differs from farm to farm, (ii) some families use cow-dung for home fires and (iii) the farm yard manure is spread until it "looks good" in the field. As such, it is never weighed nor evenly distributed among fields. Hence, the obvious difficulty in measuring a suitable rate for farm yard manure precluded all attempts to include it as a variable.

As discussed in Chapter V, not all farmers used chemical fertilizer. In a Cobb-Douglas function, no output is obtainable if any input equals zero (since the log of zero is not defined). However, we know that some output is obtained without N or P_2O_5. Thus, these inputs need to be treated differently from the conventional inputs of land and labor.

In order to handle the zero values, we let M = M' + C where M' = number of pounds of fertilizer applied and where C is some constant which was arbitrarily set equal to 0.01. In this way, the log of M is defined for all levels of output.

The example of Massel and Johnson illustrates the conceptual changes that must be taken into consideration.[6/] In Figure 7.1, fertilizer is measured along the vertical axis, OE, and land along the horizontal, OT. Curve CD is a Cobb-Douglas isoquant which shows the trade-offs between fertilizer and land for a specific level of output, holding all other

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[6/] *Op. Cit.* pp. 35-36.

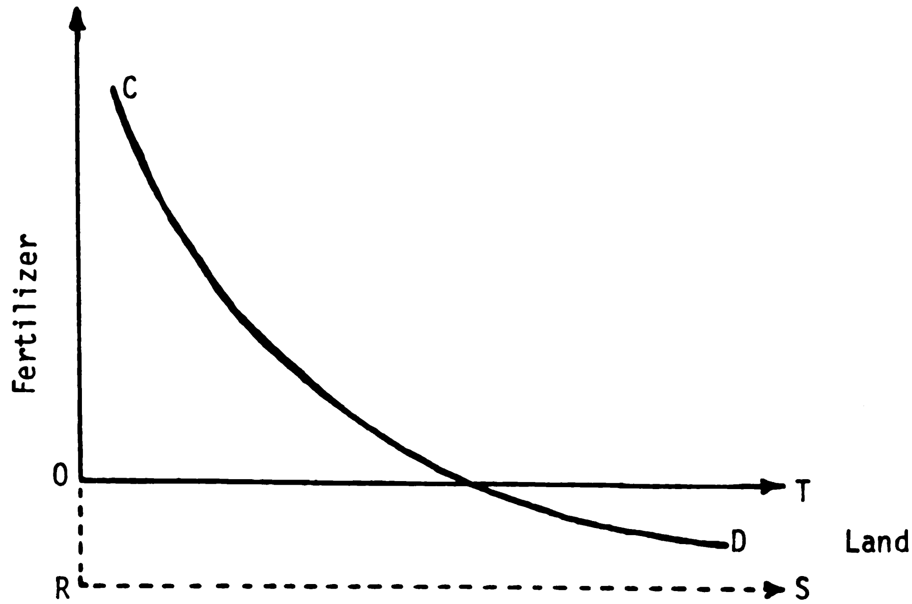

FIGURE 7.1 A MODIFIED COBB-DOUGLAS ISOQUANT

inputs constant. Instead of being asymptotic to OT, the isoquant is asymptotic to RS. The distance RO = C is a measure of natural soil fertility.[7/]

By using the above measure of M in the Cobb-Douglas production function, the regression coefficients for M are not equal to the production elasticities. The elasticity, however, is easily obtained by multiplying the regression coefficient by (X-C)/X where X = the value of the variable with the constant and C = the constant.[8/] The calculations in what follows were made at the gemetric means of the respective variables.

7/ Ibid., p. 36

8/ Ibid., p. 47

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Overview of the Inputs Used to Produce Dwarf and Desi Wheat

The contrasts between dwarf and desi wheat production are exemplified by the input/output relationships shown by the geometric means in Table 7.1. A comparison of the geometric mean values illustrates that for all input categories, substantially more resources go to produce dwarf wheats than desi wheats. In turn, the yield differential is also substantially higher for dwarfs. In a purely physical sense, innovation with dwarf wheats is both factor using and output increasing; the magnitude of which is analyzed below. The comparisons also indicate that the production functions for dwarf and desi wheats, though computed with the same functional form, are different from each other. Analysis of the significant differences between dwarf and desi wheat production follows.

TABLE 7.1 SUMMARY OF INPUTS AND THEIR GEOMETRIC MEAN VALUES FOR DWARF AND DESI WHEAT PRODUCTION: HAZARA DISTRICT,

Output and Input Category		Geometric Mean Values*			
		Dwarf Wheat	(n=71)	Desi Wheat	(n=35)
Y	Yield (mds)	14.436	(13.59)	7.764	(7.48)
X_1	Land (acres)	1.062	(1.00)	1.038	(1.00)
X_2	Labor (man-hours)	76.926	(72.41)	61.712	(59.48)
X_3	Seed Rate (seers)	37.733	(35.52)	31.954	(30.80)
X_4	Nitrogen (lbs)	4.529	(4.26)	0.036	(0.04)
X_5	Phosphate (lbs)	0.434	(0.41)	0.034	(0.03)

* Geometric mean values are average estimates derived from computations with the Cobb-Douglas production function. Figures in parenthesis show conversions to a per acre basis.

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Estimation of Model Parameters

Analysis of Variance

An F test was used to test for the significance of interfarm differences in dwarf and desi wheat production. For both dwarf and desi wheats, the null hypothesis that all $b_i = 0 (i = 1,2,...5)$, can be rejected with a Type I error of less than 0.05 percent. The coefficient of determination (R^2) for the regression model as a whole for dwarf wheat was 0.7155 (standard error = 0.24) and for desi wheat, 0.6803 (standard error = 0.24). Both R^2's indicate that approximately 71 and 68 percent, respectively, of the sum of the squared deviations from the mean of the dependent variables are accounted for by the independent variables. In other words, both dwarf and desi production models show that the wheat yields are significantly responsive to variation in the inputs quantified. The remaining 28 and 32 percent, respectively, of the unexplained variance might be attributed to such factors as management, soil fertility, weather, and other factors which are not quantified but are assumed to be randomly and normally distributed among the sample of observations.

Production Elasticities

Table 7.2 shows the estimated elasticities of production together with their standard errors (S.D.) and levels of significance. Elasticities are important because they indicate the percent change in output which would, on the average, be associated with a one percent increase in the input concerned while all other inputs are held constant. The elasticities are also needed to estimate marginal productivities of the inputs.

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TABLE 7.2 ESTIMATED ELASTICITIES WITH THE COBB-DOUGLAS PRODUCTION FUNCTION

INPUT	WHEAT TYPE					
	DWARF (n=71)			DESI (n=35)		
	Elasticity	S.D.	Sig[a/]	Elasticity	S.D.	Sig[a/]
Constant	0.660	0.472	0.167	1.334	0.524	0.016
1. Land	0.339	0.298	0.260	1.091	0.372	0.007
2. Labor	-0.020	0.081	0.810	-0.102	0.188	0.590
3. Seed Rate	0.318	0.281	0.262	-0.152	0.330	0.648
4. Nitrogen [b/]	0.067	0.019	0.001	0.012	0.035	0.629
5. Phosphate [b/]	0.050	0.017	0.003	0.014	0.032	0.603

[a/]Significance -- The null hypothesis $b_i = 0$ can be rejected with the probability of a Type I error (two-tail test) shown in this column.

[b/]Regression coefficients for N and P_2O_5 have been corrected for the constant value which was added to all observations.

A comparison of the two sets of production elasticities reveals consistently the following results: (1) An important factor in explaining interfarm differences in output is land. The estimated elasticity for land sown with desi wheats is significant at the 0.7 percent level of probability. The estimated elasticity for dwarf wheat land, however, has a much higher probability of a Type I error associated with it; that is, in 26 cases out of 100, if functions were fitted to different samples from the same population, the production elasticity for land with dwarfs would be as large or larger than the present estimated coefficient. (2) The production elasticities for labor are negative but not significantly different from zero. As such, in the production of both wheats, additional man-hours of labor contribute almost nothing

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to output. A priori, with large extended families and small scale of operation, we would expect "cheap" labor to be used very (too?) intensively; something we discuss in more detail below. (3) All of the production elasticities for fertilizer indicate positive influences on output. However, only the elasticities for fertilizer applied to dwarf wheats are significant. In the case of nitrogen applied to dwarf wheats, an increase in N by one percent increases total output by 6.7 percent. An increase in P_2O_5 by one percent increases total output by 5 percent, all other factors held constant.

Another important factor to explain changes in dwarf wheat output is the number of seers of seed used per farm. However, a negative elasticity is evident for the input of seed used for desi wheat; as are the signs on the elasticities for the inputs of labor. The negative sign with the coefficient implies that total output can increase with less of the input. Negative coefficients may result from high intercorrelations between variables. Among the sample of observations, land, labor and seed rate are positively correlated with one another to a large degree as shown in Table 7.3. Such intercorrelation comes about as the farms employ more labor and use more seeds in accordance with expanding wheat acreage. Complementarity of these inputs, however, tends to obscure their separate contributions to output since their standard deviations are also large. In essence, overestimation of one production elasticity tends to necessitate some underestimation of one or more of the other production elasticities. Hence, reduced reliability can be placed in the accuracy of the estimates presented.

Aggregation of variables is suggested when high complementarity is evide

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X_3	Se
X_4	N
X_5	P_2

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X_2	L
X_3	S
X_4	N
X_5	P

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is evident.[9/] However, inputs were not combined in the present study because of the difficulty in finding another way to indicate the individual contributions of the inputs, i.e., land, labor and seed rate.

TABLE 7.3 MATRIX OF SIMPLE "ZERO-ORDER" CORRELATIONS

Dwarf Wheat Model

		Yield	Land	Labor	Seed	N	P_2O_5
Y	Yield	1.0000					
X_1	Land	0.7524	1.0000				
X_2	Labor	0.5968	0.7332	1.0000			
X_3	Seed	0.7699	0.9636	0.7052	1.0000		
X_4	N	0.6211	0.4629	0.3993	0.4918	1.0000	
X_5	P_2O_5	0.4949	0.2902	0.3894	0.3306	0.3420	1.0000

Desi Wheat Model

Y	Yield	1.0000					
X_1	Land	0.8176	1.0000				
X_2	Labor	0.6182	0.8028	1.0000			
X_3	Seed	0.7559	0.9508	0.8098	1.0000		
X_4	N	0.4198	0.4775	0.4146	0.4719	1.0000	
X_5	P_2O_5	0.0852	0.0470	0.0932	0.0066	-0.1652	1.0000

[9/] Bradford, L.A. and Johnson, Glenn L., Farm Management Analysis, New York, Wiley, 1953, pp. 143-45.

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Marginal Productivities

Table 7.4 shows the estimated marginal physical productivity (MPP) and the marginal value of productivity (MVP) for each input. The MPP for each input was calculated as the product of the input's elasticity of production and its average product calculated at the geometric means of output and input, i.e.:

$$MPP_{xi} = \frac{E_{ij}\ (G_{yj})}{G_{xij}} \qquad i = 1,2, \ldots, 5.$$

where E_{ij} = the elasticity of factor i in the production of crop j and G = the geometric means of outputs Y_j and inputs X_{ij}, accordingly. The MPP's for both dwarf and desi variables are multiplied times Rs. 20.00, the average price for both dwarf and desi wheat in Hazara during the time of the interviews, in order to derive the MVP's. Theoretically, MVP's are the net earning powers (or net returns) of the different inputs.

It should be noted, however, that there are limitations arising from the method of estimating MVP's. Notably, MVP's are derived from production elasticities. Any bias in the latter also results in the MVP's being biased in the same direction as the elasticities used. The results can be useful, though, in comparing the relationships between those inputs which are significant and for which the farmer has more control; namely, the amount of seed sown per acre and the amount of fertilizer applied to wheat. In the following, an analysis will be given for each factor of production used in producing dwarf or desi wheat.

TABLE 7.4

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TABLE 7.4 ESTIMATED MARGINAL PRODUCTIVITIES OF INPUTS USED TO PRODUCE BARANI WHEATS: HAZARA DISTRICT, 1969/70

	WHEAT TYPE			
	DWARF (n=71)		DESI (n=35)	
INPUT	MPP	MVP*	MPP	MVP*
1. Land	4.601	92.02	8.160	163.20
2. Labor	-0.004	-0.08	-0.013	-0.26
3. Seed Rate	0.122	2.44	-0.037	-0.74
4. Nitrogen	0.024	0.48	0.008	0.16
5. Phosphate	0.028	0.56	0.018	0.36

*MVP_i = Rs 20 · MPP_i (where i = 1...5).

Analysis of Resource Use

A Note On the Optimal Use of Inputs

In perfectly competitive markets, where factor and product prices are independent of the actions of any single buyer or seller, inputs are employed in the most profitable quantities when their MVP's are just equal to their prices. That is, for optimal input usage, the cost of employing the last unit of the factor (marginal factor cost of MFC) should just equal the value of the additional product (MVP) which is produced as a result of adding that last unit of the factor. With a perfectly elastic supply of the factor, MFC = factor price. Thus, when the MVP of an input exceeds its price (or MFC), it becomes more profitable to use more of the input. The converse is true when the MVP of an input is less than its MFC or price. Knowledge of the way MVP's relate to factor prices indicat

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Land

Very little is known about the rates of return to land in Hazara because few farmers actually sell land. This is an age old practice since land is kept in the family and is usually handed down from generation to generation of family members. The most common practice is for farmers to borrow money with land used as collateral. The interest paid on the loan is equal to the cash value of the crops produced on the land (until the debt is paid) by the lender.

The production function, however, yields marginal returns to land as many rupees per acre per wheat crop. (The returns are for average quality maira land.) Judging from the relative scarcity of land in Hazara District and the exodus of manpower from the area, it should be expected the rate of return to land would be relatively higher than those of other inputs. The fact that the MVP of land for dwarfs is lower than that for desi wheats should not be construed to mean that farmers should produce more of the latter since the two varieties produced are from completely different production functions as noted above. More important is the conclusion that the marginal returns to land are generally consistent with what is known about the scarcity of the input. Furthermore, it indicates that leaving land fallow during the winter period is a costly practice for barani smallholders to continue and that each acre sown with wheat during winter can be expected to add at least Rs 90.00 to the farmer's total income. Furthermore, this information also gives us an idea on the approximate price to attach to barani land in evaluating net profits for dw

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Labor

An interesting conclusion from the results is that the marginal products of labor for both varieties of wheat are zero and with elasticities not significantly different from zero. This may be attributed to two main factors: the first is the prevailing labor-intensive techniques of agricultural operations and the second is that labor availability is high relative to available cultivable acreage. The latter is contingent upon the prevailing pattern of off-farm migration.

As noted previously, migrants are generally those between 20 and 40 years of age. Thus, a growing cadre of young and a large proportion of old males are left to till the land. The opportunity costs for those on the farm are apparently low in Hazara District and the chances for long distance mobility are less for these two age groups of males. Understanding the general pattern for off-farm migration plus the fact that many men were still available on the farm, it was not too surprising to find that farmers were plowing more often for dwarf wheat; even to the extent that the marginal product of labor approximates zero. Generally, with dwarf wheats, the number of plowings increased 3 to 4 times over the usual 2 or 3 plowings for desi wheats. Some farmers plowed as many as 6 times for dwarfs. Aside from believing that more plowings would add more fertility to the soil, they generally thought that the new varieties "required" the extra plowings in order to give good yield. The point is, there was labor available to plow the dwarf wheat fields more often than is normally done for desi wheats.

Considering all aspects of the labor situation, the findings on

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labor indicate that: (1) Even though the labor input used to cultivate the technologically improved varieties has increased, there is no evidence that the marginal returns to labor under present circumstances have increased substantially enough to alter the conclusion that surplus labor is available in Hazara District.[10] (2) As long as family size is large and families can sustain themselves with partial support from migrant remittances, there will be others on the farm (the young and the old) who will be willing to accept lower than "non-farm" returns for their labor. (3) As long as families are "held together" by tradition in the present cultural context, there will continue to be an attachment to the farm family. With these considerations, it is quite probable that the MVP for labor in the production of wheat is close to zero for all phases of crop production. Hence, the productivity of labor is apt to remain low until farm production can be raised substantially above present levels or until the size of land holding can expand for the farm families.

Seed Rates

It should be recalled (from Table 7.1) that the geometric mean values of seed rates were 35.52 seers per acre for dwarf wheats and 30.80 seers per acre for desi wheats. At this level of "seed rate", the MPP for desi varieties is not significantly different from zero. On the other

[10] Corroborative evidence of the possibility of an existing agricultural labor force with almost zero returns to output is cited in: Mian, Nural Islam, Disguised Rural Unemployment in the N.W.F. Region, Board of Economic Enquiry, 1965, pp. 8. In particular, it is noted from field survey data that rural workers were engaged in work for only 712 hours during the year (or about 89 days per year). "Agriculturalists proper" were employed only 87 days, according to the study.

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hand, the MPP for dwarf "seed rate" is positive and significantly different from zero, according to the production elasticities. The findings contradict the hypothesis that barani farmers would use dwarf wheat seed sparingly with fertilizer in order to effectively use the residual moisture for good yield. The relatively higher seed rate and yield with dwarf varieties make it difficult to recommend one way or the other the amount of seed that should be used per acre.

When we view desi wheats separately, it is plausible to explain that farmers (who have used desi varieties for years) are using a seed rate that pushes output to the maximum possible level. Hence, at a rate of around 30 seers of desi seed per acre, we should expect the MPP of this "seed rate" to approximate zero. In the case of dwarf wheats, the higher seed rate and larger output per acre suggest that dwarf wheat seed, especially Mexipak-65, is a relatively more efficient user of residual moisture, even when combined with chemical fertilizer. Tied to this is the realization that farmers plowed their fields more often for dwarfs. The net effect may be that the soil's residual moisture was actually higher on the land plowed more often than on the land plowed for desi varieties. These are in no way conclusive findings, but they do indicate that more research is needed to test the resistance of dwarf varieties to various levels of drought stress.

Fertilizer

As noted in Chapter V, few desi growers used chemical fertilizer. Of the 35 farmers included in the sample for desi wheat, five applied nitrogen and another five phosphate; none used both chemical fertilizers on their desi wheat which explains the negative simple correlation for $r_{x5\ x6}$ shown in Table 7.3. Because few farmers who grew desi wheat applied fertilizer and because neither N nor P_2O_5 were significant in the case of their production elasticities, there is little that can be said about the use of fertilizer on desi varieties. Hence, attention is focused on fertilizer applied to dwarf wheat.

Positive production elasticities were estimated for both N and P_2O_5 applied to dwarf wheats and both can be accepted as significantly different from zero at the 95 percent confidence levels. Table 7.5 gives estimated total (TPP) and marginal physical products (MPP) and MVPs for the usually observed fertilization rates of N and P_2O_5, holding all other inputs constant at their geometric means. Estimates calculated for nitrogen fertilizer application, indicate that at least 9.56 maunds per acre of dwarf wheat can be achieved with 0.01 pounds of N. With the same amount of phosphate, the minimum expected output can approximate 12 maunds per acre. It should be remembered, though, that the calculations hold when all other inputs are measured at their geometric means. One other observation is that yields in excess of 15 maunds require heavy fertilization with N and P_2O_5. In addition, the marginal returns to 10 pound units of fertilizer drop very quickly from Rs 1.54 to Rs 0.33 for both fertilizers.

Sample respondents who purchased and used chemical fertilizer were asked during the interview the price paid for each bag of fertilizer. Farmers paid, on the average, about Rs. 0.54 (or 54 paisa) per pound of nitrogen and 44 paisa per pound of phosphate. The price of each includes the transportation cost between wholesale outlets and village merchants and the latter's profit. Adding a small amount to account for the cost of transporting fertilizer from the village to the farm, a pound of nitrogen may be assumed to have cost the farmer about 56 paisa and about 46 paisa per pound of phosphate. These costs can be compared with the MVP's estimated with the production functions in Table 7.5.

TABLE 7.5 TOTAL AND MARGINAL PRODUCT CURVES WITH MVPs FOR NITROGEN AND PHOSPHATE FERTILIZER APPLIED TO DWARF WHEATS (ON A PER ACRE BASIS) [a/]

Pounds of Fertilizer	Nitrogen (N)			Phosphate (P_2O_5)		
	TPP (mds)	MPP (mds)	MVP (Rs)	TPP (mds)	MPP (mds)	MVP (Rs)
.01	9.56	NA	NA	11.93	NA	NA
0.41 [b/]	NA	NA	NA	13.59	1.630	20.56
4.26 [c/]	13.59	0.162	3.24	NA	NA	NA
10	14.59	0.076	1.51	16.01	0.770	1.54
20	15.11	0.035	0.69	17.51	0.042	0.84
30	15.39	0.026	0.52	17.77	0.028	0.56
40	15.67	0.020	0.39	18.02	0.022	0.43
50	15.97	0.017	0.33	18.25	0.017	0.35

NA = not applicable.

[a/] Estimates are approximate due to rounding and extrapolation between some values for TPP.

[b/] Geometric mean for P_2O_5.

[c/] Geometric mean for N.

The geometric mean values for phosphate and nitrogen applied to dwarf wheat were 0.41 lbs. and 4.26 lbs. (per acre), respectively. At these points, the MVP's were much higher than the costs of both. We should expect, that as long as MVP > MFC, usage of N and P_2O_5 will expand by barani smallholders if possible. In particular, optimal use of N at present prices should be between 20 to 30 pounds per acre. Approximately 30 to 40 pounds of P_2O_5 would come close to an optimal use of phosphates at the given price of 46 paisa per pound. With the application of these rates of fertilizer, the variability in dwarf wheat yield may be reduced substantially for barani wheat production.

Section II Costs and Returns to Dwarf and Desi Wheat Production

The preceding discussion focused on the patterns of resource use and the ways to produce either dwarf or desi wheat at least cost. Before dwarf wheats are substituted for desi wheats, they must show the ability to raise net profits above former levels for sustained periods of time. What happens if the price of fertilizer or another input rises? Will smallholders still find it profitable to continue dwarf wheats? This question and others can be answered by partial budgeting analysis which is a useful technique for choosing between alternative packages or technologies of wheat production. In addition, it gives policy makers a picture of the input/output relations and the associated values under different prices.

Partial Budgeting Analysis

Bradford and Johnson define a budget as a written plan for future actions which is composed of two main figures, total revenue and total expenses.[11/] The difference between the two is called net profit or net

[11/] Bradford, Lawrence A. and Glenn L. Johnson, op.cit., pp. 328-329.

loss depending on whether total revenue is greater or less than total expenses. Partial budgeting consists of altering one assumption of a budget, such as factor cost in order to predict its effects on net return or net loss. As such, it forms a part of static microeconomic analysis and like regression analysis, partial budgeting analysis assumes the conditions of perfect competition and divisibility of inputs. In the present context, involving the comparison of a "new package" (the factor requirements for dwarf wheats) and an "old package" (the factor requirements for desi wheats), these assumptions do not pose major limitations.

The usefulness of partial budgeting analysis can be illustrated with the following example: Assume that a farm is producing 1000 rupees worth of wheat with a total input cost of 400 rupees. The difference leaves 600 rupees to pay for other incidentals of the farm family. Thus, the ratio of net returns to expenses in wheat production equals 1.5 to 1. Now assume that the farmer tries a new package of inputs but now spends 650 rupees (or 150 rupees more than the former expenditure). However, the new package produces 2,000 rupees worth of wheat. In the second case, the net return is 1350 rupees and the ratio of net returns to expenses is about 2 to 1. As soon as the farmer becomes certain that he can produce 2 rupees worth of wheat for 1 rupee of additional expenditure, on the average, he will seek to do so by using the new package of inputs. The farmer is better off than before. However, if input and output prices change, it is quite possible that the relative profitability can change such that the old package results in a more favorable ratio of net returns to costs. If this happens the farmer may shift back to the old package of inputs to the exclusion of the new. Partial budgeting analysis (which compares the results of price changes) is thus important in determining whether the barani smallholders will continue employing the new package of inputs compared to the old. In the following, the components of total expense and total revenue will be examined separately before comparing costs and returns for dwarf and desi varieties.

Total Expenses and Input Pricing

Total expenses are the summation of all items used in production times their prices for a given time period. There are notably two factors which can change in the evaluation of total expenses: the quantity used of each item and the price of each item.

Table 7.6 summarizes the prices paid by farmers for materials and other items to produce wheat during 1969/70. The table also summarizes the average quantity of inputs used per acre to produce the wheats. The quantities shown are the "actual" average levels of inputs used by the sample of respondents and should be distinguished from the "geometric mean" levels which were estimated from the Cobb-Douglas production function (see Table 7.1). In actuality, the average fertilizer dosage was more than the amount estimated by the model of production. All other "actual" figures correspond closely to the geometric mean values. The following discussion will elaborate on each of the inputs quantified in Table 7.6, with focus on input pricing.

TABLE 7.6 AVERAGE QUANTITY OF INPUTS USED PER ACRE AND THE AVERAGE PRICE PER UNIT: HAZARA DISTRICT, 1969/70.

Item	Ave. Quantity of Inputs Used For Dwarf Wheats (n=71)	Ave. Quantity of Inputs Used For Desi Wheats (n=35)		Ave. Price 1969/70 (Rupees)
Land	1.0	1.0	Acre	70.00/Acre
Human Labor	31.5	21.1	Man-Days	0.50/Day
Bullock Team	13.1	8.8	Days	2.50/Day
Seed Rate	36.5	32.2	Seers	0.50/Seer
Nitrogen	40.7	19.2	Pounds	0.56/lb.
Phosphate	28.7	8.3	Pounds	0.46/lb.

1. Land

For the price of land, an intermediate price between the value of the marginal product estimated by the dwarf wheat model (refer to Table 7.4) and the opportunity cost (what one acre would earn if used for the next best crop) was selected. In Hazara District, where land is not readily sold, it was thought that the MVP of land would reflect its real worth in present employment. The next best alternative crop for the sampled areas is barley. Before wheat, barley was grown more extensively in Hazara (and still is in a few areas) during the winter months, matured in the same period as desi wheat, did not receive any fertilizer and yielded about 8 maunds per acre. The average wholesale price of barley grain has generally been about 13 rupees per maund, and its net profit per acre of rainfed land has recently been estimated at Rs. 56.00 per maund.[12/] The intermediate price, Rs. 90.00, appears

[12/] Department of Agriculture, West Pakistan Peshawar, Report on Cropping Pattern for Peshawar Region, published by the Director of Agriculture, Peshawar Region, Peshawar, 1969, p. 47.

to be an adequate reflection of the price of land used during the wheat cultivation period.

2. Human Labor

Labor poses an interesting anomaly for two related reasons: (i) it has a positive wage rate when actually employed but shows up as a factor with zero returns, in the MVP's, for dwarf and desi wheat production, and (ii) it is primarily family labor as reflected by the fact that 99 percent of the labor used in wheat production among the sample of respondents was family labor. Accordingly, the problem of valuing labor becomes one of (i) deciding whether or not to attach a positive wage rate to the services of labor and (ii) deciding whether or not to consider the services of labor as either an expense or a return to the farm family. The final decision obviously has strong bearing on the net profits per acre of dwarf or desi wheat and is not easy to deal with. To simplify matters, it is assumed that labor has a positive opportunity cost of 50 paisa per day. Labor kept on the farm is also considered an expense undertaken by the farm family to maintain its food supplies.

It has been noted that the labor used for dwarf wheat field preparation and sowing has increased by about 50 percent for the same chores done for desi varieties. Though dwarf wheat yields have increased by as much as 100 percent over desi yields, the man days used for harvesting, threshing, winnowing and storage have only increased by around 50 percent.[13/]

13/ One man-day is equivalent to eight man-hours of work.

TABLE 7.7. MAN-DAYS EMPLOYED PER ACRE FOR DWARF AND DESI WHEAT PRODUCTION AND PROCESSING: HAZARA, 1969/70

(n=143)

Wheat	Field Preparation and Sowing	Harvesting	Clara & Threshing	Winnowing & Storage	Total
1. Dwarf	12.1	9.3	5.1	5.0	31.5
2. Desi	7.8	6.5	3.5	3.3	21.1
3. Added labor (2 from 1)	4.3	2.8	1.6	1.7	10.4
4. (3 as % of 2)	55.13	43.08	45.71	51.52	49.29

The man-days actually employed for both varieties are illustrated in Table 7.7. Evident are notable economies with increased output which indicate that the average cost per maund of processed dwarf wheat becomes less for barani smallholders. This is quite possible because of the specific way in which tasks are performed. Namely, harvesting is done by hand, cutting the wheat near the base of the plant with a small sickle. The relatively larger number of tillers on dwarf wheat places more plant stems in a unit area, compared to desi wheat, which means that the harvestor can grab more stems with little extra effort. Before wheat can be threshed, a clara[14/] is prepared which requires the same amount of work, whether for five maunds of wheat or one hundred (if less than five maunds of wheat are harvested, the grain is usually threshed by beating the stalks against a log or rock). The bundles of wheat are placed on the clara and are trampled by bullock teams. Winnowing is largely a function of the velocity of wind. A "windy" day makes the task of separating the chaff from the grain much easier and quicker. After the two are separated, farmers

[14/] A clara is a threshing floor prepared by driving bullock teams in circles on a particular spot in the field until the ground is packed hard. None of the farmers interviewed has a permanent (cement) threshing floor because, as the farmers say, "they crack under the strain of the bullock teams and the quick changes in climate from cold to hot."

measure the grain with a wodi and empty the wodi's contents into a bag or basket. The grain is then taken into the home where it will be milled by the women when flour is needed. Straw is saved and stacked into piles. Large piles of straw are bound tightly and covered with a mud "ceiling" to protect against wind and rain. As in the other tasks, the additional labor required is less than proportional to the amount of grain available with the new varieties relative to the traditional.

3. Bullock Team

Fields are plowed by bullock pairs. For every man-day of labor used in field preparation and sowing there is a pair of bullocks. Thus, a bullock team is employed, on the average, 12.1 days and 7.8 days for dwarf and desi wheat field preparation and sowing. A pair of bullocks works approximately one extra day to prepare a clara. Bullocks are rarely rented. They are usually loaned in exchange for labor. Hence, the average price per day for a pair of bullocks has been estimated from separate pieces of information collected during the survey and is shown in Table 7.8.

4. Seed and Fertilizer

The amounts and prices of seed, nitrogen and phosphate have been discussed in Section I. It should be added, however, that dwarf wheat seed is now readily available and its price has converged to approximate the price of wheat grain sold for food in Hazara. On the average, wheat seed sells for around 50 paisa per seer. However, most seed is saved from one crop to another and very little is sold commercially in village bazaars.

As mentioned, the government attempts to standardize the price of a pound of nitrogen at 0.50 rupees and a pound of phosphate at 0.40 rupees regardless of source. At these prices, the government is subsidizing the price of fertilizer by about 25 percent.

TABLE 7.8. COSTS OF BULLOCK TEAM IN HAZARA DISTRICT, 1970

Bullock Team Item	Unit	Amount
Market Value	Rupees	500
Useful Life	Years	8
Use Per Year	Days	70
Salvage Value	Rupees	250
Area Cultivated Per Annum	Acres	6
Annual Costs:		
Feed/care/shelter	Rupees	165
Depreciation	Rupees	30
Interest	Rupees	25
Death Loss	Rupees	10
Miscellaneous	Rupees	20
Total:	Rupees	250
Annual Credit:		
Manure	Rupees	75
Net Cost:		
Per Year	Rupees	175
Per Day	Rupees	2.50

Total Revenue and Product Pricing

Total revenue is the summation of all goods produced times their respective prices. In Pakistan, both wheat and straw have economic value, and are, in essence joint products. Since Menipak-65 and the popular desi varieties look (and many say taste) alike, they are equally priced at Rs 20.00 per maund in Hazara (whereas desi wheats receive up to 50 paisa more per maund over dwarf wheat in the Punjab.) Dwarf wheat straw is short compared to desi wheat. Hence, it is assumed that for every maund of desi wheat there is a maund and a half of desi straw produced. And for each maund of dwarf wheat a "grain : straw" ratio of 1:1 is assumed.

Again, like other factors in Hazara, straw is generally not marketed. It is kept for feeding farm livestock. Farmers do say, however, that on the average wheat straw is worth approximately five rupees per maund if sold; either dwarf or desi straw, but the latter is preferred. This price is used in the computations below.

Budget Analysis of Costs and Returns[15/]

Now that we have examined the major components used in partial budgeting analysis and have priced inputs and outputs according to their average values for 1969/70, the next consideration is to analyze the costs and returns associated with dwarf and desi wheat production. Such an analysis can help determine whether or not dwarf wheats are relatively more profitable than desi wheats and from that, infer whether or not the relative income position of barani smallholders has improved with the production of dwarf wheats.

Table 7.9 gives a break-down for total costs and total returns on a per acre basis for dwarf and desi wheats. Cost items are divided into the costs for (i) family-farm inputs and (ii) purchased inputs. Assuming that the figures are broadly true for individual barani farms, the added "family-farm" inputs for dwarf wheats cost 15.95 rupees per acre and the added "purchased" inputs for dwarf wheats cost 32.57 rupees. Together, the incremental expenses brought about from the "new package" of inputs cost the farmer about 48.52 rupees more than the "old package" per acre. However, the additional income from dwarf wheat grain and straw is 178.50 rupees over the return from an acre of desi wheat. Thus, 48.52 rupees of added expenditures brought 178.50 rupees of added income, a ratio of about 3.7 to 1. By deducting the "family-farm" inputs, since their opportunity costs are relatively low in the short run, the ratio of added income to added expenditures is even greater, a ratio of about 5.5 to 1. Either way, the comparisons indicate that dwarf wheats, grown on a per acre

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[15/] The analysis follows the same technique used by: Witt, Lawrence, "Cost of Production And All That," mimeo, The Ford Foundation, Islamabad, Pakistan, August 8, 1969, pp. 14.

basis, are at least three times more profitable than desi wheats, using 1969/70 average figures. This implies that barani smallholders can afford significant amounts of added expenditure if yields can be increased substantially.

TABLE 7.9 INCREMENTAL COSTS AND RETURNS FOR DWARF AND DESI WHEAT IN HAZARA DISTRICT, 1969-70*

(Rupees/Acre)

ITEM (1)	Wheat Type: DWARF (2) (n = 71)	Wheat Type: DESI (3) (n = 35)	INCREMENTAL CHANGE (4) (2) - (3)
FAMILY-FARM INPUTS:			
Land @ Rs. 70.00/acre	70.00	70.00	0.00
Labor @ Rs. 0.50/day	15.75	10.55	5.20
Bullocks @ Rs. 2.50/day	32.75	22.00	10.75
PURCHASED INPUTS:			
Seed @ Rs. 0.50/seer	18.25	16.10	2.15
Nitrogen @ Rs. 0.56/lb.	22.79	3.36	19.43
Phosphate @ Rs. 0.46/lb.	14.81	3.82	10.99
sub-total	55.85	23.28	32.57
TOTAL COSTS (rupees)	174.35	125.83	48.52
RETURNS:			
Grain @ Rs. 20.00/md.	330.00	170.00	160.00
Straw @ Rs. 5.00/md.	82.50	64.00	18.50
TOTAL RETURNS (rupees)	412.50	234.00	178.50
INCOME ADDED BY ONE RUPEE OF EXPENDITURE FOR:			
PURCHASED INPUTS	About 5.47		
TOTAL INPUTS	About 3.68		

* Average input levels are shown in Table 7.6.

Understandably, the ratio can worsen by (i) higher input prices, (ii) lower product prices, (iii) reduced dwarf wheat yields or increased desi yields and, (iv) in general, reduced productivity of dwarf wheat resources. Analysis of changes in the ratio from anyone of these (or in different combinations) is possible with partial budgeting analysis. But because of the number of possible combinations and difficulty of demonstrating them all, only two examples are given.

First, if we assume that the government subsidy on fertilizer is removed, so that nitrogen costs 70 paisa per pound and phosphate 60 paisa (and no change occurs in the quantity applied) then we would have the following calculations:

	Dwarf Wheat	Desi Wheat	Incremental Change
Family-Farm Inputs	118.50	102.55	15.95
Purchased Inputs	63.96	25.28	38.68
Total Costs	182.46	127.83	54.63
Total Returns	412.50	234.00	178.50

With the higher prices for both types of fertilizer, the ratio of added returns to added costs drops from 5.47 to 4.60 for income added by one rupee of expenditure for "purchased inputs." The ratio is lowered from 3.68 to 3.25 for income added by one rupee of expenditure for "total inputs."

Second, if we assume that dwarf wheat yields are lowered by twenty percent (and, concomitantly, the straw yield drops) and we have the 1969/70 average input and price levels, then the ratio is lowered from 3.68 to 2.33 for income added by one rupee of expenditure for "total inputs". The income added by one rupee of expenditure for "purchased inputs" is still very favorable.

Other examples can be developed, but with more reasonable assumptions it is evident that dwarf wheats are relatively more profitable than desi wheats. The favorable ratios of returns to costs indicate that barani smallholders can be made better off by adopting the "new package" of inputs. Also, the comparisons suggest (along with the conclusions of Chapter V) that if the ratio continues to be as favorable, then it behooves barani smallholders to undertake the additional expenditures and to produce the new varieites. From these conclusions, we can infer that the relative income position has improved for the farmers who have used the new, high-yielding varieties of wheat.

CHAPTER VIII

SUMMARY AND RECOMMENDATIONS

Summary

Background

West Pakistan's agricultural sector faces two problems of constant urgency: (1) maintaining a rate of growth in food-grain production that at least equals or exceeds the rate of growth in population and (2) reducing the uneven spread in the distribution of benefits within the rural populace so that the gap between the "haves" and the "have nots" does not widen, hence creating the dismal prospect of social discontent and political unrest among the rural masses.

For a country with limited resources, solutions to the two problems are not easy to come by. For example, if Government proceeds with guidelines specifically directed towards increased crop production (at least cost), then it must work to push the economic factors whose multiplier effects would be the greatest, and perhaps faster to adjust, in terms of attaining the desired result. In usual cases, this calls for programs with incentives to stimulate the major producers of the agricultural economy -- the large commercial farmers. However, such programs of change benefit large farmers in the first instance and widen the distribution of benefits in the second, a result which apparently conflicts with the other problem of lessening the disparity in incomes. Certainly such measures to increase production have created the spectre of only improving the conditions of the large commercial farmers and leaving the smallholder relatively worse off.

Whether or not barani smallholder farmers have benefitted from Pakistan's agricultural strategy to diffuse technologically improved varieties of wheat is thus of concern to policy makers. For if these relatively poorer farmers (whose crops are largely dependent upon rainfall) cannot benefit from the development strategy that moves large farmers, then other measures and programs may be required. But if the same strategy increases agricultural crop production and benefits both large and small growers then its expansion and reproduction is called for.

The objectives of this study were to: (1) determine the extent to which barani smallholders use dwarf wheats, (2) identify the factors associated with dwarf wheat diffusion and adoption among smallholders, (3) examine the phenomena of off-farm migration and non-farm employment which apparently influence farm management decisions and the income position of barani smallholders, (4) analyze the economics of wheat production on barani land, and (5) make practical recommendations for improving the well-being of barani smallholders. The importance of this study is further indicated by the fact that: approximately 30 percent or 3.8 million acres of West Pakistan's wheat is sown on barani land each year; wheat yields are invariably lower on barani acreage (by as much as 50 percent) compared to irrigated acreage in West Pakistan; over 6 million people live on barani farms and very little is known about the socio-economic conditions and constraints within which barani smallholders perform.

West Pakistan's principal barani or rainfed area spans the Northern territory between 33° to 35° North Latitude and 71° to 74° East Longitude. This area is affected by the summer monsoons and enters into the Himalayan foothills of West Pakistan. For purposes of analysis "the barani" can be divided into three geographically distinct areas: (1) the Potwar Plateau and Pabbi Areas, (2) the Himalayan Foothills and Valley Areas and, (3) the Peshawar Vale and Kohat Range.

This study focused on barani smallholders who live in Hazara District, an area which is largely representative of the Himalayan Foothills and Valley Areas. Hazara receives relatively higher rainfall than other barani areas, between 30 to 60 inches annually. In addition, the District faces problems associated with a dense and rapidly expanding population on a small base of comparatively unproductive cultivable acreage. The majority of the farmers grow primarily wheat in winter and maize in summer. Very little of the grain produced is sold commercially.

Data for the study were collected during two field surveys in 1970 which coincided with the post harvest periods for wheat and maize: May/June and October/November, respectively. A special sampling technique was developed in order to have a widespread sample of respondents. It involved approaching and interviewing farmers who were in the field or on the trail in the vicinity of villages which were chosen at random by the interviewing team. The latter consisted of the author and an interpreter who was raised in similar barani surroundings. Special care was taken by the interviewing team to encourage reliable answers from the respondents. Altogether, 226 farmers were interviewed. The average size of holding cultivated by the interviewees is about 5 acres; 97 percent of this cultivated acreage is barani. Also, about 82 percent of the respondents own their land, 4 percent both own and rent land, and the rest are tenants.

Dwarf Wheat Diffusion and Adoption

(1) In the survey locations of Hazara, it was found that there has been rapid adoption of new dwarf wheats (particularly Mexipak-65, the common dwarf) and chemical fertilizer. In the sample of 226 respondents, two smallholder farmers (0.9%) were sowing dwarf wheats in 1966/67. By 1967/68, a total of 30 farmers (13%) were trying dwarfs. In 1968/69, 75 farmers (33%) grew dwarf wheats and by 1969/70, the year covered by the survey, 150 smallholders (66%) were dwarf wheat adopters. The test of dwarf wheat endurance came when farmers were asked if they were going to plant dwarf wheats during the next winter season (1970/71). The response showed that 200 out of 226 (86%) anticipated growing the new variety, some for the first time. The pattern of fertilizer adoption was quite similar to that described for dwarf wheats, also starting with initial usage in 1966/67.

With regard to the intensity of adoption, the findings show that barani smallholders moved cautiously at first by experimenting with handfuls of seed. More specifically, the findings indicate that smallholders will rarely sow more than 30 percent of their acreage with a new variety during the initial year of experimentation. As they become more familiar with the innovation, the decision to adopt or reject completely comes into their consideration.

(2) Respondents in Hazara District adopted dwarf wheats because they: (i) gave better yields over desi varieties, (ii) fit the cropping pattern of the farmer and grew in a faster time than desi varieties, (iii) were subject to experimentation on a small scale by individual farmers, (iv) were not complex in relation to desi wheat with respect to the manner in which they were planted and cared for, and (v) had other

positive features like beards which protected grain against birds. In a few cases, Mexipak-65 even tasted better than desi wheats. One complaint, however, was that dwarf wheat gave less fodder. But in all cases of adoption, barani smallholders were willing to substitute less fodder for a higher grain yield.

With regard to yields, data were presented which showed that for each and every year, from 1967/68 to 1969/70, dwarf wheats out-yielded desi wheats by a consistently wide margin, nearly 100 percent on the three year average. On the average, dwarf wheat growers can expect around 16.5 maunds per acre with dwarfs and 8.5 maunds per acre with desi wheats. However, to date, dwarf wheats show a wide variability in yield, from a possible low of 6.5 to a high of 26.6 maunds per acre. On the other hand, desi growers experience a range in output from 4 to 13 maunds per acre. Evident is greater risk and uncertainty associated with the new varieties. With better farm management practices and increased experience with the new varieties it may be possible to reduce the variability in dwarf wheat yield in the coming year. However, complicating the process of adjustment to dwarf wheats is the finding that farmers have substituted much more than a new variety of wheat for an old. Namely, dwarf wheat growers apply more man-hours of labor, higher seed rates, and chemical fertilizer to their crop than desi growers. In essence, they have adopted a completely "new package."

(3) There were two principal communication channels which informed barani smallholders of the new varieties of wheat: (i) mass media channels and (ii) interpersonal channels, including the sub-categories. The most effective mass media channel was the radio. Nearly 24 percent of the respondents who knew of "Mexipak" indicated

that they first heard about dwarfs over the radio. Overall, 39 percent of the respondents owned radios. Seven percent who did not own radios indicated that they were first made aware of dwarf wheats over this media. Less than one percent first learned of dwarf wheats from the written media.

There were essentially three types of interpersonal channels which informed the barani smallholder of dwarf wheats: (i) interpersonal localite, (ii) interpersonal cosmopolite and (iii) the demonstration plots. While the radio was evidently important, the interpersonal localite contacts still had the largest impact of informing smallholders of new seed; 35 percent of those who knew about dwarf wheats first heard of them from neighbors. Another 16 percent of the sample first saw dwarf wheats in demonstration plots and asked the farmers growing them about the crop. These two findings show that interpersonal exchanges between farmers and the dwarf wheat demonstration plot (which showed striking differences next to desi wheat) were effective transmitters of information.

Another 25 percent of the respondents heard about dwarfs initially from interpersonal cosmopolite sources such as the government extension agents and the distributors of farm supplies. It should be noted that Field Assistants (lowest level extension agents of the Agriculture Department) were very instrumental in diffusing dwarf wheat varieties. Aside from personally informing farmers of dwarf wheat potential, they were responsible for the installation of many of the demonstration plots on farmers' fields which, in turn, were catalysts in dwarf wheat diffusion.

(4) Three types of independent variables were correlated with

awareness and innovativeness: economic, communication, and intervening variables (of migrants and their remittances). The results from the zero-order correlations show that:

(a) <u>With regard to awareness</u>:

(i) Of the economic variables, farmers who owned most of their land and had comparatively larger families were significantly earlier than others in their community to become aware of dwarf wheats. A very weak relation tends to indicate that farmers with medium size farms (4 to 5 acres) score relatively higher in terms of awareness than farmers with large farms. In addition, it is quite probable that "wealth" (the combination of farm area and cash income) in a smallholder environment is not a major determinant of early awareness of innovations.

(ii) Of the communication variables, both interpersonal cosmopolite and mass media channels were significantly important in creating awareness sooner than other channels among smallholders. Also significant is the finding that the last farmers to become aware of dwarf wheats were all informed of the innovation by interpersonal localite channels.

(iii) The data do not lend themselves to testing whether or not off-farm family migrants were important sources of first information in dwarf wheats; one can only surmise that migration leads to increased awareness of the developments in the world outside the village community.

(iv) Taken together, the zero-order correlations indicate that smallholders who become aware of innovations before others are generally those who own most of their land, have large families, frequently listen to the radio and have more interpersonal contacts with change agents and sales representatives of farm inputs.

(b) With regard to innovativeness:

(i) Judged by the zero-order correlations, income per capita per farm, mass media channels, demonstration plots, migrants and migrant remittances seem to have little influence on smallholder's innovative behavior (with dwarfs).

(ii) Of the significant economic variables, smallholders who own five acres or more, have large families and relatively higher incomes are usually more innovative than others.

(iii) Of the significant communication variables, smallholders who score high on awareness and interpersonal cosmopolite contacts are more likely to adopt innovations before others in their community.

Two types of independent variables were also correlated with innovativeness by way of two regression models in order to identify whether communication or economic variables were more important in explaining innovativeness among smallholders. The results show that both communication and economic variables are significantly important and necessary in explaining innovativeness. Furthermore, it does not seem to be a useful argument to see which set of variables is most important since both communication and economic variables are highly interdependent and sequentially different from one another.

Migration and Non-Farm Employment

Migrant exodus apparently influences the farm production/subsistence environment of the barani smallholders in Hazara. In order to understand the nature of migration, non-farm employment and their possible influence on barani smallholders, a series of questions on these factors were included in the survey schedules. The preliminary conclusions are that:

(1) The "extended family" appeared to be one of the most important factors perpetuating the pattern of migration and non-farm employment.

(2) Migrants are generally young men with some schooling and they are usually from small farms with "medium size" extended families.

(3) Mostly adult males leave the village family. Married men will even stay away from their family for a year or more while they work in other places.

(4) Male family members go to such far-off places as Karachi (1,000 miles from the village area) to find various forms of employment.

(5) Jobs taken by barani smallholders are varied but the general job is low-paying, manual and not related to agriculture.

(6) There is a large cash flow from the places of non-farm employment to the needy villagers in the mountains; on the average, about 62 rupees per month is sent back to the village per migrant. Though off-farm remittances are an important component of family income for barani smallholders, the zero-order correlation analysis (discussed above) indicates that migrant remittances do not have much bearing on the farmers' willingness to use dwarf wheats. On the other hand, migrant remittances can provide for some degree of "risk insurance" against the failure of innovation.

(7) Among other things, off-farm migration serves to reduce the disparities within Pakistan conditioned by the differential rates of natural increase in population and between the income earned by the many different groups which serve the country.

The Economics of Barani Wheat Production

Production relationships between inputs and outputs for both dwarf and desi varieties of wheat were specified with the Cobb-Douglas production function. The objectives in fitting the function to the raw data were to depict the economic impact of dwarf wheats at the farm level, to evaluate the performance of the sample of barani farms in producing either wheat, and to estimate optimal levels for the use of seed and fertilizer. Limitations with the use of the Cobb-Douglas function and the estimates which were obtained were noted throughout the analysis.

The noticeable economic impact with dwarf wheats is manifested in: (i) the development of a new production function and (ii) the changes in the production factor proportions. The two sets of production elasticities consistently revealed the following results: (i) an important factor in explaining interfarm differences in wheat output is land; (ii) the production elasticities for labor were negative and not significantly different from zero; and (iii) fertilizer appears to contribute relatively little at the margin to output for both types of wheat. The signs of the fertilizer elasticities were positive but only the elasticities for fertilizer applied to dwarf wheats were significantly different from zero. The results also came up with a negative production elasticity for "seed rate" applied for desi wheats and a positive elasticity for seed rate applied for dwarf wheats.

The marginal productivities which were estimated with the Cobb-Douglas function indicated that: (i) the rate of return to land was relatively higher than those of other inputs; (ii) the MVPs for labor used in producing desi and dwarf wheats were zero, showing that there is surplus labor on barani smallholdings; (iii) it is not possible to say conclusively what the seed rate should be for either dwarf or desi varieties sown under barani conditions; and (iv) nothing conclusively can be recommended with regard to fertilizer applied to desi varieties. On the other hand, a comparison of the MVP's for fertilizer applied to dwarf wheat with their MFC's indicate that optimal use of N at present prices should be between 20 to 30 pounds per acre and that between 30 to 40 pounds of P_2O_5 would come close to an optimal use of phosphates.

By all indications, the performance of dwarf wheats on barani land can be improved substantially by a proper utilization of the inputs studied. However, the variability in the sample data suggest that more research and analysis is needed to understand what readjustments are necessary in the factors of production presently utilized.

Cost and returns to dwarf and desi wheat production were examined with partial budgeting analysis. Problems with placing a price on the inputs of land and labor were discussed. Altogether, values were placed on land, human labor, bullock labor, seed, and fertilizer (both N and P_2O_5). Returns were estimated for the joint products of wheat and straw combined. Using the actual level of inputs employed and the output obtained (for 1969/70) for the sample of 71 dwarf wheat growers and 35 desi wheat growers, the costs and returns indicate that, on the average, dwarf wheats are at least three times more profitable than desi wheats. In addition, partial budgeting analysis indicated that the relative profitability with dwarf wheats compared to desi wheats was virtually unchanged when the price of fertilizer was increased by 25 percent in one case and when dwarf wheat (and straw) yield was lowered by 20 percent in another case, all other things held constant. Overall, partial budgeting analysis showed the potential for barani smallholders to finance agricultural improvements themselves. With moderate-sized investments in dwarf wheats and fertilizer, farm income appreciably doubled over former levels with only traditional wheat and complementary inputs. Finally, one can infer from the above that as smallholder income and barani agricultural productivity increase, the prospects for maintaining an ever-growing population improve. Looked at another way, the "need" to migrate is essentially balanced out by the ability to feed more people on the farm.

General Conclusions Concerning the Fourth Five Year Period

Analysis of the survey results leads to the conclusion that new strategies and programs need not be a necessary component of the Fourth Five Year Period; that programs similar to the Food Self-Sufficiency Program should be designed to develop and diffuse new, high-yielding varieties of seed and complementary inputs to barani areas in order to make a substantial impression on the livelihood of barani smallholders.

The survey has shown that smallholder barani farmers are responsive to economic incentives and communication stimuli. They will make rapid adjustments in resource allocation with high-yielding varieties of seed provided they become aware of the potential improvements with the new seeds and receive equal opportunities in terms of acquisition of the genetically-improved varieties. Concomitantly, the possibility of successfully diffusing an innovation so that it may eventually be adopted depends very much on the characteristics of the innovation and the risk and uncertainty bearing on the subsistence level of the farm producer. To be adopted, the innovation must show relatively higher profitability, an ability to fit into present cropping patterns, and other positive features mentioned above. Also, the findings indicate that the lack of credit does not appear to be a limiting constraint on the ability of farmers with small holdings in Hazara district to adopt new, high-yielding varieties of seed, since they apparently have sources of income from local employment and migrant remittances.

It was also found in this study that any program designed to diffuse agricultural innovations must first concentrate on creating awareness among smallholders in general. Specifically, the findings show that barani smallholders who own most of their land and have comparatively larger incomes and families can be informed most effectively of agricultural innovations by the radio and the interpersonal cosmopolite channels of communication. Barani smallholders who rent proportionately more of their land, have small families and relatively little cash earnings depend almost entirely on interpersonal localite channels for information on innovations. The larger (in terms of numbers) intermediate category of farmers can be informed of innovations by both mass media and interpersonal types of communication. In addition, it behooves the extension staff to select those smallholder farmers, who exemplify the "best" farm management practices, to serve as demonstrators of further innovations.

It can be concluded that the impact of the new varieties has been to increase output, to employ more resources and to influence cropping patterns. And as we have seen, the relative income position of barani smallholders has been able to improve in the process. However, due to the small size of farm operations, the quantifiable differences may not show as major repercussions on the total economy of West Pakistan.

Recommendations

The following discussion should be considered in light of the survey findings of this study. Furthermore, the recommendations presented are made with the fundamental desire of indicating ways to sustain the current production advances of the Green Revolution, to broaden the base of agriculture technology and cropping alternatives available to the smallholder, to build viable extension institutions to service smallholders, and to improve the transmission of information from both domestic and foreign research to the farmers and extension personnel.

The following recommendations apply to situations found in Hazara District, and, as such, they are directed towards the Provincial Government of the N.W.F.P. They may also be applicable to parts of the Himalayan Foothills in the Punjab and Azad Kashmir where similar agro-climatic farming conditions prevail.

For More Immediate Consideration

(1) The most immediate action should be to develop a full-scale crop improvement program with particular attention given to developing and diffusing new crop varieties suitable to barani conditions. This entails intensified research in two interrelated areas: plant breeding and farm management.

Plant breeding research should strive to develop newer and "better" varieties adaptable to barani conditions. New varieties need not be higher-yielding to be better. For example, although genetic structures of a variety do not change, disease organisms do. The pathogens that attack wheat, particularly the rusts, continuously mutate into new types with different degrees of aggressiveness against the wheat plant.

New varieties which are popularly grown may become susceptible to new pathogens. If Mexipak-65, which is the common dwarf variety sown by smallholders, becomes susceptible to new rusts, smallholder wheat production will be vulnerable to suffer drastic losses that may bring serious repercussions on smallholders and the total farm economy. The only defense against such a scourge is a research and distribution program which insures that alternate varieties are constantly being introduced.

Farm management research is desperately required to identify the types of farming, crop and livestock combinations, crop varieties, levels of capital, and labor input which are needed to use land and labor resources fully and efficiently to the best advantage of the smallholders. In addition, farm management research is needed to analyze ways to improve the external environment of tenure, credit, marketing and price conditions which are required to accelerate agricultural progress and general economic development.

If effective, farm management research can provide a feedback linkage from farm to policy-making agencies. A clear knowledge of averages, variations, and relationships within agriculture can lead to sound hypotheses concerning the effects that alternative policies may have on smallholders. Farm management research can also be useful for: (i) advising farmers engaged in agricultural production, (ii) teaching those who are to serve agriculture in operating capacities, and (iii) informing those formulating public agricultural policy.

(2) Plant breeding research should be carried out on existing research stations with experimentation through a "farm testing program" in cooperation with the extension service. Pakistan has long-established

and successful plant research institutions that can give valuable support to crop improvement campaigns for wheat, maize, sorghum, millets, and rice. These institutions have also had strong ties with the International Maize and Wheat Improvement Center (in Mexico) and the International Rice Research Institute (in the Philippines). Such ties should be continued with periodic exchanges of breeding materials, crop specialists and students. This requires the availability of modest funds to import small quantities of materials, critical equipment, and skilled specialists. Together, both domestic and foreign institutions should devote more attention to developing varieties which are attractive to barani farmers. The major characteristics of favorable varieties are: high yields, short growing periods, good taste, and fodder supply to feed farm livestock. Research should also focus on developing varieties which are drought, disease, and insect resistant. Perhaps, most important of all, research should concentrate on ways to reduce the extreme variability in yields with the new varieties. To accomplish this requires a thorough testing program of new varieties under different soil and climatic conditions.

The research stations at Tarnab, Pir Sabak, and Mansehra provide ideal agro-climatic conditions suitable for developing varieties for "the barani". In particular, Tarnab and Pir Sabak facilities are adequate to test for drought resistant varieties of the major food-grain crops. The Mansehra station is well-located to serve Hazara District. It is not a new experiment station which is needed, though; it is a specific set of agricultural research outputs that provide new possible breakthroughs to protect and improve what has been attained.

Research experiments carried out on farmers' fields in a "farm testing program" should include closely supervised instructions to innovative smallholders on the use of new varieties. To do this, it will be necessary to have detailed plans for each test plot indicating varieties, treatments, etc. Farm test experiments can be developed and packaged by research station personnel. The selection and observation of farm test sites can also be handled by the Department of Agriculture extension staff. Such farm tests, which could range from a quarter of an acre to a full acre for experimentation,can also serve as demonstration plots for the neighboring farmers to see.

(3) Farm management research should be developed and implemented as a complement to plant breeding research. Since risk and uncertainty bear on subsistence farm production decisions and ultimately affect the intensity of adoption of new varieties, certain steps are required to assure a greater rapidity and extent of adoption of new technology. First, farm management research should be conducted through well-executed advanced preparations and carefully constructed interview schedules in order to gain useful information from village respondents. Second, farm management research should focus on determination of (2) optimal input levels and (b) optimal combinations of farm products. Knowledge of optimal input levels is more important in helping governments to allocate the scarce fertilizer supply, for example, among areas and even among crops so that farmers can have prior knowledge on fertilizer availability. Knowledge of optimal farm combinations is useful to the farmers as they become commercially oriented and influenced by changing price relationships for purchased inputs and marketed outputs. Third, farm management research should focus on the formulation of budgets which

show the economic effects of various combinations of changes in practices and enterprise combinations. The information can be used in advising farmers of the net returns they should expect by following different techniques of production.

Farm management research does not need a large budget, but does require a few experienced and exceptionally talented researchers working together as a team. Institutions such as the Board of Economic Enquiry in Peshawar, the Pakistan Academy for Rural Development, and the agricultural and economic faculties at the University of Peshawar have individuals capable of conducting small farm management research projects. Their cooperation and funding could be engaged and coordinated through a "Farm Management Section" in the Planning and Development Department in Peshawar.

Farm management research need not require large and cumbersome samples of farmers. Such exigencies, in early stages of development, encounter problems with data compilation and scarcity of skilled interviewers. It might best be started on a small scale with initial surveys limited to 30 to 100 well-selected farms which have conditions conducive to effective comparisons on the points raised above. Emphasis should be placed on working out practical research methods and simple field schedules and procedures. Furthermore, the initial studies should be made to spot problems for more intensive study, to provide basic data for farm budgeting and to provide a learning experience for conducting more intensive studies. Each year at least one specific problem should be studied. At this juncture, the most important research can be found in the barani areas of Kohat, Potwar and Pabbi areas. The economic problems in these areas are also serious. At this time farm-level field research is needed both to orient crop research and agro-economic research and to provide guidelines for government action in these areas.

(4) Channels of communication between research outlets and farmers should be strengthened so that smallholders are kept informed of innovations available to them. If new varieties and production alternatives are specifically designed for the difficult conditions and precise cropping patterns of the barani, then the mass media and interpersonal channels of communication will need to remain dynamic. Since interpersonal contacts are especially needed to reach the smallest farmers, the extension agents will require additional training and experience in the use and limitations of the new technology adapted for the barani smallholders. Better demonstration plots, not necessarily more, will need to be installed in order to enhance the farmers educational needs. In addition, radio programming will assume greater responsibility which implies that its broadcasts will have to be timely and relevant with respect to the particular information needs of the farmer.

In particular, there is critical need to improve the knowledge of Field Assistants who will be called upon by farmers who desire information on new varieties. Moreover, to alleviate the problem of excessive distribution of extension resources, the use of "farm test experiments" is recommended for involving Field Assistants in practical activities. Such an approach would be educational for the Field Assistants and the farmers alike.

For Later Consideration

Government attention should be given to enhancing the supply and extension of profitable factors of production pertaining to innovations. More specifically, the success of any crop improvement program depends upon the availability of production inputs at sites conveniently located for the farmers well in advance of the appropriate time of utilization. If supplies are not available well in advance, the uncertainty affecting farmers' decisions may be such that the continued use of innovations is thwarted.

An allied recommendation is to develop pure seed supplies. Seed multiplication should be encouraged and expanded among farmers in "the barani". Seed certification would be an important concomitant to seed multiplication. It necessitates records on "proof of origin," inspection of the growing crop to check for purity of stand, seed germination, and purity tests after harvest.

Plant breeding research should give attention to developing diversified crop production and intensive land use techniques. Studies, for example, on the use of fertilizer with various levels of residual moisture should be undertaken to find profitable levels of its use with new crops. Multiple cropping should be studied to utilize "scarce" land more intensively and efficiently.

Finally, it is recommended that an agronomist or a "subject matter specialist" position be established in each District to handle several related activities: (i) to work with Field Assistants (FA's) in setting up farm test experiments,(ii) to train FA's to upgrade their performance and to keep them abreast of the latest research output available for testing, (iii) to serve as a liaison between farmers, Field Assistants, and research stations, (iv) to attend annual research reporting and extension planning meetings, and (v) to experiment with multiple cropping techniques on farmers' fields. A subject matter specialist should hold at least an M.S. degree in agronomy and have some field experience and practical expertise with farmers' problems. He should be administratively under the Extra Assistant Director of Agriculture and at least on the same status level with Agricultural Assistants (who attend to the Administration of FA's and the necessary paper work).

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APPENDICES

APPENDIX A

GLOSSARY OF PAKISTANI TERMS AND MEASURES

Units of Measure

1. Cropping Intensity = the ratio of "net area sown" plus "area sown more than once" to "net area sown" times 100.
2. Kanal = 1/8th of an acre.
3. Maund = standard unit of measure for agricultural produce = 82.286 pounds. Approximately 27 maunds = one ton.
4. Merla = 1/20th of a kanal.
5. Rupee = name for Pakistani currency. One rupee = about 21 U.S. cents at the official exchange rate.
6. Seer = 1/40th of a maund = 2.057 pounds.
7. Wodi = a wooden or metal bowl used for measuring grain on the threshing floor (in Hazara District). One wodi holds approximately 5-1/2 seers of wheat grain.

Urdu Terminology

1. Barani - land which has only natural precipitation as a source of moisture; used synonymously with "rainfed."
2. Bunjar - land which is pebbly, undeveloped and generally uncultivated.
3. Burra-sahib - burra means "big" and sahib means "Mister."
4. Chowkidar - night watchman.
5. Clara - a threshing floor prepared by driving bullocks on a particular spot in the field until the ground is packed down.
6. Desi - anything which is "local" or traditional.
7. Kera - method of sowing seed by dribbling it by hand directly

into a furrow.

8. Maira - cultivated land near the household which generally receives farm yard manure.

9. Mexipak - the term which is commonly used by farmers for identifying the new dwarf varieties of wheat.

10. Patwaris - village revenue collectors, usually elder citizens.

11. Pora - method of sowing seed by dropping it into a funnel attached to the traditional plow.

12. Purdah - Muslim practice of female seclusion whereby women are concealed from non-family members.

13. Shalwar/kameez - Shalwar means pants and kameez means shirt. Combined, the term refers to traditional dress.

14. Thana - literal translation is "police station." However, it refers to an area of police jurisdiction as well.

15. Zamindar - literally means "landowner" but generally refers to the farmers with wealth and large land holdings with tenants.

APPENDIX B

DEFINITIONS OF "ZERO-ORDER" AND "MULTIPLE" CORRELATIONAL ANALYSIS

Correlational measures were developed by social scientists to measure the strength or degree of relation between socio-economic characteristics and population behavior.

(1) Zero Order Correlational Analysis refers to the process of measuring the closeness of the relation between two variables. The standard measure is called the coefficient of correlation designated by the statistical symbol "r" which is generally estimated by the "product-moment" method for the coefficient of linear correlation. Estimation of "r" is useful in telling us whether variables are related to each other and the strength of the relationship. For example, if we find a perfect and positive correlation, the value of r will equal +1. For a perfect and negative correlation, the value of r will equal -1. If there is no relationship at all, the value of r will equal 0. Thus, r can have any value between +1 and -1. When two variables are correlated with each other and significantly different from zero, then the independent variable is said to "explain" variance in the other. The two variables are called independent and dependent, according to which one is viewed as depending on the other. In the following analysis it should be noted that the ordinary coefficient of correlation assumes a linear relation between two variables. Also, it cannot help us decide whether the

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Only a brief review can be given here. More detail is found in Ezekiel, Mordecai and Karl A. Fox, Methods of Correlation and Regression Analysis: Linear and Curvilinear, John Wiley & Sons, Inc., New York, Third Edition, 1965.

relation is one of cause and effect.

(2) Multiple Correlational Analysis refers to the statistical method of measuring the joint relation between one dependent variable and two ore more independent variables. The multiple correlation coefficient among several variables is always positive and at least as large as the largest zero-order correlation coefficient. As such, it is almost always labelled "R". A regression equation describes the relation between the dependent variable and all of the independent variables. It has the following form:

$$Y = a + b_1 x_1 + b_2 x_2 + ---$$

where Y represents the estimated value of the dependent variable from the regression equation, "a" is a constant term, the b's are the partial regression coefficients, and the x's are the independent variables.

As we increase the number of x's, visualization of relations between variables becomes difficult. Determining which independent variables should be added or eliminated also becomes a difficult problem.

APPENDIX C

FACSIMILE OF FIELD SURVEY INTERVIEW SCHEDULE*

Resource Use On Barani Farmland of Hazara District, 1970

- CONFIDENTIAL -

Date of Interview: ______________ I.D. No: ______________

Farmer's Name: ______________ Age: ______________

Village: ______________ Literate: Yes/No

Part I. -- General Information

Farm Characteristics

1. How many total kanals of land do you own? __________ rent? __________

2. How many total kanals of land do you cultivate in a year? __________

3. Are any of the kanals that you cultivate irrigated? Yes/No

   If yes, how many? _________ What do you grow on the irrigated land? __________

4. How many fragments do you cultivate? __________________

Production

5. How many kanals of wheat did you plant this rabi (1969/70)? _________

6. How many maunds of wheat were harvested altogether? _______________

7. How many kanals were planted with (a) Mexipak? ___________ (b) desi? ______

8. If both grown, did you thresh the mexipak and desi separately? Yes/No

9. If mexipak planted and threshed separately,

   (a) how many total maunds of mexipak did you harvest this year? _______

   (b) was mexipak planted on your best land? Yes/No

   If yes, was this land all maira? Yes/No

* This interview schedule incorporates the principle questions asked during the first and second rounds of interviews which are used in this study. Superfluous questions have been eliminated.

10. <u>If desi planted and threshed separately</u>,

    (a) how many total maunds of desi did you harvest this year? ________

    (b) was desi planted on your best land? Yes/No

    <u>If yes</u>, was this land all maira? Yes/No

11. What other crops did you grow this rabi? ____________ kanals

    used? ____________

Part II. -- Economic and Communication Factors

<u>If Mexipak was grown, ask the following</u>:

12. When did you first hear about mexipak (month and year)? __________

13. Did you first hear about mexipak from the radio, a neighbor, a government worker, a store clerk, someone in your family or other? ______________

    (a) Do you own a radio? Yes/No

    (b) Do you listen to any agricultural programs? Yes/No

14. When did you first plant mexipak (month and year)? ____________

    Why? __________________

15. How many kanals of mexipak did you plant:

    (a) the first year? ________ (b) the following year(s)? _________

16. How many maunds of mexipak did you harvest:

    (a) the first year? ________ (b) the following year(s)? ________

17. Will you grow mexipak next year? Yes/No

18. Why didn't you grow mexipak sooner? ____________________

19. How many seers of mexipak seed did you use this year? ____________

20. Where did you get the mexipak seed from? ____________________

21. How much did you pay for your mexipak seed? ____________________

If desi was grown (and no mexipak), then ask the following:

22. Have you heard about the mexipak wheats? Yes/No

23. When did you first hear about mexipak (month and year)? ______________

24. Did you first hear about mexipak from the radio, a neighbor, a government worker, a store clerk, someone in your family or other? __________________

(a) Do you own a radio? Yes/No

(b) Do you listen to any agricultural programs? Yes/No

25. Will you grow mexipak next year? Yes/No

If yes, why? ___________ On how many kanals? ________

Where will you get the seed from? ________________

Part III -- Resource Use

Bullocks:

26. In preparing your wheat fields, did you use bullocks? Yes/No

27. How many bullocks do you own? __________________________

28. How many pairs of bullocks were used in preparing your wheat fields? ______

29. How many times do you plow each wheat field including the time for sowing? _________________

30. How many days does it take to plow all your wheat fields one time? ____

31. How many hours per day do you usually spend in the fields plowing? ____

Field Preparation and Threshing:

32. Do you plow your fields more often for mexipak than for desi wheat?

Yes/No If yes, how much more time is used? days______ hours ______

33. Did you use bullocks to prepare the clara and to thresh? Yes/No

If yes, how many? ______ How long did they work? ___________

Labor: Family and Purchased

34. How many people helped you harvest your wheat this rabi? ________

35. How many days did it take? ________

36. How many hours did it take each day? ________

37. Did you hire people to help you harvest your wheat? Yes/No

If yes, how many? ________ What did you pay each? ________

38. How many relations (family members) helped you? ________

39. How much is a laborer paid in rupees for one day's work in this village? ________

(a) Does that include lunch? Yes/No

(b) Does that include a share of the harvest? Yes/No, How much? ____

40. How many people helped you winnow your wheat this rabi? ________

41. How many days did it take to winnow your wheat? ________

42. How many hours did you work each day? ________

43. Did you hire people to help you winnow your wheat? Yes/No

If yes, how many? ________ What did you pay each? ________

44. How many relations (family members) helped you? ________

Fertilizer:

45. Did you use chemical fertilizer on your wheat this year (1969/70)?

Yes/No If yes, then ask:

(a) what kind of chemical fertilizer did you use? ________

(b) where did you buy it? ________

(c) how many bags did you buy? ________

(d) how much did you pay for each bag? ________

(e) what was the weight of each bag? ________

(f) how much did you use on your mexipak? ________ desi? ________

(g) how many kanals of mexipak did you use it on? ________

46. How long have you been using chemical fertilizer (in years)? _________

Part III -- Miscellaneous

47. How much does a maund of flour (ata) cost on the local market? ________

48. Did you sell any wheat last year? Yes/No

49. Will you sell any wheat this year? Yes/No

50. How much does a maund of mexipak ________ desi ________ flour cost?

51. Have you taken any loans this year? Yes/No

Part IV -- Family and Employment

52. How many people are presently eating in your household? __________

(a) adult (over age 12) _______ male ________ female _______

(b) children (under 12) ________ male ________ female _______

(c) total family _________ total _______ total ________

53. Do you and/or any of your family member -- now in your house -- work in the village area? Yes/No

If yes, (a) who? ________ (b) what type of work? _______

(c) how much is earned? _______

54. Are any of your family members away from the village at this time? Yes/No

If yes, how many family members are away? _________________

55. For each member of your family that is away, would you please give me the following information:

Relation to interviewee? _________ Are they married? _______

Where are they now? ______________ Family here or in place of work? _____________

What do they do? _______________

How long have they been away? _____ How often does he visit village? _____________

What is their age? _______________

Years of schooling? ____________

Do they speak: Urdu/English?

Do they write: Urdu/English?

How much cash do you receive? ____________

What else do you receive? ____

Why did he leave the farm? ___

56. Have you worked away from the village? Yes/No

If yes, then ask: Where? _______ Doing what? _______ For how long? ________ When did you return? _______ Why did you come back? ______________

57. How do you and your family members know when there is a job available outside the village? __________________

58. What kind of work do you/they usually look for? ________________

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