THE MART/AZR PROJECT

HIGH ELEVATION RESEARCH IN PAKISTAN

Pakistan Agricultural Research Council

ARID ZONE RESEARCH INSTITUTE

Brewery Road, Quetta, Pakistan.

No. 26

BARLEY PRODUCTION AND ITS SCOPE FOR IMPROVEMENT IN THE HIGH ELEVATION RAINFED FARMING SYSTEMS OF BALUCHISTAN

by

J.G. Nagy, G. Farid Sabir,
Nisar Ali Shah, M. Afzal,
D.J. Rees andJ.D.H. Keatinge

1989

MART/AZR PROJECT RESEARCH REPORTS

This research report series is issued by the Management of Agricultural Research and Technology Project/Arid Zone Research Component (MART/AZR). This project is sponsored financially by the Mission to Pakistan of the United States Agency for International Development (USAID).

The project contract is implemented by the International Center for Agricultural Research in the Dry Areas (ICARDA) and Colorado State University (CSU) at the Pakistan Agricultural Research Council's Arid Zone Research Institute (AZRI).

This Institute has responsibility for undertaking dryland agricultural research in all provinces in Pakistan through its headquarters in Quetta, Baluchistan and its sub-stations at D.I. Khan (NWFP), Umerkot (Sind) and Bahawalpur (Punjab)

The principal objective of the MART/AZR Project is the institutional support and development of AZRI in the period 1985-1989. This series of research reports outlines the joint research findings of the MART/AZR Project and AZRI. It will encompass a broad range of subjects within the sphere of dryland agricultural research and is aimed at researchers, extension workers and agricultural policy-makers concerned with the development of the resource-poor, arid areas of West Asia and the Middle East.

Libraries, individuals and institutions may obtain single copies of this research report series free of charge and may request that their names be placed on a mailing list for periodic notifications of published papers by writing to the MART/AZR Project Office, P.O. Box 362, Quetta, Pakistan.

BARLEY PRODUCTION AND ITS SCOPE FOR IMPROVEMENT IN THE HIGH ELEVATION RAINFED FARMING SYSTEMS OF BALUCHISTAN, PAKISTAN

J.G. Nagy, G. Farid Sabir, Nisar Ali Shah, M. Afzal, D.J. Rees and J.D.H. Keatinge.

INTRODUCTION

Barley is an important rainfed crop in the high elevation (upland) areas of Baluchistan and is second in importance only to wheat as a cereal grain. Wheat hectarage however exceeds barley hectarage by a factor of 23 to 1 for all Baluchistan and by a factor of 20 to 1 in the dryland farming systems of upland Baluchistan (Government of Baluchistan - GOB). GOB Agricultural Statistics indicate that rainfed wheat out-yields rainfed barley in upland Baluchistan with yields of 0.8 and 0.6 t/ha respectively. (GOB, average 1981-82 to 1985-86 yields).

The Arid Zone Research Institute, Quetta, (AZRI) has conducted research on wheat and barley productivity. Under on-farm experimental field trial conditions, preliminary indications are that:

(1) Local landrace barley grain yields are higher than local landrace wheat grain yields (straw yields being similar); net benefits were greater for wheat because of a higher wheat grain price in the particular year of the experiments; in most other years the margin between wheat and barley prices is closer, making net benefits for barley as good as, or better than, for wheat;

(2) The biological yield and net benefits for an "improved" barley variety were higher than for the local landrace with and without the addition of fertilizer and the net benefits for the treatments without fertilizer were higher than when fertilizer was added and;

(3) In the absence of conditions conducive to yellow rust (Puccinia striiformis), the local bread wheat landrace "Local White" continues to be at least as productive as other bread wheat varieties in experimental field trials (ICARDA, 1987).

These experimental results raise several questions:

Firstly, if barley is higher yielding than wheat as suggested by the field experiments and net benefits are as good as wheat in most years, why do farmers not grow more barley?

Secondly, through further research, it is possible that improved barley varieties could out-yield wheat thus making barley production a more profitable enterprise, therefore

under what conditions of yield and price would farmers switch to produce more barley?

Thirdly, barley yields are lower than wheat yields in the Government of Baluchistan crop reporting statistics but the experimental field trial data indicate that barley out-yields wheat; can this be a reporting problem or are there production related reasons for lower barley yields not uncovered by the current series of field experiments (ICARDA, 1989)?

This paper focuses on barley production vis-a-vis wheat production in the rainfed farming systems of upland Baluchistan. The principal objectives of the paper are to:

(1) describe the current and historical production patterns of barley and wheat;

(2) identify production problems and circumstances that would indicate reasons for wheat out-yielding barley;

(3) identify why farmers grow more wheat than barley and under what circumstances might farmers increase barley production.

METHOD AND PROCEDURES

Area, production and yield data of barley and wheat from the Government of Baluchistan, Agricultural Statistics Department were analyzed for trends and growth rates. The variability of barley and wheat yields were analyzed by comparing their standard deviations, C.V.%'s and year to year changes as a percentage of the mean yield.

A formal survey of barley producers was conducted in upland Baluchistan (see survey document in Appendix A). Thirty farmers who were barley growers were interviewed in Khuzdar District (Area I), 31 farmers were interviewed in Kalat, Quetta and Pishin Districts (Area II) and 25 farmers were interviewed in the Loralai and Zhob Districts (Area III) - see Fig. 1. The interviews took place in the latter part of June, 1988 following a pre-screening test of the questionnaire. Villages and farmers within villages were selected at random with the qualification that part of their enterprise included rainfed barley production. The survey indicated that the average age of all respondents was 43 years and that 62% of the farmers were engaged in a rainfed crop/livestock enterprise, while 36% were engaged in a rainfed crop/livestock/irrigated crop & vegetable enterprise. One farmer operated an exclusively rainfed crop enterprise.

A follow-up survey was conducted in the three areas in October, 1988. This survey clarified farmers yield data estimates, farmers perceptions of production problems and included questions on crop cutting of wheat and barley for fodder (see survey document in Appendix B). The number of farmers surveyed in Areas I, II and III were 13, 8, and 10 respectively. The average age of the respondents was 40. Sixty-eight percent of the farmers were engaged in a rainfed/livestock enterprise, 16 % were engaged in a rainfed crop/livestock/irrigated crop & vegetable enterprise and 16% had exclusively rainfed crop enterprises.

The three areas chosen for the survey represent different rainfall levels (Fig 2) and patterns: Area I receives a higher level of summer rainfall because it is on the edge of the monsoon rainfall area. Altitudes, also vary: Area I, 1200 m at Khuzdar, Area II, 2000 m at Kalat and Area III, 1400 m at Loralai. Fall Planting also occurs about one month later (in October) in Area I when temperatures are cooler. Ethnic group differentiation in the three areas is as follows: Baluch in Area I, Baluch and Pathan in Area II and Pathan in Area III.

CURRENT AND HISTORICAL PRODUCTION PATTERNS

Barley and rapeseed are the two most important crops after wheat sown on rainfed land. Wheat was sown on 247.6 thousand hectares in 1985-86 of which 75.6 thousand hectares were rainfed (Table 1). Barley was sown on 13.3 thousand hectares in Baluchistan in 1985-86 of which 5.1 thousand hectares were rainfed. The government of Baluchistan crop statistics as reported in Tables 1, 2, and 3 indicate that wheat out-yields barley under both irrigated and rainfed conditions.* Irrigated barley yields appear to be unrealistically low relative to irrigated wheat yields.

---

* Reporting of crop statistics in Baluchistan is not based on standard agricultural statistical procedures of crop cutting and measurement. Data is obtained from Patwaris (village accountants) who gather information in their area on a subjective basis relating the current years hectarage and production to the previous years. The reliability of this method and the agricultural statistics that it provides is unknown.

Wheat in upland Baluchistan (an area comprised of Khuzdar[2], Kalat, Kachhi,** Quetta, Pishin, Loralai and Zhob Districts), is the principal crop averaging 122.5 thousand hectares for the 1981-82 to 1985-86 five year period as compared to 8.7 thousand hectares for barley (Tables 2 and 3). For the same period, the area of rainfed wheat in upland Baluchistan averaged 79.3 thousand hectares as compared to 3.9 thousand hectares for barley.

The upland areas grow about 80% of all the barley in Baluchistan (about 70% of all irrigated barley and about 90% of all rainfed barley, Tables 1 and 2). Baluchistan Government statistics for rainfed upland Baluchistan also indicate that the growth rates of barley area sown (8.2%) and barley production (11%) are greater than the growth rates for wheat area sown (1.5%) and wheat production (4.3%) over the 1974-75 to 1985-86 period (Tables 2 and 3).

Table 4 presents an analysis of yield variability comparing wheat and barley yields over the 1974-75 to 1985-86 period. Assessing yield variability (which may be interpreted as production risk) using standard deviations and coefficients of variation (C.V.) suggests that wheat yields on both irrigated and rainfed land are more variable than barley yields on both irrigated and rainfed land. The analysis also indicates that the C.V. for both rainfed wheat and barley yields are more variable than for irrigated wheat and barley yields. The year-to-year change as a percentage of the mean shows that rainfed wheat yield (11.7%) is more variable than rainfed barley yield (10.0%) which supports the C.V. analysis. In conclusion, the analysis of available data suggests that barley yield production risk is not greater than that of wheat. Production risk is therefore probably not a determining factor as to why farmers do not grow more barley.

The data in Table 5 show the average area, production and yield figures of wheat and barley for the three survey areas using Government of Baluchistan statistics. Hectarage sown to wheat in Area I and Area II are over double that of hectarage sown to wheat in Area III for the 1981-82 to 1985-86 period. Wheat yield in Area I (1 t/ha) for this same period is higher than both Area II (0.8 t/ha) and Area III (0.7 t/ha). The growth rate in hectarage sown in Area I (+13.1%) is in contrast to the decline in hectarage sown to wheat in Area II (-0.6) and Area III (-2.9).

** Not all the areas of Kachhi and Khuzdar Districts have altitudes higher than 1000 meters. Because data is available only on a District basis, those areas under 1000m could not be separated out.

Barley hectarage in Area I for the 1981-82 to 1985-86 period is 4 to 5 times that sown in Area II and Area III (Table 5). Yield for the same period is highest in Area I (0.6 t/ha), second highest in Area III (0.5 t/ha) and lowest in Area II (0.4 t/ha). In contrast to wheat, barley hectarage growth rates for each area are positive: Area I (11%), Area II (8.7%) and Area III (5.7%).

Published crop data are not readily available before the 1974-75 data presented in Tables 2 and 3. Historical evidence (Lace and Hemsley, 1891) indicates that barley was the principal crop grown in the survey area and in favourable years "considerable" hectarages were sown. In the survey, farmers were asked if their family grew barley at the time of the partition between India and Pakistan; 81 of the 86 farmers interviewed could recall and 79 of the 81 farmers (97%) said that their family grew barley at that time. Twenty-three percent indicated that they now grow less barley then their families did at Partition, 11 % said they grow about the same and 66% said that they now grow more. The principal reasons given for increased barley production by some farmers included a better barley price than previously, a larger market, and development of new lands. Reasons for growing less barley now included land shortages because of more land devoted to orchards, vegetables and to grow wheat for food security. It may also be inferred that the major changeover from growing barley to wheat, as the principal food crop, occurred well prior to 1947.

BARLEY AND WHEAT PRODUCTION IN THE FARMING SYSTEMS

An Overview

Rees et al., (1988) have described the dryland arable farming systems of upland Baluchistan. Farmers base their wheat and barley planting decisions on the amount and timeliness of the summer and winter rains. When sufficient rainfall occurs in the July to September period (greater than 40 mm), farmers will plant in September/October. When fall moisture is not sufficient, farmers then plant in the January-February period. Harvest is in May-June for both fall and winter planted wheat and barley. Depending on the planting period and crop growing conditions, farmers cut barley and wheat crops for green fodder - usually in November or December.

Farmers' land is classified as irrigated, "sailaba" or "kushkaba". Sailaba land is land that receives runoff from ephemeral streams whereas kushkaba land receives water only as direct rainfall. Sailaba land is more productive than kushkaba land, however stream flow does not occur every year.

Inter- and intra-year rainfall is variable. Three years out of ten can be classified as a "good" agricultural year (rainfall > 275 mm), three years out of ten as a "normal" agricultural year (rainfall 200 to 275 mm) and 4 years out of ten as a "poor" agricultural year (rainfall < 200mm) (Keatinge and Rees, 1988). Farmers indicate that wheat and barley grain yields range from 500 to 800 kg/ha in a good rainfall year and between 200 to 400 kg/ha in a normal rainfall year. Many farmers in rainfed upland Baluchistan do not plant in poor rainfall years.

Farmers use local wheat and barley landraces - very few farmers use improved varieties. Most dryland farmers use animal traction (camel or oxen) for land preparation, planting and threshing. Fertilizers, herbicides and pesticides are not used.

Survey Results Regarding Production

Table 6 presents farmer estimates of their wheat and barley yields for 1985-86, 1986-87 and 1987-88. The data is from the follow-up survey and based on recall. Communication problems between the interviewers and farmers made yield estimates from the initial June survey unsatisfactory.

Based on annual rainfall and crop growing conditions, 1987-88 can be classified as a poor agricultural year, 1986-87 as a good agricultural year and 1985-86 as a normal to poor agricultural year. The farmers yield estimates for the three years, in general, reflect the growing conditions. Estimates for 1987-88 are the lowest except for kushkaba barley while estimates for 1986-87 are the highest. The yield estimates are higher in all three years than would be expected - interviewers indicated that they felt that the farmers exaggerated the estimates. While the estimates may be high, the relative yields among the three years appears acceptable.

Farmers also perceive that barley out-yields wheat on sailaba land and is nearly as good or better on kushkaba land (Table 6). This yield relationship is true over the different crop growing conditions in each of the three years. Thus the farmers perceptions reflect the preliminary experimental results that barley can out-yield wheat. The evidence, however, is based on a very small sample of farmers and further clarification is required before definitive statements can be made.

The follow-up survey included questions on the practice of cutting wheat and barley as green fodder. Fifty-two percent of all farmers said that, in general, they cut both wheat and barley for fodder. Thirteen percent indicated that they only cut barley and 35% said that they only cut wheat as fodder. Seventy-eight percent of all farmers said that

they cut fodder only in the months of November and December while 3% said that they only cut fodder in the April-May period - 19% indicated that they cut barley and wheat for fodder in both periods. Ninety-four percent said that they gave the crop cuttings directly to their animals. Six percent of the farmers said that they sold their crop cuttings in the market.

The percentage of farmers who cut green barley and wheat fodder in the months of November and December over the 1985-86 to 1987-88 period is shown in Table 7. The number of farmers cutting green fodder in each year bears a relationship to the crop growing conditions of each year. A higher percentage of farmers cut fodder in the "good" agricultural year of 1986-87.

Farmers were asked about their fall sown crop sequences. Farmers were asked to choose their two largest fields that had been planted to wheat in 1986-87 and their two largest fields that had been planted to barley in 1986-87 and indicate what had been planted on these same fields for the previous three years for both sailaba and kushkaba land. The rotations did not substantially differ over the three survey areas - the results for upland Baluchistan are presented in Table 8. For example, on sailaba land, the same fields that were planted by 100% of the farmers to wheat in 1986-87 were planted to wheat by 78.5%, 68.5% and 81.5% of the farmers respectively in the three previous cropping years. Wheat planted on kushkaba land exhibited a similar pattern with wheat dominating the sequence.

The fields that were planted to barley in 1986-87 were also most often preceded by a barley crop. The information in Table 8 thus suggests that wheat and barley are dominant in the cropping system; but that farmers appear to have wheat fields where wheat is most often planted and barley fields where barley is most often planted. To examine the degree of continuous monocropping associated with particular fields Table 9 presents the percentage of survey farmers who grew wheat or barley on the same field over the four year period from 1983-84 to 1986-87. The results indicate that the same crop is grown almost year after year without much rotation with other crops for either wheat or barley. For example, on what farmers regarded as their main wheat field, 28% of the farmers planted wheat in all four years, 67% planted wheat in at least 3 of the 4 years and 99% planted wheat in at least 2 of the 4 years.

Farmers were also asked for their perceptions as to the quality of land that barley was normally sown on relative to the quality of land in which wheat is normally sown. The results indicated (Table 10) that over all three Areas, 57% and 50% of the farmers said that there were no land quality differences on sailaba or kushkaba land

respectively. Only 10% and 17% of the farmers said that barley was sown on lower quality sailaba and kushkaba land respectively. A surprising 33% did say that they grew barley on better quality sailaba and kushkaba land relative to the quality of sailaba and kushkaba land in which wheat was sown. Thus land quality differences seem not to play an important role in any difference there may be between wheat and barley average yields.

PRODUCTION PROBLEMS AS PERCEIVED BY FARMERS

Farmers were asked about the production problems that they experienced with wheat (Table 11). Farmers indicated that they had all experienced problems with rust diseases. The incidence of farmers experiencing smut disease was highest in the north in Area III and least in the south in Area I. Insects were stated to be a problem in all three areas. Emergence was not regarded as a major issue with the highest problem incidence being recorded in Area III. Farmers did not have lodging problems with wheat.

Farmers were then asked about barley production problems relative to those experienced for wheat production (Table 12). Only 13% of the farmers indicated that barley was more susceptible to rust than was wheat. Sixty-five percent of the farmers indicated that smut was less of a problem in barley than in wheat although farmers in Area III indicated a higher degree of smut in barley relative to wheat. Forty-one percent of the farmers indicated that insect problems were the same for barley as for wheat. Thirteen percent said that they had worse insect problems in barley than in wheat. Emergence was not a problem.

The follow-up survey re-interviewed farmers about their production problems and added "birds" as a category to the question. This was based on information from local agronomists who suggested that birds, which eat the ripe grain before it is threshed, may be a major problem. The category "Other" was also included to account for vertebrate pests such as porcupines, mice and hares. In the follow-up survey, farmers were asked about their production problems for both wheat and barley. The results (Table 13) indicated a similar ordering to that given in the initial survey (Table 12) but with the category "birds" inserted in second place and the category "Other" second from last. Farmers also suggested that the damage to barley by birds was less than the damage done to wheat but this was reported by only sixteen percent of farmers.

The results indicate that rust, birds, insects and smut are production problems in both wheat and barley. On balance, it appears, with the exception of smut in Area III, that barley production is not influenced by disease, birds, insects or other problems at a much higher rate of incidence

than wheat. These factors thus would not account for lower barley yields relative to wheat as suggested by the GOB agricultural statistics.

Farmers were also asked if they had problems with the threshing of barley in that it might require more time to thresh relative to the threshing of wheat. In contrast, 80% of the farmers indicated that it required between 25% to 50% less time to thresh barley relative to threshing the same amount of wheat.

CONSUMPTION, DISPOSITION AND PRICE OF BARLEY AND WHEAT

Most of the wheat grain production is consumed as food, sold in the market, or sold to private individuals (Table 14). Very little wheat grain is fed to animals. Only 1% of barley grain is consumed as food with 67% sold in the market and to private individuals. As with wheat, very little barley grain is fed to the farmer's own animals. Most wheat and barley straw is sold in the market. Farmers indicated that they gave more than twice the percentage of wheat straw to their animals than barley straw.

Farmers indicated that only 5% of wheat and 3% of barley grain production was kept for seed which would only meet about half of their seed requirements*** . Farmers, while being interviewed, did indicate that they purchased seed from other farmers when they run short or do not have good quality seed. The private sales figures in Table 12 for the most part account for the sale of seed to other farmers.

Farmers indicated that the price of barley and price of wheat was Rs. 235/100 kg and Rs. 238/100 kg respectively (In 1988 1$ US was approximately equal to 17.5 Rs). Farmers were asked for their last year post harvest wheat and barley prices, but interviewers soon came to realize that the farmers were giving prices from the previous few months which reflected the current poor agricultural conditions. There was no difference between the wheat and barley price in 1987-88 in contrast to a 15% higher post harvest wheat price (Rs. 200/100 kg) over the post harvest barley price (Rs. 175/100 kg) in 1986-87 which was a good agricultural year (ICARDA, 1987). Although not conclusive, and further study is merited, these prices would suggest that in poor agricultural years, barley grain is not discriminated against and receives the same price as wheat.

*** The overall average wheat and barley yields/ha from Table 6 are 1100 and 1788. Five percent and 3% of the overall average yields would provide 54 to 55 kg/ha for seed for both wheat and barley which is about 50% of the seed rate used by farmers.

Straw prices were on average Rs. 100/ 100 kg for wheat straw and Rs. 90/100 kg for barley straw reflecting a slight differential in favor of wheat straw. 1987-88 prices for both wheat and straw have about doubled over the previous prices of 1986-87 which was a good agricultural year (ICARDA, 1987).

FARMERS PERCEPTIONS ON INCREASING BARLEY PRODUCTION

Farmers were asked in the survey for the reasons why they did not grow more barley. Farmers were asked to choose from a list and rank the three most important reasons. Table 15 presents the relative rankings. Ninety-seven percent of the farmers ranked as the first reason that they used their resources to plant wheat for family food security. The second major reason was that only a small and uncertain market for barley existed for the sale of their crop. The third major reason was that most of the available land resources were being used in the production of wheat, and other crops. The first and second reasons throw light on why farmers grow more wheat relative to barley when existing data suggest that wheat has a higher production risk (Table 4).

The next three reasons in order of importance were that farmers preferred: wheat straw to barley straw, the higher price of wheat relative to barley over the long run, and that other enterprises were much more profitable such as irrigated orchards and vegetables. The preference of wheat straw over barley straw is consistent with the price premium of Rs. 10/100 kg paid for wheat straw as indicated by the straw prices previously presented. The "barley yielding less than wheat" category was not given much prominence as a reason and may reflect the wheat and barley yields as given by the farmers in Table 6. Shortages of labour were not considered to be a problem.

Farmers were asked to give their perceptions of the required increases in barley yield and price before they would increase barley production substantially (Table 16). Most farmers responded that there would have to be a 100% increase in barley yields over that of wheat or a 100% increase in the price of barley before they would increase their barley production relative to that of wheat. Very few farmers indicated that they would never grow barley under any increased yield or price scenario thus indicating that most farmers would exploit the production of barley if economic conditions were more favorable.

A 50% to 100% increase in barley yield or price is the premium that farmers would require before they would switch to barley production. This premium seems high but one must consider that the premium covers a change in their food security patterns from attempting to grow their own to

relying on the market and that most of all, the barley market is presently small and uncertain. The premium would probably come down if farmers were assured of food supplies from the market and that a secure market existed for the sale of their barley. An increase less than 25% in the barley yield or price would not persuade many farmers to increase barley production.

Farmers were asked how their planting decisions would be altered if a high yielding barley were made available. Sixty-five percent of all respondents said that they would replace wheat hectares with barley hectares thus decreasing the amount of wheat grown. This is corroborated by farmers ranking land shortage as the third most important constraint to increasing barley production (Table 15). Thirty-five percent said that they would plant barley to new land.

DISCUSSION

The growth rate in hectarage of rainfed barley is much higher than that of wheat in upland Baluchistan but overall barley production is quite small relative to wheat production. Thus, the increase in rainfed wheat production per year is larger by a factor of 3 to 4 over the increase in barley production per year. The barley growth rates do, however, indicate that the industry is active.

Farmers indicated that the same fields were sown to the same crops with regularity. When a crop sequence was used, it was most often monocropping with wheat or barley. Farmers perceptions were that rainfed barley yields on average were at least comparable to, and most often higher, than rainfed wheat yields. Most wheat grain is consumed for food or sold. Most barley grain is sold. Small amounts of wheat and barley grain are fed to the farmers own livestock. A high proportion of the wheat and barley straw is sold with animals being fed most of the remainder. There is an indication that wheat and barley grain prices in poor agricultural years do not exhibit the differences that are seen in good agricultural years.

Differences in land quality on which wheat and barley is sown, diseases, birds, and insect production problems seem not to be greater for barley than wheat and therefore not reasons for greater wheat hectarage or lower barley yields. There may be other reasons, such as poorer barley seed, the planting of the more important wheat crop before barley giving wheat an advantage of better moisture conditions, or better wheat management practices that were not disclosed by the present survey. The variability analysis suggested that rainfed barley yield was less variable (risky) than rainfed wheat production. Thus Farmer's reasons for growing less barley than wheat may have

to do more with growing wheat for food security and with the present small uncertain barley market than with production problems.

Most farmers indicated that they would grow more barley if the barley yield or barley price increased by 50% to 100%. This is their risk premium to forgo growing wheat for food security and/or for coping with the risk involved with marketing barley. Many farmers indicted that land resources were scarce and that they would only replace wheat hectarage with barley given the 50% to 100% risk premium.

The future for increased barley production within the farming system of upland Baluchistan seems to hinge on the two aspects of growing wheat for food security and the market for barley. Baluchistan society is in a state of transition as it reacts to social and economic forces both from within and from outside its borders. The question of growing wheat for food security by dryland farmers may give way as increased migration from the rural areas takes place and farmers become more commercial in outlook. Greater feed demands that are projected from small ruminant producers may also act as a stimulus for a changeover to increased forage production such as barley (Keatinge et al., 1988).

A main impediment to the increase in barley production seems to be the small and uncertain market for barley. Even at current prices and yields, a secure market for barley would probably solicit an expansion in production. However, marginal increases (up to 25%) in either barley yield or barley price given the current barley market would not encourage much increased barley production. The barley market could be made more secure by better government regulation and improved infrastructure. What the barley industry needs, however, is a larger market. Baluchistan probably does not have a comparative advantage in exporting barley to other provinces or abroad. Its only major hope for increase lies in an expanded commercial livestock industry where it can be used for both grain and fodder (see Nagy et al., 1989).

REFERENCES

Government of Baluchistan (GOB). various years. Agricultural Statistics of Baluchistan, Directorate General of Agricultural Department, Baluchistan, Statistics Wing, Quetta, Baluchistan.

International Center for Agricultural Research in Dry Areas (ICARDA). 1988. High-elevation research in Pakistan: The MART/AZR project annual report for 1987. ICARDA Research Publication 127, ICARDA, Aleppo, Syria.

International Center for Agricultural Research in Dry Areas (ICARDA). 1989. High-elevation research in Pakistan: The MART/AZR project annual report for 1988. ICARDA Research Publication 138, ICARDA, Aleppo, Syria.

Keatinge, J.D.H. and D.J. Rees. 1988. Analysis of precipitation and air temperature records in the Quetta Valley, Pakistan: the implications for potential improvement in agricultural productivity. MART/AZR Research Report 9, ICARDA, Quetta, Pakistan.

Keatinge, J.D.H., B. Roidar Khan, D.J. Rees, R.S. Aro and C. Talug. 1988. A strategic plan for the PARC Arid Zone Research Institute 1990-2000. MART/AZR Research Report 23, ICARDA, Quetta, Pakistan.

Lace, J.H. and W.B. Hemsley. 1891. A sketch of the vegetation of British Baluchistan, with descriptions of new species. Linnean Society Journal of Botany vol. XXV111, 288-329.

Nagy, J.G., G. Farid Sabir and J.M. Stubbs. 1989. Descriptive and diagnostic studies of sheep and goats in the farming systems of upland Baluchistan. MART/AZR Research Report (in press) ICARDA, Quetta, Pakistan.

Rees, D.J., Nagy, J.G., Raza, S.H., Mahmood, K., Chowdry, B.A. and Keatinge, J.D.H. 1988. The dryland arable farming systems of Upland Baluchistan: a case study. MART/AZR Research Report 5, ICARDA, Quetta, Pakistan.

Table 1. Area and yield of selected autumn sown crops, Baluchistan, 1985-86.

Crop	Area Sown				Grain Yield			
	Irrig.	Rainfed	Total	% Rainfed[1]	Irrig.	Rainfed	Total	% Rainfed[1]
	----- Thousand's of Hectares ----				------- Tonnes/Hectare --------			
Wheat	172.0	75.6	247.6	30.5	2.06	0.78	1.67	37.9
Barley	8.2	5.1	13.3	38.3	0.94	0.60	0.81	63.8
Rapeseed	18.1	6.2	24.3	25.5	0.63	0.45	0.58	71.4
Cuain	2.5	0.8	3.3	24.2	0.63	0.44	0.58	69.8
Chickpea	21.1	0.0	21.1	-	0.77	-	0.77	-
Lentils	0.07	0.06	0.13	46.2	0.63	0.40	0.53	63.5
Peas	6.2	0.0	6.2	-	0.46	-	0.46	-
Fodder	8.7	0.2	8.9	2.2	-	-	-	-
Total	236.9	88.0	324.9	27.1				

Source: Government of Baluchistan, Agricultural Statistics of Baluchistan, Directorate General of Agriculture Department, Baluchistan, Statistics Wing, Quetta.

[1]Percentage rainfed of irrigated.

TABLE 3 . BARLEY HECTARAGE, PRODUCTION AND YIELD UNDER IRRIGATED AND RAINFED CONDITIONS IN UPLAND BALUCHISTAN.*

	IRRIGATED			RAINFED			TOTAL		
YEAR	HECTARES	PRODUCTION	YIELD	HECTARES	PRODUCTION	YIELD	HECTARES	PRODUCTION	YIELD
	ha	Tonnes	Kg/ha	ha	Tonnes	Kg/ha	ha	Tonnes	Kg/ha
1974-75	1170	643	549.6	614	225	366.4	1784	868	486.5
1975-76	1933	1583	818.9	1797	615	342.2	3730	2198	589.3
1976-77	1279	1048	819.4	640	219	342.2	1919	1267	660.2
1977-78	1327	1080	813.9	714	256	358.5	2041	1336	654.6
1978-79	1515	1327	875.9	984	331	336.4	2499	1658	663.5
1979-80	3424	3060	893.7	1794	600	334.4	5218	3660	701.4
1980-81	2079	1960	942.8	1579	671	425.0	3658	2631	719.2
1981-82	2422	2275	939.3	2568	1117	435.0	4990	3392	679.8
1982-83	6665	6130	919.7	3576	2150	601.2	10241	8280	808.5
1983-84	3296	3177	963.9	3228	2026	627.6	6524	5203	797.5
1984-85	5818	4955	851.7	5325	2942	552.5	11143	7897	708.7
1985-86	5959	5799	973.1	4696	2857	608.4	10655	8656	812.4
1974-75 to 1985-86:									
Mean	3073.9	2753.1	863.5	2292.9	1167.4	444.2	5366.8	3920.5	690.1
STD	1914.1	1830.8	109.3	1536.4	995.8	113.8	3369.0	2769.2	89.6
1976-77 to 1985-86:									
Mean	3378.4	3081.1	899.3	2510.4	1316.9	462.1	5888.8	4398.0	720.6
STD	1952.3	1825.5	54.8	1574.4	1023.9	116.5	3434.5	2783.1	59.6
1981-82 to 1985-86:									
Mean	4832.0	4467.2	929.5	3878.6	2218.4	564.9	8710.6	6685.6	761.4
STD	1659.5	1499.8	43.2	999.3	661.2	69.5	2476.4	2046.4	55.8
1974-75- to 1985-86 Growth Rate (%), (LogY= a+b.time).									
	6.6	7.9	1.3	8.2	11.0	2.8	7.3	8.8	1.5

Source: Government of Baluchistan, Agricultural Statistics of Baluchistan, Directorate General of Agriculture Department Baluchistan, Statistics Wing, Quetta.

* Upland Baluchistan includes data for the Districts of Khuzdar , Kalat , Kachhi , Quetta , Pishin , Loralai and Zhob.

Table 4. Barley and wheat yield variability in upland Baluchistan, 1974-75 to 1985-86.

	Wheat Yield			Barley Yield		
	Irrigated	Rainfed	Total	Irrigated	Rainfed	Total
	kg/ha					
Mean	1579	652	996	864	444	690
Std.Dev.	273	198	204	109	114	90
C.V.%[1]	17.3	30.4	20.5	12.6	25.7	13.0
Yr-to-yr[2] change as % of mean	8.2%	11.7%	7.7%	7.4%	10.0%	8.1%

Source: Government of Baluchistan agricultural statistics from Tables 2 and 3.

[1]Coefficient of Variation (Std. Dev./mean x 100).

[2]Year to year change as a percentage of the mean calculated as: (((SUM (ABS($Yield_t$ - $Yield_{t+1}$)))/n-1) x 100)/ mean yield; where t = 1 to 12, where 1 = 1974-75, n = 12.

Table 5. Average area, production, and yield of wheat and barley under rainfed conditions by survey area, Upland Baluchistan.

	Area I[1]						Area II						Area III					
	Wheat			Barley			Wheat			Barley			Wheat			Barley		
	ha	Prod	Yld	ha	Prod	Yld	ha	Prod	Yld	ha	Prod	Yld	ha	Prod	Yld	ha	Prod	Yld
	----- Area in thousands of hectares, Production in thousands of tonnes, and Yield in tonnes[2] -----																	
	1974-75 to 1985-86																	
Mean	17.6	17.1	0.8	1.4	0.8	0.5	32.5	19.7	0.6	0.4	0.4	0.4	17.5	10.5	0.6	0.4	0.2	0.4
STD	16.8	19.6	0.2	1.3	0.9	0.1	8.7	7.5	0.2	0.2	0.1	0.1	5.1	3.2	0.1	0.4	0.2	0.1
	1976-77 to 1985-86																	
Mean	20.6	20.2	0.8	1.5	0.8	0.5	33.8	21.4	0.6	0.4	0.1	0.4	16.7	10.3	0.6	0.4	0.2	0.4
STD	16.7	20.1	0.2	1.3	1.0	0.1	9.0	7.1	0.1	0.3	0.1	0.1	5.1	3.5	0.1	0.4	0.2	0.1
	1981-82 to 1985-86																	
Mean	32.4	35.0	1.0	2.4	1.4	0.6	30.8	23.6	0.8	0.5	0.1	0.4	14.1	10.1	0.7	0.6	0.3	0.5
STD	16.2	19.0	0.2	1.5	0.9	0.1	9.3	9.0	0.1	0.2	0.1	0.1	4.6	4.4	0.1	0.4	0.2	0.1
	Growth Rate (%) 1974-75 to 1985-86[3]																	
	13.1	15.0	1.6	11.0	14.0	3.0	-0.6	-2.1	-2.7	8.7	8.8	0.1	-2.9	-1.4	1.4	5.7	8.9	3.2

Source: Government of Baluchistan, Agricultural Statistics of Baluchistan, Directorate General of Agriculture Department, Baluchistan, Statistics Wing, Quetta.

[1]Area I = Khuzdar District, Area II = Kalat, Kachhi, Quetta, and Pishin Districts, Area III = Loralai and Zhob Districts.

[2]All numbers rounded thus yield data in many cases will not correspond to production divided by hectares.

[3]Growth rate calculated as Log Y = a + b x Time.

Table 6. Farmers perceptions of rainfed wheat and barley yields on sailaba and kushkaba land in upland Baluchistan[1].

	Wheat Kg/ha			Barley Kg/ha		
	Sailaba	Kushkaba	Average[2]	Sailaba	Kushkaba	Average[2]
1987-88 (Poor Agricultural year)						
Yield	874	666	841	1303	989	1281
No. Farmers[3]	18	4	-	15	3	-
1986-87 (Good Agricultural Year)						
Yield	1407	1204	1358	2358	1192	2288
No. Farmers	25	6	-	23	3	-
1985-86 (Normal to Poor Agricultural year)						
Yield	1154	800	1097	1898	756	1795
No. Farmers	15	5		15	3	-

Source: MART/AZRI formal follow-up survey, October, 1988.

[1]Khuzdar, Kalat, Kachhi, Quetta, Pishin, Loralai, and Zhob Districts.

[2] Sailaba and kushkaba yields weighted by the proportion of sailaba and kushkaba hectarage.

[3]Number of farmers who gave information on area sown and yield.

Table 7. Farmers who cut wheat and barley crops for fodder in Nov./Dec. months in the past three years (1987/88 to 1985/86), upland Baluchistan.

	Area I[1]		Area II		Area III		All	
Year	Wheat	Bar.	Wheat	Bar.	Wheat	Bar.	Wheat	Bar.
	Percent of farmers							
1987-88	15	15	88	75	100	80	61	52
1986-87	92	77	100	63	100	100	97	81
1985-86	77	62	50	37	60	60	65	55

Source : MART/AZRI Wheat-Barley Follow-up formal survey, October, 1988.

[1]Area I = Khuzdar District, Area II = Kalat, Kachhi, Quetta and Pishin Districts and Area III = Loralai and Zhob Districts.

Table 1. Area and yield of selected autumn sown crops, Baluchistan, 1985-86.

Crop	Area Sown				Grain Yield			
	Irrig.	Rainfed	Total	% Rainfed[1]	Irrig.	Rainfed	Total	% Rainfed[1]
	----- Thousand's of Hectares ----				------- Tonnes/Hectare --------			
Wheat	172.0	75.6	247.6	30.5	2.06	0.78	1.67	37.9
Barley	8.2	5.1	13.3	38.3	0.94	0.60	0.81	63.8
Rapeseed	18.1	6.2	24.3	25.5	0.63	0.45	0.58	71.4
Cumin	2.5	0.8	3.3	24.2	0.63	0.44	0.58	69.8
Chickpea	21.1	0.0	21.1	-	0.77	-	0.77	-
Lentils	0.07	0.06	0.13	46.2	0.63	0.40	0.53	63.5
Peas	6.2	0.0	6.2	-	0.46	-	0.46	-
Fodder	8.7	0.2	8.9	2.2	-	-	-	-
Total	236.9	88.0	324.9	27.1				

Source: Government of Baluchistan, Agricultural Statistics of Baluchistan, Directorate General of Agriculture Department, Baluchistan, Statistics Wing, Quetta.

[1]Percentage rainfed of irrigated.

TABLE 2 WHEAT HECTARAGE, PRODUCTION AND YIELD UNDER IRRIGATED AND RAINFED CONDITIONS IN UPLAND BALUCHISTAN.*

	IRRIGATED			RAINFED			TOTAL		
YEAR	HECTARES	PRODUCTION	YIELD	HECTARES	PRODUCTION	YIELD	HECTARES	PRODUCTION	YIELD
	ha	Tonnes	Kg/ha	ha	Tonnes	Kg/ha	ha	Tonnes	Kg/ha
1974-75	37530	41530	1106.6	48400	21920	452.9	85930	63450	738.4
1975-76	40550	48470	1195.3	52580	26930	512.2	93130	75400	809.6
1976-77	36160	48130	1331.0	73260	37330	509.6	109420	85460	781.0
1977-78	35550	47250	1329.1	70190	38950	554.9	105740	86200	815.2
1978-79	34130	60419	1770.3	57760	32250	558.3	91890	92669	1008.5
1979-80	36780	55310	1503.8	63920	35630	557.4	100700	90940	903.1
1980-81	35560	55980	1574.2	59410	31350	527.7	94970	87330	919.6
1981-82	32712	54180	1656.3	52083	23750	456.0	84795	77930	919.0
1982-83	40690	73360	1802.9	105340	98180	932.0	146030	171540	1174.7
1983-84	42800	82320	1923.4	96260	92795	964.0	139060	175115	1259.3
1984-85	50450	96210	1907.0	87700	84360	961.9	138150	180570	1307.1
1985-86	48570	90000	1853.0	55060	46310	841.1	103630	136310	1315.4
1974-75 to 1985-86:									
Mean	39290.2	62763.3	1579.4	68496.9	47479.6	652.3	107787.1	110242.9	995.9
STD	5350.4	17430.7	272.9	17908.4	26508.7	197.5	20564.9	41259.0	204.2
1976-77 to 1985-86:									
Mean	39340.2	66315.9	1665.1	72098.3	52090.5	686.3	111438.5	118406.4	1040.3
STD	5820.8	16925.1	212.0	17497.4	26728.9	199.3	20613.3	40456.8	194.9
1981-82 to 1985-86:									
Mean	43044.4	79214.0	1828.5	79288.6	69079.0	831.0	122333.0	148293.0	1195.1
STD	6288.7	14668.5	96.0	21746.8	29037.8	192.7	23876.4	38460.9	146.8
1974-75- to 1985-86 Growth Rate (%), (LogY=.a+b.time).									
	1.0	3.1	2.1	1.5	4.3	2.9	1.3	3.7	2.3

Source: Government of Baluchistan, Agricultural Statistics of Baluchistan, Directorate General of Agriculture Department Baluchistan, Statistics Wing, Quetta.

* Upland Baluchistan includes data for the Districts of Khuzdar , Kalat , Kachhi , Quetta , Pishin , Loralai and Zhob.

TABLE 3 . BARLEY HECTARAGE, PRODUCTION AND YIELD UNDER IRRIGATED AND RAINFED CONDITIONS IN UPLAND BALUCHISTAN.*

	IRRIGATED			RAINFED			TOTAL		
YEAR	HECTARES	PRODUCTION	YIELD	HECTARES	PRODUCTION	YIELD	HECTARES	PRODUCTION	YIELD
	ha	Tonnes	Kg/ha	ha	Tonnes	Kg/ha	ha	Tonnes	Kg/ha
1974-75	1170	643	549.6	614	225	366.4	1784	868	486.5
1975-76	1933	1583	818.9	1797	615	342.2	3730	2198	589.3
1976-77	1279	1048	819.4	640	219	342.2	1919	1267	660.2
1977-78	1327	1080	813.9	714	256	358.5	2041	1336	654.6
1978-79	1515	1327	875.9	984	331	336.4	2499	1658	663.5
1979-80	3424	3060	893.7	1794	600	334.4	5218	3660	701.4
1980-81	2079	1960	942.8	1579	671	425.0	3658	2631	719.2
1981-82	2422	2275	939.3	2568	1117	435.0	4990	3392	679.8
1982-83	6665	6130	919.7	3576	2150	601.2	10241	8280	808.5
1983-84	3296	3177	963.9	3228	2026	627.6	6524	5203	797.5
1984-85	5818	4955	851.7	5325	2942	552.5	11143	7897	708.7
1985-86	5959	5799	973.1	4696	2857	608.4	10655	8656	812.4
1974-75 to 1985-86:									
Mean	3073.9	2753.1	863.5	2292.9	1167.4	444.2	5366.8	3920.5	690.1
STD	1914.1	1830.8	109.3	1536.4	995.8	113.8	3369.0	2769.2	89.6
1976-77 to 1985-86:									
Mean	3378.4	3081.1	899.3	2510.4	1316.9	462.1	5888.8	4398.0	720.6
STD	1952.3	1825.5	54.8	1574.4	1023.9	116.5	3434.5	2783.1	59.6
1981-82 to 1985-86:									
Mean	4832.0	4467.2	929.5	3878.6	2218.4	564.9	8710.6	6685.6	761.4
STD	1659.5	1499.8	43.2	999.3	661.2	69.5	2476.4	2046.4	55.8
1974-75- to 1985-86 Growth Rate (%), (LogY= a+b.time).									
	6.6	7.9	1.3	8.2	11.0	2.8	7.3	8.8	1.5

Source: Government of Baluchistan, Agricultural Statistics of Baluchistan, Directorate General of Agriculture Departmen Baluchistan, Statistics Wing, Quetta.

* Upland Baluchistan includes data for the Districts of Khuzdar , Kalat , Kachhi , Quetta , Pishin , Loralai and Zhob.

Table 4. Barley and wheat yield variability in upland Baluchistan, 1974-75 to 1985-86.

	Wheat Yield			Barley Yield		
	Irrigated	Rainfed	Total	Irrigated	Rainfed	Total
	kg/ha					
Mean	1579	652	996	864	444	690
Std.Dev.	273	198	204	109	114	90
C.V.%[1]	17.3	30.4	20.5	12.6	25.7	13.0
Yr-to-yr[2] change as % of mean	8.2%	11.7%	7.7%	7.4%	10.0%	8.1%

Source: Government of Baluchistan agricultural statistics from Tables 2 and 3.

[1]Coefficient of Variation (Std. Dev./mean x 100).

[2]Year to year change as a percentage of the mean calculated as: (((SUM (ABS($Yield_t$ - $Yield_{t+1}$)))/n-1) x 100)/ mean yield; where t = 1 to 12, where 1 = 1974-75, n = 12.

Table 5. Average area, production, and yield of wheat and barley under rainfed conditions by survey area, Upland Baluchistan.

	Area I[1]						Area II						Area III					
	Wheat			Barley			Wheat			Barley			Wheat			Barley		
	ha	Prod	Yld	ha	Prod	Yld	ha	Prod	Yld	ha	Prod	Yld	ha	Prod	Yld	ha	Prod	Yld
	----- Area in thousands of hectares, Production in thousands of tonnes, and Yield in tonnes[2] -----																	
	1974-75 to 1985-86																	
Mean	17.6	17.1	0.8	1.4	0.8	0.5	32.5	19.7	0.6	0.4	0.4	0.4	17.5	10.5	0.6	0.4	0.2	0.4
STD	16.8	19.6	0.2	1.3	0.9	0.1	8.7	7.5	0.2	0.2	0.1	0.1	5.1	3.2	0.1	0.4	0.2	0.1
	1976-77 to 1985-86																	
Mean	20.6	20.2	0.8	1.5	0.8	0.5	33.8	21.4	0.6	0.4	0.1	0.4	16.7	10.3	0.6	0.4	0.2	0.4
STD	16.7	20.1	0.2	1.3	1.0	0.1	9.0	7.1	0.1	0.3	0.1	0.1	5.1	3.5	0.1	0.4	0.2	0.1
	1981-82 to 1985-86																	
Mean	32.4	35.0	1.0	2.4	1.4	0.6	30.8	23.6	0.8	0.5	0.1	0.4	14.1	10.1	0.7	0.6	0.3	0.5
STD	16.2	19.0	0.2	1.5	0.9	0.1	9.3	9.0	0.1	0.2	0.1	0.1	4.6	4.4	0.1	0.4	0.2	0.1
	Growth Rate (%) 1974-75 to 1985-86[3]																	
	13.1	15.0	1.6	11.0	14.0	3.0	-0.6	-2.1	-2.7	8.7	8.8	0.1	-2.9	-1.4	1.4	5.7	8.9	3.2

Source: Government of Baluchistan, Agricultural Statistics of Baluchistan, Directorate General of Agriculture Department, Baluchistan, Statistics Wing, Quetta.

[1]Area I = Khuzdar District, Area II = Kalat, Kachhi, Quetta, and Pishin Districts, Area III = Loralai and Zhob Districts.

[2]All numbers rounded thus yield data in many cases will not correspond to production divided by hectares.

[3]Growth rate calculated as Log Y = a + b x Time.

Table 6. Farmers perceptions of rainfed wheat and barley yields on sailaba and kushkaba land in upland Baluchistan[1].

	Wheat Kg/ha			Barley Kg/ha		
	Sailaba	Kushkaba	Average[2]	Sailaba	Kushkaba	Average[2]
1987-88 (Poor Agricultural year)						
Yield	874	666	841	1303	989	1281
No. Farmers[3]	18	4	-	15	3	-
1986-87 (Good Agricultural Year)						
Yield	1407	1204	1358	2358	1192	2288
No. Farmers	25	6	-	23	3	-
1985-86 (Normal to Poor Agricultural year)						
Yield	1154	800	1097	1898	756	1795
No. Farmers	15	5		15	3	-

Source: NART/AZRI formal follow-up survey, October, 1988.

[1]Khuzdar, Kalat, Kachhi, Quetta, Pishin, Loralai, and Zhob Districts.

[2] Sailaba and kushkaba yields weighted by the proportion of sailaba and kushkaba hectarage.

[3]Number of farmers who gave information on area sown and yield.

Table 7. Farmers who cut wheat and barley crops for fodder in Nov./Dec. months in the past three years (1987/88 to 1985/86), upland Baluchistan.

	Area I[1]		Area II		Area III		All	
Year	Wheat	Bar.	Wheat	Bar.	Wheat	Bar.	Wheat	Bar.
	Percent of farmers							
1987-88	15	15	88	75	100	80	61	52
1986-87	92	77	100	63	100	100	97	81
1985-86	77	62	50	37	60	60	65	55

Source : MART/AZRI Wheat-Barley Follow-up formal survey, October, 1988.

[1]Area I = Khuzdar District, Area II = Kalat, Kachhi, Quetta and Pishin Districts and Area III = Loralai and Zhob Districts.

Table 8. Crop rotations: type of crop grown on the same land over the 1983-84 to 1986-87 period, upland Baluchistan.

Year/ Crop Sown	Main Wheat Field		Main Barley Field	
	Sailaba	Kushkaba	Sailaba	Kushkaba
	% Farmers Who Planted			
1986-87				
Wheat	100.0	100.0	-	-
Barley	-	-	100.0	100.0
1985-86				
Wheat	78.5	83.0	31.5	12.5
Barley	17.0	8.5	63.5	81.5
Fallow	3.5	6.5	4.0	6.0
Cumin	1.0	2.0	1.0	-
Total	100.0	100.0	100.0	100.0
1984-85				
Wheat	68.5	79.0	13.0	9.0
Barley	21.0	13.0	80.5	88.5
Fallow	3.5	9.0	3.0	2.5
Cumin	7.0	-	2.5	-
Lentils	-	-	1.0	-
Total	100.0	100.0	100.0	100.0
1983-84				
Wheat	81.5	89.0	25.0	8.0
Barley	15.0	7.0	68.5	88.0
Fallow	3.0	4.0	5.0	4.0
Cumin	0.5	-	1.5	-
Total	100.0	100.0	100.0	100.0

Source: MART/AZRI formal survey, May/June, 1988.

[1]Sailaba land is streamfed and Kushkaba land is rainfed.

Table 9. Percentage of farmers growing wheat or barley on the same field over a four year period in upland Baluchistan.

No. Years Farmers Planted Crop on Same Field	Main Wheat Field				Main Barley Field			
	Sailaba		Kushkaba		Sailaba		Kushkaba	
	%	Acc%[2]	%	Acc%	%	Acc%	%	Acc%
	% of Farmers							
All Four Years	28	28	50	50	21	21	65	65
Three of Four Years	39	67	35	85	39	60	19	84
Two of Four Years	32	99	15	100	27	87	12	96
One of Four Years	1	100	-	100	13	100	4	100

Source: MART/AZRI formal survey, May/June, 1988.

[1]Sailaba is streamfed and Kushkaba is rainfed land.

[2]Accumulative percentage.

Table 10. Farmers perceptions of the quality of land in which barley is sown relative to that of wheat in upland Baluchistan[1].

Relative Land Quality	Area I		Area II		Area III		ALL	
	S[2]	K	S	K	S	K	S	K
	% of Farmers							
Same	44	33	47	56	78	100	57	50
Better	52	66	21	13	22	0	33	33
Lower	4	0	32	31	0	0	10	17
Total	100	100	100	100	100	100	100	100

Source: MART/AZRI formal Survey, May/June, 1988.

[1]Area I = Khuzdar District, Area II = Kalat, Kachhi, Quetta, and Pishin Districts and Area III = Loralai and Zhob Districts.

[2]S = Sailaba (stream fed) land and K = kushkaba (rainfed) land.

Table 11. Farmers perceptions of production problems with wheat, upland Baluchistan.

	% Farmers with Production Problems[1]			
Problem	Area I	Area II	Area III	All
Rust	100	100	100	100
Insects	93	52	88	76
Smut	40	81	92	69
Emergence	0	3	12	5
Lodging	0	0	0	0

Source: MART/AZRI formal survey, May/June, 1988.

[1] Area I = Khuzdar District, Area II = Kalat, Kachhi, Quetta and Pishin Districts, and Area III = Loralai and Zhob Districts.

Table 12. Farmers perceptions of barley production problems relative to wheat in upland Baluchistan[1].

	Problems of Barley Relative to Wheat			
	Area I	Area II	Area III	All
	--- Percent of Farmers ---			
Rust				
Less	50	36	40	41
Same	17	2	4	8
More	13	10	16	13
No Problem	20	52	40	37
Total	100%	100%	100%	100%
Smut				
Less	20	39	48	34
Same	7	16	8	10
More	20	16	36	23
No Problem	53	29	8	31
Total	100%	100%	100%	100%
Insects				
Less	7	10	32	15
Same	77	29	12	41
More	17	6	16	13
No Problem	0	55	40	31
Total	100%	100%	100%	100%
Emergence				
Less	0	3	0	1
Same	0	0	0	0
More	0	0	4	1
No Problem	100	97	96	98
Total	100%	100%	100%	100%

Source: MART/AZRI formal survey, May/June.

[1]Area I = Khuzdar District, Area II = Kalat, Kachhi, Quetta and Pishin Districts, and Area III = Loralai and Zhob Districts.

Table 13. Farmers perceptions of production problems with wheat and barley in upland Baluchistan: follow -up survey results.

Problems	% Farmers with Production Problems[1]			
	Area I	Area II	Area III	All
		Wheat		
Rust	85	100	100	94
Birds	62	88	100	81
Insects	77	63	70	70
Saut	46	100	60	65
Emergence	46	0	0	19
Other[2]	58	13	20	33
Lodging	0	0	0	0
		Barley		
Rust	77	100	60	77
Birds	61	62	100	74
Insects	77	30	70	65
Saut	46	75	80	65
Emergence	46	0	0	19
Other[1]	45	12	20	27
Lodging	0	0	0	0

Source: NART/AZRI Wheat-Barley follow-up formal survey, October, 1988.

[1]Area I = Khuzdar District, Area II = Kalat, Kachhi, Quetta and Pishin Districts and Area III = Loralai and Zhob Districts.

[2]Other: vertebrate pests; porcupine, mouse, hare.

Table 14. Consumption and disposition of wheat and barley, upland Baluchistan[1].

Consumption/ Disposition	Wheat		Barley	
	Grain	Straw	Grain	Straw
	Percent			
Food Consumption	34	-	1	-
Sold in Market	41	60	58	73
Private Sales	7	-	9	4
Gifts/Ushr	6	-	6	-
Fed to:				
Sheep/Goats	2	14	5	6
Draft Animals	4	16	5	6
Kept for Seed	5	-	3	-
Other[2]	1	10	13	11
Total	100%	100%	100%	100%

Source: MART/AZRI formal survey, May/June, 1988

[1]Khuzdar, Kalat, Kachhi, Quetta, Pishin, Loralai, and Zhob Districts.

[2]Includes gifts to poor and in the case of straw, used in house and wall construction.

Table 15. Ranking of reasons why farmers do not grow more barley in upland Baluchistan[1].

Farmers Reasons for not Growing More Barley	Top Three Rankings[2]		
	First Reason	Second Reason	Third Reason
	-- % Farmers Responding --		
Grow wheat for food security	97	3	0
No secure barley market	0	47	21
Land shortage	2	16	38
Prefer wheat to barley straw	0	13	9
Wheat price higher than barley	0	13	6
Orchards are more profitable	0	5	20
Barley yields less than wheat	1	2	2
Labour shortage	0	1	2
Not profitable to feed barley	0	0	2
Total	100%	100%	100%

Source: MART/AZRI formal survey, May/June, 1988.

[1]Khuzdar, Kalat, Kachhi, Quetta, Pishin, Loralai, and Zhob Districts.

[2]Farmers were asked to choose and rank the three most important reasons as to why they do not grow more barley.

Table 16. Farmers perceptions of the required increases in barley yield and price before they would increase barley hectarage in upland Baluchistan[1].

Percentage Increase Required	Increase in Barley Yield	Barley Yield Increase Over Wheat Yield	Increase in Barley Price
	------- Percent of farmers responding ------		
25% increase	-	-	5
50% increase	20	17	14
75% increase	10	12	12
100% increase	64	64	61
Would never grow more	6	7	8
Total	100%	100%	100%

Source:Hart/AZRI formal survey, May/June, 1988.

[1]Khuzdar, Kalat, Kachhi, Quetta, Pishin, Loralai and Zhob Districts.

APPENDIX A

UPLAND BALUCHISTAN WHEAT-BARLEY SURVEY

MART/AZRI

****

Interview #. _____

Interviewer's Name _____

Date of Interview ¦___¦____¦_____¦
Day Month Year

Village _____, Tehsil_____, Dist._____

****

SECTION I. GENERAL INFORMATION.

1. Name of Respondent. 1. _____

2. Position in Household
   - Head of Household = 1
   - Wife of Head = 2
   - Brother of Head = 3
   - Son of Head = 4

   2. _____

3. Age 3. _____

4. Enterprise Type:
   - Rainfed Crops only = 1
   - Rainfed & Irrigated Crops = 2
   - Livestock & Rainfed Crops = 3
   - Livestock, Rainfed and Irr. = 4

   4. _____

5. Total cropped acres **LAST** year

   - Irrigated 5. _____
   - Sailaba 6. _____
   - Kushkaba 7. _____

SECTION II. CURRENT AND PAST YEARS WHEAT AND BARLEY PRODUCTION PRACTICES.

A. Wheat and Barley Sown Area and Yield for Current and Last Two Years on Sailaba and Kushkaba Land.

1. Acres Sown and Yield of **SAILABA** Planted **WHEAT**:

1(a)	This year (1987-88) in the **Fall.**	1. _____
1(b)	Yield	2. _____
1(c)	This year (1987-88) in the **Spring.**	3. _____
1(d)	Yield	4. _____
1(e)	Last year (1986-87) in the **Fall.**	5. _____
1(f)	Yield	6. _____
1(g)	Last year (1986-87) in the **Spring.**	7. _____
1(h)	Yield	8. _____
1(i)	Year before last (1985-86) in the **Fall.**	9. _____
1(j)	Yield	10. _____
1(k)	Year before last (1985-86) in the **Spring.**	11. _____
1(l)	Yield	12. _____

2. Acres Sown and Yield of **KUSHKABA** Planted **WHEAT**:

2(a)	This year (1987-88) in the **Fall.**	13. _____
2(b)	Yield	14. _____
2(c)	This year (1987-88) in the **Spring.**	15. _____
2(d)	Yield	16. _____
2(e)	Last year (1986-87) in the **Fall.**	17. _____
2(f)	Yield	18. _____
2(g)	Last year (1986-87) in the **Spring.**	19. _____
2(h)	Yield	20. _____
2(i)	Year before last (1985-86) in the **Fall.**	21. _____
2(j)	Yield	22. _____
2(k)	Year before last (1985-86) in the **Spring.**	23. _____
2(l)	Yield	24. _____

3. Acres Sown and Yield of **SAILABA** Planted **BARLEY**:

3(a)	This year (1987-88) in the **Fall**.	25. _____
3(b)	Yield	26. _____
3(c)	This year (1987-88) in the **Spring**.	27. _____
3(d)	Yield	28. _____
3(e)	Last year (1986-87) in the **Fall**.	29. _____
3(f)	Yield	30. _____
3(g)	Last year (1986-87) in the **Spring**.	31. _____
3(h)	Yield	32. _____
3(i)	Year before last (1985-86) in the **Fall**.	33. _____
3(j)	Yield	34. _____
3(k)	Year before last (1985-86) in the **Spring**.	35. _____
3(l)	Yield	36. _____

4. Acres Sown and Yield of **KUSHKABA** Planted **BARLEY**:

4(a)	This year (1987-88) in the **Fall**.	37. _____
4(b)	Yield	38. _____
4(c)	This year (1987-88) in the **Spring**.	39. _____
4(d)	Yield	40. _____
4(e)	Last year (1986-87) in the **Fall**.	41. _____
4(f)	Yield	42. _____
4(g)	Last year (1986-87) in the **Spring**.	43. _____
4(h)	Yield	44. _____
4(i)	Year before last (1985-86) in the **Fall**.	45. _____
4(j)	Yield	46. _____
4(k)	Year before last (1985-86) in the **Spring**.	47. _____
4(l)	Yield	48. _____

B. Crop Rotations For Wheat and Barley on Sailaba and Kushkaba Land For the Farmers Two Largest Fields.

1. Sailaba Land.

	WHEAT		BARLEY	
	Field 1	Field 2	Field 1	Field 2
last Year (86-87)	Wheat	Wheat	Barley	Barley
Year before(85-86)	49------	52------	55------	58------
Year before(84-85)	50------	53------	56------	59------
Year Before(83-84)	51------	54------	57------	60------

*Wheat = 1, Barley = 2, Fallow = 3, Cumin = 4, Lentil = 5.

2. Kushkaba Land.

	WHEAT		BARLEY	
	Field 1	Field 2	Field 1	Field 2
Last Year (86-87)	Wheat	Wheat	Barley	Barley
Year before(85-86)	61------	64------	67------	70------
Year before(84-85)	62------	65------	68------	71------
Year Before(83-84)	63------	66------	69------	72------

*Wheat = 1, Barley = 2, Fallow = 3, Cumin = 4, Lentil = 5.

C. Land Quality.

1(a). On **SAILABA** Land, is Barley sown on the same, better, or lower **quality** land as Wheat?

Same = 1 (Go To 2(a))
Better = 2 (Go to 2(a))
Lower = 3 (Go to 1(b)) 73. _____

1(b) What would **Barley** planted on **good** Sailaba land yield relative to the **Barley** yield planted on **poor** Sailaba land?

% increase 74. _____
% Decrease 75. _____
Same yield 76. _____

2(a). On **KUSHKABA** Land, is Barley sown on the same, better, or lower **quality** land as Wheat?

Same = 1 (Go to D)
Better = 2 (Go to D)
lower = 3 (Go to 2(b)) 77. _____

2(b) What would **Barley** planted on **good** Kushkaba land yield relative to the Barley yield planted on **poor** Kushkaba land?

% Increase 78. _____
% Decrease 79. _____
Same yield 80. _____

D. Historical Production of Barley.

1. Did the Farmers Father (Family) grow Barley at the time of Partition?

Yes = 1 No = 2 (Go to Section III) 81. _____

2. If **Yes**, does the Farmer plant less, the same, or more Barley **now** then his Father (Family) planted at Partition?

% Less acres 82. _____
The same = 2 (Go To Section III) 83. _____
% More acres 84. _____

3. Why has the **Barley** production pattern changed from Partition?

_____
_____
_____

SECTION III. PRODUCTION PROBLEMS OF WHEAT AND BARLEY.

1. Is **WHEAT** susceptible to the following problems?

Rust	Yes = 1, No = 2	1. _____
Smut	Yes = 1, No = 2	2. _____
Insect Pests	Yes = 1, No = 2	3. _____
Emergence Problems	Yes = 1, No = 2	5. _____
Lodging	Yes = 1, No = 2	6. _____

2. Is **BARLEY** more susceptible or less susceptible than **Wheat** to the following problems?

Rust	More=1, Less=2, Same=3	7. _____
Smut	More=1, Less=2, Same=3	8. _____
Insect Pests	More=1, Less=2, Same=3	9. _____
Emergence Problems	More=1, Less=2, Same=3	11. _____
Lodging	More=1, Less=2, Same=3	12. _____

3.Does it take a longer or shorter time to thresh **Barley** by hand/animal than it takes to thresh **Wheat** by hand/animal?

50% less time = 1
25% less time = 2
10% less time = 3
The same time = 4
10% more time = 5
25% more time = 6
50% more time = 7

13. _____

SECTION IV. CONSUMPTION AND MARKETING PRACTICES.

1. last year, how many Maunds of **WHEAT GRAIN** production were:

		Mds.	%
Consumed in the home as food	1.	_____	_____
Sold in the Market	2.	_____	_____
Fed to animals:			
Sheep/Goats	3.	_____	_____
Draft Animals	4.	_____	_____
Kept for seed	5.	_____	_____
Given as gifts/Alms/Ushr	6.	_____	_____
Sold to private individuals	7.	_____	_____
Other _____	8.	_____	_____
			100%

2. Last year, how many maunds of **WHEAT STRAW** production were:

		Mds.	%
Used for home building	9.	_____	_____
Sold in the Market	10.	_____	_____
Fed to animals:			
Sheep/Goats	11.	_____	_____
Draft animals	12.	_____	_____
Other _____	13.	_____	_____
			100%

3. Last year, how many maunds of **BARLEY GRAIN** production were:

		Mds.	%
Consumed in the home as food	14.	_____	_____
Sold in the Market	15.	_____	_____
Fed to animals:			
Sheep/Goats	16.	_____	_____
Draft Animals	17.	_____	_____
Kept for seed	18.	_____	_____
Given as gifts/Alms/Ushr	19.	_____	_____
Sold to private individuals	20.	_____	_____
Other _____	21.	_____	_____
			100%

4. Last year, how many maunds of **BARLEY STRAW** production were:

		Mds.	%
Used for home building	22.	_____	_____
Sold in the Market	23.	_____	_____
Fed to animals:			
Sheep/Goats	24.	_____	_____
Draft animals	25.	_____	_____
Sold to private individuals	26.	_____	_____
Other _____	27.	_____	_____
			100%

5. What price/bag did the farmer receive for last years **WHEAT GRAIN**? 28. _____

6. What price did the farmer receive for last years **WHEAT STRAW**? 29. _____

7. What price/bag did the farmer receive for last years **BARLEY GRAIN**? 30. _____

8. What price did the farmer receive for last years **BARLEY STRAW**? 31. _____

SECTION V. REASONS FOR FARMER NOT GROWING MORE BARLEY.

1. Why does the Farmer **NOT** grow more Barley?

RANK the following, 1 to 3 (No.1 being the most important) as the **three** most important reasons:

Barley yields less than Wheat	1. ____
No Market for Barley	2. ____
Require Wheat for food consumption	3. ____
Price of Wheat is higher	4. ____
Prefer Wheat straw to Barley straw	5. ____
Does not pay to feed Barley grain to livestock	6. ____
Land shortage to plant Barley	7. ____
Labour shortage to plant Wheat	8. ____
Difficult to thresh Barley	9. ____
Orchards and vegetables more profitable	10. ____

SECTION VI. REQUIRED CONDITIONS FOR INCREASED BARLEY PRODUCTION.

1. Would the Farmer grow more Barley if threshing machines were more readily available and cheaper?
   Yes = 1 No = 2 1. _____

2. Would the Farmer grow more Barley if a better marketing and transport infrastructure were present?
   Yes = 1 No = 2 2. _____

3. Would the farmer grow more Barley if a new higher yielding Barley variety was available?
   Yes = 1 No = 2 3. _____

4. How much higher would the new Barley variety have to yield above local **BARLEY** before the farmer would grow more Barley?

   1.25 times the yield of Barley = 1
   1.50 times the yield of Barley = 2
   1.75 times the yield of Barley = 3
   2 times the yield of Barley = 4
   Would not matter = 5
   4. _____

5. How much higher would the new Barley variety have to yield above local **WHEAT** before the farmer would grow more Barley?

   1.25 times the yield of Wheat = 1
   1.50 times the yield of Wheat = 2
   1.75 times the yield of Wheat = 3
   2 times the yield of Wheat = 4
   Would not matter = 5
   5. _____

6. If the farmer grew more Barley , what would the increased **BARLEY GRAIN** production be be used for?

	Yes = 1	No = 2
Consumed in the home as food	6. _____	
Sold in the Market	7. _____	
Fed to animals:		
Sheep/Goats	8. _____	
Draft Animals	9. _____	
Kept for seed	10. _____	
Given as gifts/Alms	11. _____	
Sold to private individuals	12. _____	
Other _____	13. _____	

7. If the farmer grew more Barley , what would the increased **BARLEY STRAW** production be be used for?

	Yes = 1 No = 2
Building and construction	14. _____
Sold in the Market	15. _____
Fed to animals:	
Sheep/Goats	16. _____
Draft Animals	17. _____
Sold to private individuals	18. _____
Other _____	19. _____

8. If the farmer grew a higher yielding BARLEY variety, how would the Farmers planting decisions be altered?

Replace Wheat acres with Barley = 1

Plant same Wheat acres and add more land for Barley = 2 20. _____

9. Given the current yield of local Barley, would the Farmer grow more Barley if the Barley Price was higher?

Yes =1 No = 2 21. _____

10. How much higher would the **BARLEY Price** have to be before the farmer would grow more Barley?

1.25 times the present Barley price = 1
1.50 times the present Barley price = 2
1.75 times the present Barley price = 3
2 times the present Barley price = 4 22. _____
Would not matter = 5

APPENDIX B

WHEAT-BARLEY FOLLOW-UP SURVEY
MART/AZRI

****

Interview #. _____

Interviewer's Name _____

Date of Interview ¦___¦____¦_____¦
Day Month Year

Village _____, Tehsil_____, Distt._____

****

SECTION I. GENERAL INFORMATION.

1. Name of Respondent. 1. _____

2. Position in Household
   Head of Household = 1
   Brother of Head = 2
   Son of Head = 3 2. _____

3. Age (Years) 3. _____

4. Enterprise Type:
   Rainfed Crops only = 1
   Rainfed & Irrigated Crops = 2
   Livestock & Rainfed Crops = 3
   Livestock, Rainfed and Irri. = 4 4. _____

5. Total cropped acres THIS year
   Irrigated 5. _____
   Sailaba 6. _____
   Kushkaba 7. _____

6. No. of Animals owned:
   Sheep 8. _____
   Goats 9. _____
   Others 10._____

7. Classify the last 3 years as:

   1987/88

   Good = 1
   Normal = 2
   Poor = 3 11._____

1986/87

Good = 1
Normal = 2
Poor = 3 12._____

1985/86

Good = 1
Normal = 2
Poor = 3 13._____

SECTION II. CURRENT AND PAST YEARS WHEAT AND BARLEY PRODUCTION PRACTICES

1. Area planted and yield of <u>DRYLAND</u> wheat (state units on form) :

Year	KUSHKABA Area	KUSHKABA Yield	SAILABA Area	SAILABA Yield
1987/88	1. _____	2. _____	3. _____	4. _____
1986/87	5. _____	6. _____	7. _____	8. _____
1985/86	9. _____	10. _____	11. _____	12. _____

2. Area planted and yield of <u>DRYLAND</u> BARLEY (state units on form) :

Year	KUSHKABA Area	KUSHKABA Yield	SAILABA Area	SAILABA Yield
1987/88	13._____	14. _____	15._____	16. _____
1986/87	17._____	18. _____	19._____	20. _____
1985/86 *	21._____	22. _____	23._____	24. _____

SECTION III. PRODUCTION PROBLEMS OF WHEAT AND BARLEY

1. What pest or disease problems have you had with your wheat and barley crops:

	Wheat (Yes= 1) (No = 2)	Barley (Yes= 1) (No = 2)	Is the problem More or Less in Barley than in Wheat? (More = M) (Less = L)
Emergence problems	1. _____	2. _____	3._____
Rust	4. _____	5. _____	6._____
Smut	7. _____	8. _____	9. _____
Insects	10. _____	11. _____	12. _____
Lodging	13. _____	14. _____	15. _____
Bird damage	16. _____	17. _____	18. _____
Other (specify)	19. _____	20. _____	21. _____
Other (specify)	22. _____	23. _____	24. _____

SECTION IV. PRODUCTION, CONSUMPTION AND MARKETING PRACTICES OF WHEAT AND BARLEY GREEN FODDER

Note: Fodder production: Sometimes the crops are cut for fodder or simply grazed. We are interested in the use of barley as a hay/fodder crop. The crops are sometimes cut for fodder in November/December, or they could be cut or grazed after flowering (instead of waiting to harvest grain and straw).

1. Did you cut any of your crops for fodder in November/December months;

	Wheat (Yes=1) (No =2)	Barley (Yes=1) (No =2)	Remarks
1987/88	1._____	2._____	
1986/87	3._____	4._____	
1985/86	5._____	6._____	

b. Did you Cut or Graze any of your crops for fodder after flowering, or did you just wait and Harvest the seed and straw

(Cut= C Graze= G Harvest= H and No= O)

	Wheat	Barley
1987/88	7._____	8._____
1986/87	9._____	10._____
1985/86	11._____	12._____

2. Do you cut green fodder;
   Yes=1
   No =2 — 13. _____

3. Which crop do you cut for green fodder;
   Wheat =1
   Barley=2
   Other =3 — 14. _____

4. In which months do you cut these crops;
   - Nov./Dec. = 1
   - April/May = 2 (After flowering) — 15. _____

5. Why do you cut these crops;
   - For Animals = 1
   - For market sale = 2 — 16. _____

6. For which animals do you cut these crops:
   - Sick Animals = 1
   - Lambs and Kids = 2
   - Pregnant Females = 3
   - All = 4 — 17. _____

7. Last Year, at what price (Rs./Mds) did you sell the Green Fodder:

   - Wheat Fodder — 18. _____
   - Barley Fodder — 19. _____

8. Did these prices vary in the last 3 years:
   - Yes= 1
   - No = 2 — 20. _____

If Yes, Pl. Give the details:

	Wheat	Barley	Lucerne
1987/88	21._____	22._____	23._____
1986/87	24._____	25._____	26._____
1985/86	27._____	28._____	29._____

==========

Questions to ask fodder dealers in the bazaars

Note: If the farmer has never cut or sold wheat or barley as fodder then get the information on price about lucerne at least.

We want to know what price we could get for barley fodder or barley hay. However this may not be a product that the dealers ever handle so the questions may have to be theoretical. The questions should cover the following:

Do you ever buy barley cut for fodder (ie the whole plant - stem, leaves and flowering head)?(Y or N) 78._____ If so how much would you pay for it per maund? 79._____

Do you ever buy barley hay (ie the whole plant cut in April/May and then dried)? (Y or N) 80._____ If so how much would you pay for it per maund? 81._____

If a farmer were to offer a good supply of barley cut for fodder, how much would you pay per maund? 82._____ Is this more or less than you would pay for lucerne (M or L)? 83._____ How much do you pay for lucerne fodder? 84._____

If a farmer were to offer a good supply of barley hay, how much would you pay per maund? 85._____ Is this more or less than you would pay for lucerne (M or L)? 86._____ How much do you pay for lucerne fodder? 87._____

Have the prices of fodder paid by you to the farmer or distributor varied in the last three years?

	Wheat	Barley	Lucerne
1987/88	88._____	89._____	90._____
1986/87	91._____	92._____	93._____
1985/86	94._____	95._____	96._____

NB. Get the prices for lucerne, even if he can't give prices for wheat and barley.