

Full Length Research Paper

Adoption and economic impact of improved wheat varieties in rainfed pothwar, Punjab, Pakistan

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The process of informal seed production and distribution was started recently only two years ago in the study area. As wheat is the most important crop grown in rain fed pothwar area of Punjab Province, so adoption of improved technology has significant affect on the livelihood of the farmers. In the present study, paired t-test methodology has been used for varietals analysis, as two years areas and yield comparison has been carried out. The results are highly significant for the wheat variety Bhakar-2002. The results are also significant for area of Wafaq variety. The farmers are replacing Inqlab-91 by these varieties. The costs of producing improved variety seeds per kg are significantly lower as well as the returns to investment are almost doubled than that of conventionally used varieties. On the basis of results, the adoptions of improved varieties are highly recommended and have significant positive impact on the farmers of studied area.

Key words: Adoption, impact, wheat varieties, rain fed pothwar, conventional varieties, and improved varieties.

INTRODUCTION

Punjab (Pakistan) has 20.63 million hectares of its total geographical area with a composition of 65 and 35 percent as irrigated and rainfed respectively. The rainfed Pothwar is located across the northern portion of the Punjab province, north of the Salt Range, between the Jehlum and the Indus rivers. The districts that fall in this zone are Attock, Rawalpindi, Jehlum and Chakwal. Whole of the Attock and Rawalpindi districts (except the Murree hills) are included in the Pothwar region. Approximately, 70 percent of district Chakwal, 15 percent of the district Jehlum and 15 percent of district Mianwali also are included in the Pothwar region. The region comprises 16800 km² geographical area, representing 23 percent of the Pakistani's rainfed tract (National Engineering Service Pakistan, 1988).

Food and fodder securities are the main concern of the area wherein, crop production is very uncertain and entirely depend upon the intensity and distribution of rainfall. The total value of the crop sector economy is estimated to the tune of 4.1 billion rupees (GOP 2007)¹.

The contribution of the area in production during 2005-06 was about 4.1 percent in wheat, 82.7 percent in groundnut, 4.7 percent in maize, 32.9 percent in sorghum, 9.8 percent in millet, 48.4 percent in lentil and 12.6 percent in mustard (GOP 2007). Majority of the farmers in this tract own less than two hectares of land. The total seed requirements of Punjab province are 637.9 thousand tons of wheat, 57.4 thousand tons of gram, 14.3 thousand tons of maize, 8.3 thousand tons of millet, 6.4 thousand tons of groundnut and about 0.5 thousand tons of sorghum. The seed requirement share of barani Pothwar towards the total seed requirements of Punjab province represents 90 percent in case of groundnut, 35 percent for sorghum, 17 percent each for maize and millet, 7.2 percent for wheat and about 2.5 percent for gram seed².

. Area farmers are the only source for rainfed wheat seed. The major wheat variety being grown sustainably for the last many years is Inqlab 91 which is reported to

¹ Estimates computed using crop production and prices data for 2004-05.

² Calculated using district based area under these crops taken from district wise Agricultural Statistics of Pakistan for the year, 2004-05

be grown on more than 90 percent of the area. This variety for the last two years has become susceptible to rust. In spite of this, Farooq et al., (2007) had reported that the banned (rust susceptible) variety, Inqlab 91 was noticed the most popular and grown by majority of the farmers. More than 50 % of the surveyed farmers have reported that unavailability of improved wheat seed were the main causes for cultivating Inqlab-91 wheat variety in the area. Therefore, the variety replacement has become indispensable to avert from any devastation. Therefore, it was high time to act before it was too late. Participatory research had been conducted by the applied research component of Barani (Rainfed) Village Development Program (BVDP). Secondly, the existing seed marketing system seems non-friendly in adding the crops suited to rain fed areas in their seed marketing portfolio. Under these circumstances, there is an urgent need to establish some alternative mechanisms of seed production and distribution in the area. Realizing the need of the farming community under BVDP, the process of informal seed production and distribution was started during 2005-06. Improved wheat seed was produced for wider dissemination among farmers during 2006-07. Much emphasis was placed to scrutinize appropriate germplasm of wheat that can survive under erratic rainfall conditions during the initial years of the project, a number of wheat varieties were identified and tested. Out of these tested varieties, viable and potential varieties were screened for wider dissemination in the project area.

A dire need was realized to organize the seed production and marketing in such a manner that maximum quantity of quality seed of improved wheat varieties was made available to the farming community in the rainfed Pothwar so that the farmers in the project area could meet the goal of wheat self sufficiency and food security on sustainable basis. Keeping in view the situation and the requirement of the area, an effort was made under BVDP sponsored project to strengthen the informal wheat seed production and distribution system for a rapid wheat seed replacement with promising wheat varieties. The wheat seed of improved varieties recommended by the applied adaptive research component based on the participatory research at integrated research sites was purchased by the extension staff mainly from Barani Area Research Institute (BARI).

Improved seed production plots were sown with farmers' participation on their farms under the technical guidance of extension staff. Basic inputs (seed and fertilizer) were supplied out of the project to the producers. Seed was purchased by the extension department, and processed for quality seed by screening through cleaned, graded, packed and stored under close supervision before selling amongst the farmers. The thematic concern of this paper was to study the seed production and distribution mechanism. For the purpose,

a team from Social Sciences Research Institute, National Agricultural Research Center, and a representative from the extension department has carried out the study with the following objectives: Appraisal of village based wheat seed production, procurement, management and distribution by Extension Department, diffusion of selected improved wheat varieties, assessment of farmers' perception for informal wheat seed production and diffusion system; and collate suggestions for improvement through identifying gaps in the system in the target area.

MATERIALS AND METHODS

Selection of farmers

This section summarizes the methodology of the research study. It briefly describes the selection of the study area, sampling technique, selection of farmers, source of sample data, method of data collection, analysis and limitations of the study. In the present study Jand, Gujar Khan, P.D. Khan, Talagang and Attock tehsils were selected for wheat seed production and distribution. To carry out the specific objectives, large landholders who have sufficient irrigation facility were selected for production of improved seed. The study consisted of informal and formal surveys of the farmers involved in seed production and who purchased seed from extension department. A team of scientists from Social Sciences Research Institute (SSRI), National Agricultural Research Centre (NARC), Islamabad and Agricultural Extension Department of the respective tehsils, conducted a survey of the area during August, 2006 for better understanding of the complexities in seed production and distribution in the project areas. Survey questionnaire was tailored in the light of findings of the informal survey. The formal survey was conducted during October, 2006. A well designed and pre-tested survey schedule was used to collect the information regarding socio-economic characteristics of the farm and the beneficiaries in the process of wheat seed production and distribution. Agricultural Extensionists were also involved as members of survey team in the process of data collection, management and dissemination of wheat seed amongst the growers of area.

A list of the beneficiaries/farmers was obtained from the agricultural extension department and interviews were conducted personally by a multi disciplinary team comprising of social scientists and local extension agents. Out of total 62 farmers, the interviews were conducted from 13 producers and 49 beneficiary farmers (See Table 1).

Paired t-test Methodology

In the present study, paired t-test methodology was used for varietales analyses to assess two years' area and yield comparisons. Paired t-test is appropriate for testing the mean difference between paired observations when the paired differences follow a normal distribution. A paired t-test procedure matches responses that are related in a pair wise manner. This matching allows accounting for variability between the pairs usually resulting to a smaller error term, thus increasing the sensitivity of the hypothesis test or confidence interval.

For a paired t-test:

Ho: $\mu_d = \mu_o$ versus H1: $\mu_d \neq \mu_o$

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Table 1. Sample Distribution for Wheat Seed Production and Diffusion Surveys.

Area	Producer Survey	Diffusion Survey
	(No. of farmers)	
Attock	2	9
Gujar Khan	5	14
P. D. Khan	3	15
Talagang	2	11
Jand*	1	0
Total	13	49

Source: Survey data, 2006-07

*No seed was procured by extension department.

Where μ_d is the population means of the differences and μ_0 is the hypothesized mean of the differences, when the samples are drawn independently from two populations, two-sample procedure was used.

For a two-tailed test, the confidence interval is calculated as:

$$d - t_{\alpha/2} (S_d / n) \text{ to } d + t_{\alpha/2} (S_d / n)$$

Where:

$d = \sum d/n$, when $d = x_1 - x_2$ and x_1 and x_2 are observations from population 1 and 2, respectively.

$t_{\alpha/2}$ = the value from a t-distribution where α is 1- confidence level /100

s_d = the standard deviation of the difference

n = number of pairs of values

The standard deviation of the difference is calculated by

$$S_d = \sqrt{\sum (d - \bar{d})^2 / (n - 1)}$$

Minitab calculate the test statistics t , by

$$t = (\bar{d} - \mu_d) / (s_d / \sqrt{n})$$

Where μ_d is the hypothesized difference.

Confidence Interval:

For a two –tailed test, the confidence interval is calculated as:

$$\bar{d} - t_{\alpha/2} (s_d / \sqrt{n}) \text{ to } \bar{d} + t_{\alpha/2} (s_d / \sqrt{n})$$

Where:

$\bar{d} = \sum d/n$, where $d = x_1 - x_2$ and x_1 and x_2 are observations from population 1 and 2, respectively

$t_{\alpha/2}$ = the value from a t-distribution where α is 1- confidence level / 100

s_d = the standard deviation of the differences

n = number of pairs of values

The standard deviation of the differences is calculated by:

$$s_d = \sqrt{\frac{\sum (d - \bar{d})^2}{(n - 1)}}$$

Hypothesis test

Calculate the test statistic, t , by

$$t = \frac{\bar{d} - \mu_d}{(s_d / \sqrt{n})}$$

Where μ_d is the hypothesized difference (20).

RESULTS AND DISCUSSION

This section discusses mainly on the results of the survey data covering under socioeconomic characteristics of sample farmers, respondent's involvement in farming, size of operational holding, production and marketing of varieties of wheat seed, constraints in production and recommendations.

Socio-economic Characteristics of Sample Farmers

The sample farmers belonged to middle age group with average age of 37 years and exhibiting 10 years of formal education. Srivastava *et al.*, (2003) have suggested that the younger farmers (age group 31-35 years) earned higher profits by adopting more profitable crop rotations. They further suggested that by incurring less input costs and preventing economic losses caused by pest infestation. Setotaw *et al.*, (2000) have neared that the farmers' education level significantly influenced the

Table A-1. Socio-economic Characteristics of Sample Farmers

Character	Mean (Years)
Age of respondent	37.08
Years of schooling	9.62
Farming experience	12.69
Used to produced wheat seed at commercial level Experience	2.00

Source: Survey Results 2006

Table 2. Farm Size by Source of Irrigation of Sample farmers in the Project Area.

Land Type	Jand	Gujar Khan	P.D.Khan	Talagang	Attock
Areas in Acres (Percentage)					
Farm Size	175	46.38	53.13	36.25	56.25
Irrigated (%)	50(29)	27(58)	28.13(53)	15(41)	25(44)
Rainfed (%)	125(71)	19.38(42)	25(47)	21.25(59)	31.25(56)

Source: Survey Results, 2006

Table 3. Area under Wheat Grain and Wheat Seed Production in the Project Area (Acres)

Categories	Jand	Gujar Khan	P.D.Khan	Talagang	Attock
Total Wheat Area					
Irrigated	43.75	5.38	9.00	11.00	12.50
Rainfed	12.50	8.75	00	6.25	31.25
Wheat Seed Area					
Irrigated	12.50	4.38	6.63	7.50	12.50

Source: Survey Results, 2006

adoption of bread wheat production technologies. It was interesting to note that the growers interviewed were found educated right from primary education up to Master level (MA./M.Sc.). Literacy is one of the important variables which influence producers' receptivity to innovation and resource allocation and efficiency. Srivasrava *et al.*, (2003) have suggested that educational status of the farmers was also found to be an important factor in the adoption of improved cultural practices and high yielding varieties. Farooq *et al.*, (2007) have reported that socio-economic features of the farming families like personal characteristics of the farmers and socio-economic attributes related to their families and farms are generally considered important in receptivity of innovations and farm productivity. Years of schooling, farming experience and age of respondents have authority on the decisions regarding crops supervision and farm investments. On average, the respondents were involved in farming for the last thirteen years. Since the last two years, the respondents have been producing wheat seed at commercial level. However, approximately half of the total farmers were found to be practicing full time enterprise of agricultural farming, whereas, the

others were practicing it as part time venture (Table A-1)

Size of Operational Holdings

Excess to natural asset like land holdings is one of the major indicators of the financial status of farmers. The farmers with large holdings are more responsive to adopt recommended production technologies while the small owner operators can't afford the new innovations and avoid taking risk. The survey results in Table 2 depict that average farm holding was ranged from 30 to 175 acres in the target areas. Dug wells and mini/small water dams were found the main source of irrigation in the study areas.

Out of the total operational area, 40 percent was irrigated with different sources prevailing in the project areas while 60 percent area was found under rainfed. Wheat was found dominant crop for household consumption and dry fodder for their animal feed. Table 3 demonstrated the area allocated to wheat grain and wheat seed plots by sample farmers.

Various wheat varieties were distributed among the

Table 4. Wheat Seed provided to the Farmers through the Project during Rabi 2004-05

Catogries	Jand	Gujar Khan	P.D.Khan	Talagang	Attock
Total Wheat Seed (Kg)	625	1100	1100	750	1400
Seed Rate (Kg/acre)	50.00	50.00	50.00	50.00	50.00

Source: Survey Results, 2006

Table 5. Wheat Productivity under Conventional and Improved Seed Varieties Option.

Categories	Jand	Gujar Khan	P.D.Khan	Talagang	Attock
Conventional Seed Kg/acre	1432	1200	00	1389	00
Improved Seed Kg/acre	1600	1373	1696	1600	1760
Yield Difference Over improved seed ventures (%)	11.74	14.40	00	15.21	00

Source: Survey Results, 2006

Table 6. Different Varieties Sown by Sample Farmers in the Project Area

Name of Varieties	Productivity (Kgs/acre)
Chakwal- 97	1568.00
Wafaq-2001	1728.00
GA -2002	1520.00
AS-2002	1536.00
Bhakar-2002	1760.00

Source: Survey Results, 2006

selected farmers during Rabi (winter) season 2004-05 of the project area for seed multiplication and its distribution among the fellow growers. Table 4 shows the seed distribution between the farmers ranged from 625 to 1400 kg in Jand and Attock Tehsils, respectively. Whereas, the seed rate was analogous to recommended doses (50kg/acre), at the project sites.

The productivity of traditional wheat varieties was found lower as compared to improved cultivar at all the locations. Furthermore, the production of improved wheat varieties has out yielded coupled with the adoption of suitable technology package over the conventional varieties as shown in Table 5. Ortiz *et al.*, (2007) have mentioned that there has been considerable improvement in the access of farmers to new varieties and technologies in the rural areas. He further reported that significant yield jump (15.70%) have been achieved by resource-poor farmers over the existing conventional varieties through the adoption of new varieties in conjunction with improved resource conservation technologies (RCTs). The farmers have also made substantial cost savings and achieved higher yields through adopting resource-conserving agronomic techniques such as zero tillage Farooq *et al.*, (2006)

Improved seeds of wheat varieties were distributed among the sample farmers under informal seed production

and distribution in the project area. Table 5 shows the production obtained by farmers from conventional and improved varieties. Two improved wheat varieties viz., Bhakar-2002 and Wafaq-2001 were appeared to be the top ranked yielding varieties over others (Table 6).. Overall, mean production of the improved wheat varieties ranged from 11.74 to 15.21 percent higher as compared to conventional wheat varieties in the project area (Table 5). Researchers claimed that during the past century wheat breeders have produced a large number of genetically improved wheat lines/varieties. This activity has led to widespread adoption of improved varieties, a steady increase in average wheat yields during the past 4-5 decades induced to arise food security and poverty reduction. Fazal *et al.*, (2005) revealed that high yield (92 percent), better quality chapatti (bread) (62 percent), less lodging (64 percent), greater germination (64 percent), and early maturity of certified varieties (68 percent) were the key reasons that tempted farmers to use improved wheat varieties.

Rate of adoption of high yielding varieties determines the speed with which any farming community take benefits from the efforts of breeders. As demonstrated in Table 6, Bhakar-2002, Wafaq-2001, Chakwal-97, AS-2002 and GA-2002 were the major varieties as provided under the programme. Improvement in the supply of certified seed

Table 7. Wheat Seed Production and Distribution among Sample Farmers.

Categories	Jand	Gujar Khan	PDKhan	Talagang	Attock
- Total seed produced (Kgs)	18000	30120	38800	26000	22000
- Purchased by Extension (kgs)	00	7000	7300	7000	10000
- Price charged by farmers (Rs/40kgs)	00	415	415	415	415
- Seed sold to other farmers (Kgs)	500	4800	12500	00	3000
- Price charged by farmers (Rs/40kgs)	450	415-680	415	00	450
- No. of Farmers purchased seed	6	24	25	00	10
- Seed retained for own farm (Kgs)	300	2720	1150	800	400
- Seed unsold (Kgs)	00	3200	2000	10000	00
- Grains kept for home consumption (Kgs)	600	10800	4900	4000	4000
- Sold as grains (Kgs)	16600	1600	10950	4000	4600
- Price received by farmers (Rs/40kgs)	450	450	420	440	410

Source: Survey Results 2006

from public and private agencies helped in enhancing the use of certified seed. More farmers replaced their farm-produced seed with the seed obtained from other farmers.

All the wheat seed plots were planted from 10 October to 8 November in the project area. The wheat yield trend was decreased as the plantation delayed. Therefore, the planting time was also inquired for both years and no difference was found in the planting time of wheat from the previous year. Wheat management in complex farming systems is influenced by the time conflicts in the harvesting of preceding crops and the planting of wheat, and interaction effects observed due to residual effects on succeeding crops (Byerlee *et al.*, 1986). Kent, (1975) reported that planting of wheat in the middle of November gave higher yield than early and late sown crop. Ciha (1983) observed that late October and early November sowings were better for grain yield among other dates. Subhan *et al.*, (1999) claimed that maximum grain yield was obtained from planting on November 15 and yield declined significantly with late planting. Conventionally, less dynamism is found in wheat management practices.

Participatory varieties selection was started at Potohar region through BVPD program in 2005 to overcome quality seed constraints impede the farmers to grow out dated varieties. Farmers possess the ability and knowledge for selecting crop varieties suitable to their environment, resources, quality of taste and other consumer preferences. Research cost can be reduced and adoption rates increased if the farmers are allowed to participate in variety testing and selection process. Participatory research also increases farmers' knowledge that enables them to retain quality seed effectively from year to year. Sowing of plots that are implemented through nomination from the community organization of farmers. The nominated farmers were trained with the prime objectives to create awareness about crops management activities and introduce them the true technology for obtaining maximum yield. Training played a vital role to make the farmers understand about the merits of new technologies. This proves that there

should be a close contact between researchers and end-users in order to realize the optimum returns in terms of farm income leading the country to attain self-reliant agriculture. The recommended seed rate was used in the seed multiplication plots. Subhan *et al.*, (1999) has reported that the seed rates prescribed for each crop has to be adopted to maintain the optimum plant population for achieving maximum crops yield.

Normally chemical fertilizer is not applied in rainfed agriculture except somewhat reported in high rainfall zones but in this project the fertilizer for wheat crop was given to each contact farmer at 75 kgs Urea, 75 Kgs DAP and 50 kgs of SOP per acre for seed production. This intervention helped farmers, a timely availability of fertilizer. Shahjehan *et al.*, (2000) revealed that use of inputs less than recommended doses are also the major concern for low crop yield. Talug *et al.*, (1988) have also reported that the role of fertilizers has become more crucial and beneficial in different crops, thus it should be included since it proves to be one of the major factors in a technology package of improved farm inputs and practices. It has been demonstrated that maximum yield can be obtained with proper and timely use of fertilizers along with desired management practices (13): Boman (1995); Keatinge and Rees, (1988); Kent (1975) found significant response of N alone and in combination with P and K. Similar results were obtained by Gupta *et al.*, (1983); Lal and Lal, (1989) with different levels of N and P fertilizers.

Production and Marketing of Wheat Seed by the Sample Seed Producers

Total seed produced of improved wheat varieties by the farmers was 18000, 30120, 38800, 26000 and 22000 kgs in Jand, Gujar Khan, Pind Dadan Khan, Talagang and Attock, respectively (Table 7). Farmers reported that out of the total seed production, seed kept for own wheat plantation by the producers was 300, 2720, 1150, 800 and

Table 8. Uses of Improved Wheat Varieties and Seed Distribution Pattern by the Sample Farmer.

Categories	Jand	Gujar Khan	PDKhan	Talagang	Attock
- Total seed produced (Kgs)	18000	30120	38800	26000	22000
- Purchased by Extension (percent)	00	23.24	18.81	26.92	45.45
- Seed sold to other farmers (percent)	2.78	15.94	32.22	00	13.64
- Seed retained for own farm (percent)	1.67	9.03	2.96	3.08	1.82
- Seed unsold (percent)	00	10.62	5.15	38.46	00
- Grains for home consumption (percent)	3.33	35.86	12.64	15.38	18.18
- Sold as grains (percent)	92.22	5.31	28.22	15.38	20.91

Source: Survey Results, 2006

400 kgs in Jand, Gujar Khan, Pind Dadan Khan, Talagang and Attock, respectively (Table 7).

At the time of the survey, some quantity of seed could not be sold by the farmers with the tune of 3200, 2000, 10000 kg in Gujar Khan, Pind Dadan Khan, Talagang, respectively. It has been reported by the contact farmers that 6 fellow farmers in Jand, 24 in Gujar Khan, 25 in Pind Dadan Khan and 10 farmers in Attock have purchased the wheat seed. The storage of nearly half of total seed produced remained as an issue for the farmers due to their limited knowledge about safe storage methods of preserving high quality seed. It is evidenced from the survey results that new seed of wheat have positive effects in overcoming the shortage of improved wheat seed varieties in the target areas. The marketing intelligence of the area revealed that the village *beoparies* were the main agencies involved in wheat marketing to the extent of 5 to 92 percent in selected regions.

Beside this, the proportion of wheat seed was purchased by extension 23, 19, 27, and 46% from the improved seed contact farmers in Gujar Khan, PD Khan, Talagang and Attock regions respectively, while in Jand, the extension department did not purchase the wheat seed from the farmers due to unknown reasons, thus the farmers had sold 92 percent of the wheat seed at an ordinary rate as a grain to village *beoparies* (Table 8). The price received by the farmers from the Extension department was equal to support price (Rs.415 per 40 kg). The price paid by the village consumer and *arthi* were Rs.450-680 per 40 kg. The prices paid by the village *beopari* were Rs. 420-450 per 40 kg in all the selective regions. Overall, the price received by the farmers from village *beopari* was higher than all other agencies (Table 7). The percentage of improved grain transacted as food consumption by households seems high and need to be discouraged by the project managers. This trend of improved seed transaction is an alarming & warranted a focuss to make best use of improved seed either encourages barter system by exchanging with local cultivar within the community or offer higher procurement price through exploring alternative marketing avenues.

Table 9 describes the paired t-statistics analysis of the selected wheat varieties during the year 2005-06 and

2006-07. The results are quite significant for area of GA-2002 wheat variety. The results of variety Bhakar-2002 are highly significant through achieving higher wheat productivity. The results are significant for reduction in area of Wafaq variety. The results are quite in line with the ground realities in the area, as Bhakhar yield has been significantly improved as compared to last year. As a consequence in the coming years, probably the farmers will increase the area under this variety. The farmers have planted more area under Wafaq and GS-2002 during 2006-07 as compared to the last year. So this indicates that farmers are interested to adopt new varieties although there are not much significant differences observed in yield as evident from GS-2002 and Wafaq yields. The area under Inqlab-91 was decreasing and being replaced by improved varieties which is an encouraging sign of acceptance amongst the adopters of improved wheat varieties.

The economic analysis of wheat seed production in barani Pothwar indicates that the sowing, harvesting and threshing costs for both the systems were roughly equivalent. The manure and transportation costs were more in case of improved variety, whereas manure spreading cost was almost same in both the methods. The Urea and DAP costs were quite high in case of improved variety than the conventional variety. The harvesting and threshing costs were same in both the varieties. Total variable costs of wheat were high in case of improved variety as compared to conventional variety. As far the grain yield and net returns are concerned, these were significantly high in case of improved as compared to traditional variety. The cost of production per kg was high in case of improved variety as compared to traditional variety as shown in Table 10. The results indicate that farmers should adopt the improved variety in order to get high returns from the investment in wheat crop. The economic analysis revealed that improved seed venture is a profitable enterprise. The costs of producing improved variety seeds per kg are significantly lower as well as returns to investment are 1.5 times more than that of conventional varieties. Moreover, irrigated parcels are yielding further higher returns implying that using irrigated parcels for seed production enterprise

Table 9. Wheat Varietal Adoption Trend and Performance in Rainfed Areas on Sample Farms.

Varieties	2005-06 Mean±SE	2006-07 Mean ±SE	Paired t-statistics	d. f.	P-value
Inqlab-91					
Area (Kanal)	47.85±8.14	38.65±8.75	-0.71	12	0.49
Yield (Kg/Kanal)	149.05±24.33	144.46±8.22	-0.20	12	0.84
GA-2002					
Area (Kanal)	29.07±5.17	53.5±15.25	1.82*	13	0.09
Yield (Kg/Kanal)	128.93±7.62	128.14±7.24	0.07	13	0.95
AS-2002					
Area (Kanal)	63.78±27.39	42±27.50	-0.53	8	0.61
Yield (Kg/Kanal)	168.78±22.45	167.22±12.72	-0.60	8	0.96
Bhakhar-2002					
Area (Kanal)	78.37±27.21	70.50±26.28	-0.19	7	0.85
Yield (Kg/Kanal)	116.25±9.10	142.75±2.99	2.77***	7	0.03
Chakwal-97					
Area (Kanal)	92.89±43.15	23.78±3.81	-1.54	8	0.16
Yield (Kg/Kanal)	175.44±24.22	159.22±5.01	-0.68	8	0.51
Wafaq					
Area (Kanal)	31.30±4.21	17.67±5.85	-2.27**	5	0.07
Yield (Kg/Kanal)	158.17±23.53	142±18.87	-0.650	5	0.54

Source: Survey Results 2006

(*, **, *** indicates the significance level at 10, 5 and 1 percent, respectively).

ventures can be a more certain and profitable option than focusing of rainfed lands.

Economic impact

This activity has led to widespread adoption of improved varieties, a steady increase in average wheat yields during the past 4-5 decades lead major contributions towards food security and poverty reduction. The rate of generation and adoption of improved varieties, and therefore the time lag from varieties release to widespread use varies across regions. The remarkable success of wheat improvement hinges on the decisions of millions of farmers to adopt or replace older wheat varieties with superior cultivar material. Because adoption is a necessary step but not a sufficient condition for realizing economic impact. Since, the present paper synthesizes key assessment of impact from different locations of rain fed farming systems of Pothwar. The monetary gains from improved wheat varieties are more as compare to conventional wheat varieties. Similarly the net returns are more in case of improved method as compared to traditional method. Net returns from improved varieties are one and an half times more than

to conventional method, which attracts the attention of researchers, policy makers and agricultural extensionists for aiming prosperous & welfare of the farming community.

Issues realized in informal wheat seed production and marketing through Extension Department:

- (i). No application of weedicide, resulting in low yield.
- (ii). The area allocated to wheat seed trials in most of the cases was low lying. Most of the wheat varieties were not fit which resulted into low yields.
- (iii). The seed distribution was not done on merit basis as most of the wheat seed was given to the friends or the relatives.
- (iv). The wheat seed was distributed among small number of farmers.
- (v). The agricultural extension department had charged high prices to the farmers (i.e., rupees 17 per kg) while at purchasing time they charged less price (i.e., at the rate of rupees 10 per kg). In addition, sometime agricultural extension department refused to purchase the improved wheat seed, so it was either sold in the market or used for household consumption.

Table 10. Economic Analysis of Wheat Seed Production in Barani Pothwar.

Items and units	Wheat Rainfed	
	Conventional	Improved
Inputs Cost		
Cost of ploughing and Planking (Rs/kanal)	180.20	179.50
Cost of Seed (Rs/ kanal)	60.70	82.50
Sowing Cost (Rs/ kanal)	38.50	38.60
Manure and transportation cost (Rs/ kanal)	47.90	56.20
Manure spreading cost (Rs/ kanal)	39.20	39.20
Urea (Rs/ kanal)	36.20	59.80
DAP (Rs/ kanal)	91.80	118.80
Irrigation cost (Rs/ kanal)	-	-
Plant Protection (Rs/ kanal)	-	-
Harvesting cost	92.40	92.40
Threshing cost	70.20	70.20
Total variable cost (Rs/ kanal)	657.10	748.50
Land rent for six months	125	125
Interest on capital investment	97.70	109.19
Total cost (Rs/ kanal)	879.86	1065.19
Out put Going		
Grain Yield (Kg / kanal)	92.35	133.30
Straw Yield	116.40	143.10
Grain value (Rs/ kanal)	974.90	1434.30
Straw value(Rs/ kanal)	288.20	332.10
Gross returns (Rs / kanal)	1263.10	1766.50
Cost of Production (Rs/Kg)	9.53	8.00
Return Analysis		
Net Returns (Rs / kanal)	383.24	701.31
Return per rupee invested	0.44	0.66

¹Extension department has supplied the seed of improved varieties after taking it from Barani Agricultural Research Institute, Chakwal.

²Land rent in the area was Rs.250/kanal/annum for rainfed parcels and Rs.500/kanal/annum for irrigated parcels.

³Kanal is a local parameter which is equalant to 1/8th of acre
Source: Survey data 2004

(vi). Agricultural extension department in most of the cases prefer to demonstrate trials along the road side, thus the farmers of the remote areas were disseminated against the access to improved technology package. Since, presently the demonstration system was not equally accessible to all farmers. The farmers were mainly concerned about the time of seed availability and the quality.

Conclusion and Recommendation

Bhakar-2002, Wafaq-2001 and Chakwal-97 were proved promising varieties in the study area. Since with gaining of time, perhaps some more potential improved varieties could have been added that might well suit to the environment of rainfed farming systems of Pothwar. New improved varieties developed by NARS should be multiplied and made available to farmers in the shortest

possible time to realize the benefits of investments in agricultural research. Appropriate seed production techniques coupled with strict quality control measures ensure that varieties purity and identity is maintained, which is the cornerstone of the entire seed programme. The rate at which the variety is multiplied and accessed restricts the availability of seed and its adoption and rapid diffusion through formal or informal channels. Seed marketing is the final step in the seed multiplication programme. Because, in this phase the seed is available to the farmers and they have the option to buy it either for plantation or home consumption. Seed should be available to a farmer at the right time, right place, right price, in the right amount and must be of good quality. Because seed marketing is sensitive to many factors, it is often considered very risky business. Although, the whole gamut of this effort was to develop a village based seed enterprises with close participation of progressive growers as a system but still some more efforts would be

required to manifest a real successful venture. However, it is highly recommended that a group of progressive growers should take the responsibility to buy the entire improved seed produce from the farmers and made available to the community by charging some premium price after processing the seed through cleaning free from weeds and broken grains, and treating with fungicide. ICARDA activity in Balochistan can be a source of an eye opener for initiating village based seed enterprise (VBSE). The involvement of seed certification department is prerequisite for the successful of seed enterprise.

Some key considerations are suggested to follow for propagation of this venture for the farmers well being and welfare:

1. The improved seed varieties diffusion programme should be extended to more farmers at various locations, so that large number of farmers can get benefit from this novel process at local level.
2. Assure the active participation of farmers at all stages of seed multiplication including processing, grading, packing and distribution.
3. The number of varieties tested on farmers' fields should be more than (i.e., may be 3 to 5), and choice should be given to contact farmers for selection of promising variety. The wheat seed distribution system needs to be stream lined and this should be developed at least at Union Council level rather at individual or village farmer's basis. The improved wheat seed multiplication and choice of demonstration trials should be ranged from 100-150 kanals per farmer in the project area. An appropriate and systematic wheat varieties demonstration system should be followed to ensure the wider diffusion of the improved wheat seed varieties amongst maximum farmers within limited time span.
4. Enhance the accessibility of farmers at auction points with subsidized prices of improved/ certified wheat varieties seed for early adoption through mobilizing the extension services as well as initiation of public private partnership as a venture with aiming at increasing the wheat productivity for arresting the poverty reduction at village level.

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