RAISED BED TECHNOLOGY FOR WHEAT CROP IN IRRIGATED AREAS OF PUNJAB, PAKISTAN

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ABSTRACT:- The present paper analyzes the determinants of adoption of raised bed planting of wheat in irrigated areas of Punjab, Pakistan. Wheat is an important staple food of Pakistan. It contributes 13 % to the value added in agriculture and 2.6 % to the GDP. The agrarian economy of Pakistan is continuously under stress due to the low yield of almost all the crops and constrained with many problem. One of the most important issues of agriculture is water shortage which is increasing day by day and is a major challenge now a days. Therefore, water saving becomes the utmost need of the hour. The national research system is now putting their focus and efforts to manage the precious water through various modern/latest water saving models to draw some solid method of irrigation with less wastage. Raised bed planting method is also one of the modern methods of planting crop with significant water saving. The study was planned and conducted by the Social Sciences Research Institute, Faisalabad in 2011-12 to assess the determinants of the adoption of the raised bed technology for wheat crop in irrigated Punjab, Pakistan. The study was conducted at three sites of the districts Faisalabad and Toba Tek Singh where the Water Management Research Institute, University of Faisalabad promoted the raised bed technology for wheat crop. A sample of 63 farmers was interviewed in detail to understand the whole system and the factors contributing to the adoption of the technology. The study revealed that adopters typically have a more favorable resource base and tend to variously outperform non-adopters. More access to education and other social indicators increases the chances to adopt new technologies by the farming community. However, the small farmers can also be benefited with the technology with proper education regarding the technology in the area with good social mobilization for the conservation of scarce and valuable farm resources.

Key Words: Wheat; Raised Bed; Social Status; Education; Water Saving Technology; Determinants; Pakistan.

INTRODUCTION

Pakistan like many developing countries has an agrarian rural based economy. The agriculture sector contributes 21 % to GDP and absorbs 44 % of the labour force while about 60 % of the rural population depends upon this sector for its livelihood. The role of this sector is imperative in ensuring food security, generating overall economic growth, reducing

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poverty and the transforming towards industrialization (GoP, 2012). Therefore, developments in agriculture sector have a lasting impact on poverty reduction and improvement in the rural livelihoods. But unfortunately this sector is continuously under stress due to the low yield of almost all the crops including wheat as compared to other developed countries (Ather et al., 2006). Wheat is an important cereal crop of Pakistan and considered very crucial in terms of food security of population. Wheat is grown on 8 mha (GoP, 2012). Despite the availability of the high yielding varieties for different ecological zones, the average wheat yield in the country is low. This stagnation of productivity called for new resource conserving production techniques to meet the challenge of productivity enhancement, ensuring environmental safety and conserve natural resources (Ladha et al., 2003).

The irrigated rice wheat system consumes a large proportion of the region's water resources (Farooq et al., 2006). As the competition for water from industrial and domestic users is increased with the higher population growth in the country and concerns are being raised about the productivity of water used in agriculture. The scanty canal water availability in many areas forced the farmers to rely on ground water (Taj et al., 2005). The new water resources cannot be created therefore, to meet the increasing requirement of the rising population more food and agricultural products are needed. There are possible ways to reduce the losses of water through better management to ensure more water for crop production and improve the water use efficiency i.e., to increase the production from per unit of water. This can be achieved through adoption of innovative and state of the art technologies. Evidence has emerged in recent years to suggest that these efforts are beginning to bear fruit (Farooq et al., 2006). The modern resource conservation technologies and methods give benefits but experience suggests that successful adoption depends on a favorable confluence of socio economic, technical, institutional, and policy factors. An important determinant of the adoption of a new technology is the net gain to the agent from adoption, inclusive of all costs of using the new technology.

Visualizing the importance of conservation of the precious water resources many water saving technologies have been developed and disseminated by the agricultural scientists to enhance the crops yield. The raised bed planting of crops is one of the improved techniques for water and inputs saving. Raised bed planting is being practiced for all crops and all over the world and is an effective and improved irrigation method with several advantages. It increases the yield, nutrient management is better, efficient irrigation and crops lodging risk is reduced on beds (Hobbs and Gupta, 2003a). Bed planting has also been found to show improved water distribution and efficiency, fertilizer use efficiency, reduced weed infestation and lodging (Hobbs and Gupta, 2003b). Saving of 30% irrigation water was obtained by growing wheat and maize crops on raised beds. The present paper encompasses the determinants of adoption of raised bed sowing of wheat in the irrigated areas of Punjab.

The objectives of this study were

to identify the determinants of the resource conservation technology (raised bed planting) for wheat crop and suggest policy recommendations for enhancing the adoption of precious resource conservation of water in the area.

MATERIALS AND METHOD

The present study was conducted in the project area of Water Management Research Centre (WMRC), University of Agriculture, Faisalabad where the mechanized wheat bed planting was promoted by the WMRC. The climate is semi arid to arid. The soils are clay-loam and loam. The project is operational at three sites namely Khurrianwala and Qillian Wala sites of District Faisalabad and Mongi Bangla in District Toba Tek Singh since last four years and it is still operational in the area.

A well-structured questionnaire was employed to collect detailed information covering various indicators at the farm level. A list of adopters of all three sites was obtained from the WMRC, University of Agriculture, Faisalabad. About 20 respondents (10 adopters and 10 non adopters) from each project site were randomly selected during the survey from various villages. Out of the total 63 sample farmers nearly half (47.62%) of the farmers were adopters of the bed planting technique and the remaining (52.38%) were non-adopters of bed planting of wheat. Descriptive analysis was performed to delineate the research findings. Empirical analysis was carried out by employing a number of different econometric techniques like cross tabulation, Probit Model.

In probit model the dependent variable is dummy variable having value 1 in raised bed technology adoption and 0 otherwise, the independent variables in the probit model are farmers' age, education, household size, tenancy status, tube well tractor and land ownership etc. Probit model is binary response model and in such model interest lies primarily in the response probability.

$$P(y = 1 | x) = P(y = 1 | x1, x2, \ldots, xk)$$

where,

x = full set of explanatory variables.

For example, when y is an employment indicator, x might contain various individual characteristics such as education, age, marital status and other factors that affect the raised bed technology adoption.

RESULTS AND DISCUSSION

Key Characteristics of the Adopters and Non Adopters

The difference in age is positive and non significant indicating that adopters were slightly more aged (Table 1). The difference in education is positive and significant at 5 % level of significance indicating that adopters of the technology have higher education levels as compared to non adopters. The social status was included as dummy variable and the difference is positive and highly significant at 1 % level of significance indicating that adopters have higher social status and vice versa (Table 1) . The difference in family size is positive and non significant indicating that adopters have higher family size. The difference in experience is negative and significant at 10 % level of signi-

Table 1. Difference in key characteristics of the adopters and non-adopters

Characteristics	Adopters	Non-Adopters	Difference	t-values
Age (Mean)	43	42	0.07	0.48
Education (years)	11	9	1.71 **	2.03
Social Status	0.30	0.21	0.09 ***	2.54
Family Size (mean)	10	9	0.62	1.37
Experience(years)	20	22	- 2.16 *	-1.81

****,**,* = significant at 1%,5% and 10% levels, respectively.*

ficance indicating that non adopters are more experienced as compared to adopters may be due to less education level and they spend more time in gaining farming experience. It implies that the education has a positive impact on new technology adoption, as adopters were relatively more educated than non-adopters. Not only education, the social status of the adopters was also found higher in the area as 30 % of the adopter were holding some honorable position in the village like, *numberdar*, president of water user association, teacher etc. while in case of non-adopters only 21 % of the respondents occupy the same status (Table 1).

Access to Farm Resources

The research findings revealed that the adopters owned relatively more agricultural land (20 acres) as compared to non-adopters (15). The results indicated that majority of the farmers (58 %) were owner operated, whereas about 38 % of the farmers were owner-cum-tenant. The inter adopters comparison revealed that 40% and 36.36% of the adopters and non-adopters, respectively operating as owner-cum-tenant as they were getting land on rent or on share basis. Tractor (owned/rented) was the major source of traction power for ploughing in the area. About 65 % of farmers were using own tractor. The tractor ownership was higher for adopters as compared to non-adopters. Majority of the farmers (83 %) were using mixture of canal and tube well water for irrigation. The use of canal water as sole source of irrigation prevailed only 6 %. The tube well ownership was relatively more among adopters as compared to non-adopters. Preponderance of the adopters (72 %) reported that the underground water is fit for irrigation while for non-adopter the under ground water was found marginally fit for irrigation (Table 2). Furthermore, the access to new wheat varieties like Sehar, Faisalabad 2008 and Lasani was more (56 %) at the adopters' farms as compared to non adopters' farms (32%).

Determinants of Raised Bed Technology Adoption

In the model the age was included in number of years. The coefficient of age is negative and significant at 5 % level of significance indicating that young farmers are more likely to adopt this technology as compared to old aged farmers. The education was included as number of years of schooling of the farmers. The education coefficient is positive and

Table 2. Access to farm resources

Characteristics	Adopters	Non-adopters	Overall
Landholding			
Total own land (acres)	20	15	17
Rented-in land (acres)	9	7	8
Rented-out land (acres)	0.83	0.38	0.60
Total operational Holding	28	21	24
Total wheat area 2009 -10 (acres)	19	15	17
Owners (%)	64	53	59
Own tractor (%)	77	55	65
Irrigation source (%)			
Canal + Tubewell	83	83	83
Tubewell ownership (%)	86	69	77
Fitness of sub-soil water (%)	72	55	63
Adoption of new varieties (%)	56	32	44

highly significant indicating that higher literacy levels play significantly positive role in the adoption of raised bed technology. In the model the farmers social status was included as dummy variable i.e., 1 if the farmer is member of any organization and 0 otherwise. The farmer's social status coefficient is positive and significant at 10 % level of significance indicating that farmer social status also plays a role regarding technology adoption. The total number of family members living in the household was included as household size in the model. The parameter household size has negative coefficient but statistically significant that implies more family members in the household increase the chances of raised bed technology adoption. The tenancy status was included as dummy variable i.e., 1 for the owner and 0 for the tenant. The tenancy status coefficient is positive though not significant. In the model total number of acres owned by the farmer was included as land holding and coefficient is positive and highly significant at 1 % level of significance. As land holding is an indicator of household wealth, so it can be concluded that mostly the wealthy household have adopted the raised bed technology. Soil quality was included as dummy variable in the model i.e., 1 for good quality soils and 0 otherwise. The coefficient is positive and significant at 10 % level of significance, indicating the role of good quality soils in the adoption of raised bed technology. The tractor ownership was also included dummy variable i.e., 1 if the farmer own tractor and 0 otherwise. The tractor ownership coefficient is positive and significant at 5 % level of significance indicating that households having own tractor are most likely to adopt the raised bed technology. Household tube well ownership was included as dummy variable, the household tube well ownership is positive and highly significant at 1 % level of significance

Table 3. Determinants of raised bed technology adoption (probit analysis)

Variable	Coefficient	t- values	Significance level
Age (years)	- 0.043	- 2.01	**
Education (years)	0.065	2.44	***
Farmer's social status (dummy)	0.038	1.71	*
Household size (number)	0.075	2.25	**
Tenancy status (dummy)	0.043	1.39	
Land holding (acres)	0.067	2.69	***
Soil quality (dummy)	0.026	1.93	*
Tractor (dummy)	0.054	2.12	**
Tube well (dummy)	0.037	3.17	***
Seed source (dummy)	0.059	2.31	**
Harvesting method (dummy)	0.011	1.29	
District/ locations (dummies)			
Jaranwala	0.055	2.54	***
Gojra	0.048	2.52	***
Constant	0.033	2.28	**
Number of observation	60	-	
Value of R^2	0.164	-	
LR ^{2}	113.0	-	

****,**,* = significant at 1%,5 % and 10% levels, respectively.*

indicating that household having own tube well are most likely to adopt the raised bed technology and vice versa. Seed source was also included in the model as dummy variable. Results regarding seed source are positive and significant at 5 % level of significance indicating that farmers having own seed source are most likely to adopt the raised bed technology as compared to household having not own seed bed. Harvesting method was included as dummy variable in the model. The results of harvesting method are positive though not significant. The district dummies were also included in the model to capture the geographic variations. The value of R^2 is 0.164 and LR ^{2} was 113. The LR ^{2} value is significant at 1 % level of significance, thus indicating the robustness of the model and variables included in the model.

The tube well dummy and seed source are positive and significant both in case of social status and raised bed technology. The harvesting method is positive and non significant both for social status and raised bed technology. The district and location dummies were also included in the model to capture the unobserved heterogeneity i.e., location wise variations.

It is thus concluded that the agriculture sector role is imperative in ensuring food security, generating overall economic growth, reducing poverty hence transforming towards industrialization. Therefore, developments in agriculture sector have a lasting impact on poverty reduction and improvement in the rural livelihoods. The potential technologies benefits but the successful adoption depends on a favorable confluence of technical, economic, institutional, and policy factors. The present paper look into the factors of adoption of the raised bed planting of wheat in the irrigated areas of Punjab.

The results of Probit regression analysis regarding raised bed technology indicate that young and educated farmers are more likely to adopt this technology as compared to old aged farmers. The farmer's social status also plays a positive role in adoption of new technologies. The land holding coefficient is positive and highly significant at 1 % level of significance. As land holding is an indicator of household wealth, so it can be concluded that mostly the wealthy household have adopted the raised bed technology. Therefore it can be concluded that more access to education and other social indicators increases the chances of adoption of new technologies in the farming community. However, the small farmers can also be benefited with the technology with proper education regarding the technology in the area with good social mobilization for the conservation of scarce and valuable farm resources.

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