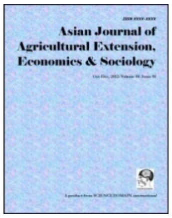

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Impact of Education and Certified Seeds on Wheat Production in Kohat, Pakistan

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Authors' contributions

This work was carried out in collaboration between all authors. Author AU conducted the study, search for literature and wrote first draft of the manuscript. Author SNMS helped in technical writing and editing of the manuscript. Authors ZS, MK and SA managed modeling specification and statistical analysis of the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

The study was conducted to investigate the impact of education and certified seed on wheat production in district Kohat, Pakistan. For the purpose, proportional allocation sampling technique was used and total of 100 respondents randomly selected to get necessary information. Simple budgeting technique was used for cost and return of wheat production. The econometric technique, Ordinary Least Squares (OLS) OLS estimation model was used to analyze contribution of major factors in the wheat yield. The sign of explanatory variables were found according to our prior expectation of the economic theory. The estimated results of production function indicated that farm yard manure(FYM), total fertilizer nutrient applied and labor days had positive and significantly effect on wheat yield, seed rate had positive but insignificant effect on wheat yield. The impact of

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both Dummy variables i.e. education and certified seed was positive and significantly affect wheat yield. Finally, it was suggested that there is the need for strengthening agricultural extension services in the study area in order to educate the farming community to ensure the use of recommended certified seed and modern agriculture technology for getting high yield of wheat crop.

Keywords: Education; fertilizers; production function; wheat; yield.

1. INTRODUCTION

Agriculture plays a key role in economic growth and development of Pakistan. Being the dominant sector it contributes 21.4% to GDP, employs 45% of the country's labour force and contributes in the growth of other sectors of the economy [1]. Wheat is essential food crop and has occupied a central position in agricultural policies of government of Pakistan. Wheat contributes 10.1% to the value added in agriculture and 2.2% to total GDP of Pakistan. Area under wheat cultivation and production was increased from 8650 thousand hectares and 23.5 million tonnes respectively (2012-11) to 8693 thousand hectares and 24.2 million tonnes respectively (2012-13) showing an increase of 0.5% in area and 3.2% in production, while the target production was 25.5 million tonnes which is 5.1% decrease . Total yield production was 2787 Kg ha^{-1} (2012-13), which achieved a positive growth of 2.7% as compared to negative 4.2 percent growth of last year. Area, Production and yield of wheat in Pakistan (2008-2013) are presented in Table 1.

Wheat consumption in Pakistan is increasing gradually due to increase in population growth rate. Wheat productivity can be increase through increase in acreage under wheat crop or through positive increase in inputs application, in which education and certified seeds are among important factors.

Education is one of the important factors, affects agricultural productivity and regarded as a stems for the building up general-skill. Field evidence suggested that educated farmers thoroughly followed the recommended instructions for application of chemicals and fertilizers etc. [2]. The emphasis of education as a driving force for the growth of agricultural productivity dates back to the early 1960s. However, empirical work failed to take into account of the fact that production technology changes with time and consequently obscure the true contribution of education in agricultural production [3].

The educated farmer has greater impact on producing quality products due to his knowledge and ability in term of education. The educated farmers (for Asia at least) have high returns of the agricultural products [4]. Education enhances agricultural productivity directly by improving labour quality, by increasing the ability to adjust to disequilibria, and through its effect upon the propensity to successfully adopt innovations. Education is thought to be most important to farm production in a rapidly changing technological or economic environment [5]. Schooling enhances the farmer's efficiency to cope with changes in market conditions. Households with more education allocate more labour and capital to non-farm activities [6]. Khaldi [7] supported the view that education enhances allocated efficiency in agriculture in United States of America by using 1964 data but weakly supported the inverse relationship between marginal efficiency and technological change. Moreover, education plays a significant role in raising the hourly earnings of farmers and education policy can play a significant role in poverty alleviation [8]. Education may increase the probability of success in each of these endeavours and, in so doing, diversify household income sources to reduce risk and improve economic security.

Table 1. Area, production and yield of wheat of Pakistan [1]

Year	Area		Production		Yield	
	000 ha	%Change	000tonnes	%Change	Kg ha^{-1}	% Change
2008-09	9046	-	24033	-	2 657	-
2009-10	9132	1.0	23311	-3.0	2 553	-3.9
2010-11	8901	-2.5	25214	8.2	2 833	11.0
2011-12	8650	-2.8	23473	-6.9	2 714	-4.2
2012-13	8693	0.5	24231	3.2	2 787	2.7

The improved agricultural technologies for increase in agricultural production have been identified as a precondition for achieving food security [9]. Therefore quality seeds play a pivotal role in boosting agricultural production both in market oriented and subsistence farming system. Seed has the unique position among various agricultural inputs because the effectiveness of all other inputs mainly depends on the potential of the seeds. Seed is a high technology product and is an innovation most readily adapted. Improving access to good quality of seed is a critical requirement for sustainable agricultural growth and food security. Effective use of improved/certified seed can result in higher agricultural production and increases the net income which has a positive impact on rural development. Hence, availability of quality seed of improved varieties is essential to achieve the production targets. The strength and efficiency of support services such as extension, credit, and input supply can condition the effectiveness of research results emanating from experiment stations. The role of improved varieties of crops, particularly wheat and rice, in alleviating poverty has been widely debated [10,11].

The purpose of this paper is to find out the impact of education and certified seeds on wheat productivity. When education and certified seeds have a significant impact upon Wheat productivity, this will provide an economic rationale for policy interventions to improve productivity of wheat crop with particular reference to District Kohat of Pakistan.

2. MATERIALS AND METHODS

The study is based on primary data collected through face to face interview from wheat growers of Kohat district, Pakistan. Due to time and financial constraint it was not possible to cover all the villages of the area. Therefore three villages namely i.e. Bilitang, Kot and Kharmatu were selected. Wheat growers of these villages were also well known to the researcher and extension oriented services. Therefore it was convenient to collect the data for study in hand. The proportional sampling allocation technique was used to get the required sample size of 100. Fakhrisarhad, Inqilab 91, Bakhtawar, Kohat 2002 etc. varieties of wheat are grown in the targeted areas.

The paper under study intends to find the impact of education and certified seed on wheat production in District Kohat. Wheat production has been treated as dependent variable while seed rate, number of irrigation, total fertilizer nutrient applied, FYM applied, Dummy variables D1& D2 (education and certified seed) are among the set of independent variables. The collected data was tabulated and analyzed by using Excel and SPSS (statistical package for social sciences) aims towards specific objectives. Further detail of modeling and analytical procedure is given below.

Cost and return of wheat production in the study area

According to the Debertin [12] and Varian [13] net returns of the farmers from wheat production can be calculated as follows:

$$\prod = TR - TC$$

$$TR = P1 * Q1 + P2 * Q2$$

Where:

$$TC = Vi * Xi$$

Hence:

$\prod$ = Net return
TR = Total revenue
TC = Total cost
P_1 = Price of main product (Grain)
P_2 = Price of by-product (Bhoosa)
Q_1 = Quantity of main product (Grain)
Q_2 =Quantity of by-product (Bhoosa)
V_i =Denotes the price of inputs
X_i = Denotes quantity of inputs
i = 1, 2, 3 ………………..n

2.1 Theoretical Model of Wheat Yield

The following multiple regression model was used to know the impact of major determinants of higher wheat yield.

Hence:

$$Y = f(X_1, X_2, X_3, X_4, D_1, D_2)$$

The above multiple regression model is explained in below equation

2.2 Empirical Model of Wheat Yield

Ordinary least square method was used for the following regression models.

$$Y = \beta_o + \beta_i \sum_{i=1}^{4} X_i + \sum_{k=1}^{2} \beta_{4+k} D_k + ei$$

$$Y = \beta_o + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 D_1 + \beta_6 D_2 + e_i$$

Where:

Y = Total wheat yield (kg $acre^{-1}$)
X_1 = Total seed rate (kg $acre^{-1}$)
X_2 = Number of irrigation $acre^{-1}$
X_3 = Total fertilizer applied (bags $acre^{-1}$)
X_4 = FYM (kg $acre^{-1}$)
D_1 = Dummy variable for education (Literate =1, Illiterate = 0)
D_2 =Dummy variable for seed sown (Certified seed =1, Local = 0)
β_i = Coefficient of explanatory variables
e_i = Error term

2.3 Tests for Heteroscedasticity Problem

To check the significance and assume that the modeling errors are uncorrelated and normally distributed and that their variances do not vary with the effects being modeled. For this purpose Formal test for heteroscedasticity was formulated.

1. Park Test
2. Goldfeld-Quandt test

2.3.1 Park test

$$Lne_i^2 = \beta_o + \beta_i LnX_i + e_i$$

2.3.2 Goldfeld- quandt test

$$\lambda = \frac{RSS_2 / df}{RSS_1 / df}$$

3. RESULTS AND DISCUSSION

3.1 Cost Analysis of Wheat Production

After detailed interview of the wheat growers in the targeted area results are presented in tabular form (Table 2) which showed that average per acre cost of seed was computed Rs. 1252.67/- and its percent contribution was 6.39% and average per acre cost for tractor used for land preparation was found Rs. 1157.04/- while percentage contribution was 5.9%. Furthermore, average per acre cost for the Labor implied and fertilizer purchase was calculated Rs. 2536.88/- and Rs.2497.04/- having percent figures were 12.95% and 12.74% respectively. During survey farm yard manure (FYM) cost was estimated Rs. 2080.58/- with 16.62%. In addition, Average per acre cost for irrigation charges was estimated Rs. 600.54/- and its percent contribution was 3.1%. Similarly, average per acre cost for the threshing expenses was derived Rs. 1400.56/- and its percentage value was 7.15%. It was observed during the study area that highest cost was reported for the rent of land. The reason for high cost was wheat grown in one season but rent of land was taken annually for two seasons. Average per acre cost for the rent of land was calculated as Rs. 7833.33, which represent high percentage of 39.99%. Moreover, Transportation and marketing cost was obtained Rs. 227.87/- and percentage share was 1.16%. At the end Rs. 19288.42/- was calculated as total average cost of production.

Table 2. Average per acre cost of wheat production in the study area

Particular cost	Units	Rate $unit^{-1}$	Quantity $acre^{-1}$	Cost	%
Seed	Kg.	26.87	46.62	1252.67	6.39
Tractor	Hours	625.43	1.85	1157.04	5.90
Labor	Days	225.50	11.25	2536.88	12.95
Chemical Fertilizers	$50kgBag^{-1}$	1675.87	1.49	2497.04	12.74
FYM	Kg	2.60	800	2080.58	16.62
Irrigation	Rs.	……..	……..	600.54	3.10
Threshing	Rs.	……..	……..	1400.56	7.15
land Rent $crop^{-1}$	Rs.	……..	……..	7833.33	39.99
Transportation and marketing	Rs.	……..	……..	227.87	1.16
Total Production cost	Rs.	……..	……..	19288.42	100

Source: Field survey, 2010-11, Rs. Represent Pakistani rupee, and 1 US$ equals to 85.62 PKR by the end of 2010

3.2 Net Return of Wheat Production

Net returns obtained from wheat crop were calculated by subtracting per acre total cost from per acre total revenue.

$$\prod = TR - TC$$

Per acre total revenue during study area was calculated Rs. 26609.56/- Hence, net returns was Rs. 7321.14/- per acre.

3.3 Results of Regression Analysis

The results of the regression analysis are presented in Table 4 as Ordinary least square method was used for the following regression models to estimate the coefficients production function. The intercept of the model is 22.88, which represents that the expected yield of wheat when there is no input. The coefficient of seed rate (X_1)is 0.203 which implies that 1 kg increase in the seed rate will bring 0.203 Kgs increase in the wheat yield. The results indicated that coefficient of irrigation (X_2) is statistically significant. The positive coefficient of number of irrigation implies that one unit increase in the number of irrigation will increase wheat yield by 0.837 kgs. The coefficient of fertilizer nutrient applied (X_3) is 2.63 indicating that the yield will increase by 2.63kgs by increasing the fertilizer nutrient applied use by 1 unit. The coefficient of FYM (X_4) is 0.888. This coefficient indicates that wheat yield will be increased by 0.888kgs by increasing the plant protection use by 1 unit. The positive coefficient implies that educational level (D_1) of farmer has impact on yield of wheat. The results suggest that one unit increase in the education level (D_1) will increase the wheat by 0.802kgs. The coefficient of certified seed (D_2) suggests that one unit increase in the seed will increase the wheat by 1.22kgs. All the important variables values are given in the Table 3.

The estimated model gives good results and the sign of explanatory variables are in accordance to economic theory. The entire explanatory variable carries positive signs. F- test determine the overall goodness of fit/significance of the model. In our case, as F calculated = 89.41 > F-tabulated= 2.09, therefore the overall model is significant. The coefficient of determination, R^2 = 0.882, suggests that 88.2 percent variation in the dependent variable (output) has been explained by the independent variable (input). These results are in in-line with the earlier studies by Yasmeen et al. [14].

Table 3. Variables values

Variabls	Values
(X_1)	1252.67
(X_2)	600.54
(X_3)	2497.04
(X_4)	2080.58
(D_1)	(Literate =1, Illiterate = 0)
(D_2)	(Certified seed =1, Local = 0)

Table 4. Regression analysis

Y	Coefficients	S.E	t-ratio
Constant	22.88	4.79	4.77
(X_1)	0.203	0.84	0.241
(X_2)	0.837	0.19	4.41
(X_3)	2.63	0.87	3.03
(X_4)	0.888	0.19	4.67
(D_1)	0.802	0.20	4.01
(D_2)	1.22	0.25	4.88

R^2 = 0.882, R^2 adjusted = 0.84, F = 89.41

3.4 Park Test

Results of the Park Test are presented in the Table 5. Statistically significant result of β_i will suggest the problem of heterscedasticity.

Table. 5. Results of the park test

Lne_i^2	Co-efficient	S.E	t- ratio
constant	-23.87	8.69	-2.74
In X_1	+1.28	4.41	0.29
InX_2	+1.47	2.13	0.69
In X_3	-3.24	1.95	-1.66
In X_4	+7.34	3.94	1.86

R^2 = 0.128, R^2 adjusted = 0.097, F = 2.31

The estimated model suggest that, in majority of the cases t-ratio are statistically insignificant, $t_{tabulated}$ = 1.77 at 0.05 level of significance. Therefore this test resulted that there is no problem of heterscedasticity. As t-ratio of all explanatory variables are insignificant except FYM.

3.5 Goldfeld-quandt Test (λ)

For the major important variables Goldfeld-quandt test (λ) is as follow;

$\lambda X_1 = 1.17$
$\lambda X_2 = 1.03$
$\lambda X_3 = 1.79$
$\lambda X_4 = 1.12$

If the $F_{calculated} > F_{tabulated}$, the problem of heterscedasticity is likely to be there. Here in our case the $F_{calculated}$ of seed rate, number of irrigation and FYM applied values are 1.17, 1.03, 1.12. $F_{calculated}$ for total fertilizer nutrient applied value is high than $F_{tabulated}$ value which is 1.79 $F_{tabulated}$ value 1.77 at 5% level of significance. Therefore it is suggested that in majority cases $F_{calculated}$ is less than $F_{tabulated}$ that is why, no problem of heterscedasticity.

4. CONCLUSION

It can be concluded that education and certified seeds have a positive impact on the productivity of wheat i.e. education and certified seeds have no impact on the wheat productivity and alternatively we accepted the alternative hypothesis that education and certified seed has a significant positive impact on the wheat productivity that in return raises the living standards of the rural poor. A number of studies including the study in hand proved that education and certified seeds have a positive impact on the agricultural productivity (as mentioned above). It implies that along with the impact studies of education and certified seed on productivity other factors should also be taken into account e.g. it is important and necessary to assess the extension and education oriented services acquired by the farmers that will give the complete fungibility analysis. Further, it was observed during the study that there is need for strengthening agriculture extension services in the district in order to educate the farming community to ensure the use of recommended modern agriculture technology for getting high yield of wheat crop.

Furthermore new varieties and recommended practices should be introduced through agricultural research and agricultural extension. Timely provision should be made of inputs i.e. certified seed, fertilizers, tractor etc. by the concerned institutions.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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