The Role of Education in Agricultural Productivity in Khyber Pakhtunkhwa (1975-2008)

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ABSTRACT

Agriculture is considered as the backbone of Pakistan's economy and a reasonable proportion of population is engaged in it. The present study aims at finding the role of education in productivity of wheat, sugarcane and tobacco crops in Khyber Pakhtunkhwa (KPK) during the period 1975-2008. The econometric techniques Ordinary Least Squares (OLS) and Cointegration have been used for analysis. The estimation results obtained from OLS shows that education, fertilizers and area under cultivation are significant determinants of agricultural productivity in KPK. The results of cointegration confirmed the existence of long run relationship between education and agricultural productivity. It is therefore, suggested to adopt effective measures to increase school enrollment especially in rural areas of the study area. Furthermore, provision of high quality fertilizers and increase in area under cultivation can be helpful in enhancing the productivity of food and cash crops in the study area.

Key words: Education, Agricultural Productivity, Ordinary Least Squares, Khyber Pakhtunkhwa

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INTRODUCTION

Agriculture sector still seems to be the backbone of Pakistan economy despite the structural transformation towards industrialization. It has employed 44.7% of the total employed labour force with a contribution of 21.8% to GDP. (Economic Survey of Pakistan, 2008-9). It is the major profession of most of rural population. Fluctuations in agricultural production leave significant impacts on employment and balance of payments in Pakistan economy. The agricultural growth in Pakistan has been sustainable with exception of few years. It grew at 4.1% in 2002-03, 6.5% in 2004-05 and 4.7% in 2008-09 (Economic Survey of Pakistan, 2008-09).

Education plays an important role in allocation of labour in farm activities in Ghana. The off-farm activities give higher return to education than on-farm work. (Jolliffe, 2004). 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 (Yang, 2004). Similarly, research in agriculture does play its due role in enhancing agricultural productivity. Research-induced technical change resulted in 20% growth in agricultural production since 1965 in china (Fan and Philip, 2007). Khaldi (1975) supported the view that education enhances allocated efficiency in agriculture 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 (Laszlo, 2008). Under the household farming system, average or highest education level of household leads to enhancement of their income and total efficiency of labour but this depends on economic and political conditions (Li and Junsen, 1998). The small farmers in developing countries are unable to muddle through changing world conditions due to lack of investment in education. The participation of farmers in Farmers Field Schools can result in immediate and developmental benefits (Berg & Jenice, 2007).

Despite the agro-based economy, out of a total 79.61 million hectares area of Pakistan, only 21.17 million hectares is being cultivated. The province of Khyber

Pakhtunkhwa (KPK) covers 10.17 million hectares. Out of the total cultivated land of Pakistan, KPK has 7.79 percent share. A substantial part of KPK is mountainous with some of the mountains having dense forests. That is why 30% of forests are in this province. Agriculture is still a major profession of notable proportion of the people in KPK. The present paper is an effort to probe into the role of various inputs in agricultural production in Khyber Pakthtunkhwa with specific emphasis on the role of education. The paper is of a different nature in the sense that it has utilized the secondary data while the analysis is based on techniques used for time series.

Agriculture and Education Profile of Khyber Pakthtunkhwa

The province of Khyber Pakthtunkhwa is spread over 12.77 percent of the total area of Pakistan with the cultivated area of 1.65 million hectares. Its plain areas are very fertile and some of the hilly areas also produce good crops. The major crops of the region are wheat, tobacco and Sugarcane. Apart from these crops, rice, maize, vegetables and some other crops are also produced. Wheat is cultivated in almost all areas of the province whether irrigated or barani. The area under the wheat crop in Buner, DI khan, Mardan, Swat and Swabi was greater than other districts of the province. Peshawar, Mardan, Swabi, Mansehra, D.I Khan, and Charsadda showed higher wheat production than other districts in 2008-9 (Khyber Pakthtunkhwa Development Statistics, 2009). The per Capita Production of wheat in Haripur was the highest.

The major areas of Tobacco production are Swabi, Mardan, Charsadda and Buner. Swabi is the major contributor to Tobacco production in the province followed by Mardan. The Per Capita production (PPC) of Swabi is greater than all other areas as Shown in the Table I.

Table IArea, Production and Per Capita production of Major Crops in Khyber Pakhtunkhwa

District	Wheat			Tobacco			Sugar cane		
	Area	Production	PPC	Area	Production	PPC	Area	Production	PPC
Bunar	49.14	57.10	74.84	2.94	7.05	7.05	0.10	2.70	3,54
charsadda	32.97	86.38	62.10	3.43	9.33	9.33	30.77	1374	987.78
l.dir	-	-	-	0.41	0.12	0.12	-	-	-
D i khan	45.32	84.40	69.93	-	-	-	10.08	423.46	9.70
Nsr	-	-	-	1.51	3.21	3.21	5.15	260.52	218.5
Haripur	37.36	75.23	85.98	-	-	-	-	-	-
Malakand	-	-	-	1.49	4.22	4.22	4.83	184.89	285.7
Kohat	39.43	39.31	49.38	-	-	-	-	-	-
Mansihra	38.13	95.76	64.23	2.24	5.10	5.72	-	-	-
Mardan	49.98	99.01	49.19	5.43	16.34	18.33	28.38	1309.74	650.74
Peshawar	35.27	83.55	28.33	_	-	_	11.51	598.6	202.97
Swabi	46.09	93.21	66.2	15.86	43.49	48.78	4.43	167.44	118.92
Swat	62.42	71.30	39.59	0.41	0.30	0.34	-	-	-

* Area is measured in (000) hectares and Production in (000) tones.

** Source: KPK Development statistics 2008-9

Sugarcane is grown in the area where the irrigation water is sufficient. Peshawar, Charsadda, Mardan and D.I. Khan are the major areas for sugarcane cultivation. It is also grown in some areas of Swabi, Malakand and Buner.

Khyber Pukhtunkhwa (KPK) is among the low literate provinces of Pakistan. The literacy rate in KPK was 35.5 % in 1998 (Population Census Organization, 1998). There were 158.4 thousands primary schools, 25.2 thousands high schools and1231 colleges in KPK in 2007(KPK Burreau of Statistics, 2010). The literacy ratio is 55 percent in KPK. The government of KPK spent Rs.10135 million on education during the year 2010-11.

MATERIALS AND METHODS

Data

The type of data used depends on the nature of the problem under study and availability of data. The study in hand is using secondary data for the period 1975-2009. The data has been taken from different issues of the Khyber Pakhtunkhwa (Former

N.W.F.P) Development Statistics and Economic Survey of Pakistan(various Issues). The data used in this paper is time series in nature, therefore to avoid the chances of spurious regression, the stationarity of data has been checked with the help of Augmented Dickey Fuller Test.

Models for Estimation

The paper under study intends to find the role of education in determining agricultural productivity in Khyber Pukhtunkhwa (KPK) province of Pakistan. Agricultural productivity has been treated as dependent variable while education, fertilizer, area under cultivation and mechanical input tractors are among the set of independent variables. Furthermore, three major crops of KPK have been taken. These include wheat, sugarcane and Tobacco.

The model for estimation used the this study is given below

(3)

Where

Y= Agricultural Production

Ar = Area under Cultivation

Edu= Education

Fert= Fertilizer

Tract= Number of Tractors

The study has measured agriculture production in thousands tones, education by school enrollment, and area in thousands of hectares. The study intends to find the role of education in total agricultural production of wheat, sugarcane and tobacco as well as production of these crops separately. Therefore, we introduce separate equations for total production, Wheat, Sugarcane and Tobbaco production as given below.

(4)

(5)

(6)

(7)

Where

Y_T = Total Agricultural Production/Productivity Y_w = Wheat Production

Y_s = Sugar Production Y_{Tb} = Tobbaco Production

The econometric techniques Johanson Cointegration (1988, 1991, 1995) and Ordinary Least Squares have been used for analysis. The study has used statistical software Eviews-6 for analysis.

RESULTS AND DISCUSSION

The present study is based on time series data for the period 1975-2008. Therefore, to get reliable results, Augmented Dickey Fuller test has been used for finding the existence of Unit Root. The test has been conducted by using "Intercept and No Trend" and "Intercept and Trend" assumptions. The Results are displayed in Table II. The results show that all variables of the study Yt, ArT, edu, Fert, Tract, Yw, Yt and Ys are non stationary at level with Intercept and No Trend. The results are displayed in Table II. I(0) in Table II shows level while I(1) shows first difference.

All variables become stationary when first difference is taken. When the test is revised with the assumption of intercept and trend, all variables are non-stationary at level. Therefore, to make the data stationary, first difference has been taken. The results show that all variables are stationary at first difference. The results are given in Table III. The estimations results have been derived by using Ordinary Least Squares method and Johanson Cointegration technique.

The regression results of equation for total production shows that education, area under cultivation and fertilizer are among the set of significant determinants of agricultural production. Education, an important determinant of socio-economic variables has been treated as explanatory variable in this model. Education makes aware the producer about the latest production techniques which enables him to increase crop productivity. The estimation results show that education affects crop production positively. One percent increase in education enrollment leads to 4% increase crop production. The result is significant at 5% level of significance. This is shown in Table IV. Similarly area under cultivation and fertilizer positively affect agriculture production

and the result is statistically significant. Tractor, an important input in agricultural production had positive impact on agricultural production but the result is not significant statistically.

The estimation results for wheat equation have been derived by using the same explanatory variables as used in total production. The use of tractors, and fertilizers appeared as positive determinants of wheat production in KPK but the result is not significant statistically. The results show that Area under cultivation and education are significant determinants of wheat production in KPK. Sugarcane is another important crop of Khyber Pukhtunkhwa province which is mainly cultivated in Peshawar, Charsadda and Mardan. The estimation results show that area under cultivation and use of fertilizer significantly affect sugarcane production. This means that in order to increase the production of this cash crop, use of more fertilizer and expansion in area under cultivation can be effective tools. Moreover, the use of mechanical implements will further push up sugarcane production. Education has positive but insignificant affect on sugarcane production in KPK province. Similarly, education, fertilizer, use of tractors, and area under cultivation appeared as significant determinants of Tobacco production in the study area. Education affects positively the Tobacco production which means that increase in school enrollment leads to increase in Tobacco production. This means that increase in number of educated producers will lead to increased awareness which enable the producers to use inputs in best possible way. This leads to increase in crop productivity.

The existence of any possible long run relationship between education and agricultural production has been checked by using Johansen Cointegration test. The test has been conducted first for the equation developed for total agricultural production and then for other equations. Results obtained from total production equation showed the existence of at most one cointegrating equation which shows long run relationship among the variables of equation. The test has been conducted with the trend assumption of No Deterministic Trend. Similarly, the wheat equation showed the existence of at most two cointegrating equations which is the confirmation of long run relationship. The trend assumption was No Deterministic Trend. Results of cointegration for Tobacco equation showed two cointegrating equations while the sugarcane equation indicated at most one

cointegrating equation. The discussion shows that education affects the productivity of sugarcane, wheat and Tobacco in long run in Khyber Pukhtunkhwa.

The results of cointegration have been displayed in Table V.

Table II ADF Test Results (With intercept but No Trend)

Variable	I(0)	I(1)		Results							
	t-Statistic	Critical value		P-value	t-Statistic	Critical Value	P-Value				
		1%	5%	10%			1%	5%	10%		
LAS	-2.0152[2]	-3.6617	-2.9604	-2.6192	0.2791	-3.7169[2]	-3.6702	-2.9640	-2.6210	0.0089	I(1)
LAT	-1.9378[3]	-3.6702	-2.9640	-2.6210	0.3114	-3.4581[1]	-3.6793	-2.9678	-2.6229	0.0169	I(1)
LAW	-2.5650[2]	-3.6617	-2.9604	-2.6192	0.1109	-5.2221[2]	-3.6702	-2.9639	-0.6210	0.0002	I(1)
LENRM	-1.6174[1]	-3.6537	-2.9571	-2.6174	0.4624	-3.4998[1]	-3.6616	-2.9604	-2.6191	0.0148	I(1)
LENRS	0.2864[0]	-3.6463	-2.9540	-2.6158	0.9740	-5.5520[0]	-3.6537	-2.9571	-2.6174	0.0001	I(1)
LFERT	-2.2525[1]	-3.6537	-2.9571	-2.6174	0.1929	-5.2301[1]	-3.6617	-2.9604	-2.6192	0.0002	I(1)
LPS	-2.2806[1]	-3.6537	-2.9571	-2.6174	0.1840	-4.6740[1]	-3.6616	-2.9604	-2.6191	0.0007	I(1)
LPT	-1.7095[1]	-3.6537	-2.9571	-2.6174	0.4170	-4.3707[1]	-3.66166	-2.9604	-2.6191	0.0017	I(1)
LPW	-2.1785[1]	-3.6537	-2.9571	-2.6174	0.2175	-4.0671[1]	-3.6616	-2.9604	-2.61916	0.0036	I(1)
LTRACT	-2.3979[1]	-3.6537	-2.9571	-2.6174	0.1502	-3.2191[1]	-3.6616	-2.9604	-2.6191	0.0283	I(1)

Source: Author's Calculations based on data obtained from Khyber Pukhtunkhwa (NWFP) Burreau of Statistics

Table III ADF Test Results (With intercept and Trend)

Variable	I(0)	I(1)		Results							
	t-Statistic	Critical value		P-value	t-Statistic	Critical Value	P-Value				
		1%	5%	10%			1%	5%	10%		
LAS	-2.8713[1]	-4.2733	-3.5577	-3.2124	0.1845	-6.1703	-4.2846	-3.5628	-3.2152	0.0001	I(1)
LAT	-3.8713	-4.2733	-3.5577	-3.2123	0.1107	-4.2916	-4.2845	-3.5628	-3.2152	0.0098	I(1)
LAW	-3.0308[2]	-4.2846	-3.5628	-3.2152	0.1404	-5.1979	-4.2967	-3.5684	-3.2183	0.0011	I(1)
LENRM	-0.4259 [0]	-4.2627	-3.5529	-3.2096	0.9822	4.4736[0]	-4.2732	-3.5577	-3.2123	0.0062	I(1)
LENRS	-2.6420[2]	-4.2627	-3.5529	-3.2096	0.2656	-5.5782[0]	-4.2732	-3.5577	-3.2123	0.0004	I(1)
LFERT	-1.9701[1]	-4.2733	-3.5577	-3.2123	0.5948	-6.1579[1]	-4.2845	-3.5628	-3.2152	0.0001	I(1)
LPS	-2.4919[1]	-4.2732	-3.5577	-3.2123	0.3296	-4.6282[1]	-4.2845	-3.5628	-3.2152	0.0044	I(1)
LPT	-2.6922[2]	-4.2845	-3.5628	-3.2152	0.2463	-5.1347	-4.2967	-3.5683	-3.2183	0.0013	I(1)

LPW	-2.0916[1]	-4.2732	-3.5577	-3.2123	0.5307	-3.9315	-4.2845	-3.5628	-3.2152	0.0225	I(1)
LTRACT	-1.8361[0]	-4.2627	-3.5529	-3.2096	0.6641	-6.6775	-4.2732	-3.5577	-3.2123	0.0000	

Source: Author's Calculations based on data obtained from Khyber Pukhtunkhwa (NWFP) Burreau of Statistics

Regression Results of Agricultural Production				
Variable	Coefficient	St.Error	t-Statistic	Probability
LTrac	0.039743	0.058944	0.674241	0.5055
Ledu	0.076989	0.036768	2.093928	0.0451**
Lfert	0.172910	0.083907	2.060720	0.0484**
LArea	0.088423	0.035078	2.520720	0.0175**
Constant	6.552590	0.724868	9.039700	0.0000*
R.Squared 56.6 F-statistic 9.4674 R-Squared(Adj) 50.7 Prob (F-Statistic) 0.0000 DW Statistic 1.89				
Regression Results of Wheat Production				
Variable	Coefficient	St.Error	t-Statistic	Probability
LTrac	0.022398	0.099244	0.225682	0.8230

Ledu	0.132730	0.061702	2.151154	0.0399**
Lfert	0.175207	0.141731	1.236195	0.2263
LArea	0.163531	0.055538	2.944491	0.0063*
Constant	5.229054	1.204547	4.341095	0.0002*
R.Squared 52.6 F-statistic 4.4666 R-Squared(Adj) 51.2 Prob (F-Statistic) 0.0062 DW Statistic 1.81				
Regression Results of Sugarcane Production				
Variable	Coefficient	St.Error	t-Statistic	Probability
LTrac	0.008181	0.039024	0.209644	0.8354
Ledu	0.007661	0.021193	0.361500	0.7203
Lfert	0.101818	0.055397	1.837960	0.0763***
LArea	1.691108	0.173568	9.743217	0.0000*
Constant	-0.432636	0.814830	-0.530953	0.5995
R.Squared 83.6 F-statistic 36.9289 R-Squared(Adj) 81.3 Prob (F-Statistic) 0.0000 DW Statistic 1.66				

Regression Results of Tobacco Production				
Variable	Coefficient	St.Error	t-Statistic	Probability
LTrac	0.216010	0.048307	4.471571	0.0001*
Ledu	0.097177	0.033166	2.930039	0.0065*
Lfert	0.166040	0.072389	2.293722	0.0292**
LArea	1.195114	0.078424	15.23909	0.0000*
Constant	-2.689338	0.496491	-5.416688	0.0000*
R.Squared 94.8 F-statistic 36.9289 R-Squared(Adj) 133.8439 Prob (F-Statistic) 0.0000 DW Statistic 1.54				

Table IV Regression Results

Results of Agricultural Production Equation				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.736772	106.0512	76.97277	0.0001
At most 1 *	0.620458	64.67452	54.07904	0.0043

At most 2	0.512880	34.64201	35.19275	0.0572
At most 3	0.226384	12.34544	20.26184	0.4184
At most 4	0.131998	4.388388	9.164546	0.3573
Results of Wheat Production Equation				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.672314	93.57776	60.06141	0.0000
At most 1 *	0.608372	58.99104	40.17493	0.0003
At most 2 *	0.463570	29.93030	24.27596	0.0087
At most 3	0.290117	10.62292	12.32090	0.0947
At most 4	1.93E-05	0.000599	4.129906	0.9880
Results of Sugarcane Production equation				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.713624	88.27013	69.81889	0.0009

At most 1 *	0.510699	49.50616	47.85613	0.0347
At most 2	0.432920	27.34805	29.79707	0.0934
At most 3	0.199147	9.763134	15.49471	0.2994
At most 4	0.088681	2.878732	3.841466	0.0898
Results of for Tobacco Production				
Variable	Coefficient	St.Error	t-Statistic	Probability
None *	0.802105	115.0469	69.81889	0.0000
At most 1 *	0.623668	64.82639	47.85613	0.0006
At most 2 *	0.521294	34.53062	29.79707	0.0132
At most 3	0.256208	11.69391	15.49471	0.1722
At most 4	0.078018	2.518112	3.841466	0.1125
* denotes rejection of the hypothesis at the 0.05 level				

Table V Results of Cointegration

Conclusion and Recommendations

The present study made a time series analysis of the role which education plays in agricultural productivity in Khyber Pakhtunkhwa during the period 1975-2008. The analytical techniques used for analysis are Ordinary Least Squares and Johansen Cointegration. The results show that education, area under cultivation and use of fertilizer are significant inputs in production of agricultural production. The area under cultivation appeared as significant determinant of agricultural production even when the analysis is carried out separately for three crops Wheat, Sugarcane and Tobacco. Education, an important variable proved a significant variable for all crops except sugarcane. It affects positively sugarcane crop but the result is not significant statistically. It is therefore concluded that education, use of fertilizers and area under cultivation are the most important determinants of agricultural productivity in Khyber Pakhtunkhwa province of Pakistan.

The following recommendations are hereby made on the basis of the study.

1. Education is an important determinant of productivity in agriculture. Therefore, all possible measures should be taken to increase school and college enrollment in KPK. The first step can be the universalization of primary education. The subject of agriculture at all levels should be encouraged.
2. It is suggested to provide high quality of fertilizers to cultivators. The provision of fertilizers on easy installments in sowing season can be an effective tool to increase production
3. In order to increase the production of food and cash crops, the area under cultivation needs to be increased.
4. The use of technology in form of tractors can also produce far-reaching results.

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