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Labor and Agriculture Productivity: A Case of Thana, Sakhakot and Palyai Sher Khana of District Malakand

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Abstract
Pakistan is an agrarian country and agriculture sector has been remained the main stay for the economy since independence in 1947. There are a number of factors which can affect its productivity in different ways. The present study examines agriculture productivity in district Malakand using a random sample of 56 farmers. A structured questionnaire is developed, and explained to respondents whenever needed. Data gathered is analyzed using descriptive statistics and linear production function of Cobb-Douglas type. The econometric model is estimated using OLS, after testing for all its major assumptions. The empirical analysis is carried out in two ways: first, simple descriptive statistics has been calculated, and secondly, an econometric model has been estimated. The descriptive analysis reveals that the average agri. Productivity in the sample area is Rs 6.02. The average of labor hours is 25.1875 per day. The use of tractor by a farmer on average is 958.04 hours per year. The average fertilizers used in agriculture productivity is 3245 kilo gram per year. The average level of water used by the farmer is 1.93 times per week. The average pesticides in the sample area 2.34 times per month. As shown in the general theory of production, production depends on a number of factors such as labor (L), Tractor (TRC), Fertilizer (F), Water times (WTUS). The expected coefficients of each variables is expected be positively related to production level under certain assumptions. Labor input is positively related to production of agri. Output. The tractor has smaller and smaller positive effects on productivity. These effects are so small that it is statistically insignificant contribution to productivity. Water and pesticide is an essential input for forming. Many studies have shown that water and pesticide have positive effects on agriculture productivity. . The role of govt. is not very impressive in promotion of know how related to agri. diseases and its medicine. It may be due to this that the impact of pesticide is negative, which is being a small amount in use.

1 Outset of the study

Pakistan is agrarian country and agriculture has been remained the main stay for the economy of Pakistan since independence 1947. Agriculture sector is having a handsome contribution to the GDP, that is, 21.4 percent and 45 percent employment of the total labor force, (Economic Survey of Pakistan, 2012). Besides providing employment opportunities to 45 percent of labor force, majority of the population of Pakistan is living in rural areas and their lives are directly or indirectly dependent on agriculture. Agriculture also provides raw materials to agro-based industries and it heavily contributes to the country exports. Thus any change in policy for agriculture sector will affect the economy and a large portion of the population in the country. The use of modern technology along with the yielding varieties of quality seeds and fertilizers has helped agricultural sector in increase of value-added growth, (Economic Survey of Pakistan, 2012).

Malakand's District having an area of 964 square km and the total population of the region is 9.5 lakes as per population census in 2009 of Government of Pakistan. It is situated in the lower reaches of swat region. Malakand is substantially different today as it was to be in past. The distinctive characteristics of Malakand land is that, it serves as a bridge for trade with other districts like Swat, Dir, Shangla, Bunner and Chitral districts.

The soil of Malakand and its other surroundings areas are generally moist and loamy, it is irrigated through the river swat, which flows from Swat and joins the river Kabul near Peshawar. There is moderate climate in the region and rainfall is not enough, so soil requires artificial irrigation.

There was lack of irrigating water in Malakand region at the time of Malakand tunnel construction as the flow of river swat was changed. The current scenario is that excess of water is available, the land of Malakand is fertile

among its near regions rice, maize and sugarcane are the major crops in the area, as they are produced in abundance. Other crops and fruits produced in Malakand region are wheat, barley, grain and tobacco. The famous and delicious fruits include like Oranges, Kinos, Laquats, pears and over GDP growth. Similarly, there is an improvement in absorptive capacity of the labor, especially illiterate labors or having only the general education. Growth in GDP and squeezing the labor absorptive capacity go hand in hand.

Ali & Hamid (1996) analyze the technical change, technical efficiency, and their impact on input demand in the agricultural and manufacturing sector of Pakistan. The relationship between technical change, technical efficiency, capital and labor for Pakistan is estimated using Cobb-Douglas production function. They use time series data from the period of 1973 to 1995. The regression equation is estimated using ordinary least square method and all major assumptions such as multicollinearity and autocorrelation are checked to get robust results. They find that technical change, capital stock and labor employment has positive relationship with agriculture growth of Pakistan.

Burney (1986) investigates the sources of Pakistan's economics growth that is, the relationship between GDP growth, capital and labour units of Pakistan. He uses time series data from the period of 1960 to 1985. He estimates that the capital and labor is contributing by 60 percent to Pakistan's GDP growth and the contribution of investment in GDP growth is very small. In demand side, the consumption largely contributes to GDP growth. The commodity production sector is more than 40 percent of the growth of GDP. The major crops are main contributor in agriculture sector. In manufacturing sector contributes by more than 60 percent.

Hamid & Ahmad(2009) analyze the growth and productivity in purview of transitional dynamics in Pakistan agriculture sector. They examine the relationship between the value added in the agriculture to number of labor hours, quantity of capital stock and intermediate inputs, level of technology and human resources development in the agriculture sector of Pakistan. They use time series data from 1972 to 2006 and applied Cobb-Douglas production function. They test for the existence of multicollinearity . Their estimates show that the technology and capital stock have positive relationship with value added in agriculture sector. The labor employment is some time positive and some time negative relationship with value added in the agriculture.

Chen.et.al (2008) examine total factor productivity (TFP) growth in chine's agricultural sector. The relationship between TFP growth, education, technical change and efficiency of investment has been tested. They use panel data from 1990 to 2003 and apply output oriented MALM productivity index, sequential DEA and the second stage MLE approach has been used to identify the major determent of TFP growth. They estimate that education, technology change are very sustainable development in TFP growth in 1990's.

Hamid and Pichler (2009) analyze the human capital spillovers, productivity and growth in the manufacturing sector. The relationship between value-added growth in manufacturing, labor employment, capital stock, level of technology and human resources of Pakistan has been examined. They use times series data from 1972 to 2007 and apply translog production function, stochastic frontier approach and time trend model. They check the homogeneity of variables. The estimate show that labor employment, capital and technology is positively related to changes in value added growth in manufacturing sector.

Ali (2000) analyzes the total factor productivity (TFP) growth in Pakistan agriculture. The relationship between input index (land, labor, capital and material), output index (major and minor crops output) and total productivity of agriculture has been tested. He uses time series data from 1960 to 1996 and applies arithmetic index method along with Tornquvist - Thesil Index. He finds that input index and output index is positively related to changes in productivity of agriculture.

Fan (1999) analyzes the technical changes, technical and allocative efficiency in Chinese's agriculture. They examine relationship between technology changes, technical efficiency, allocative efficiency and agriculture productivity. He uses annual time series data from 1980 to 1993. He uses frontier production function approach, cost function approach, translog functional, stochastic frontier shadow cost function. He finds that the technical changes, technical and allocative efficiency have positive impacts on agriculture's productivity.

In the background of literature, it is evident that studies related to agriculture productivity and its major determinants in District Malakand are rare into my knowledge. The presented is intended to fill this research gap. It analyzes the overall trend in agriculture productivity in Pakistan and assesses the determinants of agricultural productivity especially role of labor in the district Malakand.

2 RESEARCH METHODOLOGY

The present study analyzes the contribution of labor in agriculture productivity in district Malakand of Pakistan. A random sample of 56 farmers has been taken from the different village of Malakand district like Thana, Paylai Sher khana, Sakhakot. However, sample size is evenly distributed among all three villages on the assumption that statistical population of these village is same. A structured questionnaire has been developed for data collection and explained to respondents whenever needed. Data gathered is analyzed using descriptive statistics and linear production function of Cobb-Douglas. The econometric model is estimated using OLS, after testing for all its major assumptions.

The following functional relationship can be expressed to analyze the impact of labor hours per unit along with other determinants on agriculture productivity.

$Y = f(L, Trc, Ft, Wtus, Pes)$ ..... (1)

where

Y = Market value of agriculture products,
L = Labour hours per day ,
Trc = Tractor hours per acre,
Ft = Amount of fertilizer (in kgs) ,
Wtus = No of times water is given per acre in a whole month.
Pes = No of time pesticide per month.

The mathematical form, after testing for specification tests, has been adopted as similar to Cobb – Douglas production function, which is given below.

$$logY = \alpha_o + \alpha_1 L + \alpha_2 Trc + \alpha_3 Ft + \alpha_4 Wtus + \alpha_5 Pes + e_i \quad \text{..... (2)}$$

The above model has been estimated using Ordinary Least Square (OLS) method. The assumptions of OLS has been checked. Results are reported in the result section .

3 Data Analysis and Discussion

The average agri. Productivity per labor in the sample area is Rs 6.02, it means that each individual, on the average, produce agri. Output amounting Rs. 6.02. The max productivity is Rs 6.77 whereas min is Rs 5.17. The standard deviation is Rs 0.37 which shows the scantiness of productivity across the sample. Since the JB test indicate that there agri. Productivity is normal across the region, so the descriptive statistics are not misleading, (see Table No. 1)

Table No 1: Descriptive statistics for selected variables

	Y	L	TRC	FT	WTUS	PES
Mean	6.028261	25.1875	958.0357	3245.79	1.9375	2.349161
Minimum	5.176091	6	0	64	0.5	0.83
Maximum	6.778151	135	8000	15600	4	15
Standard Deviation	0.370328	24.819	992.0895	3940.033	0.853136	2.189637
J.B TesT	0.52	0.0000	0.0000	0.0000	0.05	0.0000

Sources: results taken from survey

The average number of labor hours is 25.1875 per day on farm, which means that in each field per day the labor hours are 25.1875. The minimum labor hours per day in each field are 6 and the maximum labor hours are 135 per day. Where, the standard deviation is 24.8 hours per day. In J.B test shows that labor hour distribution is normal, in sample area.

The use of tractor by a farmer on average is 958.04 hours per year. The minimum use of tractor by farmer is 0 hours per day, because of the fact that tractor have no access to some of the fields and farmer depend upon using alternate methods. These are, on average, smaller agri. Plots in the middle of houses. The maximum use of tractor is noted at 8000 hours per year. The standard deviation is not so high, however, Jarque Bera test shows that statistical distribution of tractor use per hour is not normally distributed.

The average fertilizers used in agriculture productivity is 3245 kilo gram per year. It means that each farmer used 3245 kilogram of fertilizers per year. The minimum use of fertilizers is 64 kilogram per year and maximum use of fertilizers, in agriculture fields, is 15600 kilogram per year. The standard deviation is 3940 kilogram per year. J.B test shows that statistical distribution of fertilizer use is not normal across the agri. Fields.

The average level of water use by the farmer is 1.93 times per week, the minimum level of water usage is 0.5 time per week (or once after 3 days), because water is compliment good for growth of the crop. The maximum use of water is 4 times a week, depends on the availability of water and efficiency of farmer (also on the required level of water for a crop).

The average pesticide in the sample area 2.34 time per months. It mean that each farmer use pesticide 2.34 time per month. the max pesticide is 15 whereas min is 0.83 time per month. The standard deviation is 2.18. Since the JB test shows that the pesticide is normal across the region, so the descriptive statistics are correct.

Table no 2 shows the estimated production function for agri. Products in the Malakand District including three villages namely Thana, sakakhot and palyai sharkhana. As shown in the general theory of production function, production depends on a number of factors such as labor (L), Tractor (TRC), Fertilizer (F), Water times (WTUS). The expected coefficients of each variables is expected be positively related to production level under certain assumptions. For instance, the short run production function with variable input “labor” and fixed input capital, states that there exists diminishing return to scale. It means that production increases initially with every expansion of labor, and it falls after the employment of more labor relative to farm capacity. In the table No 2, Labor input is positively related to production of agriculture Output. Its coefficient is 0.00046 and statistically significant at conventional level of significance, that is, 5 percent. The value of labor coefficient is

smaller; it means that labor enhances output at very decreasing rate.

Table 2: Estimated results of model (2)

Variable	Coefficient	Std.Error	T-statistic	Probability
C	5.59	0.1273	43.91	0.000
L	0.0046	0.0019	2.29	0.026
TRC	1.71E-05	4.84E-05	0.35	0.725
FT	9.81E-07	6.67E-07	1.47	0.147
WTUS	0.148	0.0565	2.63	0.011
Pes	-0.04	0.020	-0.186	0.853
$R^2 = 0.28$, Adj. $R^2 = 0.22$, F- Statistic = 4.99 (Probability = 0.0017)				

Source: Results are taken from survey data

The use of mechanization in enhancing agriculture Productivity is well established in the literature. Mechanization of farm means that use of modern machinery for farm operation. It may be in form of tractor, reaper, thrasher, spray machines etc. However, most of these machines are expensive, that is, capital intensive and poor farmers of Malakand District cannot afford it. The use of these machines is rare in the production area. For the purpose of quantification of impact of mechanization on productivity, the use of tractor is taken as a proxy for mechanization process. However, this proxy may not be good approximation, that is, it is used once a year in the time of cultivation or preparation of land for cultivation in case of damages due floods. In this context, the effects of tractor on productivity are expected to positive, however, may not be significant. In the table no 2, it is shown that tractor has smaller and smaller positive effects on productivity. These effects are so small that it is statistically insignificant contribution to productivity.

The standard theories of agriculture economics show that fertilizers have positive effect on the agri. Productivity. The present study concludes in line with the standard theories, that is, fertilizer plays vital role in agri. productivity of District Malakand. The coefficient of fertilizer is 0.72 which is significant at five percent level of significance. The interpretation of coefficient is very simple and straight forward, that is, if there is one unit increase in the use of fertilizers, it enhances output by 0.72 units.

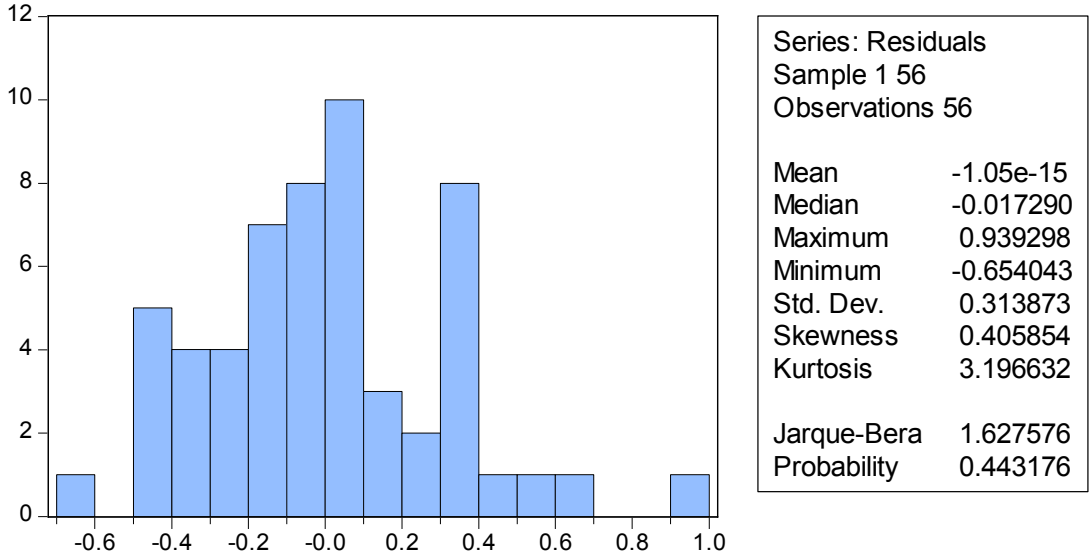
Water and pesticide is an essential input for forming. Many studies have shown that water and pesticide have positive effects on agriculture productivity. The present study confirm the positive effects of water on agriculture productivity in District Malakand, however, it is negative in case of pesticide. One of the explanations for such surprising result is the prevailing state of diseases and availability of medicine for it. Most of the farmers are uneducated, and they do not know about the nature of diseases and its appropriate medicine. The role of govt. is not very impressive in promotion of know how related to agri. diseases and its medicine. It may be due to this that the impact of pesticide is negative, which is being a small amount in use.

The fitness of the model can be judged from the value of R-squared value which is equal to 0.281. It may looks low, however, the studies based on primary data used to report R-square up to 0.30. In the present case, it is 0.28 which is good fit. The value of R-square shows that 28 percent variation in dependent variable is explained by independent variables and the rest of 72% variations are emerging from error term or random factors. Overall significance of the model can be tested using F-statistic, which is significant at conventional five percent level of significance, in our case. It means that model is overall significant and can be used for policy formation with the low chances of being incorrect or misleading decisions.

If the probability (F-statistic) value is less than 0.05 or 5% so the overall model is significant and the fit is good otherwise if greater then it is insignificant and the fit is not good. In the above table the probability (F-statistic) value is 0.001776 which is less than 0.05 or 5% so the overall model is significant and fit is good.

The diagnostic tests of the estimated model are given below. First, the test of normality is given in the figure 2. The Jargue – Bera test and simple histogram is used as test of normality. Figure No 2 shows that the residual of the model (2) are completely normal at conventional level of significance, which is one of the core assumptions of OLS.

Figure 1: Test of Normality of residuals in model (3.1)



Source: Survey data

Since, it is the survey data, therefore the test of autocorrelation is not undertaken because it is not a problem in the present case. Similarly, the probability of presence of Multicolleanarity is also low in our case, as by design the explanatory variables are not expected to have Collinearity by simple economic intuitions. However, the test of Heteroscedasticiy is applicable in the present case. Table No 3 shows the value of Breush - Pagan - Godfrey test of Heterosecdasticity with F and chi square versions. Both the test accepts the null of no Heteroscedasticity at conventional level of significance, which is another core assumption of OLS.

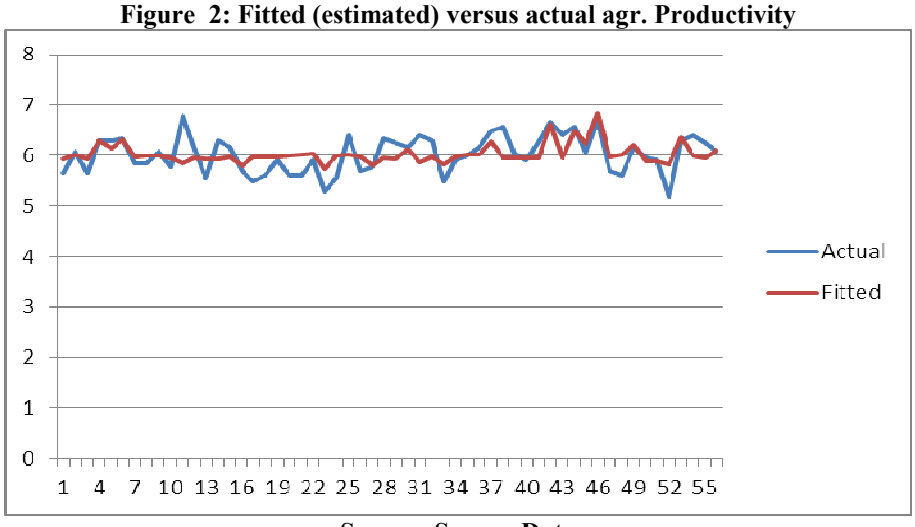
Table 3: Breush – Pagan - Godfrey test of heterosecdasticity

F-statistic	1.80	Prob. F(4,51)	0.1413
Obs*R-squared	6.96	Prob. Chi-Square(4)	0.1380
Scaled explained SS	6.34	Prob. Chi-Square(4)	0.1751

Source : Survey Data

It means that the OLS estimates presented in table no 2 are unbiased, consistent and efficient as there are no evidences of violation of basic assumptions of the OLS. One of the glimpse of the above statement is shown the figure no 2 which shows the comparison of estimated agri. Productivity from model (2) to that of actual agri. Productivity taken from field. The figure shows that there is a very close correlation among the two productivities measure or in other words, the model (2) best explains the agri. Productivity and its behavior in the District Malakand.

Figure 2: Fitted (estimated) versus actual agr. Productivity



Source: Survey Data

Conclusion and Recommendations

The empirical analysis is carried out in two ways: first, simple descriptive statistics has been calculated, and

secondly, an econometric model has been estimated. The descriptive analysis reveals that the average agri. Productivity in the sample area is Rs 6.02. It means that each individual, on the average, produce agri. Output amounting Rs. 6.02. The average of labor hours is 25.1875 per day, which means that in each field per day the labor hours are 25.1875. The use of tractor by a farmer on average is 958.04 hours per year. The average fertilizers used in agriculture productivity is 3245 kilo gram per year. The average level of water used by the farmer is 1.93 times per week, the minimum level of water usage is 0.5 time per week (or once after 3 days), because water is compliment good for growth of the crop. The average pesticides in the sample area 2.34 times per month.

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In the light of above empirical findings, it is recommended that govt. may initiate the following steps:

- Govt. may initiate skill development programs to educate farmers related to scientific farming. It would enable farmers to know about the timing of water, pesticides and insecticides as well as a general know how about various types of diseases.
- The supply of various insecticides is not properly available in the local market of Malakand. Govt. may ensure regular supply of such insecticide.
- The availability of irrigation water is not regular. Govt. may ensure availability of canal water.
- The land holding is not optimal, that is, the average land holding is 2 acre. which is very low. It cannot put under modern technology, that is, the use of technology require optimum amount of land holding. Govt. may promote a sort of cooperative farming which would increase productivity.
- Most of the farmers are poor. They can not purchase modern inputs of farming. They easy and soft loans for farming. Govt. may initiates schemes that facilitate such poor farmers.
- The recent floods in 2009 and 2010 have damaged the land. Govt. may restore it by proper application of technology.

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