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Economics and Dependence of Wheat Productivity on Farm Size in Southern Punjab

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Article History
Received
October 24, 2014
Revised
December 10, 2014
Accepted
December 20, 2014
Published Online
January 13, 2015

Keywords:
Crop productivity,
Land holding,
Farmer economics,

Abstract: Wheat is the major staple food in Pakistan and used for variety of purposes. The crop is also very important for country's economy as it has a contribution of 10.1 percent in agricultural value added and 2.2 percent in overall GDP of Pakistan. Within this context, the present study examines the wheat productivity level and economic analysis of wheat for each productivity level in district Rajanpur .Total sample of 120 respondents was interviewed. The regression results for the high, medium and low yielding groups were following. The value of R2 was 0.73, 0.75 and 0.68. Benefit cost ratio in the sample area with opportunity cost of land and family labor was 1.32, 1.60 and 1.96 for low, medium and high yield groups. There is dire need to strengthen the coordination between agriculture researchers and extension department to guide the farmers about the efficient utilization of agriculture resources. Pure and healthy seed contributes much to increase the yield of crop.

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Cite this article as: Akhtar *et al.,* 2015. **Economics and dependence of wheat productivity on farm size in Southern Punjab.** *Journal of Environmental and Agricultural Sciences.* 2:4.

1. Introduction

The agriculture sector continues to play a central role in Pakistan's economy. Pakistan is undergoing many structural changes in its economy as it is shifting from agricultural to services sector. Despite these changes, agriculture is still the single largest sector of Pakistan's economy. Although the share of agriculture in the country's GDP is declining, still it contributes a big share of 21 percent in its GDP. Almost 45 percent population of Pakistan receives employment from this sector. Furthermore, the population living in rural areas of Pakistan accounts for more than two-thirds of its total population and 60 percent of this population is dependent on agriculture and its allied industries for their livelihood (GOP, 2012). Agriculture sector also provides inputs for other industries based on agriculture. This sector is primary supplier of raw material to downstream industry, contributing substantially to Pakistan's export and it is a large market for industrial products such as fertilizer, pesticides, tractors and agricultural implements (Govt. of Pakistan, 2010).

There are two principal crop seasons in Pakistan, namely the "Kharif", the sowing season of which begins in April-June and harvesting during October-December; and the "Rabi", which begins in October-December and ends in April-May. Rice, sugarcane, cotton, maize, mong, mash, bajra and jowar are "Kharif" crops while wheat, gram, lentil (masoor), tobacco, rapeseed, barley and mustard are "Rabi" crops. Major crops, such as, wheat, rice, cotton and sugarcane account for 82.0 percent of the value added in the major crops. The value added in major crops accounts for 32.8 percent of the value added in overall agriculture. Thus, the four major crops (wheat, rice, cotton, and sugarcane), on an average, contribute 33.1 percent to the value added in overall agriculture and 7.1 percent to GDP. The minor crops account for 11.1 percent of the value added in overall agriculture (Govt. of Pakistan, 2010).

Wheat crop is exposed to the dangers of various epidemics such as pests, diseases, lodging by winds and grain shriveling due to sudden rise in temperature at grain maturity stage. An experienced farmer can easily anticipate the extent of loss in output caused by these problems. It was found that during the year 2002-03, decline was 9.9 mounds per acre as compared to last year. According to farmers' perceptions attack of aphids/jassids, more rainfall at maturity stage and cold wind blow were the main causes of yield decline in the area. Low temperature, water shortage and disease attack also contributed in yield decline during Rabi 2002-03. According to farmers, the pesticides companies were suggesting pesticides for aphids/jassids control, whereas, the extension department was against the spray at this

stage. There was a mix response regarding the control of aphids/jassids by pesticides. It was, therefore suggested that there should be an integrated approach of both extension and field staff of private companies to avoid confusion among the farmers for control of such attack in future (Bashir et al., 2006).

Barkley et al., (2010) studied the wheat variety selection to maximize returns and minimize risk. Their results concluded that there were three ways to take advantage of differing varietal traits to enhance yield stability: (1) traditional and advanced wheat breeding techniques; (2) blends of varieties, and (3) variety portfolios. Breeders could benefit by careful examination of the quantitative relationship between varieties. Specifically, there were large potential gains from combining varieties that were characterized by inverse yield responses to growing conditions such as drought or the presence of a disease. Perhaps most importantly, the results of the study indicated that a carefully-selected portfolio of wheat varieties was a major risk reducing strategy for wheat producers. They argued that many producers plant several varieties in rotation, as a way of diversification and adoption of new varieties over time. The major implication of the research was that data and statistical tools were available to improve the choice of wheat varieties to plant each year. Efficient variety portfolios, if adopted, would enhance wheat yields and the economic gains had shown larger.

Tozer (2010) measured the efficiency of wheat production of western Australian growers and he found that the production function model used and a relatively simple input model, consisting of wheat yield, effective rainfall, fertilizer application rates and year of study. Inefficiency was captured in a second model that incorporated machinery capital investment, opening equity level, and year of study. Data covered in this paper was collected from the four production years i.e., from 2004 to 2007. The results demonstrated that inefficiency was present in wheat production in Western Australia and that inefficiency increased over the period from 18% in 2004 to 29% in 2007. Higher machinery investment per hectare and opening equity levels reduced inefficiency, due to producers having sufficient capacity, mechanical or financial, to adapt to variability within the production season. The results generated from two models show that the responses from the production function are consistent with expectations and that the output responses to changes in any of the inputs increased at a decreasing rate and that over the period of study output had increased due to scale neutral technological change by approximately 8%.

Hassan (2010) conducted a study on technical inefficiency and yield gap of wheat production in Bangladesh. The cross sectional data from wheat growing areas was used in study. The average technical inefficiency of wheat production was 16 and average wheat yield gap 454 kg/ ha. He argued that this gap can be minimized by focusing on better formal education, technologies related to wheat production, and farming experience of growers as the results of the study indicated that these factors had a significant effect on technical efficiency and yield of wheat production.

The wheat productivity remained different among different farmer groups, the efforts are required to evaluate the factors which cause the variation in productivity. Therefore, this study has been designed to fulfill the following objectives:

- To determine various productivity levels obtained by the farmers and the magnitude of productivity gap on different farm categories.
- To examine the farm management practices and to conduct economic analysis of each productivity level.
- To evaluate the impact of various factors on different wheat productivity levels.
- To give suggestions to improve wheat productivity.

2. Methodology

Due to time and financial constraints, a purposive sampling technique was applied to select the sample respondents. By selecting 10 villages from both tehsil (i.e., Jampur and Rajanpur,) approaching six respondents from each village, total 60 respondents were interviewed from both tehsil. Thus total sample size of respondents was 120 which were interviewed. The farmers were classified into three productivity group, taking the yield level as the basis of classification. They were classified in such a way that each group contains the equal number of respondents.

- Low yield group obtaining yield less than 30 mounds per acre.
- Medium yield group obtaining yield 30 to 35 mounds per acre.
- High yield group obtaining yield more than 35 mounds per acre.

Estimate cost of production

Following methodology was adopted to estimate cost of various farm inputs and their allocation to wheat crop and to estimate the economics of wheat production and variation in yield Benefit Cost Ratio (BCR) will be used (Chaudhry and Ahmad, 1986).

$$\Pi = PY - TC \quad (1)$$

Mathematical form of the Model

As described above, Cobb-Douglas type of production function was found to be the best for analysis. Function was estimated by using stepwise regression procedure. The equation 2 which is used for analysis is as under:

$$LnY = \beta 0 + \beta 1Ln + \beta 2Ln + \beta 3Ln + \beta 5Ln + \beta 6Ln + \mu i \quad (2)$$

Where Y = yield (mound), β_0 = intercept, β_1 = farm size in terms of operational farm area (acres), β_2 = cost of chemicals, β_3 = cost of cultivations, β_4 = cost of tube well, β_5 = cost of irrigation, β_6 = cost of fertilizer

Economic Analysis

Before selecting any specific production function for econometric analysis various production functions were tried to estimate the effect of various factors on the yield variability in wheat crop.

Explanation of Variables

Wheat yield physically depends upon a large number of factors of both type i.e. qualitative factors as well as quantitative factors. However, some most important factors, highly related to the yield were included in the analysis. Explanation of different variables are given below which were included in the analysis.

Dependent Variable

Dependent variable was per acre yield of wheat (Mounds Acre^{-1})

Table 1. Comparison of Cost of Production by Various Productivity Levels (Rs. Acre^{-1})

Variable		Productivity Level		
		Low	**Medium**	**High**
Cultivations (Cost Rs)		2992.10	3226.00	3523.45
Seed (Cost Rs)		1335.40	1491.29	1676.19
Canal Irrigation (Cost Rs)		86.35	84.13	85.67
Tube well Irrigation (Cost Rs)		5500.90	4256.18	4000.70
Fertilizer (Cost Rs)		6046.00	6644.08	8086.83
FYM (Cost Rs)		642.19	693.55	668.52
Chemicals (Cost Rs)		900.00	947.20	870.98
Harvesting and Threshing (Cost Rs)		3748.25	4654.00	4766.00
Labor (Wages Rs)		2824.61	3277.89	3000.78
Total Cost without Opportunity Cost (OC)		24075.90	24580.94	24500.62
Opportunity Cost of Land Rent (Cost Rs)		10000	13000	13000
Opportunity Cost of Family Labor (Wages Rs)		1050.00	1300.25	1590.00
Total Cost With OC (Cost Rs)		35125.80	38781.90	41899.62
Yield per acre (Mound)		29.13	34.85	47.00
Price per 40 Kgs.		1200	1200	1200
Income	Grains	34800	42000	53400
	Straw	8700	10500	13350
Gross Income		43500	52500	66750
Net Income without OC		19424.10	27919.06	39440.38
Net Income with OC		8374.20	13718.10	24850.38
Benefit Cost Ratio without OC		**1.80**	**2.13**	**2.72**
Benefit Cost Ratio with OC		**1.32**	**1.60**	**1.96**

Table 2. Regression coefficients & estimated equation

Sr. No.	Variables	Coefficient (βs)		
		Low Yield Group	Medium Yield Group	High Yield Group
1	Constant	17.291	22.983	15.484
2	Area Under Wheat Crop	0.109	0.007	0.372
3	Tube Well Status	0.250	0.459	0.378
4	No. of Cultivations	0.586	0.623	1.190
5	Irrigation Numbers	0.607	0.598	0.812
6	Fertilizer use	0.361	0.569	0.789
7	Chemical use	0.791	1.192	2.183

Independent Variables

The variables which were responsible for the variation in wheat yield included the following;

Area under Wheat Crop (Acres)

Area under wheat crop was taken in acres and expected to have a positive sign.

Cultivations (No. of Cultivations Acre^{-1})

It is very important variable in yield variation. It was expected that as the number of cultivations increased yield will also increase.

Tube Well Status

Tube well was used as an independent variable. It is used as dummy variable. Mostly high yield farmers have own tube well. They effect on the yield of farmers.

Irrigations (No. of Irrigations Acre^{-1})

The effect of irrigation was also determined. Here one thing should be kept in mind that what is the quality of underground water.

Fertilizers (Bags Acre^{-1})

Fertilizer is very important variable in yield variations. Number of bags of fertilizers as (Urea, DAP, Others) was taken as measure and expected to have a positive sign.

Plant Protection (Cost of Chemical used Acre^{-1})

The use of chemicals was expected to have positive sign.

3. Results and Discussion

3.1 Economic analysis of different yield groups

Total cost of production for one acre of wheat including opportunity cost of land and family labor was 35125.80, 38781.90 and 41899.62 respectively for low, medium and high yield group.

The gross income of producing wheat on one acre was Rs. 43500, Rs. 52500 and Rs. 66750 for low, medium and high yield groups. Net income simply obtained by subtracting total costs from gross income, the net income without opportunity cost was Rs. 19424.10, Rs. 27919.06 and Rs. 39440.38 and including opportunity cost Rs. 8374.20 Rs. 13718.10 and Rs. 24850.38 respectively for low, medium and high yield groups.

Benefit cost ratio in the sample area with opportunity cost of land and family labor was 1.32, 1.60 and 1.96 for low, medium and high yield groups. This shows that low yield farmers obtaining a Rs. 1.32 against their cost of Rs. one, medium and high yield groups obtained 1.60 and 1.96.

The value of F-test are given in table 3, which were significant at 0.001, 0.001 and 0.002 level of significance for different yield groups.

Table 3. Values o R2 and F-Ratio for different yield groups

Yield groups	R^2	F-Ratio
Low Yield Group	0.68	13.85
Medium Yield Group	0.75	16.50
High Yield Group	0.73	14.87

4. Conclusion

Wheat is an important food crop having a high nutritional value and contributing much towards the economy of Pakistan. The study shows that wide gap is existing in the per acre yield of wheat in Pakistan as compared to many other countries of the world.

Following policy recommendations are made to bridge this yield gap and improve the economic conditions of the farmers as well as the whole economy.

- Reorganize and reactive the public and private sectors to support the farmers by purchasing their crop, provide storage facilities, proper post-harvest handling, new investment opportunities and inform them about the proper application of physical inputs to get higher yield.
- Procurement procedure should be made easy and transparent to facilitate the farmers.

- There is dire need to strengthen the coordination between agriculture researchers and extension department to guide the farmers about the efficient utilization of agriculture resources.
- Pure and healthy seed contributes much to increase the yield of crop. So the Govt. should open stores in an easy access of the farmers where they get certified seed at proper time and at reasonable rates.

Adoption of modern farming practices by small farmers is critically dependent upon the availability of adequate institutional credit and an effective extension services. Therefore, maximum credit should be disbursed on minimum interest rate and in easy installments especially for small farmers.

Acknowledgements

Authors are thankful to staff of Institute of Agricultural & Resource Economics, University of Agriculture, Faisalabad for providing technical assistance to conduct this study.

Competing Interests

Authors declare that they have no competing interests.

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