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Economic Analysis Of Rice Crop Cultivation In In District Dera Ismail Khan

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Abstract

An investigation on the economics of rice crop farming in Dera Ismail Khan district (usually referred to as D.I. Khan) was carried out in 2023 at the Institute of Social Sciences, Gomal University, Dera Ismail Khan, Khyber Pakhtunkhwa, Pakistan. Purposive sampling was used to choose three tehsils: D.I.Khan, Parova, and[1] Paharpur. Three villages and five varieties i.e IRRI-06, IRRI-09, KSK-282, KSK-133, and PK-385 were chosen from each tehsil. Nine hundred farmers were chosen at random using a pre-tested questionnaire provided primary data for the study. Based on the proportionate allocation approach, the sample size was distributed across these nine communities. The marginal rate of replacements, log-linear Cobb-Douglas production function, and benefit cost ratios were determined for the purpose of data analysis. As a result, the KSK-133 variety is the most lucrative rice variety when compared to all other rice varieties. The benefit cost ratio for PK-385, IRRI-06, IRRI-09, KSK-282, KSK-133, and PK-385 was recorded as 2.10, 2.70, 2.81, 2.93, and 2.38, respectively. The results showed that the area, seed, nursery, fertilizer, labor, pesticides and harvesting / threshing had production elasticities of 0.256817, 0.6157, 0.21684, 0.08719, 0.14278, 0.0033717 and 0.6264 respectively. Growing returns to scale are found in the input-output connection. It should be suggested to the farmers to grow high producing cultivars such as KSK-133 and KSK-282.

Keywords: *Rice; cost benefit analysis; input-output relationship; rate of returns to scale; Dera Ismail Khan; Pakistan.*

INTRODUCTION

Pakistan's economy has always been based mostly on agriculture, which is essential to the nation's growth and survival. Pakistan's economy is largely dependent on its main crops, which employ a sizable section of the labor force. Pakistan's economy depends heavily on agriculture, which generates a sizeable amount of the country's GDP (Anam Azam and Muhammad Shafique, 2017). The agriculture sector is vital for ensuring food security, as it contributes significantly to Pakistan's economy by providing 37.4% of the nation's employment and 22.9% of its GDP. This sector not only feeds the population but also supports the industrial sector by supplying essential raw materials. The strong interdependence between agriculture and industry underscores the importance of maintaining and enhancing agricultural productivity. As highlighted in the Pakistan

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Economic Survey 2022-23, the sector's role in the economy is fundamental, making it a key driver of both economic stability and growth. For a significant percentage of the population, especially in rural regions, it is their source of income. In Pakistan, the agriculture industry is a significant employer. Pakistan's economic growth, cultural legacy, and food security all depend on basic food crops. The Pakistani people's production and consumption of them are fundamental to their way of life, serving as both a source of food and a symbol of their country. The main basic crops are rice and wheat, with maize and sugarcane following closely behind. The staple crops of the country, they provide vital proteins, carbs, and other nutrients needed for human health (Special Section 2 (2017): The Status of Food Security in Pakistan).

Dera Ismail Khan, also known as D.I. Khan, is a division of Pakistan's Khyber Pakhtunkhwa Province and shares borders with Punjab, Balochistan and Sindh provinces. The city, along with four other tehsils known as Parowa, Daraban, Paharpur and Kulachi. According to the 2023 Census, the D.I.Khan division had a total population of 16,25,088 people (Sources: Pakistan Bureau of Statistics Censes Results 2023), making it the largest city in the southern part of Khyber Pakhtunkhwa. DIKhan has an arid, sub-mountain, subtropical, continental climate that is close to being semi-arid in the north. The region may be classified topographically into four groups: rainfed dry areas, reverine belts, Kanal irrigated, and Rod-Kohi spate irrigated. With 246,801 hectares of farmed land, 483,774 hectares of uncultivated land, and 3909 hectares of woodland, the district has a total area of 730,575 hectares (Crop Reporting Services, D.I. Khan).

Yaqoob., et. All (2022). The agriculture sector is a significant driver of economic growth and employment in many regions of the world. The demand for agricultural products is still influenced more by flavor, price, and nutritional value in the modern world than by climatic variation. This study investigates the level of grain productivity in Pakistan using data on farm inputs and important grain crops from 1960 to 2020. There are two sections to the study. To determine total factor productivity (TFP), we first aggregate production and input data for rice, corn, and wheat separately using the parametric Tornqvist-Theil index. The unit root test is then used to look at the variables' long-term trend and stationarity. The presence of co-integration in both the long and short runs among the variables.

Elahi et al. (2021) carried out research to ascertain the expenses and yields (profit) associated with rice farming in the D. I. Khan District, Province of Khyber Pakhtunkhwa in 2020. The idea that growing rice would only be viable for people or farmers if it improved their financial situation was the primary tenet of rice farming. It was computed that the average rice production (output) per acre was 1800 kg, and the results indicated that the average cost per acre was Rs. 31,220. Thus, the total return on rice output per acre was Rs. 70,500. Thus, the study shows that, on the one hand, the import cost of rice hurts rice production, while on the other hand, there is a positive relationship between the return price and rice export.

Elahi et al. (2020) assessed the expenses and advantages of wheat farming in Pakistan's Khyber Paktoonkhwa Province's Dera Ismail Khan area in 2015. According to the study, producing one acre of wheat costs Rs. 35,680, while the yield is 1650 kg (42 mounds) per acre, or Rs. 63,600. By factoring in the value of family labor and owned land that is adequate to support a typical family, farmers' margins also increase. Furthermore, the study's conclusion indicated a positive relationship between wheat output and return price, but a negative relationship between cost and output was also seen. Land preparation (LP), seed and sowing (SS), farm inputs (FI), irrigation (Irr), pesticides (Pest), and harvesting/threshing (HT) have, in that order, output elasticity values of 0.1244587, 0.31244, 0.5874, 0.55461, 0.08248, and 0.65743.

Elahi, et al. (2018) computed the cost-benefit analysis and the appropriateness of the meteorological profile for wheat production in the seasons of 2015–2016 and 2014–2015. The cost of producing one acre of wheat was Rs. 35,680, but the yield was 1680 kg (42 mounds) per acre, or Rs. 63,600. In addition, the value of family labor and owned land enough to support a typical family raises the farmers' margin.

Furthermore, the study's conclusion indicated a positive relationship between wheat output and return price, but a negative relationship between cost and output was also seen. Land preparation (LP), seed and sowing (SS), farm inputs (FI), irrigation (Irr), pesticides / insecticides (Pest), and harvester threshing (HT) have the following relative output elasticity values: 0.12447, 0.31244, 0.5874, 0.55461, 0.08248, and 0.65743. From a climatic perspective, the district under study has computed cumulative rising degree days throughout the course of the two seasons, averaging around 2663.5 degree days. This is enough for the wheat variety that is grown here to push through the various growth phases and produce an economically viable crop yield.

Tian (2000) examined changes in China's rice production patterns between 1978 and 1995 as well as the variables influencing rice output. The output of rice had declined faster in affluent areas than in underdeveloped provinces.

Rehman et al. (2015) Agriculture serves as the cornerstone of Pakistan's economy, deeply reliant on its key crops. However, the nation grapples with substantial disparities between projected and actual crop yields, attributed to a lack of suitable technology, ill-timed input application, water and land utilization issues, and limited knowledge of insect pest management. This predicament detrimentally impacts both crop quality and quantity. Predominantly, farmers resort to synthetic insecticides for pest control, yet they often employ these chemicals erroneously. To cast light on the profound rift between expected and realized agricultural productivity, this study delves into the intricate relationship between Pakistan's agricultural GDP and the production of pivotal crops like wheat, rice, sugarcane, maize, and cotton over a five-year span. The significance of agriculture in the national economy cannot be overstated. This sector not only contributes significantly to the country's GDP but also provides livelihoods to a substantial portion of the population. However, the potential of Pakistan's agriculture sector remains largely untapped due to various challenges. One of the primary issues plaguing agriculture in Pakistan is the gap between projected and actual crop yields. Despite being blessed

The input-output connection and cost-revenue comparison of several wheat varieties in district D, I, Khan are the primary foci of the current study.

MATERIALS AND METHODS

The research is limited to district D.I. Khan's economic analysis of rice, a key staple food grain production. Three tehsils DIKhan, Parova, and Paharpur of the five tehsils in total have been chosen using the purposive sample approach since they are conveniently accessible. Additionally, these crops meet the majority of the requirements for the production of food grain crops. The regions that have been chosen are located along the CRBC Canal, where rice crops, in particular, are widely farmed together with other food grains. Three villages were chosen at random from each tehsil. The three villages were Himat, Ketch, and Shorkot from Tehsil DIKhan. Dhap Shumali, Lar, and Bhand Kurai were chosen from Tehsil Paharpur, and Malana, Lunda, and Naivela were chosen from Tehsil Parova.

Because the villages were fairly uniform in terms of cropping patterns, population, and agricultural activities, as well as land quality (field, soil type, and irrigation sources), a sample of nine hundred farmers was utilized, which makes sense and is sufficient. Using the following formula, the sample size was distributed across these nine communities based on the proportionate allocation method:

Where

$$SS = n_i (N_i/N)$$

SS = Total sample size used (i.e 900)

Ni = Population of particular village

N = Total population of the nine villages

As a result, 900 respondents from Tehsil DIKhan, Paharpur, and Parova, respectively, were chosen for each. In the tehsil DIKhan, 100 respondents were chosen from the villages of Himmat, Ketch, and Shorkot, respectively. There were one hundred responders from each of the three villages in Tehsil Pahapur: Dhap Shumali, Lar, and Band Kurai. 100 respondents were chosen in Tehsil Parova, one hundred from each of the villages of Malana, Lunda, and Naivela. Furthermore, because the farmers' farming practices and socioeconomic circumstances were essentially the same, a random selection of farmers was made from each hamlet to comprise the respondents.

It is commonly used to quickly assess the costs and revenues of several rice cultivars (Ahmad et al., 2005; Santana, 1993; Elahi et al., 2020 & 2021). The Benefit Cost Ratio for each variety has been computed using the following formulas:

Benefit Cost Ratio for rice varieties = TR / TC--------------------------------eq.1

where TC is the total cost of the rice variety per acre in rupees and TR is the total income from the rice variety per acre in rupees.

The contribution of different inputs to the output of food grains was determined using the Cobb-Douglas production function approach. In agriculture, this approach is commonly employed to ascertain the type of returns to scale. For the rice individually, the log-log Cobb-Douglas production function was used. Raviksh et al. (1997), Haq et al. (2002), Khattak & Anwar (2006), and Elahi et al. (2018) have all used this strategy; however, in the current work, a modified version of these models has been employed.

Estimation of Log-log Rice Cobb-Douglas Production Function

To show the input output relationship of rice crop, the Method of Least Square was used to estimate the following log-log model:

ln P = ln a0 + a1 ln AREA+a2 ln SEDD+ a3 ln NURSERY + a4 ln FERT +a5 ln LABR + a6 ln PESTICIDE+a7 ln HART/THREH+ e2--------------------------------------eq. 2

The above model was then converted to the following general form:

or in the most general form

P = bo+Ab1+SEEDb2+NURb3+FERTb4+LABb5+PSTb6+Harv/threshb7+ e2 ------eq.3

Where

P	=	Total Rice production (in kgs)
A	=	Area under Rice crop in acres
SD	=	Seed in Kgs used for cultivated area of Rice
NUR	=	Nursery Establishment
FERT	=	Fertilizer
LABW	=	Total Labour used for cultivated area of Rice (in man days)
PSTW	=	Total pesticides/insecticides used for cultivated area of Rice (in Rs.)
HAVT/THRH	=	Harvesting / Threshing of Wheat

b1, b2, b3 , b4 , b5 , b7 and b8 are the output elasticities of A, SEED, NUR, FERTW, LABW, PSTW and HAVT/THREH respectively.

b0 = Shows the impact of innovations or technology.

E1 = The residual term (absorbs the effect of those variables, which are not included in the model).According to the equations, A, SEED, NUR, FERTW, LABW, PSTW and HAVT/THREH are the explanatory variables, whereas rice production is the dependent variable. Since irrigation was free in the research region, it was not included in the list of explanatory factors.

In 2023, all variables were priced using the going rates in the market. Additionally, tabulation, basic arithmetic, averages, and categorization were employed as analytical tools. Utilizing statistical software like SPSS and E-views, the outcomes were obtained.

RESULTS AND DISCUSSION

Average cost of components and revenue

The average cost per acre for all types is Rs. 87,179, which includes additional expenditures such as seed (3640/-), fertilizers (34,300/-), labor (15,479/- per man day), harvesting/threshing (4500/-), and other expenses (Table 1). In comparison to the cost per acre calculated by Hussain et al. (11) and Elahi et al. (15), this cost is greater. This is a result of the ongoing upward trend in input prices.

Table-1. Average Per Acre Costs of Rice Varieties

Particulars/Inputs	Unit	Quantity/No	Rate (Rs)	Amount/Acre
Land preparation				
Harrow with tractor	Hour	1	1800	1800
Tiller with tractor	Hour	1	1400	1400
Rotavator	Hour	1	1400	1400
Raising Nursery				
Seed	kg	10.4	350	3640
Nursery bed preparation	Day	4	673	2692
Sowing Nursery	Day	4	673	2692
Nursery Transportation	Day	5	673	3365
Fertilizers				
DAP	No	1	15000	15000
SOP	No	½	17000	8500
Urea	No	2	4500	9000
Zinc	No	1	1800	1800
Transplanting				
Transplanting	Day	10	673	6730
Irrigation				
Abiyana	-	Rs. 1800/cropping season	1800	1800
Plant Protection				
Insecticides	No	2	1500	3000
Weedicides	No	2	700	1400
Harvesting and threshing	Day	1	4500	4500
Gunny Bags	Bags	16	150	2400
Land Rent				16,000
Total cost				**87,179**

Source: Field Survey

The average yield of rice across all kinds was determined to be 2164 kg from one acre of land, or Rs. 201,600 (Table 2). An acre of rice straw, regardless of variety, yielded an average of Rs. 4,000. Thus, Rs. 205,600 was determined as total and net revenue from all types (Table 2).

Table-2 Average Total and Net Revenue of Rice Varieties

Item	Quantity (kg per acre)	Rate (Rs per 100 kg bag)	Total Amount (Rs.)
Rice grain	2164	9,000	201,600/-
Bhusa	1 Acre	4000	4,000/-
Total Revenue	**-**	**-**	**205,600/-**

Source: Field Survey

Benefit Cost Ratios of Different Rice Varieties

Benefit Cost Ratios (BCRs) were calculated for each rice variety in order to examine costs and revenues across them. According to Table 3, the BCRs for the varieties PK-385, KSK-282, KSK-133, IRRI-06, and IRRI-09 were 2.10, 2.70, 2.81, 2.93, and 2.38, respectively. This table clearly shows that, according to the economic theory, variety KSK-133 is the most lucrative rice variety when compared to all other rice varieties since it has the greatest BCR value.

Table-3 Benefit Cost Ratios for Different Rice Varieties

Wheat Variety	Total Rice Revenue (In Pak Rs.)	Total Costof Rice (In Pak Rs.)	Benefit Cost Ratios BCR = TR/TC
IRRI-06	87679	184000	2.10
IRRI -09	86279	232800	2.70
KSK-282	87679	246000	2.81
KSK-133	87679	257000	2.93
PK	86279	205600	2.38

Source: Personal calculations

Estimation of Log-log Production Function for Rice

The estimated log-log Cobb-Douglas production function is:

ln WP = ln b0 + b1 ln AREA + b2 ln SEED+ b3 ln NUR+ b4 ln FERT+ b5 ln LABOUR + b6 ln PESTICIDE +b7 ln HARVT/THRESHING+ e1 -------------------------------------eq. 4

Table-4 Regression Results of Log-log Production Function for Rice

Dependent Variable: ln RP				
Sample: 900				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	2.652	0.13784	24.123	0.0010
ln WA	0.256817	0.013754	21.035	0.0073
ln SDW	0.6157	0.008157	16.723	0.0459
In NUR	0.21684	0.002549	19.374	0.0043
In FERT	0.08719	0.054871	34.0350	0.0005
ln LABW	0.14278	0.008543	24.86524	0.0461
ln PSTW	0.003717	0.0009213	5.1425	0.8642
ln HAR/TRHW	0.6264	0.01797	20.46935	0.0013
R-squared	0.691871	Durbin-Watson stat		1.9212 1
Adjusted R-squared	0.70125			

A good match is shown by the R-square and adjusted R-square values. With an R-square value of 0.69, it is seen that the (log of) included explanatory variables explain for 69% of the fluctuations in the (log of) total wheat output. Additionally, there is a strong correlation between the majority of these explanatory factors and the dependent variable.

Rate of Returns to Scale for Wheat Crop

The log-log Cobb-Douglas production function (equation 2) was used to study the input-output dynamics and provide light on the nature of returns to scale. The cumulative output elasticities are 1.94 (more than 1), indicating growing returns to scale in rice production.

Table-5: Wald-Test Results for Rice Crop

Samples 150			
Null Hypothesis:	b1+b2+ b3+ b4+ b5 + b6 + b7 = 1		
F-statistics	8.893986	Probability	0.007222
Chi-square	8. 893986	Probability	0.007201

Whereas, b1, b2, b3, b4, b5, b6 and b7 are the co-efficient of In AREA, SEED, NURSERY, FERTR, LABOUR, PST and HAR/TRH respectively.

CONCLUSION AND RECOMMENDATIONS

The study concludes that the average per-acre cost for all varieties across all villages amounted to Rs. 87,179/-. On average, farmers obtained total revenue of Rs. 205,600/- and net revenue of Rs. 118,421/- from all varieties. Notably, KSK-133 emerged as the most profitable variety in terms of both total and net yield. Additionally, inputs such as area, tractor hours, seed, fertilizer, labor, pesticide, threshing/harvesting, and land rent were found to be statistically significant. The output elasticities of these inputs were estimated as follows: AREA (0.256817), SEED (0.6157), NURY (0.21684), FERTILIZER (0.08719), LABOR (0.14278), PESTICIDE (0.003717), and HARVESTING/THRESHING (0.6264).

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