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Economic Analysis Of Wheat Crop CultivationIn In District Dera Ismail Khan

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Abstract
A study was conducted at Institute of Social Sciences, Gomal University, Dera Ismail Khan, Khyber Pakhtunkhwa, Pakistan during 2023 to make economic analysis of Wheat crop cultivation in district Dera Ismail Khan (commonly known as D.I.Khan). Three tehsils namely D.I.Khan, Parova and Paharpur were selected on the basis of purposive sampling technique. From each tehsil, three villages were selected and five wheat varieties Khaista and Wadan, Pirsabak-15, Pirsabak-19, and AZRC-Dera were grown. Primary data were collected from 900 respondents (farmers) randomly selected through structured questionnaire. Sample size was allocated to these nine villages on the basis of proportional allocation method.For data analysis, benefit cost ratios, log-linear Cobb-Douglas production function and marginal rate of substitutions were estimated. According to the results benefit cost ratio was noted for Khaista-2017, Wadan-2017, Pirsabak-2019, AZRC Dera-2020 and Pirsabak-2021 were 1.89, 1.99, 1.96, 2.19 and 2.14 respectively, thus the AZRC Dera-20 variety is the most profitable variety of wheat as compared to all otherwheat varieties. The output elasticities of area, tractor hours, fertilizer, seed, labour and pesticides were observed as 0.3112, 0.0012, 0.5924, 0.6212, 0.5124 and 0.0013, respectively. The input-output relationship holds increasing returnsto scale. The farmers should be advised to cultivate high yielding varieties likeAZRC Dera-20 and Pirsabak-21.

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

INTRODUCTION

Agriculture has long been considered the backbone of Pakistan's economy, playing a pivotal role in the country's development and sustenance. Pakistan's economy heavily relies on its major crops, and the sector employs a significant portion of the population. Agriculture contributes substantially to Pakistan's economy, accounting for a significant portion of the Gross Domestic Product (Anam Azam and Muhammad Shafique, 2017). It provides livelihoods to a substantial portion of the population, particularly in rural areas. The agriculture sector is a major source of employment in Pakistan. staple food crops are indispensable to Pakistan's food security, economic prosperity, and cultural heritage. Their cultivation and consumption are deeply ingrained in the lives of the Pakistani people, making them not only a source of sustenance but a reflection of the nation's identity.Wheat, rice, maize, and sugarcane are among the key staple crops, with wheat and rice being the most prominent. These crops form the backbone of the nation's diet, providing essential carbohydrates, proteins, and other nutrients that are essential for human well-being (Special Section 2 (2017): The State of Food Security in Pakistan). 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. Topographically, the area can be divided into four categories: Rod-Kohi spate irrigated, Kanal irrigated, rainfed dry lands, and reverine belts. The district covers a total of 730,575 hectares, with 246,801 hectares of cultivated land, 483,774 hectares of uncultivated land, and 3909 hectares of forest (Crop Reporting Services, D.I.Khan). Thomas & Ramappa (2023) analyzes crop diversification and cropping patterns in the Indian state of Karnataka from 1998–1999 to 2020–2021 using secondary data. The dynamics of cropping patterns and the factors influencing crop diversification were evaluated using the Composite Entropy Index (CEI). Low crop diversification was found in Kodagu, Dakshina kannada, Yadgir, Udupi, and Shivamogga, according to the results. Abdulai (2023) noted that a significant barrier to technology adoption among smallholder farmers in underdeveloped nations is a lack of information about the advantages of and understanding about novel agricultural technologies. Elahi et al. (2021) conducted study to determine the cost and returns (profit) of rice cultivation in D. I. Khan District, Province Khyber Pakhtunkhwa in 2020. The fundamental underlying principle of the viability of rice cultivation was that rice would only be grown by individuals/farmers if it had a positive effect on their financial condition. The results showed that the per-acre average cost was Rs. 31,220, and it was calculated that the

average rice production (output) was 1800kg per acre. The total return of the production of rice was, thus Rs. 70,500 per acre. Therefore, the analysis demonstrates that there is a positive effect between the return price and the export of rice, while the import cost of rice harms the production of rice, on the other hand.Elahi et al. (2020) evaluated cost and benefit of wheat cultivation in district Dera Ismail Khan, Khyber Paktoonkhwa Province of Pakistan during 2015. The study revealed that the cost of wheat production was Rs. 35,680/- per acres, whereas output comes 1650 Kg per acre (42 mounds) amounting Rs. 63,600/- per acre. Farmers' margin also rises by adding the value of family labour and owned land which is sufficient to sustain a normal family. Moreover, positive influence between return price and output of wheat was concluded from the study, whereas negative effect of cost was also observed. The output elasticity of Land Preparation (LP), Seed and Sowing (SS), Farm Inputs (FI), Irrigation (Irr), Pesticides (Pest) and Harvesting/Threshing (HT) are 0.124587, 0.31244, 0.5874, 0.55461, 0.08248 and 0.65743, respectively.Okello. et. Al. (2019). With the exception of rice, which is becoming important as a food and cash crop, smallholder farming, which is common in Uganda, is characterized by low productivity for most crops. 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.Elahi, et. al. (2018) calculated cost and benefit, as well as climatic profile suitability for wheat cultivation, during 2014/2015 and 2015/2016 seasons. The cost of wheat production was Rs. 35,680 per acres, whereas output comes 1680 kg per acre (42 mounds) amounting Rs. 63,600 per acres. Farmers' margin also rises by adding the value of family labor and owned land, which is sufficient to sustain a normal family. Moreover, positive influence between return price and output of wheat was concluded from the study, whereas negative effect of cost was also observed. The output elasticity of Land preparation (LP), Seed and Sowing (SS), Farm inputs (FI), Irrigation (Irr), Pesticides / insecticides (Pest) and Harvester threshing (HT) are 0.124587, 0.31244, 0.5874, 0.55461, 0.08248 and 0.65743, respectively. From climatic point of view, calculated accumulated growing degree days all over the studied seasons at the studied district were about 2663.5 degree days two seasons average. This is sufficient for the used type of wheat at this area to push the different growing stages and present economic crop yield.Changes in the patterns of rice production in China from 1978 to 1995 and the factors affecting rice production were discussed in Tian (2000). In prosperous regions, rice production had decreased more quickly than in backward provinces.The present study mainly focuses on input-output relationship and cost- revenue comparison of different wheat varieties in district D,I,Khan.

MATERIALS AND METHODS

The study is confined to the economic analysis of major staple food grains crop i.e. wheat in district D.I.Khan. Out of the total five tehsils, three tehsils namely DIKhan, Parova and Paharpur have been selected on the basis of purposive sampling technique because these areas were easily accessible. Further, these thesils qualify most of the characteristics favorable for food grain crops cultivation. The selected areas are situated on the bank of CRBC Canal, where food grains in general and particularly rice crop is grown extensively. From each tehsil three villages each were randomly selected. From Tehsil DIKhan, the three villages were Shorkot, Ketch and Himat. From Tehsil Paharpur, Dhap Shumali, Lar and Bhand Kurai were selected while from Tehsil Parova, the three selected villages were Malana, Lunda and Naivela.

A sample of size nine hundred farmers was used and is logical and enough to use because the villages were quite homogeneous in terms of land condition (field, soil type and irrigation sources), cropping pattern, population and farming activities. Sample size was allocated to these nine villages on the basis of proportional allocation method, using the following formula:

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

Accordingly, 900 respondents each were selected from tehsil DIKhan, Paharpur and Parova respectively. In tehsil DIKhan, 100 respondents each from villages Shorkot, Ketch and Himmat were selected respectively. In tehsil Pahapur, 100 respondents from each villages Dhap Shumali, Lar and Band Kurai respectively. In Tehsil Parova, 100 respondents were selected from each village Malana, Lunda and Naivela respectively. Further, the respondents (farmers) have been selected randomly from each village, because the farmers possessed almost homogenous farming and socioeconomic conditions.To compare the cost and revenue of different wheat varieties at a glance, and is widely used (Ahmad, et al, 2005), (Santha, 1993) and (Elahi, et al, 2020 & 2021). For each variety, Benefit Cost Ratio has been calculated using the following formulas:Benefit Cost Ratio for wheat varieties = TR / TC----------eq.1 Where TR is the per acre total revenue in rupees generated from variety of wheat and TC is the total per acre cost in rupees of wheat variety.The Cobb-Douglas production function technique was used to find out the contribution of various inputs towards food grain output. This model is widely used in agriculture for determining the nature of returns to scale. The log-log Cobb-Douglas production function was applied for the three crop i.e. wheat, rice and maize separately. This approach has been used by Raviksh et al (1997), Haq, et al (2002), Khattak & Anwar (2006) and Elahi, et. Al (2018) while in present study modified form of these models has been used.

Estimation of Log-log Wheat Cobb-Douglas Production Function

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

ln WP = ln b0 + b1 ln AREA + b2 ln TRATOR+ b3 ln FERTILIZER + b4 ln SEED + b5 ln LABOUR + b6 ln PESTICIDE +b7 ln HARVT/THRESHING+ b8 ln LAND RENT + e1 ----------eq. 2or in the most general form
P = bo Ab1 TRHb2 FERTb3 SDb4 LABb5 PSTb6 arv/threshb7 Land Rentb8-------- eq.3
Where

P	=	Total wheat production (in kgs)
A	=	Area under wheat crop in acres
TRH	=	Tractor hours for cultivated area of wheat
SD	=	Seed in Kgs used for cultivated area of wheat
FERT	=	Total fertilizer used for wheat (in bags)
LABW	=	Total Labour used for cultivated area of wheat (in man days)
PSTW	=	Total pesticides/insecticides used for cultivated area of wheat (in Rs.)
HAVT/THRH	=	Harvesting / Threshing of Wheat
Land Rent	=	Land Rent of Cultivated land

b1, b2, b3 , b4 , b5 , b7 and b8 are the output elasticities of WA, TRHW, FERTW, SDW, LABW, PSTW, HAVT/THREH and LAND RENT 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).

The equations indicate that wheat production is dependent variable whereas WA, TRHW, FERTW, SDW, LABW, PSTW, HAVT/THREH and LAND RENT are explanatory variables. Irrigation cost was excluded from the set of explanatory variables because it was available free of cost in the study area.All variables were valued at the prevailing market prices during 2023. Further, simple arithmetic, averages, classification and tabulation were also used as analytical tools. Statistical packages such as SPSS and Eviews were used for deriving the results.

RESULTS AND DISCUSSION

Average cost of components and revenue

Average per acre cost for all varieties became to Rs. 89,247, which included cost of seed (Rs. 5776), fertilizers (Rs. 32500), labour usage (man days) (Rs. 6460), transplanting (Rs. 4805), harvesting (Rs. 9000) in addition to other costs (Table 1). This cost is higher as compared to per acre cost computed by Hussain et al. (11) and Elahi, et al. (15). This is due to increasing trend of prices of inputs over time.

Table-1. Average Per Acre Costs of Wheat Varieties

S.No.	Inputs/Operation	Operation Price	Pre-Basic (Rs. Per Acre)
1	Land Preparation with Tractor	Ploughing No.s: 3 Rate/ Ploughing: avg 5-6 L/Ac for one plough	6000
2	Seed	Application per Acre: 49.2 kg Price of Seed: Rs. 154/kg	7576
3	Fertilize (Urea)	Urea : 2 bags/acre Price: Rs. 4500/bag	9000
4	Fertilizer (DAP)	DAP : 1 bag/acre Price: Rs. 15000/bag	15000
5	Fertilizer (SoP)	SOP: half bag/acre Price: Rs.17000/bag	8500
6	Fertilizer Application	Labour : 4 Wage / Labour: 961	3844
7	Insecticides	Herbicide: 1 packet /Acre Price: Rs. 2100	2100
8	Insecticides Application	Labours /Day: 2 Wage/Labour: 961	1922
9	Laborer charges for Irrigation	Total left irrigations: 4 Labour/ irrigation: 2 Wage/Labour: 961	6460
10	Abiyana	Rs. 640/cropping season	640
11	Harvesting & threshing	Combine Harvester @ Rs. 9000/acre	9000
12	Packing, loading, unloading, transportation, cleaning, grading, sewing, bagging and stacking	Labours /Day: 5 Wage/Labour: 961	4805
13	Gunny Bags	Bags: 16 per acre Price/bag: Rs. 150	2400
14	Land Rent (Half for six month crop)	Rs. 3000/- per Kanal. Rs. 24,000/- Acres (Half will be calculated for six month crop)	12000
Total average cost of production per acre			**89,247/-**

Source: Field Survey

Average wheat production for all varieties was calculated as 1570 kg from one acre area amounting to Rs. 172,700 (Table-2). Average amount of wheat straw from all varieties was Rs. 9,000 per acre. Thus total and net revenue from all varieties was calculated Rs. 181,700 (Table-2).

Table-2 Average Total and Net Revenue of Wheat Varieties

Item	Quantity (kg per acre)	Rate (Rs per 100 kg bag)	Total Amount (Rs.)
Wheat grain	1570	11,000	172,700/-
Bhusa	1 Acre	9000	9,000/-
Total average Revenue	**-**	**-**	**181,700/-**

Source: Field Survey

Benefit Cost Ratios of Different Wheat Varieties

To analyze the cost and revenues across different wheat varieties, Benefit Cost Ratios (BCRs) were computed for each. The BCRs for Khaista-2017, Wadan-2017, Pirsabak-2019, AZRC Dera-2020, and Pirsabak-2021 were 1.89, 1.99, 1.96, 2.19, and 2.14 respectively (refer to Table-3). Notably, AZRC Dera-2020 emerges with the highest BCR, indicating its superior profitability compared to the other varieties, aligning with economic principles.

Table-3 Benefit Cost Ratios for Different Wheat Varieties

Wheat Variety	Total Wheat Revenue (In Pak Rs.)	Total Costof Wheat (In Pak Rs.)	Benefit Cost Ratios BCR = TR/TC
Khaista, 2017	168,500	89,067	1.89
Wadan, 207	179,500	90,141	1.99
Pirsabak, 2019	174,000	88,601	1.96
AZRC Dera, 2020	196,000	89,371	2.19
Pirsabak, 2021	190,500	88,909	2.14

Source: Personal calculations

Estimation of Log-log Production Function for Wheat

The estimated log-log Cobb-Douglas production function is:ln WP = ln b0 + b1 ln AREA + b2 ln TRATOR+ b3 ln FERTILIZER + b4 ln SEED + b5 ln LABOUR + b6 ln PESTICIDE +b7 ln HARVT/THRESHING+ b8 ln LAND RENT + e1 ----------eq. 4

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

Dependent Variable: In WP				
Sample: 900				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	1.990	0.13874	12.09659	0.0008
In Area	0.2904	0.1257	3.00056	0.0121
In Tract hrs	0.0014	0.00089	3.47127	0.0031
In Seed	0.2991	0.124810	4.39643	0.0254
In Fertilizer	0.4924	0.12657	3.52568	0.0063
In Labour	0.5479	0.18221	2.96443	0.0018
In Pesticide	0.1041	0.91124	0.11424	0.8862
In Hrvt/Threshing	0.0015	0.45001	0.00364	0.46203
In Land Rent	0.1220	0.009871	12.35964	0.0003
R-squared	0.65713	Durbin-Watson stat		1.19457
Adjusted R-Squared	0.65840			

The R-square and adjusted R-square values indicate a satisfactory fit. With an R-square value of 0.65, it's observed that 65% of the variations in the (log of) total wheat production are accounted for by the (log of) included explanatory variables. Furthermore, most of these explanatory variables demonstrate a robust relationship with the dependent variable

Rate of Returns to Scale for Wheat Crop

In order to investigate the input-output dynamics, the log-log Cobb-Douglas production function (equation 2) was utilized, providing insight into the nature of returns to scale. The cumulative output elasticities amount to 1.85 (greater than 1), suggesting that wheat production exhibits increasing returns to scale.

Table-5:Wald-Test Results for Wheat Crop

Samples 150			
Null Hypothesis:	b1+b2+ b3+ b4+ b5 + b6 + b7 = 1		
F-statistics	12.354678	Probability	0.00674
Chi-square	12.354678	Probability	0.00675

Whereas, b1, b2, b3, b4, b5, b6 and b7 are the co-efficient of In WA, TRACT HRW, SDW, LABW, FERTR and CHW respectively.

CONCLUSION AND RECOMMENDATIONS

The study concludes that the average per-acre cost for all varieties across all villages amounted to Rs. 89,247/-. On average, farmers obtained total revenue of Rs. 172,700/- and net revenue of Rs. 181,700/- from all varieties. Notably, AZRC-Dera 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 (0.2904), tractor hours (0.2991), seed (0.4924), fertilizer (0.5479), labor (0.1041), pesticide (0.0015), and harvesting/threshing (0.1120).

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