Available Online
Journal of Economic Impact
ISSN: 2664-9764 (Online), 2664-9756 (Print)
https://www.scienceimpactpub.com/jei

ECONOMIC ANALYSIS AND DETERMINANTS OF WHEAT PRODUCTION IN BATI KOT DISTRICT OF NANGARHAR PROVINCE, AFGHANISTAN

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ARTICLE INFO

Article history
Received: October 24, 2024
Revised: January 21, 2025
Accepted: February 06, 2025

Keywords
Economic analysis
Food security
Profitability
Wheat
Cobb-Douglas production function
Afghanistan

ABSTRACT

The current study aims to analyze the economic aspects and factors affecting wheat production in the Bati Kot district, Afghanistan. In Afghanistan, food security remains a long-term issue. Wheat is the major crop, serving as the primary source of dietary energy, and has a crucial role in longer-term food security. To achieve the study objectives, 120 respondents were randomly selected for interviews during the 2023 crop season. Econometric techniques, descriptive statistics, simple budgeting, and Cobb-Douglas-type production functions were applied for analysis. Descriptive statistics revealed that 50% of respondents were under 40 years old, 65% were literate beyond the elementary level and 43% had family sizes ranging from 5 to 10 members. Furthermore, 60% of respondents had only 1 to 2 extension visits during the crop season. Wheat yield ranged between 1400 kg and 1460 kg per acre. The total cost of wheat production was Afghani (Af). 38,266.56/-, with total revenue of Af. 52,978.44/-, and net returns of Af. 14,711.88/-. The regression model illustrates that DAP, weedicides, and farmyard manure have positive and significant associations with wheat production. However, seed, urea, and labor days are positively but non-significantly associated with wheat production in the study area. Irrigation had a negative impact on wheat yield. Based on the findings the study suggests the import of chemical fertilizers from adjacent neighbor countries to reduce cost. Additionally, the introduction of Salinity Control & Reclamation Programs (SCARP) to improve irrigation response and increase access to agricultural machinery such as planters, harvesters, and threshers is likely to reduce yield losses and increase net returns for wheat producers in the study area.

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https://doi.org/10.52223/econimpact.2025.7104

INTRODUCTION

In Afghanistan, households generate income from multiple streams of farm-based and non-farm activities, but the agriculture sector has a crucial role in economic growth, food security, and poverty reduction. It contributes 23 percent to Gross Domestic Product (GDP) and employs 62 percent of the labor force. Despite its importance in livelihood development, the sector faces challenges such as low productivity over the years and small average farm holding, which remain major obstacles (khaliq, 2018). Out of the total population, 85 percent depend on agriculture, livestock, and related goods for their livelihood, with the majority residing in rural areas, where wheat crop serves as the primary calorie source (Ahmadzai et al., 2016).

The Ministry of Agriculture, Irrigation, and Livestock (MAIL) executes and manages matters related to agriculture, veterinary services, land records, extension, forestry, cooperatives, plant protection and irrigation. Its primary objectives include improvement in crop productivity, ensuring food sovereignty and enhancing farmers' capabilities (Singh, 2008). Mail (2013), in collaboration with various developmental organizations such as the Aga Khan Foundation (AKF), Agency for Technical Cooperation and Development (ACTED), Development Alternative International (DAI), German Agro Action, International Development Enterprise, Rural Rehabilitation Association for Afghanistan (RRAA) and International Center for Agricultural Research in the Dry Areas (ICARDA) works to achieve self-sufficiency in wheat production through targeted policies. According to Ahmadzai et al. (2019) and Visagie et al. (2004), several policies have been developed to promote sustainable agricultural development, however, these policies have not contributed sufficiently to real field challenges faced by farmers. To ensure meaningful progress, agricultural policies need to consider the sector's dynamic nature and the key factors influencing farmers' decision-making. Land use pattern indicates that 71.58 % of the cropped area is devoted to cereals that include wheat, paddy rice, barley, and maize. Cereals are the primary agricultural products that generate cash income, contributing to food security, poverty reduction and meeting the subsistence dietary needs of farm families (Sarwary et al., 2023). Of the total, cropped area, 61.30 % is allocated to wheat cultivation.

As shown in Figure 1, the gap in wheat production and demand in Afghanistan highlights the country's lack of self-sufficiency in domestic production, which lead to reliance on imports from Pakistan, Iran, China, Turkmenistan, Uzbekistan, Tajikistan, and Uzbekistan (NSIA, 2021). With an annual per capita wheat consumption of 160 kg, Afghanistan ranks among the highest in wheat-consuming countries in the world. The self-sufficiency of cereal production in Afghanistan has fluctuated over time, ranging from 53% in 2004 to 96.6 % in 2009. Conflict-induced damage to irrigation infrastructure, limited capital, scarce arable land, and

labor shortages coupled with increasing climate instability have significantly contributed to the decline in wheat production (Poole et al., 2022; WHO, 2021).

Wheat is grown in both irrigated and rain-fed areas, but the area (1,611,500 ha) and productivity (2.50 t/ha) of irrigated wheat are greater than those of rain-fed, which cover 1,056,700 hectares with a productivity of 1.09 t/ha in Afghanistan (Poole et al., 2018). Production, yield, and import levels have fluctuated over time. At the national level, wheat is largely produced in northern zones of the country such as Baghlan, Kunduz, Takhar, Herat, Badghis, Faryab, and Sar-e-pul because of the availability of irrigation water and adequate precipitation. In contrast, Kabul and other central and southern regions face a wheat production deficit (Tiwari et al., 2020). There is a considerable yield gap between Afghanistan and neighboring countries. The average irrigated wheat yield in Afghanistan is 2.5 tonnes/ha compared to 3.5 tonnes/ha in India. The agricultural sector in Afghanistan faces several challenges, including low productivity of available wheat varieties, unstable climatic conditions, pests and diseases, global market volatility, and escalating conflicts in world major wheat-exporting countries (Mail, 2013; Bentley, 2022).

The unavailability of technologies such as on-farm mechanization, as well as limited crop management strategies for chemical fertilizer use and pest and disease control, further constrain wheat productivity and contribute to the yield gap. As a war-torn country with returning citizens, Afghanistan continues to struggle with food security. Farm-based research can assist planners in optimizing farm strategies within the country's socioeconomic conditions. The yield gap, increase in population, the return of Afghan refugees, the importance of wheat in terms of caloric intake (59.5 %), and conflicts in major wheat-exporting countries highlight the need for such types of studies. The studies could help academia and policymakers to conduct targeted research and develop specific strategies for enhancing food security in Afghanistan. This study carries policy implications and proposes measures such as resource optimization, regional cooperation for input supply, and salinity management programs to address food security through improved wheat production in the study area. The study aims to realize objectives such as: Determining the net revenue of wheat crops in the study area, identifying factors affecting wheat production in the study area, to proposing recommendations based on data analysis and findings.

Reviewing relevant literature provided valuable insights and knowledge sharing on the main topic. It offers important background information, describes techniques, and helps to avoid duplication of research studies. Additionally, it assures proper model specification and provides insights into approaches used over the years. It also allows for comparison of outcomes with similar studies. Ahmadzai and Heydayat (2020) employed a stochastic frontier production function model to data from 235 wheat growers in Pakistan's districts, Afghanistan. The findings demonstrated that users of modified wheat varieties were more efficient (78%) than those using conventional varieties (72%). Among socio-economic characteristics, age, education, gender, household size, extension visits, and land quality had significant effects on productivity. The study recommended the adoption of improved varieties and new technologies for enhancing productivity. Ahmadzai (2017) used Stochastic Frontier Analysis (SFA) to analyze the effect of Crop Diversification (CD) on farm-level technical efficiency in Afghanistan during 2013-2014. The results showed that growers who practiced crop diversification were technically more efficient. Furthermore, the study reported that extension services, farm size, asset ownership, and geographical factors had significant effects on growers' performance.

Tavva et al. (2017) examined the technical efficiency of five wheat-producing areas, in Afghanistan using a stochastic frontier production function. The mean technical efficiency estimate was 0.67, indicating that 33% additional output could be realized with the existing level of resources. To increase domestic production and reduce dependency on imports, the study recommended sound farming techniques including the adoption of improved wheat varieties, appropriate seed rates, relevant training, and extension services. Hussain (2014) examined the efficiency of wheat production in Punjab Pakistan, for the crop year 2009-2010. The technical efficiency levels in the mixed, cotton-wheat, rice-wheat, and rain-fed zones were found to be 78.2%, 82.8%, 80.2%, and 50.1%, respectively. To enhance production, the study highlights the importance of seed quality, farmer training in rain-fed areas, and optimizing plowing, fertilizer use, and irrigation in irrigated zones.

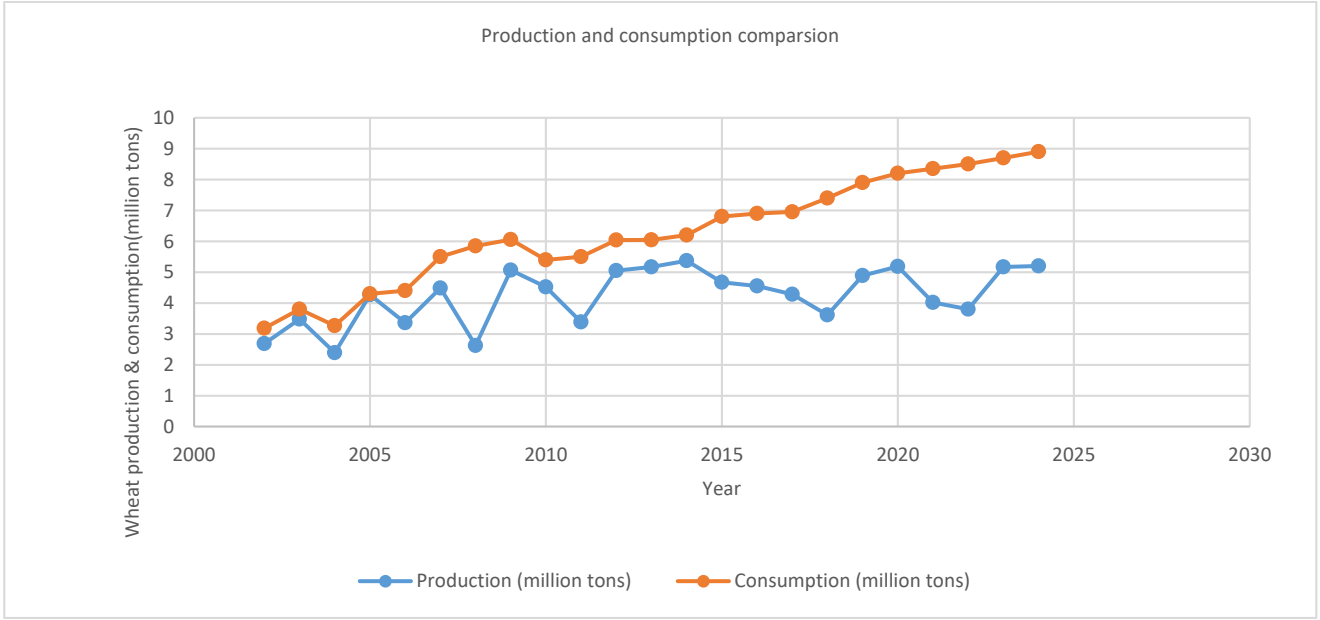

Figure 1. Wheat Production and Consumption Comparison in Afghanistan; Source: Afghanistan Central Statistics (2023).

Naseri et al. (2024) evaluated the impact of lowering agricultural tariffs in Afghanistan by using secondary data from social accounting matrices and a computable general equilibrium model. Their analysis of tariff reductions ranging from 20% to 100% revealed higher imports and increased household consumption of grains, fruits, vegetables, and livestock products. The study underscored the significance of efforts to remove tariffs on agricultural products, demonstrating how lower tariffs increased household purchasing power, food security, and overall societal welfare. The study concluded that reduced tariffs could enhance food items' affordability. Anik et al. (2017) analyzed agricultural sustainability in South Asia (Bangladesh, Pakistan, India, and Nepal) from 1980 to 2013 using Total Factor Productivity (TFP) indices. They found that Bangladesh's agricultural productivity grew at an annual rate of 1.05%, India at 0.52%, Pakistan at 0.38% and Nepal at 0.06%. Natural and human resources, along with technological capital, were identified as the primary drivers of TFP growth. The study noted varying effects of crop diversification and financial capital. In order to enhance productivity in these countries, policy recommendations emphasized the need for land reforms, improvements in education and increased investment in agricultural research and development.

METHODOLOGY

Description of the study area General

Based on weather and soil characteristics, Afghanistan is divided into eight agroecological zones (AEZs), which enable the cultivation of diverse crops. Figure 2 illustrates the contribution of each zone to wheat production. The figure shows that Herat has the highest contribution to national wheat production, followed by Helmand, Kundaz, Takhar and other regions. Such statistics help planners to focus on potential wheat production zones. The current study was conducted in the Eastern region, Bati Kot district of Nangarhar province, Afghanistan, which was randomly selected.

As of 2017, its population was estimated to be 300,000. The district lies within the heartland of the Mohmand tribe. Farming in the area primarily revolves around wheat, barley, rice, sugarcane, and vegetables. Agriculture is a significant source of livelihood for the residents, and its geography and climate support the cultivation of various crops and fruits, thus contributing to the agricultural diversity of the area.

However, agriculture activities in the district face challenges such as limited access to modern farming techniques, irrigation systems, and infrastructure. Livestock farming is also an integral part of the district's agricultural economy, providing additional income and food security for many families. Traditional irrigation methods such as surface irrigation and Karez system are still in practice. Surface irrigation includes canals and ditches that distribute water from rivers and streams to agricultural fields.

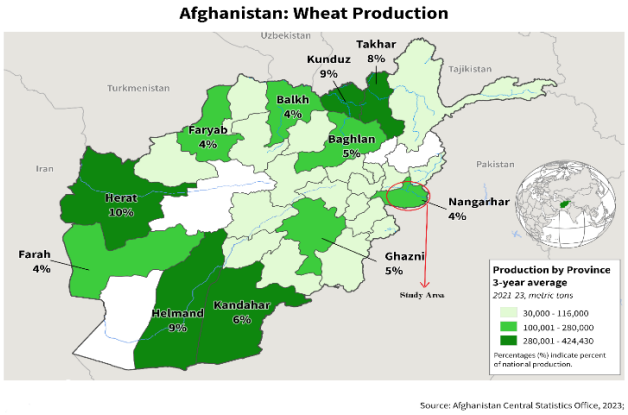

Figure 2. Agro-ecological zones and their percent contribution to wheat production.

Data source and sample size

Afghanistan's statistics yearbooks, the Ministry of Agriculture, Irrigation, and Livestock (MAIL), the National Statistics and Information Authority (NSIA, 2021), the United States Department of Agriculture (USDA), Food and Agriculture Organization of the United Nations (FAO STAT) and the World Bank are potential sources of secondary data related to crops production in Afghanistan. Similarly, published research articles on wheat crops such as Ahmadzai et al. (2019), Poole et al. (2022), and Samim and Zhiquan (2020) also serve as secondary sources of relevant data. However, the present analysis is based on primary data collected through a cross-sectional survey using a structured interview schedule, which was designed, tested and aligned with the study's objectives. Ali and Jan, (2017) and Arshad et al. (2024) have also applied similar methods in their studies.

Following, Ali and Jan (2017), Ali et al. (2019), Ayub et al. (2024), the Yamane (1967) formula method was applied to calculate the sample size. Using a random sampling technique, three village councils Ghazi Abad, Khanano Kali, and Barekab were selected for the survey. Furthermore, respondents in each village were selected proportionally for interviews as presented in Table 1.

Data Analysis: Simple Budgeting Technique

A simple budgeting technique was employed to estimate the cost and returns of wheat crops in the study area as follows:-

$$NR = TR - TC \quad (1)$$

Where NR stands for net revenue, TR = Price of output (P) * Output (Q) and

TC = Input price (V) * Input purchased (X)

Total costs include variable production costs (cost of land preparation, seed, irrigation, labor, soil fertility, and plant protection) plus fixed costs (land rent).

Table 1. Sample respondent's proportional allocation in study area.

District	Village Council	Total Respondents	Sample size in each village Council
Bati Kot	Ghazi Abad	69	48
	Khanano Kali	57	40
	Barekab	46	32
	Total	172	120

Source: Villages census office Bati Kot office (2023).

Empirical Model

In the current study, the Cobb-Douglas type production function was used. Since 1928, the Cobb-Douglas production function has been widely applied to model agricultural and other production processes. It is based on the assumptions of constant returns to scale and diminishing returns to each input. However, the Cobb-Douglas production function has limitations, as it does not fully account for the neoclassical three-stage production function. It represents only one stage of production at a time. This limitation was first identified in the 1950s, when biological scientists began employing it in agricultural economics. In order to deal with varying returns to scale, Halter et al. (1957) proposed a modified version that allowed input parameters to accumulate to values other than 1 as shown below:

$$Y=A\ X1^{\beta 1}\ x2^{\beta 2} \quad (2)$$

β_1 and β_2 sum to any number and can accommodate more than two inputs or factors of production. Specific functional form employed in this study to assess the importance of key variables influencing the yield of wheat crop was specified as follows in equation 3

$$LnY = \beta_0 + \sum_{i=1}^{n=6} \beta_i \ln x_i + \mathcal{E} \quad (3)$$

Where,

Ln = Natural Log
Y = Represents yield realized by grower per unit;
B_0 = Coefficients for variables considered
X_i = Inputs used for wheat production by i^{th} farmer
ei = Error term.

RESULTS AND DISCUSSION

Socio-economic characteristics of respondents

Primary data on socio-economic characteristics (age, education, family size, and extension contacts) that influence decision-making were identified and the findings are presented in Table 2. Age plays a role in learning, attitude and personality development. It is expected to have both positive and negative impact on the farmer's performance. Older farmers tend to have more experience but possibly may be more risk-averse, traditional, and conservative to adopting new farming practices. On the other hand, younger farmers are more risk takers, open to exploring new avenues and willing to adopt new farming technologies and hence more efficient contributors to food security (Hussain, 1989; Coelli, 1996). The results show that the average age of growers is 42.32 years; however, interestingly, even elder farmers (up to 70 years) continued to be involved in wheat production due to the crop's importance in the study area.

Education plays an important role in timely decision making, resource optimization and the adoption of modern technology. Educated farmers tend to be more efficient as compared to uneducated ones. In some studies, education serves as a proxy for managerial ability, which sharpens managerial capabilities to utilize information and production inputs effectively.

Abedullah et al. (2007) highlighted that education and experience are important tools for adapting to rapid changes in the farming system. Table 2 shows that, on average, respondents were literate up to the middle school level. The findings also reveal that the highest level of education attained in the study area is graduation, influenced by various social and economic factors.

Family size refers to the total number of individuals living in the same household, whether related by blood, marriage, or adoption. It is assumed that larger family provides an advantage of offering labor resources during peak wheat cultivation and harvesting seasons. Family labor is highly motivated, resilient, and adaptable, as they directly benefit from farm productivity. On the other hand, large family size can also strain financial resources and lead to inefficiencies due to hidden unemployment. The findings suggest that in Bati Kot, Nangarhar, the majority of families have an average of nine members. The average land holding was recorded at 1.88 acres, ranging from a minimum 0.5 to a maximum of 4 acres. Larger farm sizes enable farmers to benefit from economies of scale, machinery use, and advanced farming practices. It is believed that excess to extension services, whether through printed materials or personal interactions, play a critical role in improving production and enhancing food security.

Farmers who engage frequently with extension services have better access to market information and updated best practices, enabling them to make informed decisions. The distribution of respondents based on extension contacts is presented in Table 2. The findings reveal that, on average, respondents had fewer than three extension contacts throughout the entire wheat season, which may best explain low per-unit yields in Afghanistan compared to neighboring countries. Extension services play a role in disseminating agricultural knowledge and influencing farmers' decision-making processes. Outreach and cooperation strategies are necessary to strengthen farmers' engagement with extension services and to enhance agricultural productivity.

Table 2. Socio-economic characteristics of respondents in the study area.

Variable and unit	Mean	Minimum	Maximum
Age (Year)	42.32	28	70
Education (Year)	8	0	14
Family size (No.)	8.58	3	20
Land Holding (Acre)	1.88	0.5	4
Extension contacts (No.)	2.02	0	4

Source: Authors' calculation from survey data (2023).

Descriptive Statistics

Table 3 shows that the average tractor usage is 2.3 hours per acre, with a maximum of 2.8 hours. The average seed application is 47.92 kg $acre^{-1}$; however standard deviation of 4.964 kg reflects variability in seed application across the study area. The average fertilizer application rates for urea and Di-ammonium Phosphate (DAP) are 103.94 and 64.34 Kg per acre, with standard deviations of 9.476 kg and 7.552kg, respectively. Flood irrigation is a common practice, applied at an average rate of 1.98 per season. As a plant protection measure, weedicide application averages 1171.3 milliliters (ml) per acre, with considerable variability in application due to various factors.

Farm Yard Manure (FYM), is applied at an average rate of 1.506 trolleys per acre, with a moderate standard deviation of 0.676. The labor involvement rate for the entire season is 14.6 days, with a minor standard deviation of 1.069 days in the study area. The average crop yield is 1400 kg/acre, reaching a maximum of 1460 kg, with a standard deviation of 44.124 kg, indicating yield fluctuation among respondents. During the survey, it was revealed that respondents generally rely on their experience and knowledge to determine input levels, with limited adherence to recommended application rates.

Table 3. Summary statistics of inputs used and yield obtained for wheat crop.

Variable	Mean	Std. Deviation	Minimum	Maximum
Tractor (hrs)	2.306	.298	2	2.8
Seed (kg)	47.92	4.964	40	56
Urea (kg)	103.94	9.476	90	124
DAP (kg)	64.34	7.552	50	76
FYM (kg)	1.506	,676	.4	2.5
Labor (days)	14.6	1.069	13	16
Irrigation (No.)	1.98	.769	1	3
Weedicides (ml)	1171,3	180.647	900	1450
Yield (kg)/Acre	1400	44.124	1300	1460
Straw (kg)/Acre	1104.5	88.469	980	1230

Source: Survey data (2023).

Simple Budgeting Technique: Cost of production

The cost of production is influenced by input utilization and prevailing market prices. Table 4 presents a detailed breakdown of crop production costs in the study area, providing valuable insights into the local farming economy. Tractor operation expenses amount to Af. 1821.74, representing 4.761% of the total cost, with an hourly rate of Af. 790. Seed acquisition costs exceed Af. 1560.28 (4.077%), with 47.92 kg purchased at a rate of Af. 32.56 per kilogram. The total cost for urea and DAP fertilizers is Af. 4151.37 and Af. 5136.91, respectively. These chemical fertilizers are imported from Pakistan and Russia, its prices fluctuate based on inflation in these countries.

Labor costs, including the opportunity cost of family labor at prevailing market rates, total Af. 4065.81, accounting for 10.625% of the total cost. Additional expenses for weedicide spraying, threshing, and irrigation contribute 13.697% to the total production cost. Land rent for wheat crops is Af. 6500 per acre, comprising 16.99% of the total cost. Organic fertilizer, the largest cost component, accounts for 25.58% of the total expenditure. A possible reason noted during the survey is that the local community commonly uses animal dung as fuel, which may explain its relatively high cost.

Net revenue for wheat crop in study area

Table 5 highlights the gross revenue generated from both the main product (wheat) and by-products (wheat straw). Wheat yield was 1400 kg per acre at a market price of Af. 29.7 per kg, while the by-product, straw, yielded 1104.5 kg per acre, valued at Af.10.32 per kg. Together, these contribute to the total revenue of Af. 52,978.44. after deducting the total costs for the entire season, the net return amounts to Af. 14,711.88/- per acre for the study period.

Regression estimates for Wheat crop in the study area

Table 6 illustrates the elasticity of inputs in the production process. The results show that a 1% increase in DAP, farmyard manure and weedicides increase yield by 0.07, 0.064 and 0.057% respectively. These findings highlight the role of nutrient allocation and weed control in wheat yield. On the other hand, no significant correlation was found between wheat yield and tractor hours, seed, urea, and labor days. The positive coefficients of these inputs suggest that adjusting them to optimal levels could enhance wheat yield in the study area. The results also indicate that over-irrigation negatively impacts wheat yield. During the survey it was observed that due to unlined watercourses and continuous water seepage, the root zone became over-saturated and hence reducing yield. According to the R-squared value, the selected variables account for 47% of the yield variation, while unknown factors contribute to the remaining 53%.

Heteroscedasticity Test

In cross-sectional data, usually, the issue of heterogeneity effects arises. This phenomenon when the associated error term of parameters exhibits a non-constant variance (Gujarati, 1985). In the current study, as shown in Table 7, heteroscedasticity was tested using the Breusch-Pagan/Cook-Weisberg method, which produced a significance level of 0.5153 and a Chi-square estimate of 0.42. Based on these results researchers cannot reject the null hypothesis of homoscedasticity because the p-value (0.5153) is greater than 0.05. Therefore, the lack of significant evidence regarding heterogeneity, confirms that the variance of errors remains consistent across data, supporting the accuracy of the regression model.

Table 4. Cost of wheat production in study area.

Items	Unit	Quantity	Unit price(Af)	Total cost	Percentage
Tractor operation	Hour	2.306	790	1821.74	4.761
Seed	Kg.	47.92	32.56	1560.275	4.077
Urea	Kg.	103.94	39.94	4151.364	10.849
DAP	Kg.	64.34	79.84	5136.906	13.424
Fym	Trolley	1.506	6500	9789	25.581
Labor	Days	14.6	278.48	4065.808	10.625
Irrigation	No.	1.98	181.4	359.172	0.938
Weedicides	ml.	1137.2	2.194	2495.016	6.520
Threshing cost	Kg.	84	28.42	2387.28	6.239
Land Rent	Acre.	1	6500	6500	16.986
Total				38266.5612	100

Source: Survey Data (2023); Where Af represents Afghanistan currency: Afghani.

Table 5. Net Revenue for Wheat.

Item	Unit	Quantity	Unit Price	Total (Af.)
Yield per Acre	Kg	1400.0	29.7	41580.00
Bi product (Straw)	Kg	1104.5	10.32	11398.44
Total Revenue				52978.44/-
Total Cost				38266.56/-
Net Revenue				14711.88/-

Source: Survey Data (2023).

Table 6. Regression estimates for wheat.

Variable	Coefficient	Standard Error	t-value	P>t
Ln (Tractor hrs)	0.0355	0.04131	0.8595	0.499
Ln (Seed)	0.0226	0.05136	0.4419	0.052
Ln (Urea)	0.0230	0.06077	0.3788	0.063
Ln (DAP)	0.0711	0.03282	2.1670	0.0002
Ln (Fym)	0.0639	0.0304	2.0982	0.0005
Ln(labor days)	0.01679	0.06052	0.2774	0.0751
Ln (irrigation)	-0.00052	0.01179	-0.0448	0.324
Ln (weedicides)	0.05710	0.0245	2.3297	0.0001
_cons	7.0703	0.3902	18.117	0.000
R square = 0.47				

Source: Author's estimates from survey data (2023).

Table 7. Breusch-pagan/cook-Weisberg test for Heteroscedasticity.

Chi2(1)	0.42
Prob>chi2	0.5153

Source: Calculated from survey data (2023).

Normality of the Data

The normality assumption was checked using a visual method, specifically a histogram of residuals. The X-axis represents the residual values, while the Y-axis shows their density. The bell-shaped figure (figure 3) illustrates that the data set has no outliers. A normally distributed data set ensures valid, interpretable, and accurate conclusions aiding in informed decision making.

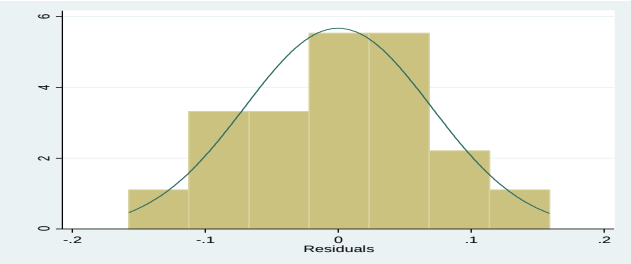

Figure 3. Data Normality Graph; Source: Calculation from survey data (2023).

CONCLUSIONS

Afghanistan is strategically positioned at the crossroads of Central Asia. Wheat is a staple crop critical to the country's food security, with an annual per capita consumption of 185 kg. Due to low domestic production relative to consumption, Afghanistan is reliant on imports from neighboring nations. Key findings reveal a significant presence of young farmers, challenges in education, and the importance of agricultural extension services in enhancing agricultural productivity and profitability. Descriptive statistics indicate that tractors were used for an average of 2.31 hours per acre. Respondents reported applying 47.92 kg of seed, 64.34 kg of DAP, and 103.94 kg of urea per acre. Challenges faced by farmers included weed growth caused by flood irrigation, with a maximum of three irrigations per season.

Wheat straw production averaged 1,104.5 kg per acre, while grain yield was approximately 1,400 kg per acre. Using a simple budgeting approach, total expenses per acre were calculated at Af. 38,266.56/-, with revenues amounting to Af. 52,978.44/-, resulting in a net revenue of Af. 14,711.88/-.

Regression analysis indicated that irrigation negatively affected wheat yields in the study area, while DAP, weedicide, and farmyard manure had significant positive effects. Other factors such as labor, urea, seed, and tractor hours showed positive but non-significant impacts at the 5% significance level. The combined cost of soil nutrients (urea, DAP, and FYM) accounted for 48% of total expenses. Since DAP and urea are imported from Pakistan and Russia, optimizing import decisions based on cost could benefit wheat growers by increasing profitability. Waterlogging caused by seepage from common canals (Olus Walli) and unlined watercourses, has degraded agricultural land, making it less suitable for crop cultivation. A government-led reclamation program could help mitigate further land degradation in the region. Additionally, access to agricultural machinery such as planters, harvesters, and tractor-mounted threshers could reduce costs, save time and labor, minimize pre- and post-harvest losses, and enhance food security by improving availability.

Authors' Contribution

E. Wahidi conducted a survey and data feeding in Excel. A. Ali did the analysis and developed the initial drop. H. Younas worked out

tables, formatting, and figures. S.A. Shah technically reviewed the article. The idea of the wheat crop was developed by A. Jan. while R. Ullah helped in the recommendations setting of the article.

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