Journal of Humanities and Social Sciences Studies
ISSN: 2663-7197
DOI: 10.32996/jhsss
Journal Homepage: www.al-kindipublisher.com/index.php/jhsss

JHSSS
AL-KINDI CENTER FOR RESEARCH AND DEVELOPMENT

| RESEARCH ARTICLE

Assessing the Efficiency of Wheat Producers in Dihdadi District

Hafizullah Radmand[1], Sayed Mahbobullah Akabri[2], Jamaluddin Akbari[3] and Habibullah Rezaei[4] ✉
[1]Department of Agricultural Economics and Extension, Agriculture Faculty, Baghlan University, Afghanistan
[2]Department of Agricultural Economics and Extension, Agriculture Faculty, Kunduz University, Afghanistan
[3]Department of Agricultural Economics and Extension, Agriculture Faculty, Kunduz University, Afghanistan
[4]Department of Agricultural Economics and Extension, Agriculture Faculty, Samangan University, Afghanistan
Corresponding Author: Habibullah Rezaei, **E-mail**: habibullahrezaei@gmail.com

| ABSTRACT
Given the strategic importance of wheat production for the country's food security, this study aimed to analyze the efficiency of wheat producers in the Dihdadi district of Balkh province, Afghanistan, using the Data Envelopment Analysis (DEA) approach. The required data were classified using a random sampling method, and 295 questionnaires were collected in 2022. The results show that the average technical, allocative, economic, pure technical (management), and scale efficiencies are 0.858, 0.632, 0.541, 0.964, and 0.893, respectively. Based on these results, increasing the efficiency of wheat producers in this district can improve technical, allocative, economic, management, and scale efficiencies by 14.2%, 36.8%, 45.9%, 3.6%, and 43.6%, respectively. 16.95% of wheat producers operate with decreasing returns relative to the scale, 72.2% use with increasing returns relative to the scale, and only 10.85% operate at the optimal scale (constant returns to scale). Therefore, increasing the production scale is suggested to enhance rational efficiency. Recommendations, management, and policy contexts related to improving the efficiency of wheat producers can contribute to local economic and social conditions.

| KEYWORDS
Efficiency, Data Envelopment Analysis (DEA), Wheat Producers, Dihdadi District, Return to Scale

| ARTICLE INFORMATION
ACCEPTED: 22 November 2023 **PUBLISHED:** 03 December 2023 **DOI:** 10.32996/jhsss.2023.5.12.2

1. Introduction
Agriculture is the backbone of many economies worldwide, helping most of the global population in livelihood and subsistence. In Afghanistan, wheat production is critical in the agricultural landscape, contributing to food security and economic stability (IPC, 2023; Rahmani et al., 2022). The Dihdadi district in Balkh province is pivotal in wheat production, making it a key area of interest. Understanding the efficiency of wheat producers in this district is crucial for optimizing agricultural production and ensuring the local population's well-being. The primary goal of this study is to identify and enhance the efficiency of wheat producers in the Dihdadi district, Balkh province (MAIL, 2019). Efficiency in wheat production is a multifaceted concept encompassing various dimensions, including technical, allocative, economic, management, and scale efficiency. Each of these dimensions contributes to the overall performance of wheat producers and affects their ability to compete in the market and sustain their livelihoods (Nawaz et al., 2020).

Scarce resources have always been a significant constraint in the production process. For a desirable life, there is no alternative for humanity but to make the best use of available resources to produce more and of higher quality (Shizgal, 2012). One of the primary strategies to achieve productivity growth in the agricultural sector is through technological innovations and efficient utilization of existing technologies. However, in developing countries like Afghanistan, many new agrarian technologies have yet to be very successful, often due to the inability or reluctance of producers to adjust input levels because of their familiarity and adherence to traditional agricultural systems, as well as financial and institutional constraints (FAO, 2017; Rezaei et al., 2021).

Therefore, enhancing production efficiency is the most viable option for increasing productivity in developing countries like Afghanistan. If farmers do not effectively utilize existing technologies, improving efficiency may be more cost-effective than introducing new technologies. Production efficiency is crucial in promoting economic growth in developing countries' agriculture sector and is particularly important for preventing resource wastage. Efficiency analysis is employed to identify the potential for increased output while preserving resources and serves as a suitable complement to the set of adopted policies for simulating domestic production (Sun et al., 2022).

The inefficiencies in agricultural production in Afghanistan and many other developing countries are due to suboptimal use of production factors and low efficiency. These countries exhibit a significant gap compared to developed nations. One of the fundamental challenges in the agricultural sector of these countries is the inefficiency of farm management and production. Thus, understanding the resources and constraints in the agricultural industry, the most suitable solution for increasing production and income, reducing the desirable allocation of production factors, and improving efficiency is essential (ANDS, 2013).

Wheat is one of Afghanistan's primary and essential agricultural products, holding a significant place in the country's food basket. Approximately 1,833,357 hectares are annually dedicated to cultivating this major crop. Afghanistan produces 3,900,000 tons of wheat yearly, with Balkh Province playing a significant role in this production. Unfortunately, the wheat production in Afghanistan is insufficient (FAO, 2023). In 2021, Afghanistan imported $1.61 million worth of wheat, making it the 158th largest wheat importer in the world. In the same year, wheat was the 269th most imported commodity into Afghanistan. Afghanistan imports wheat primarily from China ($1.17 million), Uzbekistan ($266,000), Tajikistan ($161,000), and Russia ($9.91 thousand) (OEC, 2023).

Therefore, studying the efficiency of this critical product is crucial. Given the strategic importance of this crop and its poor performance, rational and optimal utilization of resources and planning to enhance efficiency is necessary (Kandpal et al., 2022). Improving efficiency, in addition to technological innovations, relies on the efforts of researchers in studying efficiency and disseminating results among related farmers. Therefore, assessing and analyzing wheat farmers' efficiency and identifying strengths and weaknesses can provide strategic solutions for improving efficiency and achieving self-sufficiency in wheat production (Yitayew et al., 2023). In the field of technical, allocative, economic, management, and scale efficiency, numerous studies have been conducted abroad, but unfortunately, there has not been a significant study on this matter in Afghanistan.

2. Literature Review

Ahmadzai (2017) conducted an empirical investigation into the dimensions of product diversity and technical efficiency within the agricultural context of Afghanistan from 2003-2004. The research findings underscore that the diversification of products within the agrarian portfolio has a substantial and statistically significant impact on enhancing technical efficiency. Furthermore, the study highlights the salient influence of various determinants in substantially shaping technical efficiency, including access to extension services by peasant families, farm size, ownership of livestock and mechanized equipment such as tractors, and regional variables. Tavva et al. (2017) examined the technical efficiency of wheat cultivation and the concurrent mitigation of yield disparities within Afghanistan, leveraging the stochastic frontier analysis framework. The research, encompassing five distinct provinces in Afghanistan, yields insights that indicate the average technical efficiency of wheat producers to be at 0.67. However, the study posits that optimizing production factors can enhance this efficiency by up to 33 percent, offering prospects for substantial improvement in wheat production processes.

Babaei et al. (2013) investigated crop efficiency within Jahram City, yielding results establishing an average efficiency range from 0.230 to 0.858. The mean technical efficiency ascertained at 0.966 demonstrates that a substantial portion of the data points, precisely 75%, exhibit perfect efficiency, with an efficiency score of one. The efficiency scores range from a minimum of 0.88 to a maximum of 100%. Notably, when considering constant efficiency relative to scale, an excess water input is required for barley and wheat cultivation, amounting to 373.915 and 610.46 cubic meters per hectare, respectively. The methodology employed for this assessment involved the utilization of Interval Data Envelopment Analysis (IDEA). ASFAW et al. (2019) scrutinized smallholder farmers' efficiency in wheat production in the Abuna Gindeberet District of Western Ethiopia, employing a stochastic production frontier approach. The stochastic production frontier model revealed that crucial input variables, namely mineral fertilizers, land, and seed, significantly contributed to augmenting wheat output. The estimated mean values for technical, allocative, and economic efficiency were 78%, 80%, and 63%, respectively. These findings point towards inefficiencies within wheat production in the study area.

Haruna et al. (2020) scrutinized smallholder farmers' efficiency in wheat production in the Abuna Gindeberet District of Western Ethiopia, employing a stochastic production frontier approach. The stochastic production frontier model revealed that crucial input variables, namely mineral fertilizers, land, and seed, significantly contributed to augmenting wheat output. The estimated mean values for technical, allocative, and economic efficiency were 78%, 80%, and 63%, respectively. These findings point towards inefficiencies within wheat production in the study area. The mean allocative, economic, and scale efficiency were 0.91, 0.76, and

0.94, respectively, while 0.83%, 0.83%, and 6.67% achieved full allocative, economic, and scale efficiency, respectively. The percentage of farmers that operated under the CRS, IRS, and DRS were 6.67%, 85.83 and 7.5% respectively.

Manogra & Mishra (2022) assessed the agricultural production efficiency across Indian states using Data Envelopment Analysis (DEA). The findings of their study illuminate substantial disparities in the performance of conditions, with five out of the twenty states surveyed demonstrating efficiency under the Constant Returns to Scale (CCR) model of DEA, while nine out of the twenty states exhibited efficiency under the Variable Returns to Scale (BCC) model of DEA. Furthermore, the results from the Multiple Performance Index (MPI) suggest that, during the analysis period, 11 out of the 20 states made notable progress in their MPI scores. Nwahia et al. (2020) examined rice farmers' technical, allocative, and economic efficiency in Ebony State, Nigeria, utilizing a stochastic frontier production function. The outcomes of their investigation unveiled that rice farmers in Ebonyi achieved an impressive 86% level of technical efficiency, alongside 63% allocative efficiency and 54% economic efficiency. The study consequently concludes that a discernible scope exists for enhancing the technical, allocative, and economic efficiency of rice farming in Ebonyi.

Aslam et al. (2021) assessed rice and wheat production efficiency in Pakistan, India, and China, employing Data Envelopment Analysis (DEA) as their analytical framework. The mean technical productivity ratings, as determined through the Constant Returns to Scale (CCR) and Slacks-Based Measure (SBM) models, were found to be 0.87 and 0.86, respectively. These recorded values notably fall below the optimal ratings originally anticipated within the DEA framework. Imran & Ozcatalbas (2021) investigated the optimization of energy consumption and its impact on the efficiency of energy utilization and greenhouse gas emissions in wheat production in Turkey, utilizing Data Envelopment Analysis (DEA). Their results from the DEA indicated that farmers achieved an overall technical efficiency rating of 0.81, with pure technical efficiency and scale efficiency recorded at 0.65 and 0.76, respectively. SALAM & HAMEED (2022) evaluated the efficiency of significant food grain production in Punjab, Pakistan, employing the DEA methodology. Their findings revealed that wheat cultivation exhibited an average efficiency rating of 0.65 under varying returns to scale, while rice production achieved an average rating of 0.74. In the case of maize cultivation, the average efficiency rating reached 0.92. Furthermore, estimations of scale inefficiency in wheat farming ranged around 18%. In rice production, it spanned from 16% to 21%, and for maize, it varied between 7% and 17%.

Alemu et al. (2022) conducted an analysis of the economic, allocative, and technical efficiency of smallholder farmers engaged in maize production within the West Hareghe Zone of the Oromia National Regional State in Ethiopia, employing the Stochastic Frontier Production Model. The findings revealed that the mean technical, allocative, and economic efficiencies among the sampled households stood at 77%, 64%, and 51%, respectively. These results underscore the presence of significant variations in efficiency levels within the context of maize production in the study area. Esfehani (2022) examined the efficiency of wheat cultivators in the South Khorasan province, utilizing data coverage analysis as the analytical framework. The study's outcomes indicated that, on average, the technical efficiency, pure technical efficiency, and scale efficiency were estimated at 0.76, 0.89, and 0.85, respectively. Additionally, the benefit-cost ratio was determined to be 2.1, highlighting the economic implications of the findings.

Muleta & Te (2022) examined the technical, allocative, and economic efficiency of potato producers in central Oromia, Ethiopia, employing the stochastic frontier production function. This investigation revealed that households in both districts were operating with inefficiencies in potato production, as evidenced by the mean technical, allocative, and economic efficiency scores of 61.21%, 79.56%, and 50.23%, respectively. These results suggest the potential for households to augment their potato production by as much as 38.78%, as well as the possibility of reducing the production cost of potatoes by 49.76%. Zhang (2023) evaluated wheat production technical efficiency among farmers, focusing on income enhancement, utilizing the Data Envelopment Analysis (DEA) approach. The results of this investigation demonstrated notable disparities in the technical efficiency of wheat production among farmers, particularly concerning the optimal efficiency scale under both input and output orientations. The study findings further highlighted that the technical efficiency of wheat production among farmers in most major grain-producing regions was in a DEA-ineffective state, emphasizing the urgent need for improvements in agricultural technical efficiency.

A review of studies reveals the fact that, in most previous research, a specific aspect of efficiency has been the focal point, or new efficiency calculation methods have been introduced and empirically applied, with less emphasis on concurrently investigating technical, allocative, economic, management, and scale efficiency, as well as examining returns to scale. Since the Dihdadi district in Balkh province is considered one of the significant wheat cultivation areas, and a comprehensive study in this regard has yet to be conducted, it has been chosen as a study sample. Therefore, this study aims to analyze wheat growers' technical, allocative, economic, management, and scale efficiency using a non-parametric approach for comprehensive data analysis.

3. Research Methodology

3.1 Research Area

Dihdadi is one of the districts of Balkh province in northern Afghanistan, with a population of nearly 65,600 people. This district is vital because of its greenery and agricultural production. (Industrial town and chemical fertilizer factory) Moreover, (Qala-I-Jangi) is this district's famous and scenic area. It is close to the capital of the province, Mazar-I-Sharif - about 15 km in the eastern direction from the district capital, Dihdadi (CSO, 2023).

Fig. 1 Map of the Dihdadi district

3.2 Sampling Procedure

The statistical population of this research consists of wheat producers of the Nijrab district. Using the Cochran formula, a sample size of 295 individuals was selected and conducted through stratified random sampling, with proportional allocation to the villages of the Dihdadi district.

$$n_0 = \frac{(z^2_{1-\frac{a}{2}})p(1-p)}{d^2} \qquad (1$$

$$n = \frac{n_0}{1 + \frac{(n_0 - 1)}{N}}$$

$$n_0 = \frac{1.96^2 * 0.5 * 0.5}{0.05^2} = 385$$

$$n = \frac{385}{1 + \frac{(385-1)}{1250}} = 294.522 \cong 295$$

3.3 Data Envelopment Analysis (DEA)

Methods for calculating efficiency are divided into two main categories: parametric and non-parametric strategies. In non-parametric ways, ordinary production or cost functions are employed. On the other hand, Parametric methods are categorized into two broad approaches based on their characteristics: parametric and non-parametric (FØRSUND & SARAFOGLOU, 2002). The parametric approach refers to methods in which a specific form for the production or cost function is assumed, and then, using conventional statistical and econometric methods, the parameters of this function are estimated. Essential parametric methods include the frontier production function, deterministic statistical frontier production function, stochastic frontier production function, and profit function (Zhou & Xu, 2020).

As mentioned earlier, a suitable form for the production function is initially considered in the parametric approach, which imposes a constraint due to its nature. This constraint transfers all the challenges of selecting an appropriate functional form to the efficiency results. If an appropriate form for the parametric model is not chosen, the efficiency results will be unrealistic (Ahmed & Melesse, 2018). The non-parametric approach is based on mathematical programming and is called non-parametric because it does not require estimating any specific functional form to calculate production (cost) frontiers and efficiency within this framework. This approach's most common computational method is Data Envelopment Analysis (DEA). When decision-making units involve multiple inputs and outputs, parametric methods cannot adequately compute and assess the efficiency of these units. In such cases, Data Envelopment Analysis is a non-parametric method for measuring efficiency (Jadhav & Ramanathan, 2009).

Data Envelopment Analysis models are broadly categorized into three types: constant returns to scale, variable returns to scale (BCC), and non-increasing returns to scale. They indicate the relative increase in production due to changes in all production factors (Zarrin & Brunner, 2023). These models can be approached in two ways: input-oriented or output-oriented. Input-oriented refers to how much inputs should be reduced while keeping outputs constant to reach the efficiency frontier, whereas output-oriented determines how much outputs should be increased while keeping inputs constant to reach the efficiency frontier (T. J. Coelli et al., 2005).

The choice of an appropriate Data Envelopment Analysis model, whether input-oriented or output-oriented, depends on the level of control over inputs and outputs. If inputs are more controllable, the model is selected based on this criterion. Given the significant impact of weather conditions and various risks on agricultural production and the higher control over input usage, an input-oriented approach is employed in this research. The CCR model, proposed by Charnes and colleagues (1987), assumes constant returns to scale for all decision-making units (T. J. Coelli et al., 2005; Kyrgiakos et al., 2023). The constant return to scale model is used when decision-making units operate at their optimal scale (the part of the long-term average cost surface), while various factors such as imperfect competition, sudden financial constraints, weather fluctuations, pest outbreaks, and the like may cause these units not to operate at the optimal economic scale (Bjurek et al., 1990).

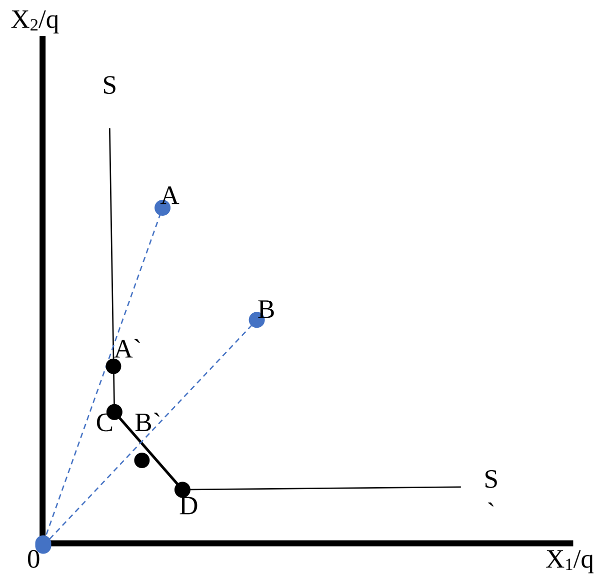
In the DEA method, a reference unit or a combination of two or more efficient units is introduced as a benchmark and model for each of the inefficient units. Since this composite unit (comprising two or more efficient units) will not necessarily exist in the industry, it is recognized as a virtual efficient unit. One of the advantages of DEA is finding the best virtual efficient unit for each of the units under examination, both efficient and inefficient. If a unit is efficient, its reference set will be its virtual efficient unit. The share of each of the efficient units in forming the virtual efficient unit (the reference unit) for an inefficient unit depends on the weights $(\lambda_1, \lambda_2, \dots \lambda_n)$ λ, which are calculated and provided for each of the efficient units through the DEA method (Farrell, 1957).

In Figure 1, units A and B are inefficient, and B` is the image of B on the efficiency frontier, situated between units D and C. B` can be obtained by a weighted combination of the two actual and efficient units, D and C. Therefore, B` is both a virtual unit and a reference unit. The coefficients are used to calculate the amount of input consumption in an efficient state, and, in other words, the amount of input consumption for inefficient units to reach the efficiency frontier is calculated. The calculation process is detailed in Equation (2).

$$\theta^* x_0 - S^- = X_n \lambda_n \qquad (2$$

In which θ^* represents the efficiency of the inefficient unit, x_0 is the input of the particular inefficient unit, X_n is the input of the n_{th} reference unit, and S represents the surplus input of the unit under consideration. The CCR model, after determining the efficiency frontier, specifies where different units are positioned relative to this frontier and what combination of inputs and outputs is required to reach the efficiency frontier.

Fig. 2 Efficiency Frontier with Two Inputs and One Output in Input-Oriented Approach



Banker and colleagues (1984) introduced the BCC model by adding the assumption of variable returns to scale to the CCR model. If m, S, and n are, respectively, the number of inputs, outputs, and decision-making units, and X_{ij} and Y_{rj} represent the values of the inputs and outputs of decision-making unit j, the linear programming models associated with the CCR, BCC, and NIRS models are defined as follows (T. J. Coelli et al., 2005):

$$
\begin{aligned}
&\min_{\theta,x}\theta \\
&st \quad \sum_{j=1}^{n}\lambda_j x_{ij} \le \theta_o x_{io}, && i = 1,2,\dots,m \\
&CCR: \sum_{j=1}^{n}\lambda_j y_{rj} \ge y_{ro}, && r = 1,2,\dots,s \qquad (3 \\
&\lambda_j \ge 0 && j = 1,2,\dots,n
\end{aligned}
$$

$$
\begin{aligned}
&\min_{\theta,x}\theta \\
&st \quad \sum_{j=1}^{n}\lambda_j x_{ij} \le \theta_o x_{io}, && i = 1,2,\dots,m \\
&BCC: \sum_{j=1}^{n}\lambda_j y_{rj} \ge y_{ro}, && r = 1,2,\dots,s \qquad (4 \\
&\sum_{j=1}^{n}\lambda_j = 1, \\
&\lambda_j \ge 0 && j = 1,2,\dots,n
\end{aligned}
$$

$$
\begin{aligned}
&\min_{\theta,x}\theta \\
&st \quad \sum_{j=1}^{n}\lambda_j x_{ij} \le \theta_o x_{io}, && i = 1,2,\dots,m \\
&NIRS: \sum_{j=1}^{n}\lambda_j y_{rj} \ge y_{ro}, && r = 1,2,\dots,s \qquad (5 \\
&\sum_{j=1}^{n}\lambda_j \le 1, \\
&\lambda_j \ge 0 && j = 1,2,\dots,n
\end{aligned}
$$

The non-increasing returns to scale model are used to judge whether each decision-making unit exhibits increasing or decreasing returns to scale. The difference between the constant, variable, and non-increasing returns to scale models lies in the convexity constraint. Adding the constraint $\sum_{j=1}^{n} \lambda_j = 1$ transforms the CCR model into the BCC model while adding the constraint $\sum_{j=1}^{n} \lambda_j \leq 1$ turns the CCR model into the NIRS model. θ represents the ratio of the actual output to the optimal output based on a specified level of inputs. The numerical value of θ ranges between 0 and 1, with values closer to 1 indicating higher efficiency. Numerical values represent companies' efficiency that satisfy the condition θ≤1 (T. Coelli & Fleming, 2004).

The assumption of constant returns to scale in a model implies that the size of the production unit is not considered in the calculation of technical efficiency, and due to the absence of scale effects, a smaller production unit can create outputs and inputs in the same ratio (scale) as a more extensive production unit. In units where scale effects exist, the assumption of constant returns to scale is not apparent, and the gap between the boundaries of constant and variable returns to scale represents the concept of scale inefficiency. Therefore, after calculating technical efficiency with three models - constant returns, variable returns, and non-increasing returns to scale, it is possible to assess technical efficiency in terms of pure technical efficiency (management) and scale efficiency in cases of increasing or decreasing returns to scale for each of the decision-making units.

Pure technical efficiency refers to the technical efficiency influenced by the displacement of scale efficiency and the efficiency calculated under variable returns to scale conditions. Scale efficiency is obtained by dividing technical efficiency under constant returns to scale conditions by technical efficiency under variable returns to scale conditions. Scale efficiency represents the ability of a production unit to operate at the optimal economic scale as it changes in size and is expressed by the following relationship (imam Mobidi, 2016; Mehrgan, 2016).

$$SE = \frac{TE_{CRS}}{TE_{VRS}} \qquad (6$$

In Equation (6), if SE=1, the decision-making unit operates with constant returns to scale; otherwise, it faces either increasing or decreasing returns to scale. Furthermore, if $TE_{VRS} = TE_{NIRS}, SE < 1$, the decision-making unit operates under decreasing returns to scale, and if $TE_{VRS} \neq TE_{NIRS}, SE < 1$, the unit operates under increasing returns to scale (Mehrgan, 2016).

4. Results

The statistical description of the efficiency results is presented in Table 1, and their frequency distribution is shown in Table 2. Examining the numbers in Table 1 reveals that the average technical, allocative, economic, management, and scale efficiencies are 0.858, 0.632, 0.541, 0.964, and 0.893, respectively, with the lowest being 0.51, 0.06, 0.06, 0.69, and 0.51, respectively, and the highest being 1.00, indicating maximum efficiency. Most technical efficiency is 90-100 percent (137 individuals). The difference between the highest and lowest technical efficiency is 49 percent, demonstrating a significant disparity among wheat producers in this region. Hence, considering the fixed production factors in use, there is substantial potential to increase technical efficiency and achieve maximum wheat production.

From an institutional perspective, this difference implies that wheat producers can produce a similar quantity of product with fewer production inputs, as they need to optimize the utilization of production inputs. The units under investigation can increase their technical efficiency by reducing inputs without reducing a specific product, thus preventing wastage of production inputs and improving production efficiency. Farm efficiency can be increased by up to 14.2 percent.

Table 1 The Results of Estimating Efficiency of Wheat Producers

Efficiency	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
Technical Efficiency	0.51	1.00	0.8581	0.12234	-0.461	-0.850
Allocative Efficiency	0.06	1.00	0.6321	0.17824	-1.850	3.316
Economic Efficiency	0.06	1.00	0.5410	0.17632	-0.934	1.368
Management Efficiency	0.69	1.00	0.9641	0.06578	-1.847	2.649
Scale Efficiency	0.51	1.00	0.8937	0.13819	-0.042	0.038

Source: Research Findings

The highest frequency of allocative efficiency falls within the 70-60 percent range (124 individuals). The average allocative efficiency of the examined region indicates that the units under investigation face a 36.8 percent level of inefficiency. In these units, an excessive use of production inputs is observed, and there is significant potential for improving the allocation of production inputs without reducing the quantity of the produced output. Moreover, the difference between the best and worst producers in allocative efficiency is 94 percent, indicating a substantial disparity in the optimal resource allocation among units concerning their prices.

The highest frequency in economic efficiency lies in the less than 50 percent range (101 individuals). The average economic efficiency for the units under examination is 0.541, equivalent to 45.9 percent being economically inefficient. Economic efficiency in the context of production is one of the measures of the profitability of production units. This criterion is relatively low for the examined region, indicating a low profitability of production units. Furthermore, the difference between the best and worst production units in terms of economic efficiency is 94 percent, signifying a significant disparity in profit generation among wheat producers.

The highest frequency in management performance falls within the range of 90-100%, with 244 individuals. The average management performance of the units under examination is 0.964. A 31% difference between the highest and lowest performance indicates a significant disparity among wheat producers. Based on the results, eliminating management inefficiency can increase performance by up to 3.6%. Most of the scale performance is within the 90-100 range. The difference between the highest and lowest scale performance is 49%, reflecting a substantial difference in scale performance among wheat producers in this region. The average technical efficiency of farms will increase from 0.858 to 0.893 by removing scale inefficiency. Focus on addressing scale inefficiency implies that units with decreasing returns to scale should avoid adding production inputs to the production process. In contrast, units with increasing returns should enhance their efficiency by adding production inputs, improving productivity and performance.

Table 2 Frequency Distribution of Technical, Allocative, Economic, Pure Technical (Management), and Scale Efficiencies of Wheat Producers

Efficiency Index (%)	TE	AE	EE	ME	SE
less than 50	0	32	101	0	0
50-60	5	32	75	0	5
60-70	38	124	79	3	20
70-80	53	86	26	6	54
80-90	62	18	12	42	60
90-100	137	3	2	244	156

Source: Research Findings

After calculating technical efficiency in terms of constant returns, variable returns, non-increasing returns to scale, and scale efficiency, the returns relative to scale for different farmers are computed, and the results are presented in Table 3.

Table 3 Return to Scale of Wheat Producers in Dihdadi District

RTS	Percentage
Decreasing Return to Scale (DRTS)	16.95
Constant Return to Scale (CRTS)	10.85
Increasing Return to Scale	72.2
Total	100.00

Source: Research Findings

The agriculture within the study area is predominantly subsistence-oriented and small-scale. The primary objective of the farmers is to reduce production costs, which the study results also confirm. It is observed that 72.2% of the farmers operate at increasing returns, 16.95% at decreasing returns, and only 10.85% at optimal scale (constant returns to scale). Therefore, increasing input usage and expanding production scale aligns with increasing the area's production level and farmers' income.

The economic rationale behind this decision is that in the case of increasing returns to scale relative to the scale, the proportion of output increases more than the increase in inputs. Assuming the prices of all production factors remain constant, this leads to movement along the average cost curve, and as the size and scale of production increase, unit production costs decrease. Specialization, division of labor, and technological factors enable producers to reduce unit costs by increasing production scale.

5. Conclusion

Given the results presented in the analysis of wheat producers' efficiency in the study area, it can be concluded that there is significant potential for improving efficiency and increasing production in this industry. In this regard, the average technical and allocative efficiency indicates that producers can achieve similar production levels by optimizing the use of input resources. This possibility enables them to reduce resource wastage and enhance production efficiency, thus improving output. Furthermore, substantial disparities among producers in terms of efficiency highlight the need for enhancements in management and resource allocation within individual units. In this context, improving management performance can aid producers in enhancing their efficiency by reducing input use and minimizing resource losses. Additionally, optimal resource allocation can contribute to increased profitability. In total, the elimination of inefficiencies in management and resource allocation can lead to an improvement of up to 3.6% in performance.

Regarding economic performance, the results indicate that production units require enhanced profitability, given the relatively low economic efficiency in the region. Improving production scale and optimal resource allocation can help increase profitability. Furthermore, significant variations in management performance and scale emphasize that units can improve their performance by enhancing these factors. Ultimately, the analysis of scale efficiency and efficiency relative to scale reveals that increasing production scale and optimizing resource allocation can lead to increased production and income for the region.

In light of these findings, it is recommended that wheat producers in the area undertake measures to enhance their efficiency and productivity. These measures may include improving management, optimizing resource allocation, and increasing production scale. These actions can contribute to achieving maximum production and profitability, benefiting both the region and the income of agricultural producers. It is also imperative for the government to adopt measures aimed at improving efficiency and productivity in the agricultural industry. These measures could encompass enhancing education and awareness among farmers regarding optimal resource management, allocation, and scale expansion. Additionally, the government can provide financial and economic incentives to motivate producers to enhance their economic and management performance. Encouraging the adoption of advanced agricultural technologies and high efficiency is also of paramount importance. These measures can assist in achieving the country's production and economic goals while improving the financial and economic conditions of farmers and the region as a whole.

Statements and Declarations:

Funding: There was no financial support received for the preparation of this manuscript.

Data Availability Statement: The datasets produced and/or analyzed during this study are available from the corresponding author upon a reasonable request.

Competing Interests: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

[1] Ahmadzai, H. (2017). Crop Diversification and Technical Efficiency in Afghanistan: Stochastic Frontier Analysis. CREDIT, 17(4).

[2] Ahmed, M. H., & Melesse, K. A. (2018). Impact of off-farm activities on technical efficiency: evidence from maize producers of eastern Ethiopia. Agricultural and Food Economics, 6(1), 3. https://doi.org/10.1186/s40100-018-0098-0

[3] Alemu, G., Angasu, B., & Sime, N. (2022). Economic Efficiency of Smallholder Farmers in Maize Production in West Harerghe Zone, Oromia National Regional State, Ethiopia. *Journal of World Economic Research, 11*(2), 98–104.

[4] ANDS. (2013). Afghanistan National Development Strategy.

[5] ASFAW, M., GETA, E., & MITIKU, F. (2019). ECONOMIC EFFICIENCY OF SMALLHOLDER FARMERS IN WHEAT PRODUCTION: THE CASE OF ABUNA GINDEBERET DISTRICT, WESTERN ETHIOPIA. Review of Agricultural and Applied Economics (RAAE), 1340-2019–782. https://doi.org/https://doi.org/10.22004/ag.econ.285931

[6] Aslam, M. S., Xue, P. H., Bashir, S., Alfakhri, Y., Nurunnabi, M., & Nguyen, V. C. (2021). Assessment of rice and wheat production efficiency based on data envelopment analysis. Environmental Science and Pollution Research, 28(29), 38522–38534. https://doi.org/10.1007/s11356-021-12892-z

[7] Babaei, M., Paknezhad, H. R., Mardani, M., & Salarpoor, M. (2013). Investigating the efficiency of crops in Jahrom city using interval data coverage analysis (IDEA). *Journal of Operations Research in Its Applications (Applied Mathematics) - Lahijan Azad University, 9*(4), 0–0. https://jamlu.liau.ac.ir/article-1-509-fa.html

[8] Bjurek, H., Hjalmarsson, L., & Forsund, F. R. (1990). Deterministic parametric and nonparametric estimation of efficiency in service production. *Journal of Econometrics, 46*(1–2), 213–227. https://doi.org/10.1016/0304-4076(90)90056-Y

[9] Coelli, T., & Fleming, E. (2004). Diversification economies and specialisation efficiencies in a mixed food and coffee smallholder farming system in Papua New Guinea. Agricultural Economics, 31(2–3), 229–239. https://doi.org/10.1111/j.1574-0862.2004.tb00260.x

[10] Coelli, T. J., Prasada Rao, D. J., Christopher, J. O., & George, B. (2005). An Introduction to Efficiency and Productivity Analysis. Springer-Verlag. https://doi.org/10.1007/b136381
[11] CSO. (2023). Settled Population of Balkh Province.
[12] Esfehani, S. J. (2022). Management of energy consumption and greenhouse gas emissions using optimal farm scale: Evidence from wheat production in South Khorasan province. Iran Agricultural Research, 40(2), 71–83. https://doi.org/10.22099/iar.2022.41569.1461
[13] FAO. (2017). The Future of Food and Agriculture. Trends and Challanges. FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS.
[14] FAO. (2023). Afghanistan: Humanitarian Response Plan 2023. https://doi.org/10.4060/cc6711en
[15] Farrell, M. J. (1957). The Measurement of Productive Efficiency. *Journal of the Royal Statistical Society: Series A (General*), 120(3), 253–281.
[16] FØRSUND, F. R., & SARAFOGLOU, N. (2002). On the Origins of Data Envelopment Analysis. *Journal of Productivity Analysis, 17*(1), 23–40.
[17] Haruna, E. O., Samuel, E. E., & Ibinayo, B. T. (2020). ECONOMIC AND SCALE EFFICIENCY OF BROILER PRODUCTION IN THE FEDERAL CAPITAL TERRITORY, ABUJA NIGERIA: A DATA ENVELOPMENT ANALYSIS APPROACH. *Russian Journal of Agricultural and Socio-Economic Sciences,* 103(7), 131–139. https://doi.org/10.18551/rjoas.2020-07.16
[18] Imam M, A. (2016). Measuring efficiency and productivity in Iran's natural gas refineries. Financial Economics, 9(30), 61–82.
[19] Imran, M., & Ozcatalbas, O. (2021). Optimization of energy consumption and its effect on the energy use efficiency and greenhouse gas emissions of wheat production in Turkey. Discover Sustainability, 2(1), 28. https://doi.org/10.1007/s43621-021-00035-w
[20] IPC. (2023). Afghanistan: Acute Food Insecurity Situation for April 2023 and Projection for May - October 2023.
[21] Jadhav, D., & Ramanathan, T. V. (2009). Parametric and non-parametric estimation of value-at-risk. The *Journal of Risk Model Validation, 3(*1), 51–71. https://doi.org/10.21314/JRMV.2009.034
[22] Kandpal, A., Kiran K, T. M., Sendhil, R., & Balaji, S. J. (2022). Technical Efficiency in Indian Wheat Production: Regional Trends and Way Forward. In New Horizons in Wheat and Barley Research (pp. 475–490). Springer Nature Singapore. https://doi.org/10.1007/978-981-16-4134-3_17
[23] Kyrgiakos, L. S., Kleftodimos, G., Vlontzos, G., & Pardalos, P. M. (2023). A systematic literature review of data envelopment analysis implementation in agriculture under the prism of sustainability. Operational Research, 23(1), 7. https://doi.org/10.1007/s12351-023-00741-5
[24] MAIL. (2019). National dry lands agriculture policy: Towards climate resilient agriculture in Afghanistan a 2030 vision. Ministry of Agriculture, Irrigation and Livestock (MAIL).
[25] Mehrgan, M. R. (2016). Data Envelopment Analysis, Quantitative Models in the Performance of Organizations (1st ed. 3). Universitry Books.
[26] Muleta, G., & Te, A. (2022). Technical, Allocative, and Economic Efficiency of Potato Producers in Central Oromia, Ethiopia. *International Journal of Business and Economics Research,* 11, 158–165. https://doi.org/10.11648/j.ijber.20221103.17
[27] Nawaz, M., Akhtar, Dr. S., Nazir, A., & Faisal, M. (2020). Technical Efficiency and Its Determinants in Wheat Production: Evidence from Punjab, Pakistan. *Journal of Economic Impact, 2*(1), 37–42. https://doi.org/10.52223/jei0201205
[28] Nwahia, O. C., Balogun, O. S., Balogun, O. L., Emeghara, U. U., Onwegbunam, N. E., & Bala, U. J. (2020). ANALYSIS OF TECHNICAL, ALLOCATIVE AND ECONOMIC EFFICIENCY OF RICE FARMERS IN EBONYI STATE, NIGERIA. *Russian Journal of Agricultural and Socio-Economic Sciences, 106*(10), 135–143. https://doi.org/10.18551/rjoas.2020-10.15
[29] OEC. (2023). Wheat in Afghanistan. The Observatory of Economic Complexity.
[30] R. L., M., & Mishra, A. K. (2022). Agricultural production efficiency of Indian states: Evidence from data envelopment analysis. *International Journal of Finance & Economics, 27*(4), 4244–4255. https://doi.org/10.1002/ijfe.2369
[31] Rahmani, Z., Safdary, A. J., & Rezaei, H. (2022). Estimating Agricultural Sustainability of Sholgara District Using the Analytical Hierarchy Process. *Journal of Humanities and Social Sciences Studies,* 4(4). https://doi.org/10.32996/jhsss.2022.4.4.38
[32] Rezaei, H., Shirani B A, F., Rezaee, A, Joolaie, R., & Abedi S, A. (2021). Assessing the Relationship between Food Insecurity and Agricultural Sustainability (Case Study: Rural areas of Gorgan County). Agricultural Economics, 15(1), 135–162. https://doi.org/10.22034/iaes.2021.529419.1842
[33] SALAM, A., & HAMEED, A. (2022). Technical Efficiency in Production of Major Food Grains in Punjab, Pakistan. Asian Development Review, 39(02), 201–222. https://doi.org/10.1142/S0116110522500160
[34] Shizgal, P. (2012). Scarce Means with Alternative Uses: Robbins' Definition of Economics and Its Extension to the Behavioral and Neurobiological Study of Animal Decision Making. Frontiers in Neuroscience, 6. https://doi.org/10.3389/fnins.2012.00020
[35] Sun, Y., Ajaz, T., & Razzaq, A. (2022). How infrastructure development and technical efficiency change caused resources consumption in BRICS countries: Analysis based on energy, transport, ICT, and financial infrastructure indices. Resources Policy, 79, 102942. https://doi.org/10.1016/j.resourpol.2022.102942
[36] Tavva, S., Aw-Hassan, A., Rizvi, J., & Saharawat, Y. S. (2017). Technical efficiency of wheat farmers and options for minimizing yield gaps in Afghanistan. Outlook on Agriculture, 46(1), 13–19. https://doi.org/10.1177/0030727016689632
[37] Yitayew, A., Abdulai, A., & Yigezu, Y. A. (2023). The effects of advisory services and technology channeling on farm yields and technical efficiency of wheat farmers in Ethiopia. Food Policy, 116, 102436. https://doi.org/10.1016/j.foodpol.2023.102436
[38] Zarrin, M., & Brunner, J. O. (2023). Analyzing the accuracy of variable returns to scale data envelopment analysis models. *European Journal of Operational Research, 308(*3), 1286–1301. https://doi.org/10.1016/j.ejor.2022.12.015
[39] Zhang, J. (2023). Evaluation of farmers' wheat production technical efficiency based on income increasing. Ciência Rural, 53(6). https://doi.org/10.1590/0103-8478cr20210828
[40] Zhou, W., & Xu, Z. (2020). An Overview of the Fuzzy Data Envelopment Analysis Research and Its Successful Applications. *International Journal of Fuzzy Systems, 22*(4), 1037–1055. https://doi.org/10.1007/s40815-020-00853-6