DOI: https://doi.org/10.59983/s2023010205
AgroEnvironmental Sustainability, 2023, 1(2), 122-132

RESEARCH

Assessment of Productivity, Profit, and Problems Associated with Wheat (*Triticum aestivum* L.) Production in West Nawalparasi, Nepal

Baishali Dawadi [1], Sudip Ghimire [1,*] and Nabin Gautam [1]

[1] Faculty of Agriculture, Agriculture and Forestry University, Bharatpur13712, Nepal
[*] Author responsible for correspondence; Email: ghimiresudip858@gmail.com.

ARTICLE HISTORY
Received: 10 July 2023
Revised: 10 September 2023
Accepted: 21 September 2023
Published: 26 September 2023

KEYWORDS
benefit-cost ratio
challenges
diseases
profitability
wheat

EDITOR
Pankaj Kumar

COPYRIGHT
© 2023 Author(s)
eISSN 2583-942X

LICENCE

This is an Open Access Article published under a Creative Commons Attribution-NonCommercial 4.0 International License

Abstract

Wheat (*Triticum aestivum* L.), a staple crop in Nepal, has a rich history of cultivation. Despite increasing demand due to population growth and agricultural development efforts, wheat production faces persistent challenges that hinder its expansion and profitability. This research, conducted from February to July 2022 in West Nawalpur district, Nepal, aims to assess the productivity, profitability, and economics, including benefit-cost analysis, of wheat in West Nawalparasi. A total of 100 wheat farmers were selected and the data obtained were analyzed using Microsoft Excel and Statistical Package for the Social Sciences (SPSS). The study reveals a positive gross margin (NRs 1113.09) and a benefit-cost ratio (BCR) of 1.6 per 0.3 hectare, indicating the profitability of wheat cultivation. Notably, most farmers procure agricultural inputs such as seeds and fertilizers from local agro-dealers within Nepal, highlighting a preference for domestic sources over imports from India. For irrigation, more than half of the population relies on pumps that draw from open water sources (59%) and use mechanization equipment such as tractors and combine harvesters for field activities. However, the study reveals the complexity of the challenges faced by wheat farmers. Chief among these are the unavailability of adequate irrigation facilities, untimely and inadequate access to agricultural inputs, disease and pest incidence, lack of training and extension services, and lack of mechanization and skilled labor. These constraints, as highlighted by the farmers, affect both productivity and profitability, highlighting the urgent need for initiatives to reduce production costs and improve wheat production in West Nawalparasi.

Citation: Dawadi, B., Ghimire, S., & Gautam, N. (2023). Assessment of Productivity, Profit, and Problems Associated with Wheat (*Triticum aestivum* L.) Production in West Nawalparasi, Nepal. *AgroEnvironmental Sustainability*, 1(2), 122-132. https://doi.org/10.59983/s2023010205

Statement of Sustainability: First, the study aligns with SDG 2 (Zero Hunger) by aiming to increase wheat productivity, which is critical for food security in Nepal. In addition, by emphasizing the preference for domestic agricultural inputs over imports from India, the study supports SDG 12 (Responsible Consumption and Production) by promoting sustainable and locally sourced agricultural practices. Furthermore, the study highlights the urgent need for initiatives to reduce production costs and increase wheat production, which directly addresses SDG 8 (Decent work and economic growth) and SDG 9 (Industry, innovation, and infrastructure).

1. Introduction

Agriculture is a cornerstone of Nepal's economic and social development and enjoys a position of paramount importance as prioritized by the government (Ghimire et al., 2023a; Chhetri and Ghimire, 2023). Among the diverse range of crops cultivated in Nepal, wheat emerges as the third most important, occupying a significant area both in terms of geographical coverage and production (Ghimire, Neupane, et al., 2023b). This emblematic crop, along with rice and maize, carries the weight of significant policy prioritization within the country's agricultural framework (Ghimire et al., 2023b). Wheat's economic contribution to the nation is underscored by its 7.14% share in Nepal's agricultural gross domestic product (AGDP) (Bhatta et al., 2020). Recent years have witnessed an upsurge in wheat production, driven by rising demand and the crop's inherent potential in terms of production and marketing (Ghimire et al., 2023b). However, Nepal's historical status as a net food exporter, particularly of rice and wheat, has undergone a troubling reversal in

recent years, largely due to declining food production (Pokharel et al., 2007). The geographic focus of this research, West Nawalparasi, is located in the Lumbini Province of Nepal. The region is predominantly agricultural, with rice-wheat cropping systems forming the backbone of the agricultural landscape. West Nawalparasi encompasses an impressive wheat-growing landscape, with 8,698 hectares of land devoted to wheat cultivation, yielding approximately 24,965 metric tons of wheat with a productivity rate of 2.87 metric tons per hectare (MoALD, 2022). However, Nepal faces the challenge of increasing wheat productivity to meet the increasing demands of its growing population. The existing demand-supply imbalance requires significant wheat imports from neighboring India. As explained by Bhatta et al. (2020), a confluence of factors, including labor shortages, poor seed and fertilizer quality, inefficient marketing practices, disease and pest infestations, and adherence to traditional farming practices, collectively inflate production costs while limiting productivity. At the same time, other factors such as lack of adequate irrigation facilities, storage facilities, limited mechanization, and low seasonal prices for farmers are major impediments to achieving higher production and profits from wheat production.

Wheat is an important source of income for farmers in western Nawalparasi. Despite the region's favorable climate and soil conditions, productivity is lower than the national average wheat yield of 2.99 tons per hectare (MoALD, 2022). A comprehensive and systematic study of the economics and production dynamics of wheat in West Nawalparasi remains conspicuously absent. This research endeavor seeks to fill this critical knowledge gap by shedding light on the intricacies of wheat production in the region. The objective of this study is to assess the productivity and profitability of wheat production in West Nawalparasi by examining the current status of wheat productivity, and farmer demographics, and evaluating the economics using benefit-cost analysis and other economic tools. This study is significant because it helps document the costs and benefits associated with wheat production, provides valuable market insights, and analyzes the pressing challenges associated with wheat production. It also helps to understand the nuances of wheat production and identify barriers to increased productivity and income for farmers. The findings of this research also serve as a clarion call to relevant agencies and policymakers, urging them to develop solutions to the challenges faced by wheat farmers and to initiate programs aimed at fostering a trend of commercial production that maximizes benefits for the farming community.

2. Materials and Method

2.1. Study Site

The study was conducted within the geographical boundaries of Ramgram Municipality, Sunwal Municipality, Pahalinandan Rural Municipality, and Sarahwal Rural Municipality, all located in West Nawalparasi district, from February 2022 to July 2022. These areas were strategically selected because they encompass the core region of the wheat zone, as shown in Figure 1.

2.2. Sampling and Data Collection

A purposive sampling approach was meticulously applied within the West Nawalparasi district, focusing exclusively on areas falling under the dominant wheat zone. Within these selected areas, a systematic and unbiased simple random sampling technique was used. The study sample consisted of a total of 100 participants, with 25 households selected from each of the study communities. Prior to the formal data collection process, an extensive pre-survey was carefully conducted. This pre-survey served as a valuable source for gathering demographic, socio-cultural, and relevant background information, which subsequently informed the development of the interview schedule and the creation of a structured sampling framework. The research adopted a mixed methods approach, drawing on both primary and secondary data sources. Primary data was carefully collected through direct interaction with farmers, using methods such as household surveys, focus group discussions (FGD), and key informant interviews (KII). Secondary data, on the other hand, was collected from various sources, including the Agricultural Knowledge Center (AKC), Prime Minister Agriculture Modernization Project (PMAMP) reports, newsletters, relevant articles, and the websites of respected national and international organizations (Ghimire and Kandel, 2023). During the FGD, wheat farmers were convened to discuss issues related to productivity, profitability, and challenges associated with wheat farming. A standardized checklist was used to systematically collect information from the targeted farmers and other relevant stakeholders (Ghimire and Chhetri, 2023; Ghimire and Gyawali, 2023). Informal discussions and brief interviews were also conducted with key informants, including model farmers, extension agents, and experienced wheat growers, to gain deeper insights into the local context and various aspects of wheat production. For this purpose, a special checklist tailored to the

specific needs of these interactions was used. The household questionnaire was carefully designed to include exploratory, descriptive, and analytical dimensions. This structured questionnaire was thoughtfully designed to collect essential household data while also capturing factual information related to wheat production.

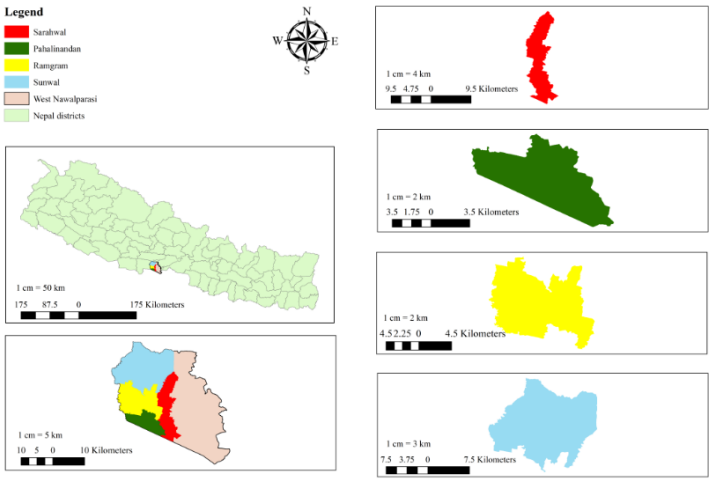

Figure 1. Map of West Nawalparasi district showing study area.

2.3. Data Analysis

All data collected from both primary and secondary sources underwent extensive processing, tabulation, and analysis. This analysis was conducted using industry-standard software, including Microsoft Excel (Microsoft Corp., Washington, USA), SPSS (IBM Statistics 28; New York, USA), and STATA (StataCorp Stata 15, Texas, USA). The dataset was rigorously examined using both descriptive statistics, such as mean and standard deviation, and analytical tools to derive meaningful insights.

2.3.1. Descriptive Statistics

Descriptive statistics were used to gain a comprehensive understanding of the demographic aspects of the study population. The demographic statistics used for analysis included basic measures such as mean and standard deviation.

2.3.2. Economic and Analytical Analyses

Gross margin serves as a simple and quick approach to assess the financial performance of an agricultural business (Acharya and Tiwari, 2021). It is the difference between the gross revenue and the costs incurred. Only variable costs were considered for gross margin analysis. Cost and gross return from production help to determine the economic aspects and profit/loss obtained from the business.

$$\text{Gross margin} = \text{Gross return} - \text{Total variable cost}$$

$$\text{Gross return} = \text{Price of wheat} \times \text{Total wheat production}$$

$$\text{Total variable cost} = \sum(\text{All variable cost})$$

$$\text{Variable cost} = C + H + T + Cf + Cp + Ic$$

Where, C= Cost of seed, H= Human labor, T= Tiller charges, Cf= Cost of farmyard manure and chemical fertilizers, Cp= Cost of pesticides, and Ic=Irrigation charges. The benefit-cost ratio (BCR) plays a central role as a financial compass that guides decision-makers through the complex terrain of project evaluation (Wijayanto et al., 2021). A BCR greater than 1 indicates a thriving production with economic potential, where the expected financial returns exceed the resources invested. Conversely, a BCR below 1 raises cautionary flags, akin to a grove plagued by neglect or disease (Chabba et al., 2022). It serves as a stark reminder that the costs of wheat production may exceed the expected returns, prompting a reassessment of farming practices or market strategies. The benefit-cost ratio was calculated using the cost of wheat production and the resulting gross return, according to the formula mentioned by Subedi and Timsina (2023) and Adhikari (2013).

$$\text{BCR} = \frac{\text{Gross return}}{\text{Total variable cost}}$$

2.3.3. Index for Importance of Production Problems

The analysis of farmers' perceptions regarding the importance attached to different production problems was carried out using a ten-point scale methodology. In this approach, the most important problem was assigned a rating of 5 points, gradually decreasing to 1 point for the least important problem (Figure 2). Respondents were given the opportunity to select whole numbers on the scale, excluding decimal values (Subedi et al., 2019). The composite index of importance was calculated using the formula provided by Subedi et al. (2019).

$$\text{Is} = \sum \frac{S_i f_i}{N}$$

Where, I_s = index $0 \angle I \angle 1$, S_i = i^{th} intensity scale value, f_i = i^{th} response frequency, and N = Overall number of interviewees.

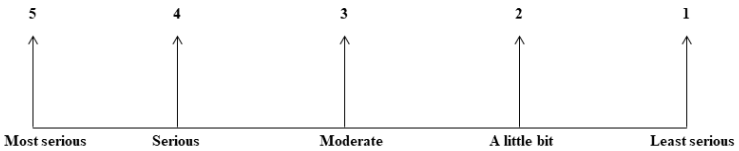

Figure 2. Rating of production problems by farmers on a 5-point scale: 5 (most serious) to 1 (least serious).

3. Results and Discussion

3.1. Socio-economic and Demographic Characteristics

3.1.1. Age of the Respondents

The age distribution of the respondents was categorized into four different groups: (i) less than 32 years (<32), (ii) 32-45 years, (iii) 46-60 years, and (iv) more than 60 years (>60). Notably, the results of the study revealed that the majority of respondents in the study area fell within the age group of 46-60 years, accounting for 33% of the sample (Table 1). This was closely followed by those aged >32-45 years, who accounted for 32% of the respondents, while those above 60 years accounted for 21%. A smaller proportion, 14%, were in the under-32 age group. The statistical analysis showed that the mean age of the respondents in the study area was 49 years, with a standard deviation of 12.715 years. In line with the research conducted by Poudel et al. (2021), the mean age of wheat growers in the Nawalparasi West district was found to be 41.58 years with a standard deviation of 7.56. The differences in age distribution between our study and the findings of Poudel et al. (2021) could be attributed to various factors. This study seems to focus on wheat growers, while Poudel et al. (2021) focused on a broader agricultural context. In addition, geographic variation and socioeconomic factors may also influence the age distribution of farmers. Differences in access to resources, land tenure systems, and economic opportunities in the study areas could lead to variations in the age of individuals engaged in farming. In addition, cultural and generational factors may play a role in determining who becomes involved in agriculture and at what age. It's also important to consider the time frame of the studies. If there have been changes in farming practices or demographics over time, this could contribute to differences in the age distribution observed in the studies.

2.1.2. Sex of Respondents

The respondent population in the study area was categorized by gender, distinguishing between males and females. The results of the study revealed that a slightly larger proportion, 68% of the respondents, were male while the remaining 32% were female (Table 1). In the context of wheat production in West Nawalparasi, there appears to be a gender disparity in favor of males, which is consistent with the findings reported by Poudel et al. (2021). According to their research, the male population in West Nawalparasi constituted 66% of the total population, which is consistent with the observations made in our study. This dominance of males in wheat production is further reflected in the lower participation of females, as the number of females engaged in wheat production was lower than the national average population distribution of 51.13% for females. Conversely, the proportion of males involved in wheat production exceeded the national male population average of 48.87% (National Statistics Office, 2023). The consistency in gender

distribution between the findings of Poudel et al. (2021) and our study suggests that this gender disparity in wheat production may be a feature specific to the West Nawalparasi region.

2.1.3. Family Size of Respondents

The average family size among the households surveyed was recorded as 6.33, with a standard deviation of 2.693. When disaggregated by gender, the average family size for males was 3.35, and for females was 3.00 (Table 1). In contrast, the average family size of wheat producers in West Nawalparasi as documented by Poudel et al. (2021) was significantly higher at 11 members. This observation suggests a substantial family size among wheat-producing households in the region, which may have implications for various aspects of agricultural practices and livelihoods. The difference in average family size between our research and the study by Poudel et al. (2021) is likely influenced by the temporal aspect. Time can be an important factor in demographic shifts, societal changes, and economic dynamics, all of which can affect family size. Over the course of just a few years, social and economic conditions can evolve, potentially leading to variations in family size within a given region.

2.1.4. Ethnicity and religion of the respondents

In this study, the respondents were carefully categorized into five different ethnic groups: Tharu/Chaudhari, Brahmin/Chhetri, Janajati, Dalit, and others, as shown in Table 1. A comprehensive examination of the distribution revealed that the largest ethnic cohort within the respondent pool was the Tharu/Chaudhari group, constituting an impressive 54% of the participants. This was closely followed by the Brahmin/Chhetri ethnicity at 17%, Dalits at 16%, Janajati at 7%, and the category labeled "other" at 7%. In addition to ethnic categorization, the respondents in the study were further categorized into three different religious groups: Hindu, Buddhist, and Islam, as shown in Table 1. Upon analysis, it was found that the predominant religious affiliation among the respondents was Hinduism, which accounted for a substantial 86% of the sampled population. Conversely, Islam accounted for 8% of the respondents, while Buddhism was practiced by 6% of the study participants. These broad categorizations provide valuable insights into the diversity of the study population and lay the groundwork for further analysis of socio-cultural factors within the research context. Interestingly, when compared to the findings of Ghimire and Kandel (2023), there are notable contrasts in ethnic composition, with Brahmin/Chhetri being the dominant ethnic group at 61%, Janajati at 13%, and Dalit at 6% in Surkhet. These differences underscore the importance of considering regional and contextual variations in ethnic and religious demographics in research studies.

2.1.5. Education Status of Respondents

In this study, the respondents were classified into seven different educational categories: illiterate, informal education, primary, secondary, SLC graduates, Isc/+2, and Bachelor and above (Ghimire and Chhetri, 2023). The analysis revealed that the largest group consisted of SLC graduates, representing 21% of the respondents. This was closely followed by individuals with some form of informal education, which accounted for 20%. Other educational categories included the completely illiterate (16%), primary (14%), secondary (14%), ISC/+2 (11%), and bachelor and above (4%). Compared to the findings of Ghimire and Kandel (2023) in Surkhet, the study site showed a higher literacy rate. In Surkhet, Ghimire and Kandel (2023) reported that a significant proportion of the respondents were illiterate, accounting for 56.25% of the surveyed population, while the literate population accounted for 43.75%. In the study site, the proportion of literate individuals was significantly higher at 84%, exceeding the national literacy rate of 76.2% reported in the 2021 census (National Statistics Office, 2023). However, when looking at a more specific level of education, national data indicated that a larger percentage of the literate population had completed primary education, at 28.7% (National Statistics Office, 2023). This contrast suggests that while the study site has a higher overall literacy rate, the national average places a greater emphasis on completing primary education among its literate population. This observation underscores the importance of examining not only overall literacy rates but also educational attainment levels within a population for a more comprehensive understanding of educational disparities.

2.1.6. Cropping Pattern of Respondent

The cropping patterns of the respondents were classified into four categories: rice-wheat, rice-wheat-mustard, rice-wheat-legume, and rice-wheat-other crops. The analysis revealed that the largest proportion of respondents adopted the rice-wheat pattern, accounting for 41% of the sample (Figure 3a). This was closely followed by the rice-wheat-mustard pattern at 40%, with the rice-wheat-legume and rice-wheat-other crop patterns accounting for 11% and 8%,

respectively. These findings provide valuable insights into the prevailing crop preferences in the study area and shed light on the predominant farming strategies of the surveyed population.

Table 1. Socioeconomic and demographic characteristics of the respondents.

Variables	Number of Respondents
Age of the respondents	
Less than 32 (<32)	14 (14%)
32-45	32 (32%)
46-60	33 (33%)
More than 60 (>60)	(21%)
Sex of the respondents	
Male	68 (68%)
Female	32 (32%)
Family size of the respondents	
Average family size	6.33
Maximum	16
Minimum	2
Ethnicity of the respondents	
Tharu/Chaudhari	53
Brahmin/Chettri	17
Dalit	16
Janjati	7
Others	7
Religion of the respondents	
Hindu	86
Islam	8
Buddhism	6
Education level of the respondents	
Illiterate	16
Informal education	20
Primary level	14
Secondary level	14
SLC	21
ISC/+2	11
Bachelor and above	4

3.1.7. Involvement in Co-operative by Respondent

The respondent population in the study area was categorized based on their involvement in cooperatives, distinguishing between those who were involved in cooperatives and those who were not involved. The results of the study showed that the vast majority, 72% of the respondents, were actively involved in cooperatives, while the remaining 28% were not affiliated with any cooperative (Figure 3b).

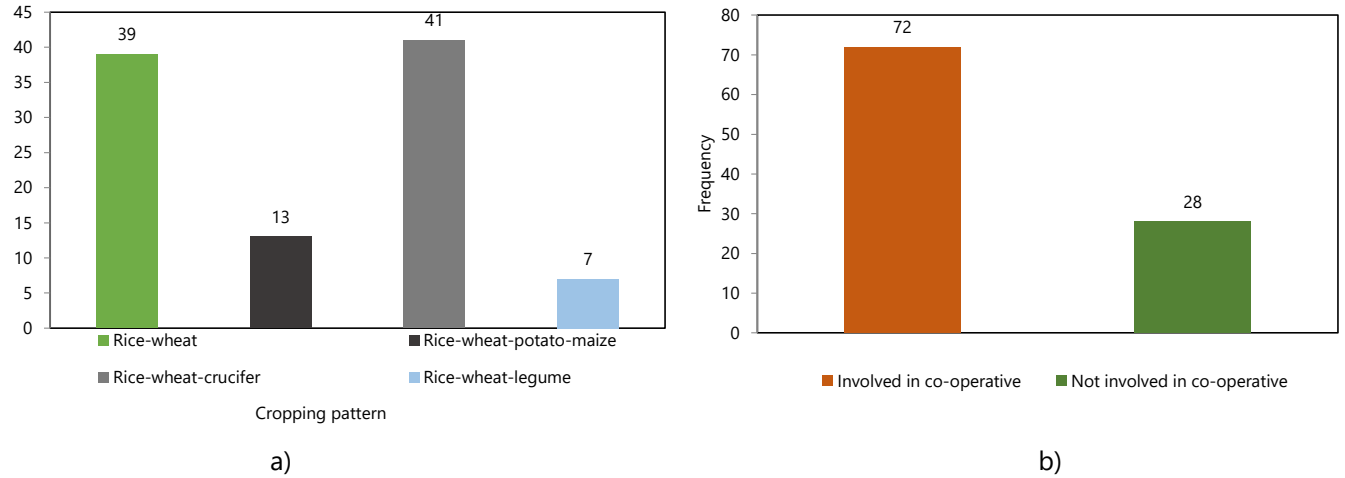

Figure 3 a) Major cropping pattern of respondents. b) Involvement in co-operatives by the respondents.

3.2 Economics of Wheat Production

3.2.1 Cost of Production of Wheat

Successful wheat production requires a combination of input and careful management. Key cost components in wheat production include field preparation, improved seeds, chemical fertilizers, pesticides, manure, labor, intercropping, irrigation, harvesting, threshing, and marketing. Together, these costs make up total variable costs, a key determinant of production profitability and input efficiency for farmers. In the study area, chemical fertilizers emerged as a significant contributor to variable costs, calculated on a per 0.03-hectare basis. In particular, the cost of diammonium phosphate (DAP) exceeded that of urea and muriate of potash (MOP). In addition, various organic fertilizers and crop protection products also accounted for some of the variable costs. Human labor, measured in man-days, was another major component. It was essential for several critical operations, including nursery bed preparation, land preparation, fertilizer and pesticide application, irrigation, weeding, harvesting, marketing, and storage. Harvesting and threshing activities accounted for a significant proportion of variable costs, while other intercultural operations contributed relatively less.

Table 2. The average cost of wheat production per 0.03 hectare.

Materials	Average Cost (in NRs)
Seed cost	217.92
Land preparation cost	157.06
Marketing and storage cost	98.5
Labor cost	225.17
FYM/organic manure cost	102.5
Chemical fertilizer (Urea, MOP, and DAP)	395.45
Micronutrient cost	54.46
Plant protection measure cost	67.64
Irrigation cost	159.37
Harvesting and threshing cost	274.15
Other variable cost	93.80
Total Variable cost	1846.05

The study revealed that the total variable cost of wheat production on a 0.03-hectare plot was NRs. 1846.05. Furthermore, the average cost of seed was estimated to be NRs. 217.92, while the cost of manure and fertilizer was NRs. 102.5 and NRs. 395.45 respectively. Similarly, the average cost of labor was NRs. 225.17, while the cost of pesticides and micronutrients was estimated at NRs. 67.64 and NRs. 54.46, respectively. Contrary to the findings reported by Kharel et al. (2021), where labor costs accounted for the highest proportion of total production costs for wheat, our study identified chemical fertilizer costs as the major contributor to production costs. Notably, chemical fertilizers emerged as the major cost contributor to wheat production. More details on the average cost of wheat production are presented in Table 2.

3.2.2. Item-wise Cost of Production

Within the cost structure of production, chemical fertilizers accounted for the largest share of 21.42% of the total production cost, followed by the combined cost of threshing and harvesting at 14.8%. Labor costs accounted for 12.2% of the total cost, while seed costs and irrigation costs accounted for 11.8% and 8.63%, respectively (Table 3). A similar result was reported by Ghimire et al. (2013) in wheat, the research findings indicated that chemical fertilizer constituted a significant proportion, accounting for 23% of the major cost items in wheat production. Land preparation costs accounted for 8.5% of the total costs. On the other hand, farmyard manure (organic manure) and marketing and storage costs were relatively lower at 5.55% and 5.34%, respectively. Similarly, the total cost of plant protection measures was 3.66%, while the cost of micronutrients was 2.95%, suggesting limited use in wheat production.

Table 3. Item-wise cost of production of wheat.

Location	Seed Cost	Land Preparation	Marketing and Storage Cost	Labor Cost	Organic Manure	Chemical Fertilizer	Micronutrient Cost	Plant Protection Measure	Irrigation Cost	Threshing and Harvesting	Other Cost
West Nawalparasi	11.8%	8.5%	5.34%	12.2%	5.55%	21.42%	2.95%	3.66%	8.63%	14.8%	5.08%

3.2.3. Benefit-cost Ratio

Total variable costs, which include various expenses related to inputs and operations, averaged NRs 1846.05. On the production side, the average yield of wheat grain was calculated to be 99.3 kg per 0.3 ha, with each kg of wheat grain fetching an average price of NRs 29.8. As a result, the total return on this wheat crop was NRs 2959.14. The gross margin, a crucial indicator of profitability, was found to be NRs 1113.09 (Table 4). Furthermore, the benefit-cost ratio, which measures the efficiency and profitability of the enterprise, was calculated to be 1.6. According to Gaire et al. (2017), the estimated BCR for wheat production is about 1.2 under irrigated conditions and 1.3 under rainfed conditions. In a study conducted by Bist et al. (2017), the reported BCR for wheat production in Kanchanpur district was found to be 1.79. Similarly, Dhital (2017) reported an overall BCR of 1.22 for wheat production in Nepal. In the Rupendahi region, Kharel et al. (2021) found a significantly higher BCR of 1.87, indicating a favorable economic outlook for wheat production in this particular area. This comprehensive analysis provides valuable insights into the economic viability of wheat cultivation in the study area, providing a clear picture of the costs and returns associated with this agricultural enterprise.

Table 4. Economic indicator for wheat production

Measuring Criteria	Average Value
Total variable cost (NRs/0.3 hectares)	1846.05
Mean production of grain (kg/0.3 hectare)	99.30
Average price of grain (NRs/Kg)	29.80
Total return (per 0.3 hectare)	2959.14
Gross margin (NRs)	1113.09
Benefit-cost ratio	1.60

3.3. Agricultural Inputs Used by Farmers for Production

Quality seed, fertilizer, and irrigation are prerequisites for wheat production (Ghimire et al., 2023b). In addition, mechanization training and support are other inputs essential for improving productivity. Thus, important information on such agricultural inputs was briefly discussed among the respondents.

3.3.1. Seed Used by Respondents

The study found that respondents had multiple sources of seed for cultivation, with options including agro-vet stores, government institutions, home-saved seeds, and imports from India. The data showed that the majority of respondents obtained their seeds from agro-vet stores, which accounted for 32% of the respondents. This was followed by those who procured seeds from government institutions, which accounted for 17% and individuals who procured seeds from India, which accounted for 16% of the sample (Figure S1a). In addition, some respondents opted for a combination of sources, with 14% using seeds from both agro-vet stores and home storage, 8% using seeds from both agro-vet stores and India, and smaller proportions relying solely on home stored seeds (7%), a combination of agro-vet stores and government institutions (3%), and a combination of government institutions and India (3%). This diverse sourcing pattern highlights the multiple channels through which farmers secure seeds for their cultivation needs.

3.3.2. Fertilizer Used by Respondents

In this study, the sources of fertilizer procurement were divided into two main categories: procuring fertilizer within Nepal or procuring it from India. The results showed that the majority of respondents, 82% of the sample, either purchased fertilizer within Nepal or received assistance to purchase fertilizer within Nepal. In contrast, a smaller proportion, 18% of the respondents, chose to purchase their fertilizer from India (Figure S1b). This distribution highlights the prevailing trend of sourcing fertilizer domestically, with a notable minority choosing to import it from India.

3.3.3. Irrigation Facilities Used by Respondents

The study identified four categories of irrigation facilities available to farmers: no facility (relying solely on rainwater), shallow tube wells, pump sets, and others. Among these categories, most farmers, 59% of the respondents, relied on pump sets for irrigation (Figure S2a). In contrast, 23% had no dedicated irrigation facility and relied solely on rainwater, while 15% used shallow tube wells. A smaller proportion, 3% of respondents, fell into the "other" category for irrigation facilities. These findings underscore the prevalence of pumping as the primary irrigation method among the farmers surveyed and underscore the importance of mechanized irrigation in the region.

3.3.4. Mechanization Device Used by Respondent

The study classified the mechanization equipment available to respondents into four distinct categories. The majority of respondents, 58% of the sample, used both tractors and combines. On the other hand, 17% of the respondents did not use any mechanization equipment and relied on traditional methods (Figure S2b). A smaller proportion, 16%, used tractors only, while 9% of respondents used a full range of mechanization equipment, including tractors, combines, and super seeds. These results illustrate the varying degrees of mechanization adopted by farmers in the study area, with a significant percentage using the capabilities of tractors and combining them to streamline their farming operations.

3.3.5. Training and Assistance Available to Farmers

The study divided the training and assistance provided to respondents into two distinct categories: those who had received such assistance and those who had not. The results showed that the vast majority, 67% of respondents, had not received training and assistance. In contrast, 33% of respondents had received training and assistance (Figure S3). This distribution underscores the prevalence of farmers who have not had access to these resources and may highlight areas for potential improvement in agricultural support and education programs.

3.4. Problem in Wheat Production to Farmers and SWOT Analysis

An indexing/scaling technique, as outlined in the methodology, was used as an analytical tool to assess the production constraints faced by wheat farmers in the study area. The research findings revealed that among the various production challenges, the most serious problem faced by the farmers was the unavailability of adequate irrigation facilities. This was closely followed by issues such as inadequate availability of fertilizer, pest and disease incidence, lack of support and training facilities, and lack of mechanization and skilled labor, in that order. In addition to identifying these challenges, farmers also proactively suggested various solutions to address the problems they encountered, as summarized in Table 5. These findings provide valuable information for policymakers and stakeholders in devising strategies to mitigate production constraints and enhance the agricultural landscape in the study area. It is interesting to note the contrasting findings reported by Ghimire and Kandel (2023) and Poudel et al. (2021) on the major challenges to agricultural production in Surkhet and West Nawalparasi, respectively. The studies of Ghimire and Kandel (2023) and Ghimire and Gyawali (2023) suggest that disease and pest problems take precedence in the context of potato and maize cultivation, while the study of Poudel et al. (2021) highlights the importance of various factors in wheat production. According to the latter, the most important problem in wheat production is the lack of agricultural machinery, with a significant index value of 0.86. Close behind was the lack of adequate irrigation, with an index value of 0.85. These differences highlight the multifaceted nature of agricultural challenges and underscore the importance of considering crop-specific factors and regional variations when addressing and mitigating production problems in agriculture. Wheat production in the study site has strengths, weaknesses, opportunities, and threats as given in Table 6.

4. Conclusion

Wheat production is still plagued by problems that limit farmers' profitability and thus hinder its sustainable and extensive growth. The results showed that the study regions indeed have a favorable potential for wheat production, supported by positive gross margins (NRs 1113.09) and a BCR above one. This indicates the profitability and financial viability of wheat cultivation in the study area, confirming it as a sound investment. However, it is important to acknowledge that wheat growers face several challenges in the production process. Some of the most pressing problems identified include lack of adequate irrigation facilities, inadequate access to fertilizer, pest and disease incidence, lack of support and training facilities, and lack of mechanization and skilled labor. These constraints have a direct impact on productivity and profitability. Addressing these challenges and further improving wheat production in the study area depends on reducing production costs and finding effective solutions to the problems faced by farmers. It is imperative to prioritize initiatives that promote cost-effective agricultural practices, ensure timely and sufficient supply of agricultural inputs, and provide comprehensive extension services, training, and technical assistance to empower farmers. By addressing these issues, we can potentially unlock even greater potential for increased wheat productivity and profitability in the study area and contribute to the overall prosperity of the agricultural sector. Further research should be undertaken to explore the production and economic disparities between command and non-command wheat production areas and to analyze the input supply chain for wheat production.

Table 5. The problems in wheat production along with suggested solutions by respondents

Problems	Index	Rank	Suggested solutions by farmers
Unavailability of proper irrigation facility	0.862	I	Availability of boring facility
Inadequate availability of fertilizer	0.84	II	Timely and adequate supply of fertilizer through the proper distribution system
Disease- pest incidence	0.614	III	Extension service with sprayer-insecticide distribution
Lack of assistance and training facility	0.372	IV	Training in local Language/area and special financial assistance to farmers
Lack of mechanization and skilled manpower	0.31	V	Distribution of mechanical machinery with subsidy

Table 6. SWOT analysis for wheat production in the study area.

Strength	Weakness
• Utilization of own local resources like FYM and seed • Use of indigenous technology and knowledge • Favorable climatic condition • The increasing number of agro-vets in wheat-producing areas • Local finance savings and co-operative	• Dependency on India for basic agricultural input • Quality inputs are not available in time and are too expensive • Lack of proper irrigation and technical facilities • Lack of collection center and processing unit along with storage infrastructure • PMAMP activities limited to smaller areas within the commanding region
Opportunities	**Threats**
• Big hotel, resort, and market in nearby district • Farmers united in groups to enhance production and marketing • Increasing demand for wheat • More availability of modern pre- and post-handling technologies	• Supply of 'cheaper wheat' from India • Fluctuation in the market price of input and overall produce • Disease and pest incidence • Lack of interest of youths in agriculture • Damage in wheat production due to heavy rainfall and other climatic hazard

Author Contributions: Conceptualization, Baishali Dawadi, Sudip Ghimire; Data curation, Baishali Dawadi, Sudip Ghimire; Funding acquisition, Baishali Dawadi; Investigation, Baishali Dawadi, Sudip Ghimire, Nabin Gautam; Methodology, Sudip Ghimire, Baishali Dawadi; Resources: Sudip Ghimire, Baishali Dawadi, Nabin Gautam; Software, Sudip Ghimire, Baishali Dawadi; Supervision, Sudip Ghimire, Baishali Dawadin, Nabin Gautam; Visualization, Sudip Ghimire, Baishali Dawadi, Nabin Gautam; Writing – original draft, Sudip Ghimire, Baishali Dawadi; Writing – review & editing, Sudip Ghimire. All authors have read and agreed to the published version of the manuscript.

Funding: Not applicable.

Acknowledgment: The authors are thankful to the Agriculture and Forestry University, Chitwan, Nepal, Prime Minister Agriculture Modernization Project, Project Implementation Unit, Rupandehi, Assistant Professor Pankaj Raj Dhital, Mr. Narayan Kafle, Mr. Suman Khanal, Mr. Ran Bahadur Mahato, Mr. Jeevan Dumre and Ms. Anjani Chaudhari for the continuous support during the research work.

Conflicts of Interest: The authors declare no conflict of interest.

Institutional/Ethical Approval: Not applicable.

Data/Supplementary Information Availability: Supplementary information for this research article is available online and can be downloaded from: https://doi.org/10.59983/s2023010205.

References

Acharya, R., & Tiwari, U. (2021). Economic analysis of mushroom enterprise in Chitwan district, Nepal. *Archives of Agriculture and Environmental Science*, 6(4), 408–415. https://doi.org/10.26832/24566632.2021.060401

Adhikari, R. K. (2013). Economics Of Organic Rice Production. *Journal of Agriculture and Environment*, 12, 97–103. https://doi.org/10.3126/aej.v12i0.7569

Bhatta, R. D., Amgain, L. P., Subedi, R., & Kandel, B. P. (2020). Assessment of productivity and profitabilty of wheat using Nutrient Expert®-Wheat model in Jhapa district of Nepal. *Heliyon*, 6(6), e04144. https://doi.org/10.1016/j.heliyon.2020.e04144

Bist, V., Acharya, N., Adhikari, S., & Dhungana, S. (2017). Resource productivity analysis of wheat production in Kanchanpur district, Nepal. *Journal of Pharmacognosy and Phytochemistry*, 6(6), 210–212.

Chabba, M., Bhat, M. G., & Sarmiento, J. P. (2022). Risk-based benefit-cost analysis of ecosystem-based disaster risk reduction with considerations of co-benefits, equity, and sustainability. *Ecological Economics*, 198, 107462. https://doi.org/10.1016/j.ecolecon.2022.107462

Chhetri, B. P., & Ghimire, S. (2023). Post-harvest Treatment of Different Concentrations of Gibberellic Acid onthe Physiochemical Characteristics and Shelf Life of Mango (*Mangifera indica* L. cv. Malda). *Proceeding of 2nd International Conference on Horticulture*, 14, 252–261.

Dhital, B. (2017). Economy of production and labor requirement in major field crops of Kavre, Nepal. *International Journal of Environment, Agriculture and Biotechnology*, 2(1), 350–353.

Gaire, S., Karki, T. B., Upadhyay, N., & Sapkota, S. (2017). Trend analysis of wheat area, production and productivity in Nepal: An overview. In: Proceedings of 30th National Winter Crops Workshop, Volume 15, pp. 495–502.

Ghimire, S., & Chhetri, B. P. (2023). Menace of Tomato Leaf Miner (*Tuta absoluta* [Meyrick,1917]): Its Impacts and Control Measures by Nepalese Farmers. *AgroEnvironmental Sustainability*, 1(1), 37–47. https://doi.org/10.59983/s2023010106

Ghimire, S., & Gyawali, L. (2023). Production Economics of Maize (*Zea mays*) in Surkhet, Nepal. *Food and Agri Economics Review*, 3(1), 22–27. https://doi.org/10.26480/faer.01.2023.22.27

Ghimire, S., & Kandel, D. (2023). Production Dynamics of Potato (*Solanum tuberosum* L.) in Surkhet District, Nepal. *Acta Scientific Agriculture*, 7(9), 22–30.

Ghimire, S., Dhami, D., Shrestha, A., Budhathoki, J., Maharjan, M., Kandel, S., & Poudel Chhetri, B. (2023a). Effectiveness of different combinations of urea and vermicompost on yield of bitter gourd (*Momordica charantia*). *Heliyon*, 9(8), e18663. https://doi.org/10.1016/j.heliyon.2023.e18663

Ghimire, S., Dhungana, S. M., Krishna, V., Teufel, N., & Sherchan, D. P. (2013). Biophysical and socio-economic characterization of cereal production systems of Central Nepal. CIMMYT, pp. 55. Available online: http://hdl.handle.net/10883/1375 (accessed on 20 June 2023).

Ghimire, S., Neupane, S., & Tharu, R. K. (2023b). Comparative Study on the Seed Health of Five Commonly Cultivated Wheat Varieties (*Triticum aestivum* L.) in Nepal. *AgroEnvironmental Sustainability*, 1(1), 3–11. https://doi.org/10.59983/s2023010102

Kharel, M., Ghimire, Y. N., Timsina, K. P., Adhikari, S. P., Subedi, S., & Poudel, H. K. (2021). Economics of production and marketing of wheat in Rupandehi district of Nepal. *Journal of Agriculture and Natural Resources*, 4(2), 238–245. https://doi.org/10.3126/janr.v4i2.33844

MoALD (2022). Statistical Information on Nepalese Agriculture, 2021/22. Government of Nepal, Ministry of Agriculture and Livestock Development, Planning & Development Cooperation Coordination Division, Statistics and Analysis Section. pp. 274.

National Statistics Office (2023). National Population and Housing Census 2021 (National Report) (p. 614). Government of Nepal, Office of the Prime Minister and Council of Ministers, Nepal Statistics Office.

Pokharel, R. R., Abawi, G. S., Zhang, N., Duxbury, J. M., & Smart, C. D. (2007). Characterization of isolates of meloidogyne from rice-wheat production fields in Nepal. *Journal of Nematology*, 39(3), 221–230.

Poudel, D., Yadav, R. K., Gauli, B., Chhetri, A., & Poudel, S. (2021). Assessment of adoption of improved wheat production technology in Nawalparasi (West) district, Nepal. *International Journal of Agricultural and Applied Sciences*, 2(2), 69–74. https://doi.org/10.52804/ijaas2021.2211

Subedi, S., & Timsina, K. P. (2023). Financial Feasibility and Prospects of Commercial Acid Lime Farming in Nepal. *International Journal of Social Sciences and Management*, 10(1), 10–15. https://doi.org/10.3126/ijssm.v10i1.51977

Subedi, S., Ghimire, Y. N., Gautam, S., Poudel, H. K., & Shrestha, J. (2019). Economics of potato (*Solanum tuberosum* L.) production in terai region of Nepal. *Archives of Agriculture and Environmental Science*, 4(1), 57–62.

Wijayanto, D., Bambang, A. N., Nugroho, R. A., Kurohman, F., & Nursanto, D. B. (2021). Effect of salinity on growth and benefit-cost ratio of Asian seabass reared in artificial media. *Aquaculture, Aquarium, Conservation & Legislation-International Journal of the Bioflux Society*, 14(5), 3000-3005.

Publisher's note/Disclaimer: Regarding jurisdictional assertions in published maps and institutional affiliations, SAGENS maintains its neutral position. All publications' statements, opinions, and information are the sole responsibility of their respective author(s) and contributor(s), not SAGENS or the editor(s). SAGENS and/or the editor(s) expressly disclaim liability for any harm to persons or property caused by the use of any ideas, methodologies, suggestions, or products described in the content.