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RESEARCH PAPER

An assessment of factors affecting productivity and production limitations of wheat farming in Kanchanpur district of Nepal

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Abstract

Despite possessing considerable prospective for wheat cultivation, productivity in Kanchanpur remains lower compared to that of neighbouring districts like Kailali, Banke, Kapilbastu, and Rupendehi which share similar meteorological conditions. The primary objective of this study is to investigate the influential variables affecting wheat production and to determine the associated challenges inherent in wheat cultivation within the area of the Kanchanpur district. Given the substantial prospects for wheat farming in this geographic region, the Kanchanpur district was purposively selected, and research was conducted during March and April of 2022. Through a simple random sampling technique, one hundred households of wheat farmers were systematically chosen. Primary data were collected through the utilization of pre-tested semi-structured questionnaires administered via face-to-face interviews, while secondary data were sourced from pertinent journals. The factors influencing wheat production were determined through the application of a multiple regression model. The findings of this research underscore that variables such as the quantity of applied NPK (Nitrogen, Phosphorus, and Potassium), the educational level of the household head, the extent of wheat-cultivated land with irrigation facilities, and the farmers' years of experience in the field exerted a significant positive influence on wheat production in the study area. To identify the major constraints in wheat production, an indexing method was applied. The research identifies the unavailability of chemical fertilizer during critical growth periods, challenges arising from damage caused by wild animals and stray cattle, the lack of access to improved seeds and irrigation, susceptibility to diseases and pests, and inadequate market access as a major constraint affecting wheat production in the research area.

Keywords

Indexing, Multiple regression model, Wheat productivity, Simple Random Sampling

Introduction

In Nepal, Wheat is the third most important crop with 716,978 hectares under cultivation. In addition to being a significant winter cereal crop in Nepal, more than 80% of wheat is farmed in a rice-wheat cropping pattern (Kandel et al. 2018). The wheat production and productivity are reported as 2,144,568 metric tons and 2.99 metric tons per hectare, respectively. Within the Sudurpashchim province, the total area dedicated to wheat production is 146,814 hectares, yielding a productivity rate of 2.56 metric tons per hectare. Notably, Kanchanpur district emerges as a major area for wheat cultivation, encompassing an area of 31,355 hectares, and exhibiting a productivity of 3.25 metric tons per hectare (Ministry of Agricultural and Livestock Development 2023).

One of the oldest and most extensively grown food crops in the world, wheat (*Triticum aestivum*) was domesticated around 10,000 years ago in the Fertile Crescent of the Near

East. It was domesticated about the same time as rice and a little earlier than maize (Awika 2011). It continues to be the most important food grain source for mankind and is being cultivated on more land area than any other commercial crops (Curtis 2002). On a global scale, wheat commands approximately 217 million hectares, establishing itself as the crop with the highest acreage among all cultivated crops, and achieves an annual production encompassing approximately 765 million metric tons (USDA 2018). During the 2022–2023 marketing year, more than 781 million metric tons of wheat were produced worldwide (Shahbandeh 2023). Because of the high demand for its derivatives in the food production process, wheat is the second most produced and consumed cereal in the world and has a major impact on the global agricultural economy (FAO 2020).

As of right now, the Nepali government has suggested 19 distinct enhanced wheat cultivars for various ecological zones (FAO 2020). Out of the recognized types, ten are suggested for Nepal's Terai region. NL971, WK1204, Aditya, Vijay, Gautam, and Bhrikuti are the most widely used wheat types in the nation (AICC Krishi diary 2023).

Kanchanpur district, situated in the western Terai region of Nepal, stands as a prominent contributor to wheat production in the country. Given the substantial involvement of the local populace in wheat cultivation, it serves as a primary occupation for the residents. The wheat yield in Nepal is reported as 2.99 metric tons per hectare, while the Sudurpashchim province records a productivity of 2.56 metric tons per hectare. Notably, Kanchanpur district outpaces the national and provincial averages with a wheat productivity of 3.25 metric tons per hectare. However, juxtaposed against neighboring districts with comparable environmental conditions, such as Kailali (3.58 Mt ha^{-1}), Banke (3.36 Mt ha^{-1}), Kapilbastu (3.73 Mt ha^{-1}), and Rupendehi (3.95 Mt ha^{-1}) (Ministry of Agricultural and Livestock Development 2023),the wheat productivity in Kanchanpur appears comparatively lower.

Despite surpassing national and provincial averages, the wheat productivity in Kanchanpur is discerned to be lower than in several neighboring districts with similar climatic, environmental, and ecological variables. Numerous issues have impeded wheat production in the Kanchanpur district of Nepal, and this study aids in identifying these issues as well as other aspects related to wheat production in the study area.

Materials and methods

Study area and sample size

The study was carried out in the Kanchanpur district of Nepal, situated at 28°12'N, 82°10'E, characterized by a climatic environment conducive to wheat production. Within the Kanchanpur district, the Bhimdatta municipality, Bedkot municipality, and Dodhara Chandani municipality were deliberately selected, given their substantial involvement in wheat farming and their classification within the PMAMP wheat zone Kanchanpur. The study involved the random selection of one hundred wheat farmers through a simple random sampling method from the total wheat growers within the PMAMP region. Face-to-face interviews were conducted with the selected farmers' households utilizing meticulously prepared and pre-tested semi-structured questionnaires. The research was performed during the months of March and April in the year 2022.

Farmers categorization

According to an analysis of the minimum, maximum, and average standard deviation of land holdings within sampled farmers' households, a classification into three distinct groups was undertaken. Specifically, households with land holdings ranging from the minimum to the mean standard deviation were classified as small household farmers. Similarly, households with land holdings ranging from the mean minus standard deviation to the mean plus standard deviation were categorized as medium farmer households. Lastly, households with land holdings ranging from the mean plus standard deviation to the maximum range were classified as large farmer households. The findings indicated that among the 100 farmers included in the study, 37 were identified as belonging to the small farmers group, 41 fell within the medium farmers group, and 22 were categorized as large farmers. The average land holdings of these respective groups were calculated as 10.20 kattha for small farmers, 17.39 kattha for medium farmers, and 41.9 kattha for large farmers.

Data analysis

The data acquired through face-to-face interviews was tabulated using MS-Excel v2019 and subsequently imported into Python 3.8 for subsequent analysis. Descriptive analysis was undertaken, specifically categorizing farmers into small holders, medium holders, and large holders. The comparison of continuous variables was executed through one-way analysis of variance (ANOVA), while the comparison of categorical variables was conducted using a contingency chi-square test, all with respect to different farmer categories.

Factors affecting wheat production

The factors influencing wheat production were examined through the utilization of a multiple regression model, following the framework proposed by Thompson (1978).

$$\text{Ln}\,(Y_{production}) = \alpha+\beta1\ \ln X1+ \beta2\ \ln X2+ \beta3\ \ln X3+ \beta4\ \ln X4+ \beta5\ \ln X5+ \beta6\ \ln X6+ \beta7\ X7+ \beta8 X8$$

α = intercept made on the regression line
X1 = Number of economically active members in the respondent household.
X2 = Total wheat cultivated land with irrigation facility
X3 = Experience of the household head in wheat cultivation (in years of wheat cultivation)

X4 = Education level of the respondent household head
X5 = Total Chemical Fertilizer (NPK) applied
X6 = Seed Rate
X7 = Dummy for intercropping if yes=1 and if no=0
X8 = Dummy for training in wheat cultivation if yes=1 and if no=0
β1 to β6 are the coefficients of those independent variables respectively.

Six continuous variables and two dummy variables were chosen as the independent variables in this model. The intercorrelated independent variable was eliminated, and the variable having the greatest impact on production was chosen, preventing multicollinearity in the model. This methodology aligns with the approach used in analyzing factors and major problems in paddy farming production in Sunsari district, Nepal (Acharya et al. 2020). A similar model was applied to ascertain factors influencing productivity and major constraints in mango production in the Saptari district of Nepal (Shrestha et al. 2021). Furthermore, this method was employed to identify the productivity and profitability of vegetable production in Swaziland (Masuku and Xaba 2013).

Problems of wheat production

The assessment of wheat production challenges was conducted utilizing a forced ranking technique employing a five-point scale. The determination of the index for the intensity of production problems faced by wheat growers was achieved through the application of the following formula:

$$I_{imp} = \Sigma = \frac{N}{Sifi}$$

Where,
I_{imp} = index of importance
Σ = summation
S_i = Ith scale value
F_i = frequency of ith importance given by the respondents
N = total number of respondents

A similar formula was employed to rank the challenges associated with wheat production (Subedi et al. 2019). This methodology aligns with the approach adopted by Acharya et al. (2020) in ranking the production constraints of rice in the Sunsari districts of Nepal, who similarly utilized a five-point scale. Furthermore, Shrestha et al. (2021) employed a similar five-point scale to rank the production constraints in mango farming in the Saptari district of Nepal.

Results and discussion

Description of important socioeconomic and demographic characteristics

The sampled respondents' socioeconomic characteristics are displayed in Table 1. The average age of the head of a household was 41.22 years for small farmers, 47.51 years for medium farmers, and 47.09 years for large farmers. For small farmers, the average household size was 5.65; for medium farmers, it was 6.32; and for large farmers, it was 7.55. For small, medium, and large farms, the average number of males in the household was 2.72, 3.26, and 4.13, respectively. Similarly, for small farmers, the average number of females in the household was 2.91; for medium farmers, it was 3.04; and for large farmers, it was 3.40. The age composition of the surveyed household population was stratified into distinct categories: 0–5, 6–17, 18–59, and 60 and above. Within this framework, individuals falling within the age range of 18–59 are regarded as the economically active population, while those in other age groups are classified as the dependent population.

Table 1. Socio-demographic characteristics (continuous variable) of sampled households Kanchanpur district of Nepal.

Variables	Small farmers (Mean±Standard deviation)	Medium farmers (Mean±Standard deviation)	Large farmers (Mean±Standard deviation)
Age of Household Head	41.22±10.17	47.51±11.35	47.09±11.86
Household size	5.65±2.18	6.32±2.31	7.55±4.28
Male members of HH	2.72±1.04	3.26±1.39	4.13±2.74
Female members of HH	2.91±1.47	3.04±1.41	3.40±1.79
Economically active member	3.64±1.62	4.10±1.54	4.86±2.41
Dependent population	2.37±1.31	2.45±1.46	3.10±2.44
Total Wheat cultivated land	10.20±2.19	17.39±4.71	43.90±22.76
Dependency ratio	0.82±0.61	0.69±0.47	0.74±0.49

The average count of the dependent population was determined to be 2.37 for small farmers, 2.45 for medium farmers, and 3.10 for large farmers per household. Likewise, the average count of the economically active population was observed to be 3.64 for small farmers, 4.10 for medium farmers, and 4.86 for large farmers per household. The dependency ratio, defined as the proportion of the dependent population to the economically active population (Ramshah Path 2014), was computed as 0.82 for small farmers, 0.69 for medium farmers, and 0.74 for large farmers. A dependency ratio of 0.82, 0.69, and 0.74 implies that, on average, 100 small, medium, and large farmers must sustain 82, 69, and 74 individuals, respectively, who are dependent on them.

Furthermore, the average landholding size was found as 10.20 kattha, 17.39 kattha, and 43.90 kattha for small, medium, and large farmers, respectively.

The socio-demographic data encompassing the gender of the household head, educational attainment, religious affiliation, family structure, and primary occupations are detailed in Table 2. Predominantly, the respondents were male, except for the small farmers' group where 32.4% of respondents were male. This difference was statistically significant at a 1% level of significance, indicating a noteworthy contingency in gender distribution across farmer categories. The major religion identified across all farmer groups was Hinduism, and this data did not yield statistical significance at any level.

Table 2. Relationship between farmers category and important categorical variable in Kanchanpur district of Nepal.

Variables	Small farmers	Medium farmers	Large farmers	Chi-square value	P-value
Gender of HH					
Male	12(32.4)	29(70.7)	20(90.9)	22.597***	0.000
Female	25(67.6)	12(29.3)	2(9.1)		
Religion					
Hindu	33(89.18)	32(78.04)	18(81.81)		
Buddhist	0(0)	3(7.31)	0	7.228	0.124
Christian	4(10.81)	6(14.63)	4(18.2)		
Ethnic group					
Brahmin/Chhetri	31(83.8)	31(75.6)	8(36.4)		
Janajati	4(10.8)	6(14.6)	13(59.1)	22.450**	0.01
Dalit	2(5.4)	4(9.8)	1(4.5)		
Education status					
Illiterate	11(29.72)	7(17.1)	5(22.72)		
Literate	0	0	0		
Primary up to class 5	3(8.10)	2(4.87)	2(9.09)		
Lower secondary up to class 8	3(8.10)	3(7.31)	5(22..72)	1.760	0.415
SLC	6(16.21)	15(36.58)	6(27.27)		
+2/certificate	10(27.02)	9(21.95)	3(13.63)		
Bachelors and above	4(10.81)	5(12.19)	1(4.54)		
Major occupation					
Wheat cultivation	33(89.2)	36(87.8)	16(72.72)		
Service	1(2.70)	2(4.87)	1(4.54)	15.815**	0.015
Remittance	3(8.10)	2(4.87)	3(13.63)		
Business	0	1(2.43)	2(9.09)		
Training					
Yes	10(27)	12(29.3)	13(59.1)	7.23**	0.027
No	27(73)	29(70.7)	9(40.9)		
Household decision					
Male	11(29.7)	19(46.3)	15(72.7)	16.92**	0.020
Female	26(70.3)	22(53.7)	7(27.3)		

Ethnicity exhibited notable variations, with Brahmin and Chettri being predominant among small and medium farmers, while Janjati held dominance in the large farmer group. The ethnic disparities were statistically significant at a 5% level. Wheat cultivation emerged as a predominant occupation in all farmer groups, demonstrating statistical significance at a 5% level. The educational profile indicated a prevalence of illiteracy among small farmers, a substantial proportion of middle farmers having passed the School Leaving Certificate (SLC), and a predominant SLC level of education among large farmers. However, these differences were not found to be statistically significant.

Regarding training on wheat cultivation, 27% of small farmers' households, 29.3% of medium farmers' households, and 59.1% of large farmers' households had received such training at least once. This discrepancy was found to be statistically significant at a 5% level, partially attributed to the larger cultivation lands of large farmers, necessitating a greater emphasis on training due to their dependency on agriculture for income.

Regarding household decision-makers, the majority of decisions were made by females in small and medium farmers' households (70.3% and 53.7%, respectively), while in large farmers' households, males predominantly took major household decisions (68.2%). This difference was statistically significant at a 5% level.

Factors of wheat production in the study area

Based on the data presented in Table 3, the R-square value was determined to be 0.95, indicating that approximately 95% of the variability in wheat production was elucidated by the explanatory variables incorporated in the model. Furthermore, the adjusted R-square value was calculated as 0.90, signifying that when accounting for degrees of freedom, approximately 90% of the variability in the dependent variable (production) was explicated by the independent explanatory variables within the model.

The table underscores that wheat-cultivated land equipped with irrigation facilities, the quantity of NPK applied, the years of experience, and the education level of the farmers made positive contributions to wheat production in the study area. Conversely, negative coefficients were observed in relation to economically active members of the farmers, seed rate, and intercropping. This result indicates that not all members of the working class actively participate in wheat farming within the household, primarily due to their engagement in other works such as government employment, business etc. and the results of Shehu et al. (2010) contradicted this finding, finding that an increase in the number of adult family members also increased yam production in Benue state, Nigeria. Similarly, the negative coefficient of seed rate suggests that as the seed rate increases, the total production of wheat tends to decrease. It indicates that using higher seed rates might lead to overcrowding of plants, which can result in competition for resources like water, nutrients, and sunlight. As a result, individual plants might not have enough space and resources to grow optimally, leading to reduced overall production, and a similar result was found by Khan et al. (2000). Their finding revealed that, due to competition among plants for nutrients, light, and air, the optimal bi-

Table 3. Factors influencing wheat production in the study area.

	Coefficient	Standard Error	t-stat	P-value
Intercept	-1.958	4.101	-0.477	0.634
Amount of Chemical fertilizer (NPK) applied	0.054***	0.008	6.750	0.000
Economically active family members	-0.596	0.275	-2.167	0.033
Experience	0.166***	0.045	3.665	0.000
Training	0.530	0.968	0.547	0.585
Wheat-cultivated land with irrigation Facility	0.617***	0.098	6.323	0.000
Intercropping	-3.415	2.687	-1.271	0.207
Seed Rate	-0.056	0.020	-2.770	0.007
Education level	2.655**	1.113	2.386	0.019
R-square=0.957	Adjusted R square=0.908			

Note: *** indicates 1% level of significance ** indicates 5% level of significance land * indicates 10% level of significance.

ological yield was not achieved with the highest seed rate. Behzad and Amani (2020), conducted additional research which revealed that a seeding rate of 140 kg ha^{-1}, as opposed to 160 kg ha^{-1}, produced the maximum grain production (4.94 t ha^{-1}).

The negative coefficient associated with the intercropping of green pea with wheat signified that the standard ratio of wheat and green pea were not followed and a huge number of green pea were intercropped which has a detrimental effect on yield. A high ratio of wheat and green pea leads to overcrowding of plants, which results in competition for resources like water, nutrients, and sunlight rather than being complementary and this result was in contrast with Dhillon and Aulakh (2017) as they found that wheat intercropping with chickpeas result on higher production of wheat (54.6 q ha) than sole cropping of wheat (46.7 q ha). Similarly, Hamdollah and Ghanbari (2010) showed that intercropping results in high productivity and profitability.

The presence of wheat-cultivated land equipped with irrigation facilities exhibited a positive and statistically significant impact on wheat production, evident at a 1% level of significance. This observation indicated that, for each additional unit increase in wheat-cultivated land with irrigation, there was a corresponding 0.617 unit increase in wheat production. Specifically, this implies that incresing the wheat-cultivated land by an additional 1 kattha, with an irrigation facility, resulted in an increase of wheat production by 0.617 quintal, holding other factors constant. A similar outcome was noted by Acharya et al. (2020), where an increase of 1 kattha in paddy-cultivated land with irrigation facilities led to a 0.0108-ton increase in paddy production, under constant conditions. Moreover, Zaveri and Lobell (2019) reported that India's national wheat yields in the 2000s were 13% greater than they would have been in the absence of irrigation patterns since 1970. According to Steiner et al. (1985), irrigation had a major impact on the wheat crop's dry matter production, grain yield, and yield components. It also took up more than 70% of the crop's water requirements during arthesis. It has been shown that more frequent irrigation produces higher grain yields than less frequent irrigation in several nations (Singh and Brar 1979).

The amount of chemical fertilizer NPK applied had a positive impact on the total production of the Wheat. It was found statistically significant at a 1% level of significance. With a one-unit increase in the fertilizer, it increases the production by 0.054 quintal other things remain constant. Fertilizers need to be applied to wheat at three different times i.e. at tillering, booting, and at grain filling. Maximum growth metrics responded considerably to NPK fertilizers, according to Malghani et al. (2010). It is found that the application of 175-150-125 NPK Kg ha^{-1} resulted in the highest grain yield, which was 5168 Kg ha^{-1}. When comparing the increased yield to the control (2502 kg ha^{-1}), which did not get any fertilizer, the difference was 51.58%. The greatest production stability and lowest agronomic risk for yield failure were offered by the mineral supply of N + P + K plus extra manure (Macholdt et al. 2019).

The acquisition of training by farmers in wheat production demonstrated a favorable effect on wheat production; however, its influence did not attain statistical significance concerning the overall wheat production within the study area. This lack of significance can be attributed primarily to the diminished efficacy of the training program implemented in the study area. Notably, this result diverges somewhat from the findings of Kijima et al. (2012), where training was identified to have a statistically significant positive impact on the adoption of improved practices and the profitability of lowland wheat production in Uganda. Ahmad et al. (2007) found that due to training, crop yield has increased, vegetable and fruit production has also shown an upward trend, and the diseases and mortality rate of the livestock has also decreased. Wonde et al. (2022) found that trainees increased their wheat and maize yield by 26.66% and 10.10% kg ha^{-1}, respectively with a net annual income increase of 19.64% from wheat production in Ethiopia.

The educational attainment of the respondent household head exerted a positive influence on wheat production. This observation suggests that individuals with higher levels of education possess greater awareness of cropping systems and production practices, enabling them to more readily adopt innovative agricultural technologies. Ullah et al. (2014) concluded that education has a positive impact on the productivity of wheat. The farming skills and productive capabilities of the farmers were enhanced by education (Weir 1999). Paltasingh and Goyari (2018) observed a positive correlation between the education level of farmers and farm productivity among Indian farmers. However, Arshad et al. (2015) reported a contrasting negative impact of education on flood insurance in rural households in Pakistan.

In the context of wheat cultivation, the experience of farmers quantified in terms of years, demonstrated statistical significance at a 10% level. The coefficient value of 0.166 indicates that with other variables held constant, a one-unit increase in experience resulted in a corresponding 0.166-unit increase in wheat cultivation in the study area. This aligns with the findings of Indian farmers (Coelli and Battese 1996). Gedara et al. (2012) also observed a positive and significant impact of farmer experience on efficacy. This concurrence is further supported by the work of Wilson et al. (2001) where the managerial experience of farmers was linked to an increased quest for new information and, subsequently, higher technical efficiency in wheat production in Eastern England.

Major constraints associated with wheat cultivation

Some of the main issues that are common in the study area were shortlisted and put in the interview schedule based on the field tour, focus group discussion, knowledge sharing between KII and AKC, and wheat zone. Following these discussions, key issues such as the unavailability of fertilizers during critical wheat plantation periods, damage caused by wild animals and stray cattle, lack of irrigation facilities, the prevalence of diseases and insect pests, insufficient access to markets, absence of quality seedlings, unavailability of training for commercial wheat production, and the lack of governmental support for agricultural inputs emerged as significant impediments to successful wheat farming. To rank these challenges, a forced ranking methodology utilizing a five-point scale was employed, prompting farmers to assign a maximum score of 1 and subsequently decreasing the score in proportion to the perceived severity of the problem. Notably, the majority of farmers identified the lack of fertilizers during critical plantation periods as a severe issue, attributing it to the limitation of the soil's overall production capacity and hindrance to plants reaching their maximum potential, resulting in diminished yields due to the essential nutrient deficiency crucial for growth, development, grain formation, and grain filling. The calculated index value for the fertilizer shortage was determined to be 0.795. Similarly, issues such as damage from wild animals and stray cattle, unavailability of improved seed, unavailability of irrigation, prevalence of diseases and insect pests, insufficient access to markets, labor shortage, lack of training on improved farming practices and natural hazards were ranked 2nd, 3rd, 4th, 5th, 6th, 7th, 8th, and 9th, respectively, with index values of 0.790, 0.718, 0.695, 0.647, 0.470, 0.336, 0.316, and 0.225. The study area is a conservation area where Sukhlapantha National Park lies, the damage from wild animals is a serious problem. Not only wildlife but also damage from stray cattle are also serious problems for farmers.

The third problem lack of quality seeds involves the unavailability of high-yielding varieties of wheat. Consequently, farmers face challenges in commercializing their production. Farmers rely on the local variety or stored seeds of previous years which are highly vulnerable to disease and pests which result in low productivity of wheat. As a result, farmers' income has decreased and production costs have increased.

Despite the freely flowing Mahakali River near the study area, there was a problem of irrigation. The huge potential of the Mahakali river hadn't been exploited yet. The only available source of irrigation was through water pumps and small canals. Only very few farmers had all-year-round access to irrigation. Moreover, being on the leeward Western side of Nepal this region received very minimal precipitation. Some of the farmers responded that there was a shortage of drinking water as well, irrigation meanwhile for the cultivation was secondary. Infestation of the diseases and pests in the field caused a severe loss in production. Leaf rust, Fusarium head blight, Septoria leaf blotch, stripe rust, spot blotch, tan spot, and powdery mildew are the fungal pathogens that cause the most severe losses. Insects such as White grubs, wireworm, fall-army worm, cutworm, and wheat stem sawfly causes major losses in wheat.

Insufficient access to the market was ranked the sixth important problem which involves the improper amount received by the farmers. As a result of the syndicate upon the processing of wheat, the farmers are not able to get the proper price of wheat. The large-scale farmers with huge capital have a monopoly over the processing plant which causes lower wheat for the produce of small farmers. No access to training was also ranked as a problem. The migration of people in search of jobs in India causes the scarcity of labor. Natural hazards like drought, hailstone, and flooding were ranked least important by the farmers.

Table 4. Ranking of Majors Constraints in Wheat Cultivation.

Major constraints	Index Value	Rank
Unavailability of fertilizers in critical plantation time	0.795	1
Problems from wild animals and stray cattle	0.790	2
Unavailability of improved seed	0.718	3
Unavailability of irrigation	0.695	4
Infestation of the diseases and pests	0.647	5
Insufficient access to markets	0.470	6
Labor shortage	0.336	7
Lack of training on improved farming practices	0.316	8
Natural hazards	0.225	9

Conclusions

The primary objective of this research was to examine the determinants influencing wheat production in Kanchanpur district, Nepal. The study findings indicate that an increase in wheat-cultivated land equipped with irrigation facilities exerts a positive impact on wheat production within the study area. Moreover, the application of fertilizer and the educational level of farmers were identified as significant factors contributing to enhanced wheat production. Results further demonstrated that farmers with greater experience in wheat cultivation achieved higher yields compared to those with limited experience. The study identified key constraints in wheat production, including a deficiency of fertilizers during peak plantation periods, damages caused by wild animals and stray cattle, and a lack of training on improved management practices. To optimize wheat production in the Kanchanpur district, it is imperative to bolster the factors identified as positively influencing production while concurrently addressing the major challenges identified. Governmental and policymaker intervention is necessary to acknowledge and rectify the issues and concerns disclosed by this study, aligning with the perceptions of the farmers engaged in wheat farming.

Conflict of interest

The authors affirm that there are no competing interests concerning this manuscript publication.

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References

Acharya S, Shrestha A, Bhandari S, Dahal B, Dutta J (2020) Analysis of factors and major problems of production of paddy farming in Sunsari district, Nepal. Azarian Journal of Agriculture 7: 164–172. https://doi.org/10.52547/azarinj.042

Ahmad M, Jadoon MA, Ahmad I, Khan HR (2007) Impact of trainings imparted to enhance agricultural production in district Mansehra. Sarhad Journal of Agriculture 23(4): 1211.

AICC Krishi diary (2023) Government of Nepal, Nepal: Agricultural Information and Communication Centre, Department of Agriculture. Harihar Bhawan, Lalitpur, Nepal.

Ashrad M, Amjath-Babu TS, Kachele H, Muller K (2015) What drives the willingness to pay for crop insurance against extreme weather events (flood and drought) in Pakistan? A hypothetical market approach. Climate and Development 8(3): 234–244. https://doi.org/10.1080/17565529.2015.1034232

Awika J (2011) Major Cereal Grains Production and Use around the World. Advances in Cereal Science: Implications to Food Processing and Health Promotion 1089: 1–13. https://doi.org/10.1021/bk-2011-1089.ch001

Behzad M, Amani A (2020) Effect of seeding rate on growth and yield of wheat. International Journal of Advanced Academic Studies 2(4): 483–485. https://doi.org/10.33545/27068919.2020.v2.i4h.441

Coelli TJ, Battese GE (1996) Identification of factors which influence the technical inefficiency of Indian farmers. Australian Journal of Agricultural Economics 40: 103–128. https://doi.org/10.1111/j.1467-8489.1996.tb00558.x

Curtis BC Wheat in the World (2019) Curtis BC Wheat in the World. [Available online:] http://www.fao.org/3/y4011e/y4011e04.htm [accessed on 28 March 2019]

Dhillon B, Aulakh C (2017) Effect on Growth and Yield of Intercrops in Wheat+Chickpea Intercropping under Limited Nutrition and Moisture. Indian Journal of Ecology 44(5): 507–511. https://doi.org/10.3923/pjbs.2000.1158.1160

FAO (2020) FAOSTAT. [Retrieved from] http://faostat.fao.org/site/291/default.aspx

Gedara KM, Wilson C, Pascoe S, Robinson T (2012) Factors affecting technical efficiency of rice farmers in village reservoir irrigation systems of Sri Lanka. Journal of Agricultural Economics 63(3): 627–638. https://doi.org/10.1111/j.1477-9552.2012.00343.x

Hamdollah E, Ghanbari A (2010) Environmental resource consumption in Wheat (*Triticum aestivum*) and bean (*Vicia faba*) intercropping: Comparison of nutrient uptake and light interception. Notulae Scientia Biologicae 2(3): 100–103. https://doi.org/10.15835/nsb234787

Kandel M, Bastola A, Sapkota P, Chaudhary O, Dhakal P, Shrestha J (2018) Analysis of genetic diversity among the different wheat (*Triticum aestivum* L.) Genotypes. Turkish Journal of Agricultural and Natural Sciences 5(2): 180–185. https://doi.org/10.30910/turkjans.421363

Khan MA, Sadozai GU, Ahmad K (2000) Effect of Sowing Rates on the Grain Yield of Wheat Variety Punjab-96. Pakistan Journal of Biological Sciences 3(7): 1158–1160. https://doi.org/10.3923/pjbs.2000.1158.1160

Kijima Y, Ito Y, Otsuka K (2012) Assessing the Impact of Training on Lowland Rice Productivity in an African Setting: Evidence from Uganda. World Development 40(8): 1610–1618. https://doi.org/10.1016/j.worlddev.2012.04.008

Macholdt J, Piepho H, Honermeier B (2019) Mineral NPK and manure fertilisation affecting the yield stability of winter wheat: Results from a long-term field experiment. European Journal of Agronomy 102: 14–22. https://doi.org/10.1016/j.eja.2018.10.007

Malghani AL, Ullah A, Sattar A, Hussain F, Abbas G, Hussain J (2010) Response of growth and yield of wheat to NPK fertilizer. Sci. Int. (Lahore) 24(2): 185–189.

Masuku M, Xaba B (2013) Factors affecting the productivity and profitability of vegetables production in Swaziland. Journal of Agricultural Studies 1(2): 37–52. https://doi.org/10.5296/jas.v1i2.3748

Ministry of Agricultural and Livestock Development (2023) Statistical Information on Nepalese Agriculture. Kathmandu: Government of Nepal.

NWRP (2017) Annual Report. Bhairahawa, Rupandehi Nepal: Nepal Agriculture Research Council.

Paltasingh KR, Goyari P (2018) Impact of farmer education on farm productivity under varying technologies: case of paddy growers in India. Agricultural and Food Economics 6(1): 7. https://doi.org/10.1186/s40100-018-0101-9

Ramshah Path (2014) CBS Population monograph of Nepal. Government of Nepal, National Planning Commission Secretariat, Central Bureau of Statistics, Kathmandu.

Shahbandeh M (2023) Wheat: production volume worldwide 1990/1991–2022/2023.; Statista.

Shehu JF, Iyortyer JT, Mshelia SI, Jongur AAU (2010) Determinants of yam production and technical efficiency among yam farmers in Benue State, Nigeria. Journal of Social Sciences 24(2): 143–148. https://doi.org/10.1080/09718923.2010.11892846

Shrestha A, Joshi N, Dahal B, Bhandari S, Acharya S, Osti B (2021) Determinants of productivity and major production constraints of mango farming in saptari district of Nepal. Malaysian Journal of Sustainable Environment 5(2): 77–81. https://doi.org/10.26480/mjsa.02.2021.77.81

Singh NT, Brar GS (1979) Effect of amount and depth of profile stored water on the yield of dry land wheat. The Indian Journal of Agricultural Sciences 29(4): 266–269.

Steiner JL, Smith GG, Meyer WS, Adeney AJ (1985) Water use, foliage temperature and yield of irrigated wheat in south-east Australia. Australian Journal of Agricultural Research 36(1): 3–11. https://doi.org/10.1071/AR9850001

Subedi S, Ghimire YN, Adhikari SP, Devkota D, Shrestha J, Poudel HK, Sapkota BK (2019) Adoption of certain improved varieties of wheat (*Triticum aestivum* L.) in seven different provinces of Nepal. Archives of Agriculture and Environmental Science 4(4): 404–409. https://doi.org/10.26832/24566632.2019.040406

Thompson M (1978) Selection of variables in multiple regression: Part I. A review and evaluation. International Statistical Review / Revue Internationale De Statistique 46(1): 1–19. https://doi.org/10.2307/1402505

Ullah A, Shah SNM, Shaofeng Z, Khan M, Ali S (2014) Impact of education and certified seeds on wheat production in Kohat, Pakistan. Asian Journal of Agricultural Extension, Economics & Sociology 4(1): 42–48. https://doi.org/10.9734/AJAEES/2015/13256

USDA (2018) USDA. [Retrieved from:] http://www.fas.usda.gov [Accessed: January 22, 2019]

Weir S (1999) The effects of education on farmer productivity in rural Ethiopia. University of Oxford.

Wilson P, Hadley D, Asby C (2001) The influence of management characteristics on the technical efficiency of wheat farmers in eastern England. Agricultural Economics 24(3): 329–338. https://doi.org/10.1111/j.1574-0862.2001.tb00034.x

Wonde KM, Tsehay AS, Lemma SE (2022) Training at farmers training centers and its impact on crop productivity and households' income in Ethiopia: A propensity score matching (PSM) analysis. Heliyon 8(7): e09837. https://doi.org/10.1016/j.heliyon.2022.e09837

Zaveri E, Lobell DB (2019) The role of irrigation in changing wheat yields and heat sensitivity in India. Nature Communications 10(1): 4144. https://doi.org/10.1038/s41467-019-12183-9