RJOAS: Russian Journal of Agricultural and Socio-Economic Sciences
ISSN 2226-1184 (Online) | Issue 11(155), November 2024

UDC 633

STATUS OF ADOPTION OF WHEAT (TRITICUM AESTIVUM L.) PRODUCTION TECHNOLOGY IN WHEAT ZONE, RUPANDEHI, NEPAL

Prabin Kandel
Ramnagar Technical and Management College, Ramnagar, Nawalparasi, Nepal

Aavash Shrestha*, **Rijwan Sai**, **Prajjwol Koirala**
Agriculture and Forestry University, Faculty of Agriculture, Chitwan, Nepal

Pratikshya Subedi, **Surakhsya Baral**
Ramnagar Technical and Management College, Ramnagar, Nawalparasi, Nepal

*E-mail: aavashstha5@gmail.com

ABSTRACT
Wheat is a staple crop in Nepal, yet significant yield gaps remain. This study aimed to assess the adoption of wheat production technologies in Rupandehi district, specifically in Kotahimai, and Sammarimai rural municipalities. Primary data were collected using a pre-tested interview schedule, supplemented by focus group discussions and key informant surveys. Secondary data were gathered from relevant literature. A total of 85 households were randomly selected for the survey. Data analysis was performed using SPSS and Microsoft Excel, employing descriptive statistics such as mean, standard deviation, frequency, and percentage. A probit regression model was utilized to evaluate the impact of various factors on the adoption of improved wheat varieties, while indexing was used to rank production challenges. The study found that 52% of farmers adopted recommended wheat varieties, while the adoption rates for seed rate, sowing methods, irrigation, and harvesting methods were 39%, 10%, 44%, and 54%, respectively. Significant factors influencing adoption included education level, organizational membership, training participation, subsidies, and loans. Major constraints in wheat production included inadequate irrigation, limited fertilizer availability, lack of agricultural machinery, poor-quality seeds, and pest and disease issues. The probit model results indicated that increased participation in training, organizational membership, higher education levels, and access to subsidies significantly enhance the adoption of improved wheat production technologies.

KEY WORDS
Adoption, probit regression model, indexing, wheat production.

Wheat (Triticum aestivum) is the most widely cultivated crop globally and ranks as the third most important cereal in Nepal, following rice and maize, in terms of area and production. However, in terms of human consumption, wheat ranks second in the country. Wheat thrives in diverse climatic conditions ranging from temperate to tropical regions, with optimal growing temperatures around 25°C (Chimdesa et al., 2018). It can be cultivated in areas receiving annual precipitation between 250 and 1750 mm, demonstrating its broad adaptability (Chimdesa et al., 2018). Nutritionally, wheat is a key source of macronutrients, including starch for energy, proteins, and dietary fiber, as well as essential micronutrients like B vitamins, vitamin E, and minerals such as potassium, phosphorus, and magnesium (Wieser et al., 2020). Consumption of wheat, particularly its dietary fiber, has been linked to reduced risks of cardiovascular diseases, type 2 diabetes, and certain cancers (Shewry & Hey, 2015).

Despite the diversity of Nepalese agriculture, it is predominantly dominated by three major crops: rice, wheat, and maize, which together account for 27% of the Agricultural GDP (AGDP) of Nepal (MoALD, 2022). Among cereals, wheat is the third most cultivated in Nepal, contributing 20% to the country's total cereal production. In terms of contribution to the

AGDP, wheat ranks third after rice (13.6%) and maize (7.6%), accounting for 5.6% of the total agricultural GDP. The total area under wheat cultivation is 2,144,568 hectares, with a total production of 716,978 metric tonnes. However, wheat productivity in Nepal has stagnated over the past three years at 3.09 tons/ha (2019/20), 2.99 tons/ha (2020/21), and 2.99 tons/ha (2021/22) (MoALD, 2022). Compared to neighboring countries like India and China, Nepal's wheat productivity remains low, with yields of 3.37 tons/ha and 5.48 tons/ha, respectively (Ramadas et al., 2020). (Timsina et al., 2019) highlighted a significant gap between the potential yield and the average national productivity, with farm-level yields in Nepal (2.85 mt/ha) falling short of the attainable yield (5.0 mt/ha).

Wheat is grown across various farming communities in Nepal. However, diminishing farm sizes in the Terai region have raised concerns about crop productivity and the efficiency of farming systems. Although wheat farming has been practiced for many years in Rupendehi, actual production and productivity have not reached potential levels. Traditional agricultural practices, while culturally significant and requiring low initial investment, are often preferred by farmers due to their accessibility and perceived lower risk, even though alternative, improved methods are available (Kapur, 2024; Prathapachandran & Devadas, 2023; Sharma et al., 2023). The adoption rate of recommended wheat production practices, such as seed rate, sowing methods, fertilizer application, irrigation scheduling, and pest management, remains low, which is often attributed to a lack of technical knowledge, awareness, access to reliable information, and various socio-economic factors (Poudel et al., 2021).

Even with the expansion of extension services and the rise of digital platforms for information dissemination, a significant gap persists between potential and actual farm yields due to the low adoption of improved wheat production technologies. This gap underscores the necessity to understand the extent of adoption, the socio-economic factors influencing it, and the major constraints faced by wheat farmers. Therefore, this study aims to assess the level of adoption of improved wheat management practices among farmers, identify the socio-economic factors influencing adoption, and examine the key constraints affecting wheat farming. Insights into these barriers can guide policymakers in developing appropriate interventions to enhance wheat production in Nepal.

MATERIALS AND METHODS OF RESEARCH

The survey was conducted in Kotahimahi Rural Municipality, Sammarimai and Marchawari Rural Municipality which are the commanding areas of the PMAMP Wheat Zone in Rupandehi District (

Figure 1). A total of 85 wheat producers were selected from the study area using a sampling formula represented by eq (1). Sample size was determined using the formula described by (Yamane, 1973):

$$n = \frac{N}{1 + N(e)^2} \quad (1)$$

Where: n is the sample size, N is the population size (sampling frame), and e is the level of precision considered to be 10%.

The sampling frame was retrieved from the PMAMP, PIU Rupendehi database, where wheat farmers were recorded across different groups, organizations, farms, and individuals. The samples were then selected using a simple random sampling technique.

Both primary and secondary sources of data were used. In this study, primary data were collected through household surveys utilizing pre-tested semi-structured questionnaires, in addition to key informant interviews, focus group discussions (FGDs), field observations, and verification. Secondary information was gathered from various sources, including websites, publications from the Ministry of Agriculture and Livestock Development (MoALD) in Nepal, as well as published and unpublished articles, research papers, and annual and progress reports from governmental and non-governmental organizations.

The collected data was coded and entered into a computer, where it was analyzed using the Statistical Package for Social Sciences (SPSS) and Microsoft Excel. Statistical tools such as mean, standard deviation, frequency, and percentage were employed for the analysis. The dependent variable in this study is the adoption of improved wheat production practices. The specific practices considered include variety selection, seed rate, sowing method, irrigation, weed control, disease and pest management, and harvesting techniques. The independent variables examined in the study include age, gender, education, family size, family income, occupation, farm size, wheat cultivation area, membership in organizations, participation in training, and access to subsidies and loans.

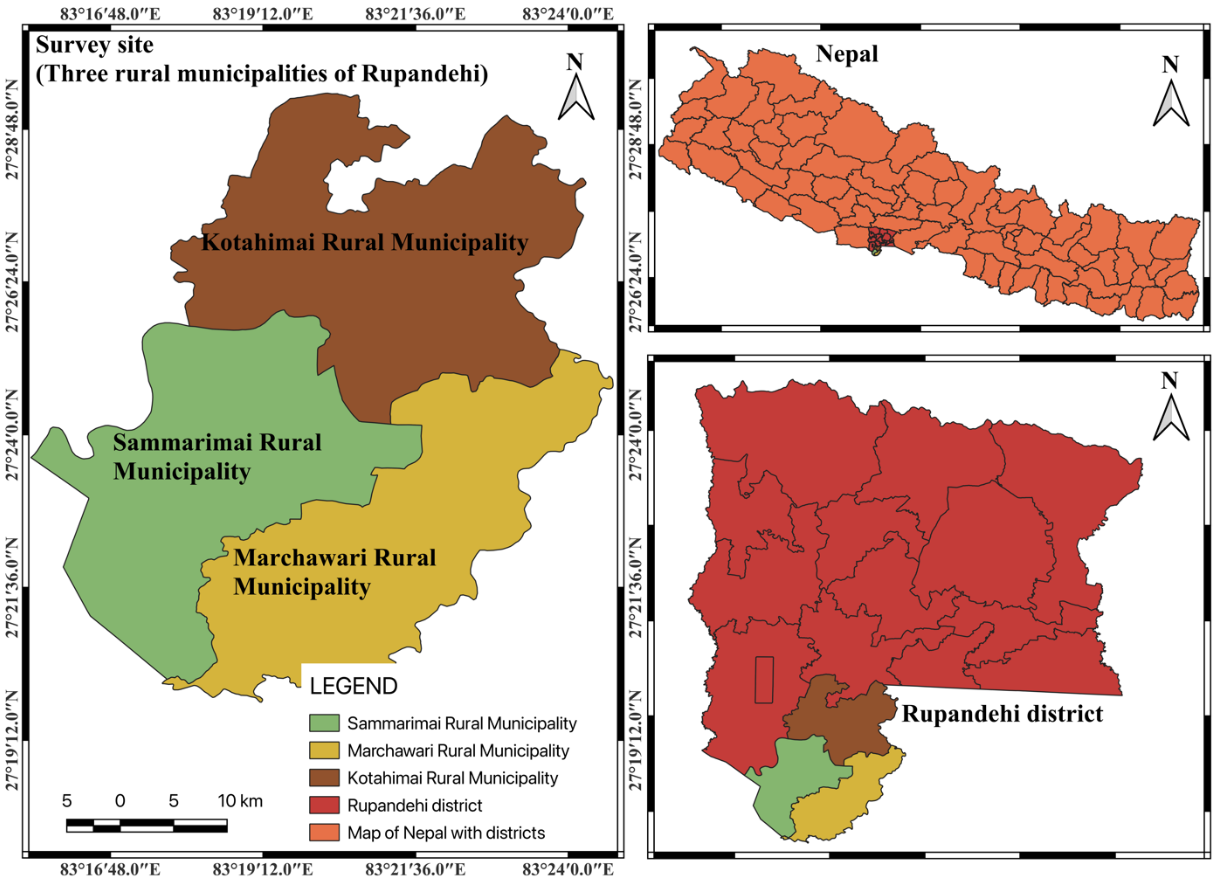

Figure 1 – Map of the study area

The adoption index is a quantitative measure that reflects the extent to which farmers have adopted specific improved practices or technologies. It is often expressed as a percentage or score that indicates the level of adoption across a set of practices or technologies. AI is calculated by the formula represented by eq (2).

$$AI = \frac{ASI}{MAS} * 100\% \quad (2)$$

Where: AI = Adoption score; ASI = Adoption score obtained by individual farmer; MAS = Maximum Adoption Score.

Similarly, an independent t-test was conducted to determine whether there were statistically significant differences between low-adopters and high-adopters of improved wheat technology with respect to their socio-economic characteristics. The formula used is represented by eq (3).

$$t = \frac{m_A - m_B}{\sqrt{\left(\frac{s_1^2}{n_A} - \frac{s_2^2}{n_B}\right)}} \quad (3)$$

Where: mA and mB are the mean of the group A and B respectively; s1 and s2 are the standard deviation of the group A and B respectively; na and nB are represent the size of the sample A and B respectively.

The Probit model is a regression tool designed for situations where the dependent variable is binary, meaning it can only take two possible values. This model is employed to explore the functional relationship between the probability of adoption and the factors that influence it. The use of a binary empirical model, such as the Probit model, allows for a more nuanced analysis of farmers' decisions to adopt new technologies (Muzari et al., 2012). The Probit model is often preferred over other models due to its assumption of a normal distribution of the error term (Wooldridge, 2010). In this study, we applied the Probit regression model to identify the factors influencing farmers' adoption of improved wheat technologies represented by eq (4).

$$\mathrm{P}(\mathrm{Adoption} = 1|\,\mathrm{X}) = \Phi(ß_0 + ß_1 X_1 + ß_2 X_2 + \dots\dots\dots + ß_{10} X_{10} \quad (4)$$

Where:

- P(Adoption=1|X) is the probability that Adoption of IWPT equals 1, given the values of the independent variables used in this model
- Φ represents cumulative distribution function of the standard normal distribution
- X_1, X_2,………,X_{10} represents age of household head, household size, years of schooling, annual income, farming experience, land holding, membership in organization (dummy variable), subsidy (dummy variable), and loan (dummy variable) as the independent variables used in this model
- $ß_0$, $ß_1$,…….,$ß_{10}$ are the coefficient associated with independent variables that the model estimates.

Furthermore, an indexing or scaling technique was utilized to construct an index for ranking problems based on farmers' perceptions. According to Miah (1993), scaling techniques effectively measure both the direction and intensity of respondents' attitudes toward a given proposition. The index values were calculated based on the frequency of responses and were ranked using a five-point scale. The index was computed using the eq (5).

$$I_{imp} = \frac{S_i F_i}{N} \quad (5)$$

Where: I = Index of importance; Si = Scale value of ith priority; Fi = Frequency of ith priority; N = total number of observations.

The study adhered to all ethical guidelines and received approval from the Prime Minister Agriculture Modernization Project, PIU, Wheat Zone, Rupandehi, and Agriculture and Forestry University, Rampur, Chitwan. Informed written consent was obtained from all participants, who were fully briefed on the study's purpose and agreed to participate. Participants were assured that their information would remain confidential, and their identities would be protected, even if the data were to be used for research dissemination.

RESULTS AND DISCUSSION

The description of socio-economic and demographic variables with mean and standard deviation are presented in Table 1 and Table 2. The average age of the household heads (HH) is approximately 51 years, with a standard deviation of 11.55 years. The average household size is 8.98 members, with a standard deviation of 4.37, suggesting a wide range of family sizes in the study area. On average, households have 4.33 male members (SD =

2.243) and 4.66 female members (SD = 2.547), showing a relatively balanced gender distribution. The average years of schooling among the respondents is 7.89 years, with a standard deviation of 3.92 years. The average annual income of the households is Rs. 238,882.35, with a considerable standard deviation of Rs. 87,825.505. The respondents have an average of 24.61 years of farming experience, with a standard deviation of 11.518 years, suggesting that most respondents have substantial farming experience. The average landholding size is 38.624 kattha, with a large standard deviation of 31.883 kattha, reflecting substantial variation in land ownership. Finally, the average area allocated for wheat cultivation is 29.35 kattha, with a standard deviation of 23.98 kattha.

The majority of household heads were male, accounting for 92.9% of the respondents, while only 7.1% were female. In terms of occupation, 69.4% of respondents were engaged in agriculture, followed by 14.1% in business, 9.4% in government jobs, and 6.1% in other occupations. Regarding organizational membership, 60% of respondents were members of an organization, whereas 40% were not. When it comes to wheat training, 32.9% of respondents had received training, while a significant 67.1% had not. Additionally, 21.2% of respondents had taken out a loan, compared to 78.8% who had not. Lastly, soil testing practices were relatively low, with only 18.8% of respondents having conducted soil tests, while 81.2% had not.

Table 1 – Socio-economic and demographic characteristics of wheat growing farmers

Variables	Mean	Standard deviation
Age of HH	51.19	11.55
Household size	8.98	4.37
Male members in HH	4.33	2.243
Female members in HH	4.66	2.547
Year of schooling	7.89	3.92
Annual income(Rs.)	238882.35	87825.505
Experience in farming(years)	24.61	11.518
Land holding (kattha)	38.624	31.883
Wheat area (kattha)	29.35	23.98

Table 2 – Socio-economic and demographic characteristics of wheat growing farmers

Variables	Frequency(n=85)	Percentage
Gender of household head		
Male	79	92.9
Female	6	7.1
Occupation		
Agriculture	59	69.4
Bussiness	12	14.1
Government job	8	9.4
others	6	6.1
Membership in organization		
yes	51	60
no	34	40
Wheat training		
yes	28	32.9
no	57	67.1
Loan		
yes	18	21.2
no	67	78.8
Soil test		
yes	16	18.8
no	69	81.2

The average adoption index was determined to be 41.20%, with no farmers matching this exact value. As a result, farmers were classified into two categories: high adopters and low adopters. The same method of categorizing farmers into high and low adopters, based on their adoption index relative to the average value, was employed by (Poudel et al., 2021). High adopters are those with an adoption index above the average of 41.20%, while low adopters are those with an adoption index below this threshold.

The status of adoption of wheat technology in the study area is presented in Table 3. In the study area, 61.2% of farmers adopted the recommended wheat varieties, while 38.8%

did not. The primary recommended varieties included Vijay, Bhrikuti, NL 971, Banganga, BL4341, Zinc1, and Zinc2. Farmers who cultivated these varieties were classified as adopters, whereas those who opted for Indian varieties were categorized as non-adopters. The recommended seed rate for wheat cultivation in Nepal is 120 kg/ha (Pokharel et al., 2022). 46% of the farmers adhered to the recommended seed rate, categorizing them as adopters. In contrast, 54% of the respondents did not follow the recommended seed rate, placing them in the non-adopter category. Only 11.8% of respondents adopted the recommended sowing method, while the remaining 88.2% did not. Farmers who used the Superseeder for sowing seeds were classified as adopters, whereas those who used broadcasting methods were considered non-adopters. Similarly, 44.70% of the respondents applied fertilizer at the recommended dose while 55.30% did not. Among the respondents, 51.8% adopted irrigation practices, while 48.2% did not. Farmers with access to irrigation facilities were able to water their wheat crops during critical growth stages, using sources such as rivers, canals, and pumps. In contrast, non-adopters relied solely on rainfall or river water for irrigation. In the study, 63.5% of respondents adopted mechanized harvesting, while 36.5% did not. Farmers who used a combine harvester or reaper for wheat harvesting were classified as adopters, while those who employed other methods were categorized as non-adopters.

Table 3 – Status of adoption of wheat technology

Particulars	Adopters	Non-adopters	% of adopters	% of non-adopters
Variety	52	33	61.2	38.8
Seed rate	39	46	46	54
Method of sowing	10	75	11.8	88.2
Fertilizer application	38	47	44.70	55.30
Irrigation Schedule	44	41	51.8	48.2
Method of harvesting	54	31	63.5	36.5

The comparison of socioeconomic characteristics between adopters and non-adopters of the studied practice is summarized in Table 4. The results indicate that the difference in the years of schooling is positive and statistically significant at the 1% level, with adopters having a higher mean level of education than non-adopters. The difference in seed rate is also statistically significant at the 1% level, but in this case, non-adopters use a higher seed rate compared to adopters. Additionally, the difference in the application of DAP is significant at the 10% level, with non-adopters applying slightly more than adopters. However, no significant differences were observed in other variables such as age, household size, annual income, landholding, experience in farming, wheat yield, and the use of urea between the two groups.

Table 4 – Difference in socio-economic characteristics of high adopters and low-adopters of IWPTs in the study area

Variables	Adopters	Non adopters	Difference	T value
Age	49.79	53.39	-3.605	-1.415
Household size	8.67	9.45	-7.81	-0.860
Year of schooling	9.31	5.67	3.641	4.648***
Anuual income	237403.85	241212.12	-3808.275	-1.94
Land holding (kattha)	38.942	38.121	0.8211	0.115
Experience in farming	23.46	26.42	-2.963	-1.158
Wheat yield(kg/kattha)	2798.08	2627.33	170.744	0.343
Seed rate(kg/kattha)	6.504	7.424	-0.9204	-3.132***
Urea	4.7735	4.9727	-0.1992	-0.943
DAP	4.0927	4.0927	-0.29216	-1.437*

*Note: * and *** represents the level of significance at 10% and 1% respectively.*

To identify the factors influencing the adoption of improved wheat varieties, a probit model was utilized in this study (Table 5). The dependent variable in the model was binary, taking the value of 1 for high adopters and 0 for low adopters. The probit model yielded a pseudo R^2 of 0.5942, indicating that approximately 59% of the variation in the probability of farm households deciding to adopt improved wheat varieties is explained by the variables included in the model. The regression analysis identified five statistically significant factors affecting adoption: membership in organizations, training, subsidies, years of schooling, and access to agricultural loans. To interpret the model's results, marginal effects were derived from the regression coefficients, calculated as the marginal probability.

The coefficient for years of schooling was found to be significant at the 10% level and positively correlated with the adoption of improved wheat varieties. An additional year of schooling increased the probability of adoption by 4.4%. This finding suggests that educated farmers, who are more likely to receive information about new technologies from extension agents, are more inclined to adopt improved wheat varieties, consistent with the findings of Chandio & Yuansheng (2018).

Membership in organizations also showed a significant positive association with adoption at the 5% significance level. Farmers who were members of any organization had a 38% higher probability of adopting improved wheat varieties compared to those without membership. This result aligns with Subedi & Dhakal (2018), who found a positive relationship between the adoption of poultry manure technology and membership in organizations or cooperatives. Mignouna et al. (2011) similarly reported that social group associations facilitate the exchange of ideas and information, promoting the adoption of new technologies.

Training was another significant factor, with a 5% level of significance. Farmers who had received training related to wheat cultivation were 47% more likely to adopt improved wheat varieties compared to those who had not received such training. This finding is consistent with the work of Kunwar et al. (2018), which emphasized the importance of training in promoting the adoption of improved agricultural practices.

Subsidies also played a significant role in adoption, with a positive relationship significant at the 10% level. Farmers who received government subsidies for wheat production were 37% more likely to adopt improved wheat varieties compared to those who did not receive subsidies. This suggests that subsidies help reduce production costs and may also involve technical assistance from government agricultural officials, supporting the adoption of new technologies. This finding is in line with Mason & Smale (2013), who reported that government subsidies can enable farmers to experiment with new technologies.

Table 5 – Factors affecting the adoption of IWPTs among the farmers

Variables	Coefficient	Std. error	P>|z|	dy/dx
Age	-0.0113	0.0430	0.793	-0.00361
Household size	0.0076	0.0603	0.900	0.00247
Year of schooling	0.1360*	0.0738	0.065	0.04434
Income	-2.34e-06	3.03e-06	0.440	-7.63e-07
Experience	-0.0193	0.03959	0.625	-0.00631
Land holding	0.01078	0.0070	0.877	0.00035
Membership	1.1401**	0.5660	0.044	0.38182
Training	1.9482**	0.8069	0.016	0.47637
Subsidy	1.0477*	0.5705	0.066	0.37215
Loan	-1.0639*	0.6233	0.088	-0.34679
Constant	-0.7862	1.7630	0.656	
Number of observations		85		
Log-likelihood		-23.042		
LR Chi^2 (10)		67.47		
Prob.> chi^2		0.00000		
Predicted probability		0.737		
Pseudo R^2		0.5942		

*Note: *,** and *** represent level of significance at 10%, 5% and 1% respectively.*

On the other hand, the coefficient for agricultural loans was significant at the 10% level but negatively associated with the adoption of improved wheat varieties. Farmers who had taken loans were 34% less likely to adopt improved varieties compared to those who had not taken loans. This may be because farmers who take loans prefer to invest in non-agricultural ventures with higher returns. However, this finding contrasts with studies by Girma (2022) and Rayhan et al. (2023) which found that access to credit was positively related to the adoption of agricultural technologies. Fear of income loss or inability to repay loans under certain agricultural conditions can make farmers reluctant to use credit (Lemecha, 2023). credit obtained from non-specialized financial institutions or intended for purposes other than directly financing agricultural inputs may not effectively encourage technology adoption. Additionally, credit conditions like collateral requirements or high transaction costs can discourage farmers from taking out loans or fully using them for adopting technology, resulting in a negative association in the study by Balana & Oyeyemi (2022).

The indexing technique was employed to prioritize the challenges faced by wheat farmers. This method, previously utilized by Subedi et al. (2019) to rank the problems encountered by wheat growers in the eastern and western Terai regions of Nepal, was applied in this study. According to the survey results, inadequate irrigation emerged as the most significant issue, followed closely by the limited availability of fertilizer (Table 6). The lack of agricultural machinery, access to high-quality improved seeds, and the prevalence of diseases and insect pests were ranked as the third, fourth, and fifth most pressing concerns, respectively, according to the farmers' perceptions.

Table 6 – Ranking of the problems in wheat production in study area

Problems	Index value	Rank
Lack of quality improved seeds	0.47	4
Poor availability of fertilizer	0.82	2
Lack of proper irrigation	0.86	1
Lack of agricultural machines	0.73	3
Disease and insect pest prevalence	0.41	5

This aligns with Subedi et al. (2019), who identified poor seed quality, limited fertilizer availability, and insufficient irrigation as major challenges in wheat cultivation in Nepal's Terai region. Similarly, Dawadi et al. (2023) emphasized that inadequate irrigation facilities, delays in accessing agricultural inputs, and pest infestations are significant issues impacting productivity and profitability.

CONCLUSION

The study evaluated the adoption levels of improved wheat management practices and identified factors influencing these practices among farmers in the study area. It was found that 61.2% of farmers adopted recommended wheat varieties, with moderate adoption rates for seed rate, irrigation schedules, harvesting methods, and fertilizer application but very low adoption for sowing methods. Significant differences between high and low adopters were noted in terms of years of schooling, seed rate, and DAP usage. Probit regression analysis indicated that years of schooling, membership in agricultural organizations, participation in training, and government subsidies positively influenced the adoption of improved practices, while loans negatively impacted adoption. Major challenges faced by wheat farmers included inadequate irrigation, poor fertilizer availability, lack of machinery, quality seeds, and pest and disease issues.

To improve adoption rates, it is recommended to enhance extension services and training programs on advanced wheat production techniques, encourage farmer participation in agricultural organizations, and increase government subsidies for wheat cultivation.

REFERENCES

1. Balana, B. B., & Oyeyemi, M. A. (2022). Agricultural credit constraints in smallholder farming in developing countries: Evidence from Nigeria. World Development Sustainability, 1, 100012. https://doi.org/10.1016/j.wds.2022.100012.

2. Chandio, A., & Yuansheng, J. (2018). Factors influencing the adoption of improved wheat varieties by rural households in Sindh, Pakistan. AIMS Agriculture and Food, 3, 216–228. https://doi.org/10.3934/agrfood.2018.3.216.
3. Chimdesa, M., Asefa, K., & Seyum, M. (2018). Participatory Variety Selection of Improved Bread Wheat Varieties for Moisture Stress Areas of Guji Zone, Southern Oromia. International Journal of Research in Agriculture and Forestry, 5(4), 1–6. https://www.ijraf.org/papers/v5-i4/1.pdf.
4. Dawadi, B., Ghimire, S., & Gautam, N. (2023). Assessment of Productivity, Profit, and Problems Associated with Wheat (Triticum aestivum L.) Production in West Nawalparasi, Nepal. Agro Environmental Sustainability, 1(2), 122–132. https://doi.org/10.59983/s2023010205.
5. Girma, Y. (2022). Credit access and agricultural technology adoption nexus in Ethiopia: A systematic review and meta-analysis. Journal of Agriculture and Food Research, 10, 100362. https://doi.org/10.1016/j.jafr.2022.100362.
6. Kapur, Dr. R. (2024). Utilization of Traditional Methods and Strategies by Rural Individuals. International Journal of Management and Humanities, 22(27), 22–27. https://doi.org/10.35940/ijmh.K1726.10100624.
7. Kunwar, B., Dhakal, D., & Panta, H. (2018). Determinants of smallholders' adoption of off-season vegetable production technology in Okhaldhunga District of Nepal. Journal of the Institute of Agriculture and Animal Science, 33, 221. https://doi.org/10.3126/jiaas.v33i0.20708.
8. Lemecha, M. E. (2023). Credit constraint and agricultural technology adoptions: Evidence from Ethiopia. Agricultural Finance Review, 83(3), 395–415. https://doi.org/10.1108/AFR-06-2022-0075.
9. Mason, N. M., & Smale, M. (2013). Impacts of subsidized hybrid seed on indicators of economic well-being among smallholder maize growers in Zambia. Agricultural Economics, 44(6), 659–670. https://doi.org/10.1111/agec.12080.
10. MoALD. (2022). Statistical information on Nepalese agriculture 2021/22. Kathmandu, Nepal: Planning & Development Cooperation Coordination Division. https://moald.gov.np/wp-content/uploads/2023/08/Statistical-Information-on-Nepalese-Agriculture-2078-79-2021-22.pdf.
11. Mignouna, D., Manyong, V., Rusike, J., Mutabazi, K., & Senkondo, E. (2011). Determinants of adopting imazapyr-resistant maize technologies and its impact on household income in Western Kenya. AgBioForum, 14, 158–163. https://agbioforum.org/wp-content/uploads/2021/02/AgBioForum-14-3-158.pdf.
12. Pokharel, B. B., Joshi, B. P., Bhat, R. B., Joshi, D., Joshi, H., Joshi, Y., Bista, R., Chaudhary, R., & Giri, R. (2022). Wheat-based Mixed-cropping Evaluation in the River-basin Areas of Far-western Nepal. Agronomy Journal of Nepal, 180–185. https://doi.org/10.3126/ajn.v6i1.47968.
13. Poudel, D., Yadav, R. K., Department of Plant Pathology, Agriculture and Forestry University, Rampur, Chitwan, Nepal, Gauli, B., F (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.
14. Prathapachandran, N., & Devadas, V. (2023). Sustainable and Traditional Agricultural Practices to Reinforce Income Dynamics among Tribal Communities in Rural Wayanad, Kerala, India. Agricultural & Rural Studies, 1(3), 0017. https://doi.org/10.59978/ar01030017.
15. Ramadas, S., Kiran Kumar, T. M., & Pratap Singh, G. (2020). Wheat Production in India: Trends and Prospects. In F. Shah, Z. Khan, A. Iqbal, M. Turan, & M. Olgun (Eds.), Recent Advances in Grain Crops Research. IntechOpen. https://doi.org/10.5772/intechopen.86341.
16. Rayhan, S. J., Rahman, Md. S., & Lyu, K. (2023). The Role of Rural Credit in Agricultural Technology Adoption: The Case of Boro Rice Farming in Bangladesh. Agriculture, 13(12), 2179. https://doi.org/10.3390/agriculture13122179.

17. Sharma, A., Manpoong, C., Pandey, H., Gupta, C. K., Baja, Y., Singh, M. S., & Mounglang, C. C. (2023). A Comprehensive Update on Traditional Agricultural Knowledge of Farmers in India. In A. Kumar, P. Singh, S. Singh, & B. Singh (Eds.), Wild Food Plants for Zero Hunger and Resilient Agriculture (pp. 331–386). Springer Nature Singapore. https://doi.org/10.1007/978-981-19-6502-9_14.
18. Shewry, P. R., & Hey, S. J. (2015). The contribution of wheat to human diet and health. Food and Energy Security, 4(3), 178–202. https://doi.org/10.1002/fes3.64.
19. Subedi, S., & Dhakal, D. (2018). Economics of poultry manure as an alternative to chemical fertilizer for agricultural production in Nepal. Journal of the Institute of Agriculture and Animal Science, 259–268. https://doi.org/10.3126/jiaas.v33i0.20713.
20. Subedi, S., Ghimire, Y., Adhikari, S., Devkota, D., Poudel, H., & Sapkota, B. (2019). Adoption of improved wheat varieties in eastern and western Terai of Nepal. Journal of Agriculture and Natural Resources, 2, 85–94. https://doi.org/10.3126/janr.v2i1.26047.
21. Timsina, K., Gairhe, S., Koirala, P., & Shrestha, J. (2019). Investment on wheat research and its effect: A case of Nepal. Agriculture Science and Technology, 11(2), 138–143. https://www.cabidigitallibrary.org/doi/pdf/10.5555/20193332558.
22. Wieser, H., Koehler, P., & Scherf, K. A. (2020). Nutritional value of wheat. In Wheat—An Exceptional Crop (pp. 133–148). Elsevier. https://doi.org/10.1016/B978-0-12-821715-3.00006-X.
23. Yamane, T. (1973). Statistics: An Introductory Analysis.