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Factors Influencing Agricultural Diversification: The Case of Northern Bangladesh

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HIGHLIGHTS

- Simpson's Index of Diversity showed that 85.1% of farmers in northern Bangladesh exhibited low to medium levels of agricultural diversification.
- Decision-making ability, risk orientation, credit-seeking behavior, extension media contact, and market accessibility positively influenced agricultural diversification.
- Farm size was the only factor found to have a significant negative influence on agricultural diversification.

ARTICLE INFO

Keywords: Simpson's index of diversity, Multiple linear regression, Smallholder farmers, Extension media contact, Market accessibility.

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ABSTRACT

Agricultural diversification has significant positive impacts, including generating more rural employment and higher incomes, creating new market opportunities, improving nutritional standards, and empowering women. However, due to socio-economic, psychological, communicational, technological, infrastructural, and climate aspects, farmers' agricultural diversification decisions are poorly understood. The study aimed to measure the extent of agricultural diversification and the influence of selected factors on it in northern Bangladesh in 2024. A multi-stage sampling method was utilized to pick 348 participants from the northern districts of Kurigram, Thakurgaon, and Dinajpur in Bangladesh. Simpson's Index of Diversity results indicate that 85.1% of farmers had low to medium agricultural diversification, with the overall diversification level in northern Bangladesh ranging from 0.534 to 0.665. Multiple Linear Regression model reveals that decision-making ability, risk orientation, credit-seeking behavior, extension media contact, and market accessibility had a positive effect on agricultural diversification, whereas farm size was found to negatively influence the adoption of agricultural diversification. Based on these findings, it is recommended that extension agencies and policymakers consider these factors when designing and implementing agricultural diversification programs in northern Bangladesh. Further research is suggested to explore smallholder farmers' preferences for agricultural diversification in the region.

INTRODUCTION

Agriculture continues to play a central role in Bangladesh's rural economy by providing livelihoods, ensuring domestic food supply, supplying raw materials for agro-based industries, and generating rural employment (Australian Centre for International Agricultural Research [ACIAR], 2024; International Food Policy Research Institute [IFPRI], 2024). Nearly two-thirds of the rural population is directly engaged in agricultural production (World Bank, 2016), and farm households are commonly categorized as landless, marginal, small, medium, and large based on landholding status (Department of Agricultural Extension [DAE], 1999). Smallholders dominate the sector; about 84% of farming households cultivate less than one hectare and largely depend on rice-based

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production systems (Islam et al., 2018; De Pinto et al., 2019). Although agriculture contributes only 11.61% to national GDP, it remains vital to rural livelihoods, supporting over 50% of employment and sustaining nearly 70% of households (Bangladesh Bureau of Statistics [BBS], 2023a; Imdad, 2021).

Bangladesh's agriculture is increasingly constrained by climate change–induced hazards and persistent socio-economic challenges that undermine productivity and threaten food security (Mondal, 2010; Ghose, 2014; Sheikh & Pervez, 2025). Erratic rainfall, droughts, heatwaves, floods, and riverbank erosion are particularly severe in northern Bangladesh, including the Barind Tract and the Tista and Jamuna–Brahmaputra basins. These vulnerabilities intensify production risks for smallholder farmers, contributing to persistent poverty and high food insecurity; the Rangpur Division reports approximately 29.98% of the population experiencing moderate or severe food insecurity (BBS, 2023b). In response, agricultural diversification has been promoted to enhance farm resilience, stabilize income, and improve rural livelihoods. The Government of Bangladesh emphasizes diversification through high-value crops, livestock, poultry, and fisheries, supported by improved seed systems, irrigation expansion, credit access, and extension services (Miah et al., 2013; De Pinto et al., 2019; United Nations Country Team, 2022; Nandi et al., 2024). Diversification reduces dependence on a single crop, expands income opportunities, and strengthens adaptive capacity under climatic and market uncertainties (Winters et al., 2006; Mastura et al., 2023). In Bangladesh, diversification typically involves a shift from rice monoculture toward non-rice crops, fruits and vegetables, and integrated crop–livestock–fisheries systems (Mastura et al., 2023).

Despite policy emphasis, rice dominates cropping systems, occupying about 75% of cropped land and over 80% of irrigated areas (Bangladesh Rice Research Institute [BRRI], 2023). In northern Bangladesh, Boro rice–Fallow–T. Aman rice rotations account for over half of cultivated land (International Rice Research Institute [IRRI], 2024). Nevertheless, diversification is gradually increasing, though trends fluctuate and vary spatially (Brown et al., 2023; Rashid et al., 2024; Nandi et al., 2025). Empirical evidence shows diversification can enhance farm income, employment, dietary diversity, food security, and women's economic participation (Joshi et al., 2004; Abro & Sadaqat, 2010; Islam et al., 2024; Nahar et al., 2024; Jannat et al., 2025). However, farmers' diversification decisions are shaped by socio-economic, psychological, institutional, and ecological factors, including age, education, farm size, irrigation access, labor, credit, markets, and extension services (Rashid et al., 2024; Nahar et al., 2025).

Although global studies on agricultural diversification are extensive (Rai, 2015; Bharadwaj, 2019; Kumari, 2021; Mukherjee, 2021; Dudhatara et al., 2022; Rathod, 2023; Nepali et al., 2024; Shekhar et al., 2024), evidence from Bangladesh, especially in agro-ecologically vulnerable riverine basins, remains limited. Most studies focus mainly on crop diversification, with less attention to integrated enterprises and drivers of farmers' decisions. Addressing this gap, the present study assesses the level of agricultural diversification among farm households in northern Bangladesh and identifies the key factors influencing diversification choices, with implications for extension strategies, policy interventions, and sustainable rural development.

METHODOLOGY

This study was conducted in the Kurigram, Thakurgaon, and Dinajpur districts, representing the three primary zones: Charland, Upland, and Barind Tract of northern Bangladesh. A multi-stage sampling method was applied to select 348 respondents using Yamane's (1967) formula. Data were collected via in-person interviews conducted by local enumerators from August to December 2024.

To assess agricultural diversification, which was the first objective, Simpson's index of diversity appeared to be an appropriate choice for this study because of its computational simplicity, robustness, and wider applicability (Dudhatara, 2021; Khatun & Roy, 2012). Therefore, this study employed the Simpson's Index of Diversity (SID) to assess the extent of agricultural diversification among the selected farm households in northern Bangladesh. According to Addisu (2017), the SID is influenced by both the number of income sources (richness) and the proportion of income from each source (evenness or balance). Considering this, the income of different agricultural activities was categorized into five (Cereals, field crops, horticulture crops, livestock, and fisheries) for computing agricultural diversification.

$$SID = 1 - \sum_{i=1}^{n} p_i^2$$

Where, SID is Simpson's Index of Diversity, n is the number of income sources, and p_i is the proportion of income coming from the i^{th} income source. Accordingly, Agricultural Diversity Index (ADI) was estimated using the equation as follows:

$$ADI = 1 - \sum_{i=1}^{N} \{(\frac{A}{Ti})^2 + (\frac{B}{Ti})^2 + (\frac{C}{Ti})^2 + (\frac{D}{Ti})^2 + (\frac{E}{Ti})^2\}$$

Where, Ti = Total household income, A = Income from cereal crops, B = Income from field crops, C = Income from horticulture crop, D= Income from livestock and E = Income from fisheries. ADI scores range between 0 and 1; a value of zero (0) denotes perfect specialization, while a value of one (1) denotes perfect agricultural diversification.

The second objective was to examine the influence of selected factors on agricultural diversification. Based on prior studies, 15 explanatory variables were hypothesized, categorized as: socioeconomic factors (age, education, family size, farm size, experience, non-agricultural income, irrigation intensity, mechanization), psychological factors (decision-making ability, risk orientation, attitude toward diversification), and institutional factors (social participation, credit-seeking behavior, extension media contact, market accessibility). The influence of these factors was explored in three steps: first, correlation analysis; second, the multiple linear regression; and finally, the stepwise multiple regression. The similar steps were followed by Mishra et al. (2025), Jayasingh and Mishra (2024), Rahman et al. (2024), and Shahin et al. (2024) to explore the influence of selected factors in their respective studies.

RESULTS

Extent of agricultural diversification practiced by farmers

The extent of agricultural diversification practiced by farmers in northern Bangladesh was measured using the Agricultural

Diversification Index (ADI), as presented in Table 1. The average ADI value across the three situations was 0.599, indicating a medium level of agricultural diversification in the study area.

Table 1. Distribution of the respondents according to their agricultural diversification index

Categories	Respondents (n=348)	
	Frequency	Percentage
Low diversification (≤0.533)	55	15.8
Medium diversification (0.534-0.665)	241	69.3
High diversification (>0.665)	52	14.9
Observed range	0.314-0.749	
Mean	0.599	
SD	0.066	

Table 2. Relationship of independent variables with agricultural diversification

Dependent variable / Independent variables	Coefficient of correlation (r)
Agricultural diversification	
Age (X_1)	0.058
Educational qualifications (X_2)	0.162**
Family size (X_3)	0.165**
Farm size (X_4)	-0.341**
Farming experience (X_5)	0.201**
Non-agricultural income (X_6)	-0.075
Irrigation intensity (X_7)	0.025
Farm mechanization (X_8)	-0.028
Decision making ability (X_9)	0.445**
Risk orientation (X_{10})	0.438**
Attitude towards agricultural diversification (X_{11})	0.188**
Social participation (X_{12})	0.178**
Credit seeking behavior(X_{13})	0.387**
Extension media contact (X_{14})	0.466**
Market accessibility (X_{15})	0.482**

** Significant at 0.01 level; tabulated value (r) = 0.138 & with 346 d.f

Table 1 also shows that 69.3 percent of farm families were classified as having medium agricultural diversification, followed by 15.8 percent with low diversification and 14.9 percent with high diversification. The probable reason for these findings might be that the farmers had small farm sizes, but they had adequate cropping intensity, which reflects the efficient use of farmland. It is also important because the majority of the respondents depend on farm produce to ensure household food security.

Factors influencing the agricultural diversification

The influence of selected factors on agricultural diversification was examined in three stages: correlation analysis, multiple linear regression, and stepwise multiple regression. Initially, Pearson's correlation coefficient (r) was estimated to test the null hypothesis regarding the relationships between agricultural diversification and the selected explanatory variables. The results of the correlation analysis indicate (Table 2) that, out of the fifteen variables considered, eleven were significantly correlated with agricultural diversification, namely educational qualification (r = 0.162), family size (r = 0.165), farm size (r = –0.341), farming experience (r = 0.201), decision-making ability (r = 0.445), risk orientation (r = 0.438), attitude towards agricultural diversification (r = 0.188), social participation (r = 0.178), credit-seeking behavior (r = 0.387), extension media contact (r = 0.466), and market accessibility (r = 0.482).

The correlation analysis can only show the direction of the relationships between variables; it is unable to highlight their influences (Sarmin & Hasan, 2019). So, these eleven variables were incorporated in multiple regression analysis (both enter and stepwise methods) to ascertain the extent to which various explanatory variables influenced agricultural diversification. The results of the multiple regression analysis are presented in Table 3. Prior to regression modelling, the Variance Inflation Factor (VIF) was employed to assess multicollinearity among the explanatory variables. The results indicated that multicollinearity was not a concern, as all VIF values were below 5.0 and tolerance values exceeded 0.25 (James et al., 2021).

Table 3. Multiple Linear Regression (MLR) with significant factors on agricultural diversification

Variable codes	Independent variables	Unstd. co-efficient B	Std. co-efficient Beta	t-values	Sig. level	Collinearity statistics	
						Tolerance	VIF
X_2	Educational qualifications	0.001	0.053	1.189	0.235	0.743	1.346
X_3	Family size	0.002	0.058	1.418	0.157	0.874	1.144
X_4	Farm size	-0.032	-0.210	-5.141	0.000	0.869	1.151
X_5	Farming experience	0.000	0.060	1.412	0.159	0.812	1.232
X_9	Decision making ability	0.003	0.244	5.932	0.000	0.861	1.161
X_{10}	Risk orientation	0.002	0.169	3.622	0.000	0.671	1.490
X_{11}	Attitude towards agricultural diversification	0.000	0.026	.613	0.541	0.793	1.261
X_{12}	Social participation	-0.002	-0.035	-.797	0.426	0.749	1.335
X_{13}	Credit seeking behavior	0.004	0.123	2.710	0.007	0.706	1.417
X_{14}	Extension media contact	0.003	0.153	3.216	0.001	0.645	1.551
X_{15}	Market accessibility	0.007	0.229	5.221	0.000	0.756	1.322

Constant = 0.344, R= 0.715, R^2 =0.512, Adjusted R^2 =0.496, F value=32.019, P= 0.000

Table 4. Step-wise multiple regression analysis showing contributing variables to agricultural diversification (n = 348)

Model	Independent variables (X)	Unstd. Coeff. (B)	Std. Coeff. (β)	R^2 change	t-value	Sig. F change
Constant+ X_{15}	Market accessibility (X_{15})	0.008	0.248	0.232	5.868	0.000
Constant+ X_{15}+X_9	Decision making ability (X_9)	0.003	0.240	0.121	5.885	0.000
Constant+ X_{15}+X_9+X_{14}	Extension media contact (X_{14})	0.004	0.175	0.069	3.869	0.000
Constant+ X_{15}+X_9+X_{14}+X_4	Farm size (X_4)	-0.031	-0.201	0.037	-5.090	0.000
Constant+ X_{15}+X_9+X_{14}+X_4+ X_{10}	Risk orientation (X_{10})	0.002	0.181	0.033	4.142	0.000
Constant+ X_{15}+X_9+X_{14}+X_4+ X_{10}+ X_{13}	Credit seeking behavior (X_{13})	0.004	0.122	0.012	2.818	0.000

Constant = .359, R= 0.709, R^2 = 0.503, F value= 57.522, P=0.000

The results of the multiple linear regression analysis indicate that only six variables farm size, decision-making ability, risk orientation, credit-seeking behavior, extension media contact, and market accessibility had a statistically significant influence on agricultural diversification in northern Bangladesh. The coefficient of determination (R^2) revealed that all independent variables together explained 51.2% of the variation in agricultural diversification. The adjusted R^2 value indicates that 49.6% of the variation in agricultural diversification is explained by the variables included in the model. The F-statistic (32.019) was significant at $p < 0.001$, confirming the overall significance of the regression model.

The results further suggest that farmers with smaller farm sizes and higher levels of decision-making ability, risk orientation, credit-seeking behavior, extension media contact, and market accessibility exhibited a greater extent of agricultural diversification. To assess the relative contribution of these significant predictors, the six variables (X_4, X_9, X_{10}, X_{13}, X_{14}, and X_{15}) were subsequently included in a stepwise regression analysis, and the results are presented in Table 4.

The stepwise regression analysis indicates that the farmers' market accessibility was found to have a great influence and accounted for 23.2% of the total variation in the extent of agricultural diversification. The other factors, in order of their extent of contribution, were decision-making ability (12.1%), extension media contact (6.9%), farm size (3.7%), risk orientation (3.3%), and credit-seeking behavior (1.2%).

DISCUSSION

The predominance of medium-level agricultural diversification observed in this study may be attributed to small landholdings, relatively high cropping intensity, efficient use of limited farm resources, and strong reliance on agriculture for household food security. Under such conditions, diversification functions mainly as a risk-management strategy rather than a pathway to specialization. Farmers' moderate to high levels of risk orientation, decision-making ability, and access to extension services, credit, and markets likely facilitated diversification. These findings align with earlier studies reporting a dominance of medium-level diversification (Miah et al., 2013; Rai, 2015; Bharadwaj, 2019; Kumari, 2021; Dudhatara et al., 2022; Rathod, 2023; Shitu et al., 2024). However, the results contrast with Bagri (2020), who reported that nearly half of the farmers in Panna district, Madhya Pradesh, belonged to the low diversification category. Such differences may reflect variations in agro-climatic conditions, institutional support, market access, and resource endowments. Recent studies from Bangladesh and the Eastern Gangetic Plains also report moderate diversification shaped by socio-economic and institutional factors (Nahar et al., 2024; Islam et al., 2024; Jackson et al., 2025; Nandi et al., 2025), underscoring the context-specific nature of diversification.

Among the explanatory variables, market accessibility exerted the strongest positive influence on agricultural diversification, accounting for approximately 23.2% of the variation. Improved rural infrastructure, transport facilities, and communication technologies in Bangladesh have increasingly connected farmers to markets, enabling better price realization, timely information flow, and access to diversified input–output channels. Similar positive relationships between market access and diversification have been documented by Jackson et al. (2025) and Reddy (2019) for livelihood diversity, Kavitha (2021) for integrated farming systems, Rehan (2020) for on-farm diversification, and Chowdhury (2017) for vertical crop diversification.

Farmers' decision-making ability was another significant determinant, contributing about 12.1% to diversification. This likely reflects improved access to information, education, farming experience, and exposure to new technologies, which facilitate informed production choices and encourage a shift from subsistence-oriented to market-oriented farming systems. Rahman (2008), Nain and Kumar (2010) similarly reported that education and farming experience enhance farmers' crop choice behavior, thereby supporting diversification and commercialization.

Regression results further revealed that extension media contact had a positive and statistically significant influence, explaining approximately 6.9% of the variation in diversification. This effect may be attributed to the sustained efforts of governmental and non-governmental organizations in disseminating agricultural information and advisory services. In Bangladesh, extension contact has been shown to play a crucial role in shaping farmers' production decisions and adoption of diversified practices (Rahman, 2009). Comparable findings have been reported in India by Rai (2015), Bharadwaj (2019), Bagri (2020), Kumari (2021), Dudhatara et al. (2022), and Rathod (2023). Recent evidence also highlights that frequent extension interactions enhance adoption of diversified and integrated farming systems (Islam et al., 2024; Nahar et al., 2024; Jackson et al., 2025).

In contrast, farm size had a significant negative effect on agricultural diversification, accounting for about 3.7% of the variance. Larger farms often concentrate on a limited number of high-yield or commercially profitable crops, whereas smaller farms diversify to reduce production risks, ensure household food security, and generate multiple income sources. This inverse relationship is supported by

studies from Bangladesh (Rahman, 2009; Islam & Hossain, 2017) and other contexts (Pfeifer et al., 2009; Kankwamba et al., 2018; Dudhatara et al., 2022; Kumari, 2021; Felix & Ramappa, 2023; Rathod, 2023). Similar patterns have also been observed in livelihood diversification studies (Pal et al., 2017; Nirmala et al., 2024).

Risk orientation positively and significantly influenced diversification, explaining approximately 3.3% of the variation. Farmers with higher risk tolerance are more willing to adopt diversified enterprises to cope with climate variability, income uncertainty, and food security challenges. Previous studies in Bangladesh and India also confirm the role of risk perception in shaping diversification decisions (Rahman, 2009; Islam et al., 2017; Rai, 2015; Bharadwaj, 2019; Bagri, 2020). Credit-seeking behavior likewise showed a positive, though smaller, contribution, reinforcing evidence that access to financial resources enables farmers to invest in diversified production systems (Rashid et al., 2024; Rai, 2015; Bagri, 2020; Rathod, 2023).

CONCLUSION

The extent of agricultural diversification in northern Bangladesh was moderate, with 85.1% of farmers exhibiting low to medium levels of diversification. Correlation analysis revealed that educational qualification, family size, farming experience, decision-making ability, risk orientation, attitude towards agricultural diversification, social participation, credit-seeking behavior, extension media contact, and market accessibility had significant positive relationships with agricultural diversification, while farm size showed a significant negative relationship. The multiple linear regression analysis further identified six key determinants-farm size, decision-making ability, risk orientation, credit-seeking behavior, extension media contact, and market accessibility as having a significant influence on diversification. Overall, higher diversification was associated with smaller farm size and stronger institutional and behavioral capacities. Therefore, extension agencies and policymakers should prioritize these factors with particular emphasis on smallholder farmers when designing and implementing agricultural diversification programs in northern Bangladesh and similar agro-ecological contexts.

DECLARATIONS

Ethics approval and informed consent: Informed consent was sought from the respondents and their organisations regarding the study during the course of the data collection.

Conflict of interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest. The authors declare that during the preparation of this work, they thoroughly reviewed, revised, and edited the content as needed. The authors take full responsibility for the final content of this publication.

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REFERENCES

Abro, A., & Sadaqat, M. (2010). Poverty alleviation through diversifying towards high value crops in Pakistan. *International Journal of Business Management and Economic Research, 1*(1), 1–8. https://www.ijbmer.com/docs/volumes/vol1issue1/ijbmer2010010101.pdf

Addisu, Y. (2017). Livelihood strategies and diversification in western tip pastoral areas of Ethiopia. *Pastoralism, 7*(1), 9. https://doi.org/10.1186/s13570-017-0083-3

Australian Centre for International Agricultural Research. (2025). *Annual operational plan 2024–25: South Asia region program – Bangladesh* (Report). https://www.aciar.gov.au/sites/default/files/2025-04/ACIAR-AOP2024-25-South-Asia-Bangladesh.pdf

Bagri, S. (2020). *Agriculture diversification among the marginal & small farmers of Panna District* (Doctoral dissertation, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Rewa). https://krishikosh.egranth.ac.in/items/06771d51-c8ea-4915-bb8e-736b9a1bfb5a

Bangladesh Rice Research Institute. (2023). *Rice in Bangladesh*. Bangladesh Rice Knowledge Bank (BRKB). https://www.knowledgebank-brri.org/riceinban.php

Bangladesh Bureau of Statistics. (2023a). *Statistical Year Book Bangladesh 2022* (42nd ed.). Bangladesh Bureau of Statistics, Ministry of Planning, Government of the People's Republic of Bangladesh. https://bbs.portal.gov.bd/sites/default/files/files/bbs.portal.gov.bd/page/b2db8758_8497_412c_a9ec_6bb299f8b3ab/2023-06-26-09-19-2edf60824b00a7114d8a51ef5d8ddbce.pdf

Bangladesh Bureau of Statistics. (2023b). *Food security statistics 2023*. Bangladesh Bureau of Statistics, Ministry of Planning, Government of the People's Republic of Bangladesh. https://bbs.portal.gov.bd/sites/default/files/files/bbs.portal.gov.bd/page/b343a8b4_956b_45ca_872f_4cf9b2f1a6e0/2024-03-16-15-54-15eb3ff72d71e6c5680a6b8111b197cc.pdf

Bharadwaj, A. J. (2019). *A study on the extent of diversification and level of livelihood security of farmers in the north Bank plains zone of Assam* (M.S. Thesis, Biswanath College of Agriculture, Assam Agricultural University, Biswanath Chariali, Assam, India). https://krishikosh.egranth.ac.in/items/d85d6b56-d878-479a-9691-b1904c10886e

Brown, B., Chaudhary, A., Sharma, A., Timsina, P., Karki, E., Rashid, M. M., Das, K. K., Ghosh, A., Rahman, W., & Jackson, T. M. (2023). How diverse are farming systems on the Eastern Gangetic Plains of South Asia? A multi-metric and multi-country assessment. *Farming Systems, 1*(2), 100017. https://doi.org/10.1016/j.farsys.2023.100017

Chowdhury, M. J. (2017). *Determinants of vertical crop diversification in peri-urban area* (M.S. Thesis, Sher-e-Bangla Agricultural University, Dhaka). http://archive.saulibrary.edu.bd:8080/xmlui/handle/123456789/700

DAE. (1999). *Agricultural Extension Manual*. Department of Agricultural Extension, Ministry of Agriculture, Government of the People's Republic of Bangladesh.

De Pinto, A., Seymour, G., Bryan, E., & Bhandary, P. (2019). Women's empowerment and crop diversification in Bangladesh:

A possible pathway to climate change adaptation and better nutrition (Vol. 1849). International Food Policy Research Institute.

Dudhatara, H. C., Patel, J. K., & Raval, K. N. (2022). Agricultural diversification among the farmers. *Gujarat Journal of Extension Education, 33*(1), 132–135. https://doi.org/10.56572/gjoee.2022.33.1.0027

Dudhatara, H. C. (2021). *Diversification in agricultural among the farmers of Banaskantha district* (M.S. Thesis, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, India). https://krishikosh.egranth.ac.in/items/8f8cec3b-06ee-4666-8a14-fa0808bd1359

Felix, K. T., & Ramappa, K. B. (2023). An economic analysis of crop diversification and dynamics of cropping pattern in Karnataka, India. *Humanities & Social Sciences Communications, 10*(1), 1–9. https://doi.org/10.1057/s41599-023-02078-y

Ghose, B. (2014). Fisheries and aquaculture in Bangladesh: Challenges and opportunities. *Annals of Aquaculture and Research, 1*(1), 1–5.

Imdad, M. P. (2021, February 11). Revitalising Bangladesh's agriculture sector. *The Daily Star*. https://www.thedailystar.net/supplements/30th-anniversary-supplements/news/revitalising-bangladeshs-agriculture-sector-2042629

International Food Policy Research Institute. (2024). *Food security and nutrition in Bangladesh* (Report). https://bangladesh.ifpri.info/files/2024/11/IFPRI_Food-Security-in-Bangladesh_Report_November-2024.pdf

International Rice Research Institute. (2024). *Unlocking agricultural diversification and intensification in Northern Bangladesh with short-duration aman rice*. https://www.irri.org/news-and-events/news/unlocking-agricultural-diversification-and-intensification-northern-bangladesh

Islam, M. S., Jahan, H., Ema, N. S., & Ahmed, M. R. (2024). Determinants of crop diversification and its impact on farmers' income: A case study in Rangpur District, Bangladesh. *JSFA Reports, 4*(10), 352–361. https://doi.org/10.1002/jsf2.216

Islam, A. H. M. S., von Braun, J., Thorne-Lyman, A. L., & Ahmed, A. U. (2018). Farm diversification and food and nutrition security in Bangladesh: Empirical evidence from nationally representative household panel data. *Food Security, 10*(3), 701–720. https://doi.org/10.1007/s12571-018-0806-3

Islam, M. M., & Hossain, M. E. (2017). Determinants of crop diversification in Northern Bangladesh. *Journal of Jessore University of Science and Technology, 19*, 2521.

Islam, M. R., Hossain, M., & Karim, R. (2017). Farmers' risk perception and crop diversification in northern Bangladesh. *Journal of Agricultural Extension and Rural Development, 9*(5), 88–97.

Jackson, T. M., Nandi, R., Jannat, A., Ghosh, A., Hajra, G. D., Mitra, B., Rashid, M. M., Bista, S., Chaudhary, A., Timsina, P., Karki, E., Chakma, K. R., Rana, G., & Kishore, A. (2025). Patterns of livelihood diversification in farming systems of the Eastern Gangetic Plains. *Agricultural Systems, 227*, 104346. https://doi.org/10.1016/j.agsy.2025.104346

James, G., Witten, D., Hastie, T., & Tibshirani, R. (2021). *An introduction to statistical learning: With applications in R* (2nd ed.). Springer

Jannat, A., Kishore, A., Jackson, T., Rahman, M. W., Haque, M. M., Rashid, M. M., Chowdhury, T., Das, K. K., & Joshi, I. R. (2025). What enables agricultural diversification in the Eastern Gangetic Plains? Learning from past success. *Urban Agriculture & Regional Food Systems, 10*(1), e70019. https://doi.org/10.1002/uar2.70019

Jayasingh, D. K., & Mishra, B. (2024). Factors influencing occupational diversification among farmers in Odisha: A quantitative analysis. *Indian Journal of Extension Education, 60*(3), 37–41. https://doi.org/10.48165/IJEE.2024.60308

Joshi, P. K., Gulati, A., Birthal, P. S., & Tewari, L. (2004). Agriculture diversification in South Asia: Patterns, determinants and policy implications. *Economic and Political Weekly*, 2457–2467. https://doi.org/10.2307/4415148

Kankwamba, H., Kadzamira, M., & Pauw, K. (2018). How diversified is cropping in Malawi? Patterns, determinants and policy implications. *Food Security, 10*(2), 323–338. https://doi.org/10.1007/s12571-018-0771-x

Kavitha, S. (2021). *A critical study on farmers of integrated farming system in Telangana state* (PhD Thesis, College of Agriculture, Rajendranagar, Hyderabad). https://krishikosh.egranth.ac.in/items/791c635a-87e1-453b-a3f6-47102f834246

Khatun, D., & Roy, B. C. (2012). Rural livelihood diversification in West Bengal: Determinants and constraints. *Agricultural Economics Research Review, 25*(1), 115–124. https://doi.org/10.22004/ag.econ.126049

Kumari, J. (2021). *A study on agricultural diversification practices by farmers in Udham Singh Nagar District of Uttarakhand* (M.S. Thesis, G. B. Pant University of Agriculture & Technology Pantnagar, Uttarakhand, India). https://krishikosh.egranth.ac.in/items/3231e1da-8d99-4e97-a8f2-fb8ff60ffa21

Mastura, T., Begum, I. A., Kishore, A., Jackson, T., Woodhill, J., Chatterjee, K., & Alam, M. J. (2023). Diversified agriculture leads to diversified diets: Panel data evidence from Bangladesh. *Frontiers in Sustainable Food Systems, 7*, 1044105. https://doi.org/10.3389/fsufs.2023.1044105

Mishra, N., Modak, S., Padhy, C., & Badavath, A. (2025). Factors influencing farming practices towards nutrition sensitive agriculture in Southern Odisha. *Indian Journal of Extension Education, 61*(3), 86–91.

Miah, M. M., Haque, A. E., Hossaim, T. M. B., Hossain, S., & Rahman, M. S. (2013). *Policy options for supporting agricultural diversification in Bangladesh*. National Food Policy Capacity Strengthening Programme (NFPCSP), Food Planning and Monitoring Unit (FPMU), Ministry of Food, FAO Bangladesh.

Mondal, M. H. (2010). Crop agriculture of Bangladesh: Challenges and opportunities. *Bangladesh Journal of Agricultural Research, 35*(2), 235–245.

Mukherjee, S. (2021). Agricultural diversification of West Bengal: Nature and policy implications. *Indian Journal of Agricultural Economics*, 76(4). https://isaeindia.org/wp-content/uploads/2022/02/01-Article-Sumana-Mukherjee.pdf

Nahar, N., Masud, K., Miah, M. A. M., Sarker, A., & Rahman, M. W. (2025). Exploring drivers of crop diversification in farming communities of northern Bangladesh. *Bangladesh Journal of Agricultural Economics, 46*(1), 25–45. https://doi.org/10.70133/bjae.2024.493

Nahar, N., Rahman, M. W., Miah, M. A. M., & Hasan, M. M. (2024). The impact of crop diversification on food security of farmers in northern Bangladesh. *Agriculture & Food Security, 13*, 9. https://doi.org/10.1186/s40066-023-00463-z

Nain M.S. and Kumar Parveen (2010). A study of women participation and decision making in farm management. *Journal of Community Mobilization and Sustainable Development*, 5 (1), 67-71.

Nandi, R., Jackson, T. M., Jannat, A., Ghosh, A., Mitra, B., Chakma, K. R., Timsina, P., Chaudhary, A., Rahman, W., Karki, E., Rana, G., Krupnik, T. J., & Pokhrel, P. (2025). Status and drivers of crop diversification in the Eastern Gangetic Plains of South Asia: Across borders and communities. *Journal of Agriculture and Food Research, 20*, 101776. https://doi.org/10.1016/j.jafr.2025.101776

Nandi, R., Krupnik, T. J., & Kabir, W. (2024). Crop diversification in Bangladesh: Public policy provisions, practices, and insights for future initiatives. *Journal of Agriculture and Food Research, 18*, 101486. https://doi.org/10.1016/j.jafr.2024.101486

Nepali, B., Jackson, T., & Johns, C. (2024). Exploring the potential of agriculture diversification as a pathway to an improved smallholder livelihood dietary system in Nepal. *Sustainability, 16*(21), 9384. https://doi.org/10.3390/su16219384

Nirmala, G., Reddy, A. A., Pankaj, P. K., Kumar, R. N., Shankar, K. R., Beevi, C. N. A., Rohit, J., & Singh, V. K. (2024). Livelihood diversification in rainfed areas of Telangana State: Evidence from household level survey. *Indian Journal of Extension Education, 60*(1), 68–72. https://doi.org/10.48165/IJEE.2024.60113

Pal P. K., Bhutia Phubu Tshering, Das L., Lepcha Norden & Nain M.S. (2017). Livelihood diversity in family farming in selected hill areas of West Bengal, India. *Journal of Journal of Community Mobilization and Sustainable Development*. 12(2),172-178.

Pfeifer, C., Jongeneel, R. A., Sonneveld, M. P., & Stoorvogel, J. J. (2009). Landscape properties as drivers for farm diversification: A Dutch case study. *Land Use Policy, 26*(4), 1106–1115. https://doi.org/10.1016/j.landusepol.2009.01.007

Rahman, M. S., Haque, M. E., Afrad, M. S. I., Hasan, S. S., Rahman, M. A., & Noman, M. R. A. F. (2024). Usage of the mobile phone on agricultural farm enterprise development by women in rural Bangladesh. *Cogent Social Sciences, 10*(1), 2383393. https://doi.org/10.1080/23311886.2024.2383393

Rahman, S. (2008). Determinants of crop choices by Bangladeshi farmers: A bivariate probit analysis. *Asian Economic Journal, 22*(4), 353–373. https://doi.org/10.1111/j.1467-8381.2008.00290.x

Rahman, S. (2009). Whether crop diversification is a desired strategy for agricultural growth in Bangladesh? *Food Policy, 34*(4), 340–349. https://doi.org/10.1016/j.foodpol.2009.02.004

Rashid, M. M., Mondol, M. A. S., & Rahman, M. S. (2024). A review on status and influencing factors of agricultural diversification in Bangladesh. *Asian Journal of Agricultural Extension, Economics & Sociology, 42*(10), 71–90. https://doi.org/10.9734/ajaees/2024/v42i102564

Rai, S. K. (2015). *Agricultural diversification for livelihood security of rural people of South Gujarat* (Ph.D. Thesis, Navsari Agricultural University, Navsari). https://krishikosh.egranth.ac.in/items/e8432970-9a9b-4633-83ee-d163830d6e02

Rathod, R. B. (2023). *Attitude and livelihood security of small and marginal farmers towards agricultural diversification* (PhD Thesis, College of Agriculture, Junagadh Agricultural University, Junagadh). https://krishikosh.egranth.ac.in/items/7e757190-fc6a-40ed-8a73-c948947b1021

Reddy, B. S. L. (2019). *A study on attitude of farmers towards livelihood diversification in Kolar District of Karnataka* (PhD Thesis, University of Agricultural Sciences, Bengaluru, India). https://krishikosh.egranth.ac.in/items/e0fe74cf-3f21-4f46-9f2b-63aa1c3ef111

Rehan, S. F. (2020). *Diversification in Bangladesh: From on-farm, income and food consumption perspectives* (Academic Dissertation, University of Helsinki, Finland). https://helda.helsinki.fi/server/api/core/bitstreams/e72083ad-e519-437a-82c5-ef9b872b7c51/content

Sarmin, S., & Hasan, M. F. (2019). Farmers' knowledge of climate change in Northern Bangladesh. *Bangladesh Journal of Extension Education, 31*(1&2), 95–106.

Shahin, A., Sarmin, S., & Hasan, M. F. (2024). Factors influencing farmers' attitude towards e-governance in agricultural services in Dinajpur District, Bangladesh. *Journal of Agricultural Extension, 28*(4), 59–69. https://dx.doi.org/10.4314/jae.v28i4.7

Sheikh, M. M., & Pervez, A. K. M. K. (2025). Climate change and agriculture in Bangladesh: Impacts and adaptation strategies. *Bangladesh Journal of Agriculture, 50*(1), 132–148. https://doi.org/10.3329/bjagri.v50i1.82943

Shekhar, R., Gupta, R., & Verma, P. (2024). An exploration of agricultural diversification in India: A study of the Bundelkhand region. *Asian Development Policy Review, 12*(2), 138–148.

Shitu, A. G., & Nain, M. S. (2024). Benefits of precision conservation agriculture practices as perceived by Indo-Gangetic Plain (IGP) community for climate-smart agriculture, *SKUAST Journal of Research* 26(2): 219-226, *https://doi.org/10.5958/2349-297X.2024.00029.2*

United Nations Country Team. (2022). *UN country team results report: Bangladesh 2021*. United Nations in Bangladesh. https://bangladesh.un.org/en/177851-un-country-team-results-report-bangladesh-2021

World Bank. (2016). *Bangladesh: Growing the Economy through Advances in Agriculture*. The World Bank, Washington, D.C. https://www.worldbank.org/en/results/2016/10/07/bangladesh-growing-economy-through-advances-in-agriculture

Winters, P., Cavatassi, R., & Lipper, L. (2006). *Sowing the seeds of social relations: The role of social capital in crop diversity* (ESA Working Paper No. 6-16). FAO, Rome.

Yamane, T. (1967). *Statistics: An introductory analysis* (2nd ed.). Harper and Row, New York.