International Journal of Life Science and Agriculture Research
ISSN (Print): 2833-2091, ISSN (Online): 2833-2105
Volume 05 Issue 09 September 2026
DOI: https://doi.org/10.55677/ijlsar/V05I09Y2026-08
Impact Factor: 7.88, Page No: 695-701

# Exploring Crops and Cropping Systems in the *Charland* Areas of Mymensingh, Bangladesh: A Survey-Based Study

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**ABSTRACT**

*Charlands* are dynamic and flood-prone environments where farmers must adjust their cropping practices to changing water conditions and limited resources. This study assessed the socioeconomic characteristics of farmers, documented existing cropping practices, and identified major cropping patterns in selected *char* areas of Mymensingh, Bangladesh. A survey was conducted among 84 randomly selected farmers from Dakshin Kalibarir *Char* in Mymensingh Sadar and Ujan Kashiar *Char* in Gouripur Upazila. Data were collected through face-to-face interviews using a pre-tested questionnaire during 20–28 April 2021 and analyzed using descriptive statistics in SPSS. Most farmers were middle-aged (57.1%), and agriculture was the major occupation of about three-fourths of the respondents. Educational attainment was generally low, with 61.9% having primary-level education, while 78.6% operated small farms of up to 0.99 ha. Farmers' knowledge of crop production practices was mainly low to medium, with 36.9% having low and 47.6% having medium knowledge. The cropping pattern *Boro* rice–Fallow–T. *aman* rice was dominant, followed by 61% of the farmers. This pattern reflects the seasonal water dynamics of *charland*s, allowing farmers to cultivate *Boro* rice during the relatively dry period, leave land fallow during rising water levels, and grow T. *aman* rice under rainfed conditions. Overall, cropping decisions were closely associated with farmers' socioeconomic characteristics, available land, crop-management knowledge, and seasonal water conditions. Strengthening extension support, practical training, and locally suitable cropping options could improve the productive use and resilience of *charland* farming systems.

**KEYWORDS:** *Charland* agriculture; Cropping pattern; Socioeconomics; Seasonal flooding; Smallholder farmers; Climate resilience

**Published online: September 29, 2026**

***Cite the Article: Habib, M.A., Islam, Md. S., Sarkar, B.C., Hossain, A., Hossain Sarker, M.S., Salam, A., Hasan, A.K. (2026). Exploring Crops and Cropping Systems in the Charland Areas of Mymensingh, Bangladesh: A Survey-Based Study. International Journal of Life Science and Agriculture Research, 5(9), 695-701.***
https://doi.org/10.55677/ijlsar/V05I09Y2026-08



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## 1. INTRODUCTION

The agricultural productivity of these riverine islands is significantly influenced by the demographic profile of the workforce, particularly the age distribution of land managers, which dictates the adoption of complex intercropping strategies (Kadir et al., 2021; Alam et al., 2024). *Charland* agriculture offers considerable opportunities for crop intensification and diversification, although production is constrained by the dynamic nature of these environments (Dash et al., 2026). Older farmers often rely on traditional monoculture methods due to higher risk aversion and physical limitations, whereas younger cohorts demonstrate a greater propensity for transitioning toward intensive relay intercropping and diversified agroforestry models (Rahman et al., 2026). This generational divide in technical expertise and labor capacity directly affects the integration of high-value perennial species alongside seasonal crops within these unstable riverine environments (Hasan et al., 2025; Islam et al., 2021).

Cropping in *char* areas is particularly challenging because the timing and extent of flooding can vary considerably between seasons and locations. Flooding is a major climatic risk in the *char* areas of northern Bangladesh, and farmers often cope by changing cropping practices, using short-duration varieties, and improving crop management (Sarker et al., 2022). Seasonal flooding and climate variability can disrupt crop establishment, reduce production opportunities, and influence farmers' cropping choices. These challenges can also affect rice production in Mymensingh, highlighting the need for locally suitable and resilient cropping practices (Hossain et al., 2014; Islam et al., 2025). Suitable crop intensification and diversification can further improve land-use efficiency and productivity in floodplain areas (Sarker et al., 2026).

Farmers' socioeconomic conditions play an important role in shaping agricultural decisions in *char* areas. Factors such as farm size, education, household resources, farming experience, training, and access to extension services can influence the crops farmers choose and the practices they adopt (Dhar et al., 2017; Anwar et al., 2017; Kundu et al., 2022). In Mymensingh's *char* areas, farming is also closely connected with farmers' livelihoods and their exposure to natural calamities (Uddin & Dhar, 2017). In addition, limited access to technology and resources, weak markets, and poor infrastructure can make sustainable crop production more difficult in *charland*s (Sarker et al., 2022). Furthermore, the age-stratified adoption of these management practices often correlates with specific land-use patterns, where younger producers are more likely to integrate trees along field boundaries to enhance long-term climate resilience (Hasan et al., 2025).

Despite previous studies, location-specific information on farmers socioeconomic conditions and cropping patterns in Mymensingh *charland*s remains limited. Therefore, this study aimed to assess farmers' socioeconomic characteristics, existing cropping practices, and major cropping patterns in selected *char* areas of Mymensingh, Bangladesh. The findings may help develop locally suitable and resilient cropping strategies**.**

## 2. MATERIALS AND METHOD

### 2.1 Study Area

The study was conducted in two selected char areas of Mymensingh District, Bangladesh: Dakhin Kalibari Char under Char Nilakshmia Union of Mymensingh Sadar Upazila, and Ujankashiar Char under Bhangnamari Union of Gouripur Upazila. The Char Nilakshmia area is located at approximately 24.724° N and 90.468° E, with an elevation of about 18 m, while Bhangnamari is located at approximately 24.685° N and 90.479° E, with an elevation of about 11 m.

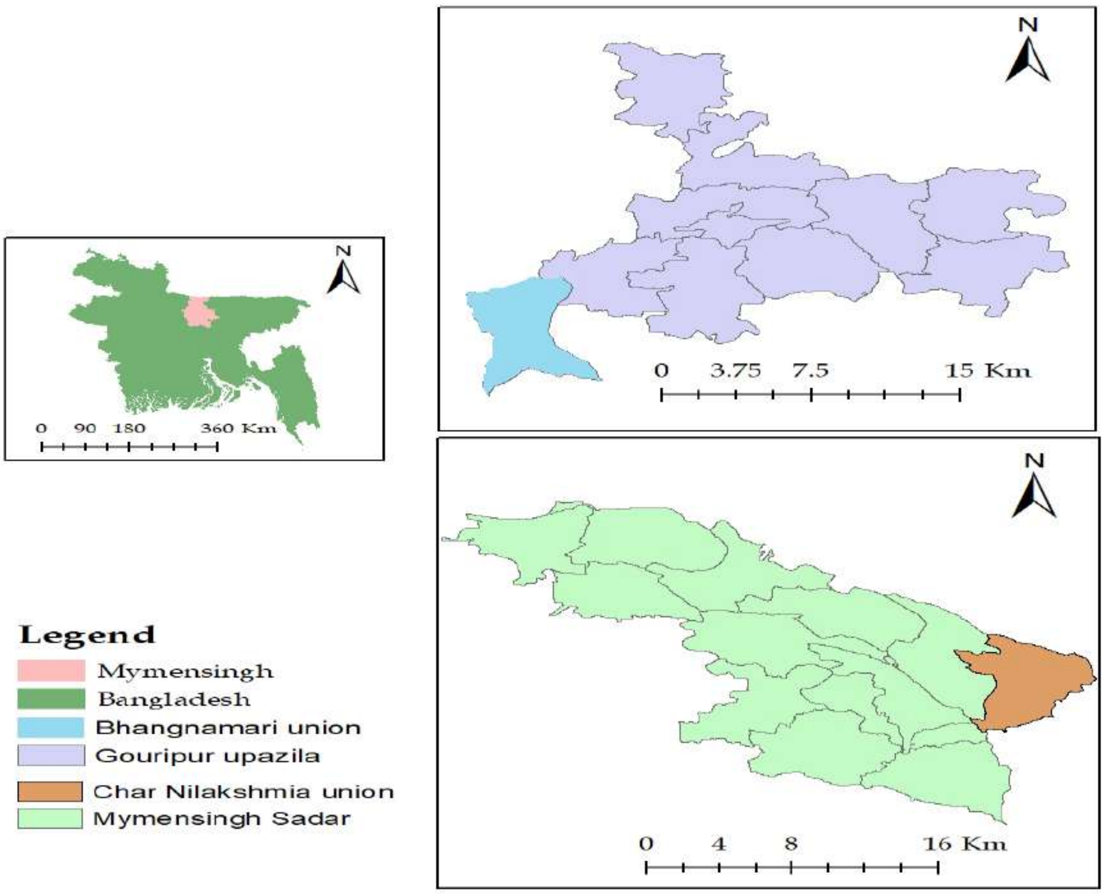


**Figure 1. Map of study area.**

### 2.2 Sampling Design

Mymensingh Sadar upazila has a total 13 unions. Among them, one union namely, Char Nilakshmia was selected from this union one village (mainly *char* area) was selected for the study. This village (*char* area) is Dakhin Kalibarir *char*. The total number of farmers in this village was 387. Gouripur upazila has a total of 10 unions. Among them one union namely, Bhangnamari was selected, from this union one village (mainly *char* area) was selected for the study. This village (char area) was Ujan Kashiar *Char*. The total number of farmers in this village was 450. List of all farmers (387 + 450= 837) of those two villages constituted the population of the study. In the second step eighty-four (39+45=84) farmers were selected as samples by using 10% random sampling technique. Farmers were selected randomly and equally from each of farmer groups; large, medium, small, marginal and landless. Total sampling procedures are stated below in Table 1.

**Table: 1 Sampling procedure**

| District | Upazila | Name of char | Population (Farmers) | Sample size (10% random selection) |
|---|---|---|---|---|
| Mymensingh | Gouripur | Ujan Kashiar *char* | 450 | 45 |
| | Mymensingh Sadar | Dakshin Kalibarir *char* | 387 | 39 |
| Total | | | 837 | 84 |

### 2.3 Data collection tool

A structured interview schedule was carefully developed with the study's objectives in mind to acquire reliable data from the respondents. Simple, easy and direct questions were used to obtain information from the respondents. Both open and closed questions were included in the interview schedule. The schedule was checked by the supervisory committee.

### 2.4 Variables of the study

To describe the cropping pattern practiced by the farmers some selected aspects including age, occupation, education, family size, farm size and knowledge of the farmers on crop production practices and cropping patterns practiced in the study areas.

### 2.5 Data collection

Data were collected from selected respondents through face-to-face interviews using a pre-tested interview schedule. Local leaders and Sub-Assistant Agricultural Officers assisted in contacting the respondents. Before each interview, rapport was established to encourage respondents to provide accurate information. Data collection was conducted from 20 to 28 April 2021. The respondents were generally cooperative, and no major difficulties were encountered during the survey.

### 2.6 Measurement of variables

The selected variables were measured using appropriate procedures, including age, occupation, education, family size, farm size, knowledge of crop production practices, and cropping pattern. Farm size was measured as the total land area available to and operated by the household, including homestead, cultivated land, leased land, pond, and garden, and was expressed in hectares using the following formula (Alam, 2019): $F=A+B+C+D+\frac{1}{2}(E)$

Where, F= Total, A= Homestead area, B= Pond, C= Garden, D= Own cropped area, E= land given or taken as *borga.*

### 2.7 Statistical analysis

The data were analyzed using the SPSS software. Descriptive statistics, including mean, standard deviation, and range, were used to summarize the variables. Respondents were categorized based on data distribution, mean and standard deviation, and appropriate scoring criteria.

## 3. RESULTS

### 3.1 Characteristics of the Farmers

#### 3.1.1 Age

The age of the respondents ranged from 25 to 65 years, with an average of 45.86 years and a standard deviation of 10.80. Based on their age, the respondents were classified into three categories i.e., young aged (up to 35 years), middle aged (36-50 years) and old aged (>50 years). The distribution of the respondents according to their age has shown in Table 2. Data presented in Table 2 shows that 57% of the farmers were in the middle-aged category, 23% were young and 19% were old. Therefore, it could be said that the practice of cropping patterns in the study areas was expected to be considerably influenced by middle and young-aged farmers.

#### 3.1.2 Occupation

Occupation is the means of livelihood of an individual. Char dwellers have diversified occupations from time immemorial. Among them, conventional crop farming is very common. Findings of the study showed that more than three-fourths (75.0%) of the respondents were engaged in farming activities as their major occupation. On the other hand, 21.3% respondents were involved with various non-farming activities like small business, wage labour, rickshaw/van driving and service as their major occupations (Tabel 2).

**3.1.3 Education**

The education of the farmers was evaluated according to its level i.e. highest grade (class) passed by them. The educational level score ranged from 0 to 9, the average being 5.80 and the standard deviation was 2.34. Based on their level of education, the farmers were grouped into four categories, and the distribution of the respondents according to their education is presented in Table 2. It is evident from Table 2 that only 8.3 percent of the farmers fell under the category of illiterate farmers, 61.9 percent with primary education and 29.8 percent with secondary education and no higher secondary level was observed. Among all respondents, the frequency of the primary education group was the highest (61.9%).

**3.1.4 Family size**

The family size of the farmers ranged from 2 to 13 people. The average was 5.44 and the standard deviation was 1.73. Based on family size, farmers were classified into three categories as small family (up to 4 members), medium family (5-7 members) and large family (>7 members) as shown in Table 2. Data presented in Table 2 indicate that the farmers of small-size family were 32%, middle-size family were 58% and large-size family were 10%. This indicates that the farmers of the study area were considerably influenced by the relatively middle size of the farmer's family.

**3.1.5 Farm size**

The farm size of the farmers ranged from 0.6 to 3.30 hectares with an average of 0.82 hectares and a standard deviation of 1.92 hectares. Based on the farm size, respondents were divided into three categories as shown in Table 2. Data indicates that the highest proportion (79%) of the respondents possessed the small farm size category compared with the medium farm size category (15%) and only 6% were large farm size category.

**3.1.6 Knowledge of the farmers on crop production practices**

Knowledge of farmers on crop management practice was scored and ranged from 4 to 21 against the possible range from 0 to 22. The average score was 11.39 and the standard deviation was 4.84. Based on knowledge of crop production practice, the respondents were classified into three categories namely low (up to 8), medium (9-16) and high (above 16). Results showed in Table 2 that 37 percent had low-level knowledge, 48 percent of the respondents had medium knowledge and 15 percent had high knowledge of crop management practice. They follow mainly traditional crop production practices in their farm.

**3.1.7 Cropping pattern practiced in the study areas**

Figure 2 showed that the pattern "*Boro* rice-Fallow-*T. aman* rice" followed by the highest number of respondents (61%). It might be due to *Boro* rice cultivation management was relatively easy for the farmers in Char areas in Rabi season. Later, as the water started coming in, they kept their land fallow for that time. They tried T. *aman* rice on the *kharif-2* because T. *aman* rice was grown in rainfed conditions. At that time, they did not need additional irrigation.

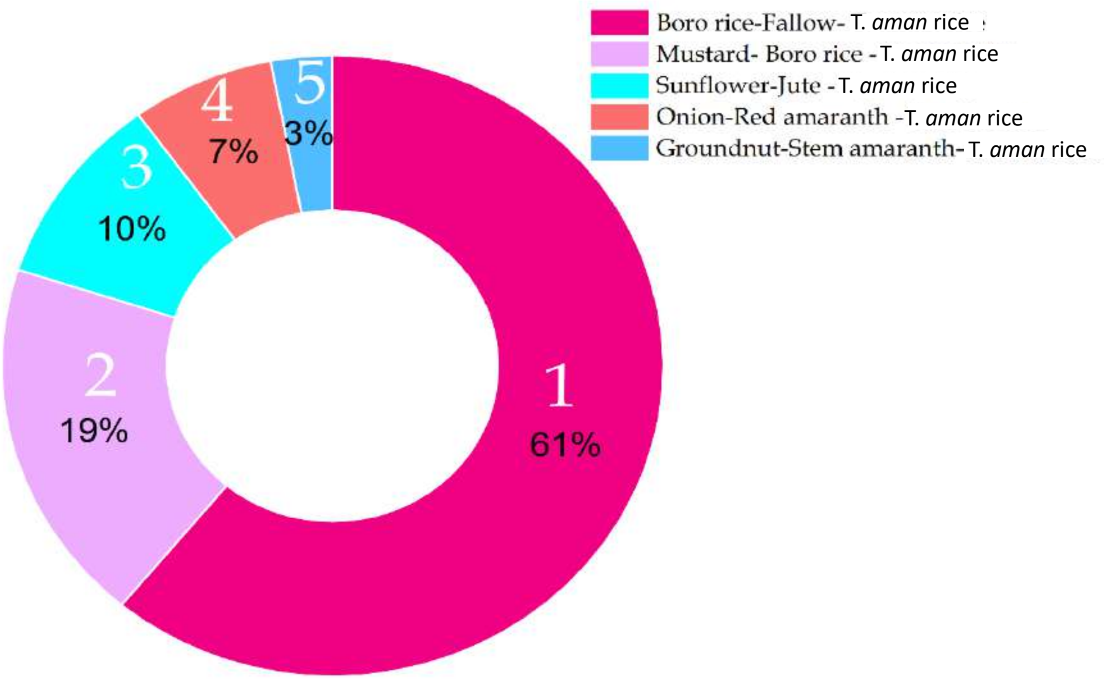


**Figure 2. Rank order of different cropping patterns with percentages in the study areas.**

**Table 2. Characteristics profile of the *charland* farmers**

| Characteristics | Score range | | Categories | Respondents (n=84) | | |
|---|---|---|---|---|---|---|
| | Possible | Observed | | % | Mean | SD |
| Age (Years) | Unknown | 25-65 | Young (up to 35 yrs) | 23.8 | 45.86 | 10.80 |
| | | | Middle aged (36-50 yrs) | 57.1 | | |
| | | | Old (>50) | 19.0 | | |
| Occupation | Unknown | Unknown | Agriculture | 75.0 | | |
| | | | Business | 14.3 | | |
| | | | Others | 10.7 | | |
| Level of education (Total years of schooling) | Unknown | 0-9 | Illiterate (0) | 8.3 | 5.80 | 2.34 |
| | | | Primary (1-5) | 61.9 | | |
| | | | Secondary (6-10) | 29.8 | | |
| | | | Higher secondary and above (above 10) | 0 | | |
| Household size (No. of members) | Unknown | 2-13 | Small (up to 4) | 32.1 | 5.44 | 1.73 |
| | | | Medium (5-7) | 58.3 | | |
| | | | Large (>7) | 9.5 | | |
| Farm size (Hectare) | Unknown | 0.6-3.30 | Small (up to 0.99) | 78.6 | 0.82 | 1.92 |
| | | | Medium (1.00- 2.99) | 15.5 | | |
| | | | Large (>3) | 6.0 | | |
| Total knowledge (Scores) | 0-22 | 4-21 | Low (up to 8) | 36.9 | 11.39 | 4.84 |
| | | | Medium (9-16) | 47.6 | | |
| | | | High (>16) | 15.5 | | |

## 4. DISCUSSION

The findings show that crop production in the *charland* areas of Mymensingh is closely influenced by farmers' socioeconomic conditions and the seasonal availability of water. Most respondents were middle-aged, while 23.8% were young and 19.0% were older. This shows that both experienced and younger farmers were actively involved in farming. Agriculture was the main occupation for about three-fourths of the respondents, highlighting its importance as a source of livelihood in the study area. Furthermore, the predominance of middle-aged farmers (57.1%) suggests that farming in the study area is largely supported by an experienced workforce familiar with local environmental conditions and challenges (Raihan et al., 2017). Moreover, this age distribution indicates a potential for the sustained adoption of emerging agricultural technologies, as middle-aged cohorts often bridge the gap between traditional practices and newer, more efficient production methodologies (Emran et al., 2021).

The dominance of small farms (78.6%) reflects the limited land resources available to most households. Small farm sizes make efficient land use essential. Suitable intercropping can help farmers increase productivity and profitability from limited land (Rahman et al., 2024). However, small farm sizes and limited crop-production knowledge often restrict diversification and encourage traditional, labor-intensive practices, making farmers more vulnerable to environmental risks (Sarker et al., 2022; Uddin & Dhar, 2017). In addition, most farmers had only primary-level education, and nearly half showed a medium level of crop-management knowledge. The relatively large proportion of farmers with low or medium knowledge suggests that stronger agricultural extension, training, and practical guidance could improve crop-management decisions in *charland* environments. Given the susceptibility of these regions to waterlogging and flooding, implementing cropping patterns that adapt to seasonal inundation, such as the *Boro*-Fallow-T. *aman* cycle, remains essential for sustaining local food security (Rahaman et al., 2022; Rashid et al., 2018).

The most common cropping pattern was *Boro* rice–Fallow–T. *aman* rice, followed by 61% of the farmers. This pattern appears to be a practical response to the seasonal water conditions of *charland*. Farmers can grow *boro* rice during the suitable dry period, keep the land unused when rising water restricts cultivation, and later grow T. *aman* rice under rainfed conditions. Therefore, the observed pattern reflects farmers' adaptation to seasonal flooding and water availability rather than simply a traditional preference. Given the susceptibility of these regions to waterlogging and flooding, implementing cropping patterns that adapt to seasonal inundation, such as the *Boro*-Fallow-T. *aman* cycle, remains essential for sustaining local food security (Rahaman et al., 2022; Rashid et al., 2018). This reliance on specific seasonal cycles is particularly prominent among middle-aged and older cohorts, who often leverage long-standing experiential knowledge to manage the inherent risks of flood-prone agricultural landscapes (Islam et al., 2019). Similar attention to crop intensification, diversification and adaptation to floodplain conditions has been highlighted in recent studies of rice-based cropping systems in Bangladesh (Anwar et al., 2026).

Overall, the study suggests that cropping decisions in *charland* areas are shaped by the combined effects of land availability, farmer characteristics, knowledge, and seasonal water dynamics. Promoting suitable crop diversification, improved extension services, and climate-resilient cropping options could help farmers make better use of these environmentally variable lands.

## 5. CONCLUSION

This study shows that farming in the selected *charland*s of Mymensingh is shaped by farmers' socioeconomic conditions, limited land resources, crop-management knowledge, and seasonal water availability. Most farmers operated small farms and had low-to-medium knowledge of crop production practices. The dominant cropping pattern was *Boro* rice–Fallow–T. *aman* rice, practiced by 61% of the farmers. This pattern reflects farmers' adjustment to seasonal changes in water availability, allowing cultivation during suitable periods and leaving land fallow when water levels rise. Strengthening agricultural extension, practical training, and locally suitable cropping options could help farmers improve crop management and make better use of *charland* resources. Such support may contribute to more productive and resilient farming systems in these environmentally variable areas.

## AUTHOR'S CONTRIBUTIONS

**Conceptualization:** Mohammad Ahsan Habib and Md. Abdus Salam; **Methodology:** Mohammad Ahsan Habib; Software**:** Bejoy Chandra Sarkar; **Validation:** Md. Shafiqul Islam and Md. Abdus Salam; **Formal Analysis:** Mohammad Ahsan Habib and Bejoy Chandra Sarkar; **Investigation:** Mohammad Ahsan Habib; **Resources:** Md. Amzad Hossain and Ahmed Khairul Hasan; **Data Curation:** Md. Abdus Salam; **Writing – Original Draft:** Mohammad Ahsan Habib; **Writing – Review & Editing:** Md. Shafiqul Islam, Mohammad Sohrab Hossain Sarker, Ahmed Khairul Hasan and Md. Abdus Salam; **Visualization:** Md. Abdus Salam; **Supervision:** Md. Abdus Salam; **Project Administration:** Md. Amzad Hossain and Ahmed Khairul Hasan; **Funding Acquisition:** Md. Abdus Salam

## DISCLOSURE STATEMENT

### Data Availability

The data supporting the findings of this study are included in this article. For additional information or further inquiries, readers may contact the corresponding author.

### Funding

The authors are pleased to acknowledge the authority of GARE (Grants for Advanced Research in Education), Ministry of Education, Government of the People's Republic of Bangladesh for funding through the project entitled "Improving crop productivity through adoption of climate resilient cropping systems of charland of Bangladesh" (Project ID.: LS20201474) to conduct the research.

### Conflict of Interest

The authors declare that there is no potential conflict of interest to report.

## REFERENCES

1. Alam, M. J., & Rana, M. S. (2024). Revealing seeding combinations of chili with brinjal, radish and coriander in a mixed cropping system to increase the productivity and profitability in Char ecosystem of subtropical climate. *Innovations in Agriculture*, *7*, 1-6. http://dx.doi.org/10.3897/ia.2024.124180
2. Alam, M. A. (2019). *Adoption of selected BJRI released varieties and their yield gap at farmers' level* [Doctoral dissertation, Bangladesh Agricultural University].
3. Anwar, M. P., Kongkon, P. R., Mia, M. L., Jannat, S. A., Ali, M. O., Islam, M. S., ... & Islam, A. M. (2026). Resilient nursery practice for enhanced rice (BRRI dhan89) productivity in the old Brahmaputra floodplain (AEZ-9), Bangladesh. *Sarhad Journal of Agriculture*, *42*(2), 898-915. https://dx.doi.org/10.17582/journal.sja/2026/42.2.898.915
4. Anwar, M., Ferdous, Z., Sarker, M. A., Hasan, A. K., Akhter, M. B., Zaman, M. A. U., Haque, Z., & Ullah, H. (2017). Employment generation, increasing productivity and improving food security through farming systems technologies in the monga regions of Bangladesh. *Annual Research & Review in Biology*, *16*(6), 1–15. https://doi.org/10.9734/ARRB/2017/35645
5. Dash, P. C., Hasan, M. M., Palash, M. S., Salam, M. A., Rahman, M. R., & Hasan, A. K. (2026). Maize-based intercropping systems in Bangladesh: Exploring the potential of spice and tuber crops in charland areas. *Agronomy Journal*, *118*(3), e70418. https://doi.org/10.1002/agj2.70418
6. Dhar, A. R., Jannat, A., & Islam, M. M. (2017). GO-NGO support in selected char areas of Sirajganj district in Bangladesh: Impact on crop profitability and farmers' income generation. *American Journal of Agricultural and Biological Sciences, 12*(3), 130–138. https://doi.org/10.3844/ajabssp.2017.130.138

7. Emran, S. A., Krupnik, T. J., Aravindakshan, S., Kumar, V., & Pittelkow, C. M. (2021). Factors contributing to farm-level productivity and household income generation in coastal Bangladesh's rice-based farming systems. *PloS one*, *16*(9), e0256694. https://doi.org/10.1371/journal.pone.0256694
8. Hasan, M. K., Roshni, N. A., & Akter, R. (2025). Estimating carbon stocks and woody perennials diversity in cropland agroforestry on three different land ecosystems in Bangladesh. *Carbon Balance and Management*, *20*(1), 3. https://doi.org/10.1186/s13021-024-00288-8
9. Hossain, M. J., Kuri, S. K., Islam, M. S., & Mondal, D. U. (2014). Estimating the effect of climate change on rice production: a study from Mymensingh district of Bangladesh using quantile regression method. *Int. J. Sustain. Crop Prod*, *9*(1), 1-7.
10. Islam, M. S., Hossain, M. Z., & Sikder, M. B. (2019). Farmers' adaptation strategies to drought and their determinants in barind tract, Bangladesh. *SAARC Journal of Agriculture*, *17*(1), 161-174.
11. Islam, M. R., Chowdhury, M. S. A., & Amin, M. S. (2021). Agroforestry Species Systems of the Charlands of Bangladesh. *Journal of Emerging Technologies and Innovative Research, 8*(6), d15–d28.
12. Islam, M. S., Sarker, U. K., Islam, M. A., Rahman, J., Bhowal, S. K., Hasan, A. K., ... & Nasim, M. R. (2025). Farmers' perceptions toward climate change with emphasis on cropping systems in the haor areas of Kishoreganj district, Bangladesh. *Asian Journal of Research in Crop Science*, *10*(2), 205-222. https://doi.org/10.9734/ajrcs/2025/v10i2364
13. Kadir, M., Rahman, J., Riad, M. I., & Alam, M. K. (2021). Intercropping maize with groundnut in Char Land. *Trop. Agrobiodivers*, *2*, 51-53. https://doi.org/10.26480/trab.01.2021.51.53
14. Kundu, N. D., Uddin, M. S., Islam, M. M., Khatun, M., & Khandoker, S. (2022). Determinants, challenges and opportunities of pulses crop in southern char land areas of Bangladesh: determinants, challenges and opportunities of pulses crop…. *Farm Economy*, *17*, 91-102.
15. Rahman, M. T., Bari, M. S., Bashir, M. A., Rajeen, A., Rahman, M. M., & Ali, M. M. (2026). Potentiality of okra-mango based agroforestry system for economic and climate resilience in Bangladesh's charland. *Discover Forests*, *2*(1), 21. https://doi.org/10.1007/s44415-026-00082-z
16. Rahman, M. M., Rahman, M. A., Ali, M. A., & Hasan, A. K. (2024). Productivity and profitability of cauliflower (*Brassica oleracea* var. Botrytis L.) based intercropping system for sorjan bed system: Cauliflower based intercropping system for sorjan bed system. *Journal of the Bangladesh Agricultural University*, *22*(2), 166-177. https://doi.org/10.3329/jbau.v22i2.74550
17. Rahaman, M. S., Sarkar, M. A. R., Rahman, M. C., Deb, L., Rashid, M. M., Reza, M. S., & Siddique, M. A. B. (2022). Profitability analysis of paddy production in different seasons in Bangladesh: Insights from the Haor. *International Journal of Agriculture Environment and Food Sciences*, *6*(3), 327-339.
18. Raihan, M. L., Sarker, M. A., & Miah, M. A. M. (2017). Shortage of water in Teesta River Basin and its impact on crop production in northern Bangladesh. *SAARC Journal of Agriculture, 15*(2), 113–123. https://doi.org/10.3329/sja.v15i2.35163
19. Rashid, M. H. A., Islam, A. B. M. J., Shirazy, B. J., & Shahidullah, S. M. (2018). Cropping systems and land use pattern in Rajshahi region. *Bangladesh Rice Journal*, *21*(2), 237-254. https://doi.org/10.3329/brj.v21i2.38209
20. Sarker, M. A. I., Mia, M. L., Islam, M. S., Kader, M. A., & Hasan, A. K. (2026). Improving the productivity of existing rice-based cropping systems through crop intensification and diversification in tista meander floodplain (AEZ-3) of Bangladesh. *International Journal of Agronomy*, *2026*(1), 9089088. https://doi.org/10.1155/ioa/9089088
21. Sarker, U. K., Kaysar, M. S., Uddin, M. R., Hossain, M. A., Hassan, S., & Hassan, M. M. (2022). Exploring farmers' insight on cropping pattern for sustainable crop production in Char area of Bangladesh. *Sustainability*, *14*(3), 1745. https://doi.org/10.3390/su14031745
22. Uddin, M. T., & Dhar, A. R. (2017). Char people s production practices and livelihood status: An economic study in Mymensingh district. *Journal of the Bangladesh Agricultural University*, *15*(1), 73-86. https://doi.org/10.3329/jbau.v15i1.33532