J Bangladesh Agril Univ 23(2): 157-165, 2025 https://doi.org/10.3329/jbau.v23i2.82583

ISSN 1810-3030 (Print) 2408-8684 (Online)

Journal of Bangladesh Agricultural University

Journal home page: http://baures.bau.edu.bd/jbau

Research Article

Adaptation Strategies used by the Coastal Farmers Coping with Consequences of Climate Change

Md. Ruhul Momin[1]. M. Asaduzzaman Sarker[1]✉. Mohammad Maruf Hasan[1]. Md Lamiur Raihan[1] and Muhammad Habibur Rahman Mukul[2]

[1]*Department of Agricultural Extension Education, Faculty of Agriculture, Bangladesh Agricultural University, Mymensingh, Bangladesh*

[2]*Bangladesh Rice Research Institute, Gazipur, Bangladesh*

ARTICLE INFO

Article history
Received: 03 February 2025
Accepted: 22 June 2025
Published: 30 June 2025

Keywords
Climate change,
Consequences,
Adaptation strategies,
Coastal agriculture

Correspondence
M. Asaduzzaman Sarker
✉: masarker@bau.edu.bd

ABSTRACT

The growing threats of climate change are extremely acute for the coastal areas of Bangladesh. Understanding the use of adaptation strategies is crucial for overcoming these challenges and formulating effective adaptation policies. This study's goals were to find out the socioeconomic characteristics of the respondents in coastal areas, to find out their use of adaptation strategies, and to find out the reasons of using and not using them. We collected data through surveys conducted in four villages within the Patharghata and Barguna Upazilas specifically targeting farmers who had implemented at least two adaptation strategies. The highest number of respondents moderately uses adaptation strategies in both areas. In terms of adoption rates, the salt-tolerant rice seeds and training were highest in both areas. However, barriers to adoption were also prevalent, with insufficient support and time constraints identified as significant challenges. The study highlights the importance of education and extension services in promoting adaptation strategies, alongside institutional support for overcoming barriers to adoption. To improve coastal Bangladeshi farmers' resilience against climate change, educational programs, strengthened agricultural extension services, collaboration between government and non-governmental organizations, community engagement, and monitoring and evaluation systems are recommended.

Introduction

Global climate change and anthropogenic greenhouse gas emissions, which drive climate shifts, contribute to the vulnerability of agricultural production systems (Dike, 2018; Upadhyay, 2020). Climate change presents a significant challenge for humanity and extends in addition to the increase in global temperature (Kabir et al., 2021; IPCC, 2023). In Bangladesh, climate change has severe negative effects on coastal area, a region highly vulnerable due to its geographic and socio-economic conditions. Coastal communities also face more frequent and intense weather events, such as cyclones and heavy rainfall, which can devastate crops and infrastructure (Das & Wahiduzzaman, 2022). The majority of Bangladesh's coastal rural population, which consists of smallholder farmers, is particularly hard hit by the effects of these climatic consequences ((Dewan, 2015; Dastagir, 2015). Significant risks to farmers' agricultural productivity and incomes are posed by the recent increase in the frequency and severity of extreme climate events, as well as increases in the frequency and intensity of climate change in the future (Bouwer, 2019). In this situation, adaptation could be the best solution to coping with climate change and according to Fankhauser (2017) adjustment is when natural or human systems change in response to real or expected changes in the climate or their effects in a way that lessens harm or takes advantage of good opportunities. The main goals of adaptation of climate change are to reduce vulnerability and build resilience to the impacts it brings (Joakim et al., 2021).

The process of adjusting to climate change's consequences to mitigate its negative effects and maximize its beneficial ones is known as adaptation (Roy et al., 2022; Pörtner et al., 2022). Up to this point,

Cite This Article
Momin, M.R., Sarker, M.A., Hasan, M.M., Raihan, M.L. and Mukul, M.H. R. 2025. Adaptation Strategies Used by the Coastal Farmers Coping with Consequences of Climate Change. *J. of Bangladesh Agricultural University,* 23(2): 157-165. https://doi.org/10.3329/jbau.v23i2.82583

the primary focus on agricultural adaptation has been on enhancing adaptation methods to more effectively manage climate-related risks (Mapfumo et al., 2017). The topic of transformational adaptation in agriculture has combined with a large body of literature over the past decade. Nonetheless, the term transformation about adaptation remains ambiguous and possesses several meanings (Vermeulen et al., 2018). Since climate change has been visible in this country, the coastal agriculture industry has been undergoing a variety of adaptations. People have been adopting independent actions to defend their agricultural activities from expected and human-induced hazards. Additionally, public knowledge of weather transformation and the necessity for adaptation processes has risen in recent times. Coastal Bangladesh has been focused on agricultural management, infrastructure development, disaster preparedness, recovery and other ways to recover from climate change effects (Saha et al., 2016). Some examples of agricultural adaptation in coastal areas are permanent raised beds, which are both an advanced and common technique. Watermelon, okra and BARI Tamato-3 produced better in raised beds with mulching in the coastal zone of Noakhali and Shatkhira. However, we want to know the adaptation approaches and the reasons for admitting those tactics and following specific research objectives were formulated as:

a. To determine the socio-economic characteristics of the coastal farmers;
b. To discover the adoption status of adaptation strategies practiced in the study areas;
c. To explore the reasons for taking those adaptation strategies; and
d. To identify the reasons responsible for non-adoption of adaptation strategies by the farmers of the saline prone areas.

Materials and Methods

Research Study Area

The research has been conducted in four villages of two Upazilas under two coastal districts in Bangladesh namely Barguna and Bagerhat. A detailed description of the study areas in terms of justifying the research objectives is given below.

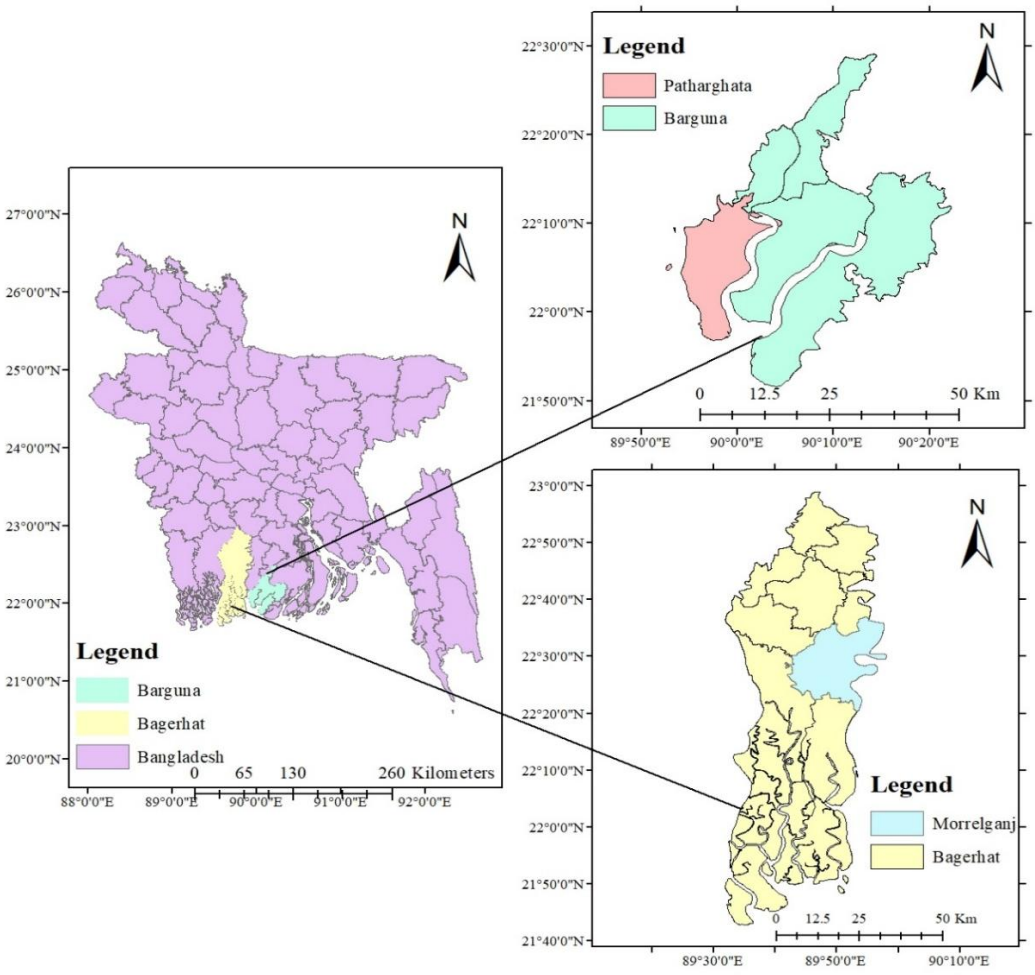

Figure 1 Map of Barguna and Bagerhat District Showing Patharghata and Morrelganj Upazila

In Barguna district, the investigation has been performed in Patharghata Upazila located in between 22°14' and 22°58 north latitudes and between 89°53' and 90°05' east longitudes. Padma and Charlatimara village were selected from Patharghata Upazila. There are 163927 people living in the Patharghata Upazila, with 80544 men and 83383 women (BBS, 2019). These villages are bound by the Bishkhali and Boleswar rivers and are close to the Bay of Bengal, making them susceptible to many natural calamities.

The investigation was performed in Morrelganj Upazila located between 22°20' and 22°37' north latitudes and in between 89°42' and 89°54' east longitudes under Bagerhat district. Sannyasi and Poshurbunia village were selected for this study. The total population of this upazila is 294,576 of which 143,251 are male and 151,325 are female (BBS, 2019). The community has about 1,877 residents. In addition to being susceptible to floods, saline intrusion, and erosion from the Panguchi River, it is a cyclone-prone location. The WAPDA built a 1.25-kilometer-long embankment (polder number 35/1) near the hamlet of Sannyasi. In Sannyasi village, more than half of the people reside outside the embankment. On both sides of the embankment, farming and fishing are the main sources of income for the residents of this community.

Determination of Sample Size

The respondents were selected cautiously on the criteria and to fulfill the objective of this study. Firstly, a population list was prepared based on the people who have practiced at least two adaptation strategies. Then, from the total population, purposely 50% was taken randomly as the sample for the study. The same procedure was followed for the selected study area. The flow chart of the sample selection procedure is given below:

Table 1. Sample size determination of the study

Area	Total population	Number of people who have practiced adaptation strategies	Sample size (50%)
Patharghata	2099	167	83
Morrelganj	750	134	67

Research Instruments

Keeping the study's aims in mind, a prepared interview schedule was accurately developed in order to obtain relevant data through literature revies. The inquiries in this schedule were phrased in a clear and straightforward manner and placed in a logical sequence to ensure that respondents easily understood them.

Methods of Data Collection

The survey was conducted from 22 to 30 March and 9 to 15 May 2022. Before conducting the survey, the interview schedule was pre-tested with 15 respondents to ensure the clarity of the questions and to avoid ambiguity of the questions. A necessary correction was made based on the pretest of the questionnaire.

Measurement of explanatory variables

The factors that explained things about the study were the chosen traits of the interviewees. Nine explanatory factors were chosen to make the study manageable. The procedures of measurement of the selected variables were as follows:

Table 2. Measurement of independent variables of study

Farmers' characteristics	**Measuring unit**
Age	Years
Level of education	Years
Family size	No. of members
Farm size	Hectares
Annual family income	Thousands taka
Natural disaster frequency	Scale score
Extension media contact	Scale score
Support received	Scale score

Focus variable measurement

The focus variable of the study was the extent of use of adaptation strategies by the respondents in the study areas in the study areas. We also explored a comparative scenario of adaptation strategies practiced between Patharghata and Morrelganj. Reponses against each of the adaptation strategies were measured following dummy such as Yes and No, and the score was assigned 1 for yes and 0 otherwise (Yarnold, 2018). The adaptation strategies adopted by

the respondent were, therefore, determined by adding the total responses against the five selected strategies. Thus, the total score for the adaptation strategies of a respondents areas range from 0 to 5, with 0 indicating "not adopted" and 5 indicating "very highly adopted." The reasons for adopting and not adopting those adaptation strategies have also been determined.

Statement of hypothesis

To guide the objectives of the study, the following hypotheses were formulated:

Research Hypothesis (H_a): There is a relationship between selected characteristics of the farmers and their extent of use of adaptation strategies.

Null Hypothesis (H_0): There is no relationship between selected characteristics of the farmers and their extent of use of adaptation strategies.

Data processing and analysis

Primary data collected were coded and analyzed using the Statistical Package for Social Sciences (SPSS) software (Version 27.0). This program facilitates a comprehensive array of statistical analysis. All the secondary information was used for a functional and effective literature review for finding out the research gap as well as development of the conceptual framework of the study. The study's variables were characterized using statistical measures including number, percentage, range, mean, standard deviation, and rank order. The Pearson Product Moment Correlation was employed to ascertain the association between the use of adaptation strategies by the respondents in the study areas and their specified attributes. Correlation matrices were developed to ascertain the interrelationships among the variables.

Results and Findings

The Socio-Economic Characteristics of the Farmers

The characteristics of the farmers have been shown in Table 3 and described in this section in more detail.

Table 3. Characteristics profile of the respondents

Characteristics (Measuring units)	Patharghata (n_1=83)		Morrelganj (n2=67)	
	Mean	SD	Mean	SD
Age (years)	44.94	12.76	49.40	13.66
Level of Education (Total years of schooling)	5.23	3.38	5.46	3.27
Family size (No. of members)	4.63	1.20	5.45	2.03
Farm size (Hectare)	0.50	0.40	0.53	0.67
Annual family income (000’ BDT)	148.11	76.99	137.10	76.15
Natural disaster frequency (Scores)	10.29	4.21	8.60	1.93
Extension media contact (Scores)	5.65	3.23	7.03	2.39
Support received (Scores)	3.70	2.34	3.87	2.10

Table 3 highlights distinct differences in the demographic and socioeconomic profiles of respondents from Patharghata and Morrelganj. Respondents from Morrelganj have a higher average age of 49.40 years compared to 44.94 years in Patharghata. The level of education is similar between the two groups, with Patharghata having an average of 5.23 years of schooling and Morrelganj 5.46 years. Family size is significantly larger in Morrelganj, averaging 5.45 members compared to 4.63 members in Patharghata. The farm sizes are comparable, with averages of 0.50 hectares in Patharghata and 0.53 hectares in Morrelganj. Annual family income is also similar, with Patharghata at 148.11 thousand BDT and Morrelganj at 137.10 thousand BDT. Notably, respondents from Patharghata experienced more challenges related to frequency of natural disasters, with a significantly higher score of 10.29 compared to 8.60 in Morrelganj. Conversely, extension media contact is significantly more frequent in Morrelganj, with a score of 7.03 compared to 5.65 in Patharghata. Support received from government and non-governmental organizations is similar, with scores of 3.70 in Patharghata and 3.87 in Morrelganj, showing no significant difference. These findings highlight the varying local conditions and resource accessibility between the two areas.

Extent of Use of Adaptation Strategies by the Respondents in the Study Areas

Table 4 presents the distribution of respondents based on use of adaptation strategies by the respondents in the study areas, as measured by total scores derived from the selected five adaptation strategies and classified into three categories: low (0-1), medium (2-3), and high (3<) user. The possible score ranges from 0 to 5, while the observed scores in this study fall between 1 to 5 in Patharghata and 1-4 in Morrelganj, indicating a moderate range of adoption among respondents.

Table 4. Distribution of the farmers according to the use of adaptation strategies

Categories	Extent of use			
	Patharghata (n_1=83)		Morrelganj (n_2=67)	
	%	Mean and SD	%	Mean and SD
Low use (0-1)	10.8		14.9	
Medium use (2-3)	61.4	2.86±1.02	61.2	2.70±1.00
High use (3<)	27.7		23.9	

The data presented in Table 4 shows that, In Patharghata, 10.8% of farmers are classified in the low user category, exhibiting a mean score of 2.86 and a standard deviation of 1.02. In Morrelganj, 14.9% of farmers are categorized as low users, exhibiting a mean of 2.70 and a standard deviation of 1.00. In both regions, the predominant proportion of farmers falls within the medium user category, with Patharghata at 61.4% and Morrelganj at 61.2%. Patharghata exhibits a higher rate among farmers at 27.7%, in contrast to Morrelganj's 23.9%. This suggests that Patharghata exhibits a marginally greater tendency towards advanced adaptation strategies among its farmers in comparison to Morrelganj, despite a somewhat similar distribution of medium and high user in both areas.

Table 5 displays the frequency of farmers adopting five selected adaptation strategies in the regions of Patharghata and Morrelganj. It highlights the number and percentage of farmers utilizing each strategy in both areas.

Table 5. Percentage of the farmers according to the use of selected adaptation strategies

Name of adaptation strategies	Adoption by the respondent farmers	
	Patharghata (n_1=83)	Morrelganj (n_2=67)
Salt tolerant rice seed	87.95	58.21
Homestead gardening	75.90	56.72
Training on coping with climate change	84.34	97.01
Vermi-compost	26.51	52.24
Irrigation	12.05	5.97

Data presented in Table 5 showed that 87.95% of respondents had adopted salt tolerant rice seed in Patharghata and 58.21% respondents had adopted salt tolerant rice seed in Morrelganj. About 75.90% of respondents had adopted homestead gardening in Patharghata and 56.72% respondents had adopted homestead gardening in Morrelganj. However, training on coping with climate change adaptation strategies was highest (97.01%) in Morrelganj compared to Patharghata. The findings indicated that Morrelganj has a greater adoption rate than Patharghata because the increased salinity there creates a barrier for livestock rearing, for Patharghata's respondents adopt less vermi-compost.

Table 6 presents the results of a correlation analysis examining the relationship between selected characteristics and the use of adaptation strategies by respondents in Patharghata and Morrelganj. The analysis evaluates the strength and significance of these correlations, with different coefficients of correlation (r) provided for each characteristic, alongside tabulated values for significance levels at 0.05 and 0.01.

In Patharghata, the level of education shows a significant positive correlation at the 0.01 level, with a coefficient of 0.369. Additionally, extension media contact and support received from government organizations (GOs) and non-governmental organizations (NGOs) have significant positive correlations at the 0.05 level, with coefficients of 0.233 and 0.244, respectively. In Morrelganj, age is significantly correlated with adaptation strategies at the 0.05 level, with a coefficient of 0.200. The level of education and extension media contact both show significant positive correlations at the 0.01 level, with coefficients of 0.311 and 0.371, respectively. Furthermore, support from GOs and NGOs demonstrates a strong significant correlation at the 0.01 level, with a coefficient of 0.489.

In comparing the two regions, the level of education is consistently significant in influencing adaptation strategy use in both Patharghata and Morrelganj, with a stronger correlation in Patharghata. Support from GOs and NGOs also emerges as a crucial factor in both regions, with a notably higher correlation in Morrelganj. Extension media contact significantly influences adaptation strategies in both areas but is more pronounced in Morrelganj. These findings highlight the importance of education, organizational support, and

media contact in facilitating adaptation among farmers in these regions.

Table 6. Results of correlation analysis between selected characteristics and use of adaptation strategies by the respondents

Selected characteristics	Patharghata 81 df			Morrelganj 65 df		
	Value of coefficient of correlation (r)	Tabulated values of r		Value of coefficient of correlation (r)	Tabulated values of r	
		0.05	0.01		0.05	0.01
Age	0.101			0.200*		
Level of education	0.369**			0.311**		
Family size	0.059			-0.01		
Farm size	0.136			0.04		
Annual income	0.155	0.199	0.264	0.08	0.200	0.265
Natural disaster frequency	0.162			0.282*		
Extension media contact	0.233*			0.371**		
Support received	0.244*			0.489**		

Notes: * Correlation is significant at the 0.05 level (2-tailed)
** Correlation is significant at the 0.01 level (2-tailed)

Reasons Responsible for Adoption of Adaptation Strategies

The data presented in Table 7 highlights the reasons for adopting various adaptation strategies in two regions, Patharghata and Morrelganj. In both areas, salt-tolerant rice seed is primarily valued for its ability to grow in saltwater, with 66.27% of respondents in Patharghata and 58.21% in Morrelganj citing this as a reason. Additionally, the higher yield provided by these seeds is a significant factor, especially in Patharghata (54.22%). Homestead gardening is another strategy that allows for the use of empty homestead areas and increases family income, noted by 14.46% and 32.53% of participants in Patharghata, respectively.

Table 7. Reasons for using adaptation strategies by the percentages of respondents

Adaptation strategies and reasons for use	Patharghata (n_1=83)	Morrelganj (n_2=67)
Salt tolerant rice seed		
1. Can grow in saltwater	66.27	58.21
2. Provided higher yield	54.22	32.83
3. Increases farm income	24.10	26.87
4. Fallow land can be used	31.33	4.48
5. Provided seed had good quality	13.25	5.97
Homestead gardening		
1. Empty homestead area can be used	14.46	14.93
2. Increases family income	32.53	19.40
3. Meets vegetable demand	54.22	25.37
4. Can be done in the water logging situation	31.32	47.76
5. Easily moveable	10.84	8.96
6. Provided higher yield	4.82	17.91
Training on coping with climate change		
1. Increases Capacity	55.42	76.12
2. Increases dignity in society	1.20	4.48
3. Knowledge of new strategies & crop variety	55.42	23.88
4. Knowledge of new strategies	28.92	34.33
5. Self-development	27.71	52.24
6. Can be taught to others	22.89	37.31
7. Can apply this knowledge	14.46	31.34
Vermi-compost		
1. Not need to buy chemical fertilizer	18.07	35.82
2. Increase fertility of the land	25.30	31.34
3. Get organic food	2.41	20.90
4. Increase production	7.23	25.37
5. Decrease the intensity of salinity	3.61	7.46
6. Get financial support	9.64	13.43
Irrigation		
1. Crops can be grown in the dry season	7.23	5.97
2. Low irrigation cost	4.82	2.99

Adaptation strategies and reasons for use	Patharghata (n_1=83)	Morrelganj (n_2=67)
3. Available water on time	4.82	1.49

Notably, 47.76% of respondents in Morrelganj find it suitable for waterlogged conditions. Training on coping with climate change is highlighted for increasing capacity, with a significant 76.12% of respondents in Morrelganj endorsing this benefit. This training also enhances self-development and the ability to teach others, with notable support in both regions. Vermi-compost is primarily appreciated for its role in reducing the need for chemical fertilizers, especially in Morrelganj where 35.82% of respondents favor it. It also contributes to increased land fertility. Irrigation, although less emphasized, is recognized for allowing crop growth during the dry season, although only by a small percentage of respondents in both areas. Overall, the data reveals a strong preference for strategies that enhance resilience through increased yield, land usability, and capacity building.

Reasons Responsible for Non-adoption of Adaptation Strategies by the Farmers

Table 8 presents the adaptation strategies and reasons for not using them in two locations: Patharghata and Morrelganj. When it comes to using salt-tolerant rice seed, a notable portion of respondents in Morrelganj (10.44%) were unaware of it, while a significant percentage in both locations cited insufficient support as a reason (10.84% in Patharghata and 22.39% in Morrelganj).

Table 8 Reasons for non-adoption of adaptation strategies by the percentages of respondents

Adaptation strategies and reasons for not using	Patharghata (n_1=83)	Morrelganj (n_2=67)
Salt tolerant rice seed		
1. Didn't know	1.20	10.44
2. Insufficient support	10.84	22.39
3. No land	0.00	8.96
4. Low Salinity	0.00	1.50
5. Don't do	0.00	2.99
6. Hard to cultivate alone	0.00	1.50
Homestead gardening		
1. Can't get time	18.07	13.43
2. Hard work needed	3.61	11.94
3. Didn't get training	4.82	11.94
4. Water scarcity	1.20	1.49
5. Lack of land	1.20	7.46
6. Financial Problem	1.20	7.46
Training on coping with climate change		
1. Didn't get offer	14.46	1.49
2. Engage in other work	0.00	1.49
Vermi-compost		
1. Engage in other works	12.04	14.93
2. Didn’t have cow and goat	30.12	26.87
3. Didn’t get training about it	34.94	10.44
4. Didn’t have the ability	8.43	8.96
Irrigation		
1. Insufficient	87.95	38.81
2. Didn’t t have land	1.20	1.49
3. Didn’t t need	0.00	50.75

Land availability issues were more pronounced in Morrelganj, with 8.96% lacking land, compared to none in Patharghata. In terms of homestead gardening, time constraints were the most significant barrier in Patharghata (18.07%), while Morrelganj respondents faced both time constraints (13.43%) and the need for hard work (11.94%). Lack of training was also more frequently reported in Morrelganj (11.94%) compared to Patharghata (4.82%). For training on coping with climate change, 14.46% of respondents in Patharghata indicated they did not receive any offers, whereas this was a minimal issue in Morrelganj (1.49%). In vermi-composting, a high percentage of respondents from both areas were engaged in other work, but lack of livestock was a greater barrier in Patharghata (30.12%) than in Morrelganj (26.87%). Additionally, a large proportion of Patharghata respondents did not receive training on vermi-composting (34.94%), compared to 10.44% in Morrelganj. Finally, for irrigation, a vast majority of Patharghata respondents (87.95%) reported insufficient availability, whereas in Morrelganj, only

38.81% reported this issue, and 50.75% indicated they didn't need it at all.

Discussion

The results of the study provide valuable insights into the socio-economic characteristics of farmers in Patharghata and Morrelganj, as well as their use of various climate-resilient adaptation strategies. The data reveals that demographic composition significantly influences the use of agricultural practices. This is consistent with findings from previous studies, suggesting that age and experience play crucial roles in the acceptance of new agricultural techniques (Elahi et al., 2022; Pfeiffer et al., 2021; Schukat & Heise, 2021).

The educational background of farmers also emerged as a critical factor affecting adaptation strategies. The study shows a strong correlation between educational attainment and the use of adaptation strategies, in both areas where a significant positive relationship was observed. This is aligned with existing literature, which indicates that higher education levels enhance farmers' ability to comprehend climate-related information and implement adaptive measures effectively (Nguyen et al., 2021; Silici et al., 2021; Warner et al., 2022). Moreover, the importance of extension media contact is emphasized, as Patharghata farmers reported lower levels of engagement in this aspect compared to their Morrelganj counterparts, potentially hindering their exposure to vital agricultural innovations.

The user of specific strategies also highlights significant differences between the two regions. For instance, while 87.95% of farmers in Patharghata used salt-tolerant rice seeds, only 58.21% did so in Morrelganj. This disparity may stem from the varying levels of salinity and soil conditions prevalent in each area, reinforcing the need for tailored adaptation strategies based on local environmental contexts (Naorem et al., 2023; Suhaeb et al., 2024; Taylor et al., 2021; Xavier et al., 2022). The results also indicate that training on coping with climate change was most prevalent in Morrelganj (97.01%), suggesting that targeted educational initiatives can significantly influence farmers' adaptive capacities.

Conversely, barriers to adoption were notably high among farmers in both regions. Insufficient support was frequently cited as a primary reason for non-adoption of salt-tolerant rice seeds and irrigation techniques, reflecting a systemic issue that requires intervention from both governmental and non-governmental organizations. Previous research indicates that access to resources and institutional support are critical for effective adaptation in agriculture (Antwi-Agyei & Stringer, 2021; Atube et al., 2021; Zobeidi et al., 2021). Additionally, time constraints were cited as a significant barrier to homestead gardening, highlighting the need for policies that facilitate better work-life balance for farmers (Braun et al., 2022; Mora-Guerrero et al., 2023).

In summary, the findings underscore the interplay between socio-economic characteristics and the use of climate-resilient strategies among coastal farmers in Bangladesh. Enhancing education and improving extension services are pivotal in fostering adaptive capacities in these communities. Furthermore, addressing the barriers to adoption through increased support and resources will be essential for building resilience against climate change impacts in the agricultural sector.

Conclusion and Recommendations

This study reveals that farmers in Patharghata and Morrelganj are employing various adaptation strategies to combat the adverse effects of climate change, with notable differences in adoption rates between the two regions. People widely recognize the effectiveness of salt-tolerant rice seeds and homestead gardening, especially in Patharghata, where salinity levels pose a significant concern. Training on coping with climate change has proven vital in enhancing farmers' adaptive capacity, especially in Morrelganj. However, barriers such as insufficient support, lack of training, and time constraints hinder the adoption of these strategies, highlighting the need for systematic interventions. To enhance the resilience of farmers against climate change impacts, it is recommended that local authorities and agricultural organizations focus on improving educational programs and extension services. We should organize tailored training sessions to enhance awareness of effective adaptation strategies, with a particular focus on regions most affected by salinity. Furthermore, providing adequate support and resources to facilitate the adoption of these strategies will be essential. Policies aimed at reducing time burdens on farmers through better work-life balance can also encourage more widespread participation in adaptation activities. By addressing these challenges, farmers in both Patharghata and Morrelganj can strengthen their resilience and ensure sustainable agricultural practices in the face of climate change.

References

Antwi-Agyei, P., & Stringer, L. C. (2021). Improving the effectiveness of agricultural extension services in supporting farmers to adapt to climate change: Insights from northeastern Ghana. *Climate Risk Management*, *32*. https://doi.org/10.1016/j.crm.2021.100304

Atube, F., Malinga, G. M., Nyeko, M., Okello, D. M., Alarakol, S. P., & Okello-Uma, I. (2021). Determinants of smallholder farmers' adaptation strategies to the effects of climate change: Evidence from northern Uganda. *Agriculture and Food Security*, *10*(1). https://doi.org/10.1186/s40066-020-00279-1

BBS. (2019). BANGLADESH BUREAU OF STATISTICS (BBS) Statistics and Informatics Division (SID) Ministry of Planning. *Report on Agriculture and Rural Statistics*.

Bouwer, L. M. (2019). *Observed and Projected Impacts from Extreme Weather Events: Implications for Loss and Damage*. https://doi.org/10.1007/978-3-319-72026-5_3

Braun, L., Freund, J., Thielecke, J., Baumeister, H., Ebert, D. D., & Titzler, I. (2022). Barriers to and Facilitators of Engaging With and Adhering to Guided Internet-Based Interventions for Depression Prevention and Reduction of Pain-Related Disability in Green Professions: Mixed Methods Study. *JMIR Mental Health*, *9*(11). https://doi.org/10.2196/39122

Das, S., & Wahiduzzaman, M. (2022). Identifying meaningful covariates that can improve the interpolation of monsoon rainfall in a low-lying tropical region. *International Journal of Climatology*, *42*(3). https://doi.org/10.1002/joc.7316

Dastagir, M. R. (2015). Modeling recent climate change induced extreme events in Bangladesh: A review. *Weather and Climate Extremes*, *7*. https://doi.org/10.1016/j.wace.2014.10.003

Dewan, T. H. (2015). Societal impacts and vulnerability to floods in Bangladesh and Nepal. *Weather and Climate Extremes*, *7*. https://doi.org/10.1016/j.wace.2014.11.001

Dike, E. (2018). Did Global Warming and Climate Change Cause the Degradation of Lake Chad, Africa's Most Important "Ecological Catastrophe"? *Review of Environment and Earth Sciences*, *5*(2). https://doi.org/10.18488/journal.80.2018.52.15.41

Elahi, E., Khalid, Z., & Zhang, Z. (2022). Understanding farmers' intention and willingness to install renewable energy technology: A solution to reduce the environmental emissions of agriculture. *Applied Energy*, *309*. https://doi.org/10.1016/j.apenergy.2021.118459

Fankhauser, S. (2017). Adaptation to Climate Change. In *Annual Review of Resource Economics* (Vol. 9). https://doi.org/10.1146/annurev-resource-100516-033554

Hans-O. Pörtner , Debra C. Roberts, H. (2022). Climate Change 2022 - Impacts, Adaptation and Vulnerability - Summary for Policymakers. In *Ipcc*.

IPCC (2023). Climate Change 2021 – The Physical Science Basis. In *Climate Change 2021 – The Physical Science Basis*. https://doi.org/10.1017/9781009157896

Joakim, E. P., Mortsch, L., & Oulahen, G. (2021). Using vulnerability and resilience concepts to advance climate change adaptation. In *Environmental Hazards and Resilience*. https://doi.org/10.4324/9781003171430-1

Kabir, A., Amin, M. N., Roy, K., & Hossain, M. S. (2021). Determinants of climate change adaptation strategies in the coastal zone of Bangladesh: implications for adaptation to climate change in developing countries. *Mitigation and Adaptation Strategies for Global Change*, *26*(7). https://doi.org/10.1007/s11027-021-09968-z

Mapfumo, P., Onyango, M., Honkponou, S. K., El Mzouri, E. H., Githeko, A., Rabeharisoa, L., Obando, J., Omolo, N., Majule, A., Denton, F., Ayers, J., & Agrawal, A. (2017). Pathways to transformational change in the face of climate impacts: an analytical framework. *Climate and Development*, *9*(5), 439–451. https://doi.org/10.1080/17565529.2015.1040365

Mora-Guerrero, G., Herrera-González, F., Constanzo-Belmar, J., Alveal-Álamos, C., & Viscardi, S. (2023). Uncovering the Work–Family Interface: The Impact of Facilitators and Stressors on the Health of Farm Women. *Healthcare (Switzerland)*, *11*(20). https://doi.org/10.3390/healthcare11202726

Naorem, A., Jayaraman, S., Dang, Y. P., Dalal, R. C., Sinha, N. K., Rao, C. S., & Patra, A. K. (2023). Soil Constraints in an Arid Environment—Challenges, Prospects, and Implications. In *Agronomy* (Vol. 13, Issue 1). https://doi.org/10.3390/agronomy13010220

Nguyen, T. H., Sahin, O., & Howes, M. (2021). Climate change adaptation influences and barriers impacting the asian agricultural industry. *Sustainability (Switzerland)*, *13*(13). https://doi.org/10.3390/su13137346

Pfeiffer, J., Gabriel, A., & Gandorfer, M. (2021). Understanding the public attitudinal acceptance of digital farming technologies: a nationwide survey in Germany. *Agriculture and Human Values*, *38*(1). https://doi.org/10.1007/s10460-020-10145-2

Roy, S., Tandukar, S., & Bhattarai, U. (2022). Gender, Climate Change Adaptation, and Cultural Sustainability: Insights From Bangladesh. In *Frontiers in Climate* (Vol. 4). https://doi.org/10.3389/fclim.2022.841488

Saha, D., Hossain, Md. S. S., Mondal, M. S., & Rahman, R. (2016). Agricultural adaptation practices in coastal Bangladesh : response to climate change impacts. *Journal of Modern Science and Technology*, *4*(1).

Schukat, S., & Heise, H. (2021). Towards an understanding of the behavioral intentions and actual use of smart products among german farmers. *Sustainability (Switzerland)*, *13*(12). https://doi.org/10.3390/su13126666

Silici, L., Rowe, A., Suppiramaniam, N., & Knox, J. W. (2021). Building adaptive capacity of smallholder agriculture to climate change: evidence synthesis on learning outcomes. In *Environmental Research Communications* (Vol. 3, Issue 12). https://doi.org/10.1088/2515-7620/AC44DF

Suhaeb, F. W., Tamrin, S., Jumadi, & Irwan. (2024). Community Adaptation Strategies To Climate Change: Towards Sustainable Social Development. *Migration Letters*, *21*(S2).

Taylor, A., Wynants, M., Munishi, L., Kelly, C., Mtei, K., Mkilema, F., Ndakidemi, P., Nasseri, M., Kalnins, A., Patrick, A., Gilvear, D., & Blake, W. (2021). Building climate change adaptation and resilience through soil organic carbon restoration in sub-saharan rural communities: Challenges and opportunities. In *Sustainability (Switzerland)* (Vol. 13, Issue 19). https://doi.org/10.3390/su131910966

Upadhyay, R. K. (2020). Markers for Global Climate Change and Its Impact on Social, Biological and Ecological Systems: A Review. *American Journal of Climate Change*, *09*(03). https://doi.org/10.4236/ajcc.2020.93012

Vermeulen, S. J., Dinesh, D., Howden, S. M., Cramer, L., & Thornton, P. K. (2018). Transformation in Practice: A Review of Empirical Cases of Transformational Adaptation in Agriculture Under Climate Change. In *Frontiers in Sustainable Food Systems* (Vol. 2). https://doi.org/10.3389/fsufs.2018.00065

Warner, D., Moonsammy, S., & Joseph, J. (2022). Factors that influence the use of climate information services for agriculture: A systematic review. In *Climate Services* (Vol. 28). https://doi.org/10.1016/j.cliser.2022.100336

Xavier, L. Y., Guilhon, M., Gonçalves, L. R., Corrêa, M. R., & Turra, A. (2022). Waves of Change: Towards Ecosystem-Based Management to Climate Change Adaptation. *Sustainability (Switzerland)*, *14*(3). https://doi.org/10.3390/su14031317

Yarnold, PR (2018). Minimize usage of binary measurement scales in rigorous classical research. *Optimal Data Analysis*, *7*.

Zobeidi, T., Yazdanpanah, M., Komendantova, N., Sieber, S., & Löhr, K. (2021). Factors affecting smallholder farmers' technical and non-technical adaptation responses to drought in Iran. *Journal of Environmental Management*, *298*. https://doi.org/10.1016/j.jenvman.2021.113552