International Journal of Scientific Research and Management (IJSRM)
||Volume||13||Issue||05||Pages||609-619||2025||
Website: https://ijsrm.net ISSN (e): 2321-3418
DOI: 10.18535/ijsrm/v13i05.ah01

Agronomic Practices of the Haor Farmers to Combat Climate Stresses On Mustard Production

Md. Fahim Faisal[1], Mohammad Ashraful Islam[1*], Zasia Sultana[2], Rakibul Alim[3]

Department of Agricultural Extension Education, Sylhet Agricultural University, Bangladesh

Abstract

Mustard cultivation in Bangladesh, particularly in the ecologically fragile Hakaluki haor region faces severe challenges of erratic rainfall, drought, hailstorms, and insect-pest infestation. As a result, germination, vegetative growth and yield of mustard are severely affected almost every year. In this context, the study aimed to identify the major climate stresses on mustard production and their ways out. The study was conducted in five different villages of Hakaluki haor under Uttar Fenchuganj union in Sylhet district. A total of 99 farmers were randomly selected as the sample for the study from a population of 250 farmers who were interviewed using a pre-tested interview schedule from January to February 2024. Data were analyzed using SPSS software and Ms-Excel. Findings revealed that mustard cultivation was hampered in two phases-at the germination phase and at the vegetative growth of its life cycle. Germination was frequently failed either by excessive soil moisture due to un-time rainfall or by in-sufficient soil moisture due to drought. On the other hand, vegetative growth was affected by hailstorm, water logging, and insect-disease infestation. Germination problem due to insufficient soil moisture was resolved by choosing alluvial soils by 60% cases because of its higher water holding capacity while, 36% had opted well drained but water source adjacent lands and 44% had fixed it by watering the soils. Adjusting of sowing time was practiced by 75% of the respondents to minimize effects of heavy rainfall on germination and hail storms on vegetative growth of mustard. Overwhelming majority of the respondents (83%) had chemical measures against insect-pests infestation while only 20% tried to mitigate this problem through well tilling of the soils. Coefficients of correlation suggested that all these coping strategies were significantly associated with the occupation, age, education level, farm size, perception and farming experience of the respondents. However, the major problems faced by them were limited access to improved seeds, inadequate irrigation facilities, high input costs, and lack of technical knowledge.

Key words: Climatic stresses, coping practices, cultivation, farmer and mustard.

Introduction

Mustard (Brassica juncea) is an essential oilseed crop, playing a vital role in ensuring global food security and strengthening to the agricultural economy worldwide (Saini et *al.*, 2017). In Bangladesh, mustard is especially important because it grows well during the winter season and is one of the main sources of edible oil for the people (Khan *et al.*, 2023). Farmers in places like hakaluki haor an ecologically delicate wetland in northeastern Bangladesh are increasingly struggling to grow mustard as changing climate conditions bring unpredictable weather and growing risk (Hossain, 2019). This region is especially at risk due to unpredictable rainfall, changing water levels, rising temperature and sudden flash flood (Dey *et al.*, 2021). These challenges make mustard farming difficult, as the crop is very sensitive to temperature shifts and water availability (Kumawat *et al.*, 2024). Mustard grows best within a temperature between 18°C and 25°C, and any variation outside this range disrupt critical processes like photosynthesis, seed formation and flowering (Ahatsham *et al.*, 2018). Challenges such as waterlogging during planting time or water scarcity during flowering stage only worsen the situation, leading crops yields and threatening the livelihood of farmers (Niwas & Khichar, 2016). Despite these difficulties, the farmers in hakaluki haor have shown great resilience by implementing various agronomic practices to manage the impacts of climate stresses (Rahman *et al.*, 2018). Agronomic Practices, like sowing seed earlier in the season, help protect the crop from extreme temperatures during critical growth phase, such as flowering (Kaur, 2022). Many farmers have started planting drought-resistant and early-maturing mustard varieties, which are more suited to the region's unpredictable weather and shorter growing seasons (Rani *et al.*, 2024). Additionally, using organic fertilizers and balanced nutrient management helps to improve soil quality, making it more capable of holding moisture and supporting plant growth even in tough conditions (Sudadi, 2024). Furthermore, community-based solution, such as shared irrigation systems and collective seed banks, help smallholder farmers overcome resource limitations and strengthen their ability to adapt to climate fluctuations (Ariyawanshe *et al.,* 2023). However, there are considerable challenges for farmers trying to implement these climate-resilient practices. Many of the solutions, like drought-resistant seeds and advanced irrigation systems, are simply too expensive for smallholder farmers in the region to afford. Additionally, the limited acess to technical knowledge and extension services hinders their ability to adopt effective agronomic strategies (Ndiwa *et al.*, 2024). For instance, a lack of awareness about integrated pest and nutrient management often reduces the effectiveness of these approaches (Samanta et *al.*, 2024). Socio-economic challenges, like low market prices for mustard and absence of crop insurance, make farmers even more vulnerable, forcing many to resort to unsustainable practices or, in some cases, abandon mustard farming entirely. This study aims to explore how climate stresses, agronomic practices and socio-economic factors affect mustard cultivation in hakaluki haor, highlighting both their innovative approach and the challenges they face. This finding will guide policy recommendations to enhance resilience and sustainability in mustard farming. This research aims to offers a framework for tacking similar challenges in other climate-vulnerable region, improving mustard productivity, securing farmer's livelihoods and promoting sustainable agricultural practices to combat climate change.

Methodology

Study Area:

The study was conducted in five purposively selected villages namely Lagamgangaour, South Maninkona, East Manikkona, West Manikkona and sultanpur located in fenchuganj Upazila of Sylhet district, within the hakaluki haor region.

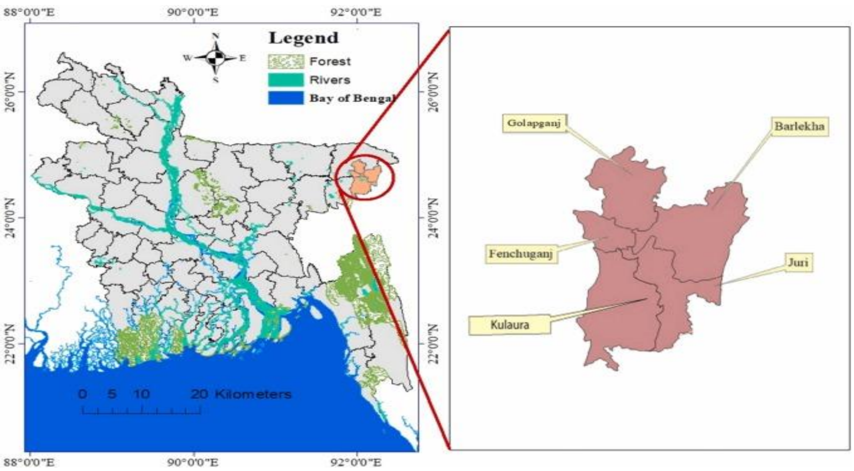

Figure 1: Map of Hakaluki haor

Population and sample:

The farmers who were engaged in mustard cultivation in hakaluki haor under fenchuganj upazila constituted the population of the study. From these five villages 99 mustard farmers were taken as sample from a population of 250 farmers for the study following simple random sampling method.

Collection of Data:

In order to collect relevant data for the study, a well- structured interview schedule was pre-tested with 99 mustard farmers from the study area by the researcher before finalizing the questions for collection of data. Data were collected from 99 randomly selected mustard farmers during January to February 2024.For determining the Agronomic practices of the haor farmers to combat climate stresses on mustard production

Focus group discussion (FGD) and key informants' interview (KII) were also conducted by using appropriate check lists.

Measurement of independent variables

The independent variables of this study were respondent's age, level of education, family size, farm size, occupation, annual income, experience, perception about climate change, extension media contact and experience of mustard growers. Age of a respondent was measured on the basis of actual age of his life and expressed in years. The education was measured by the number of years of schooling. Family size was measured by the total number of members including the farmer himself, spouse, children and other permanent dependents who lived together as a family unit. The total land area possessed by the farmer under farm and homestead was the basis of measuring farm size in this study and it was expressed in hectare. The yearly income and occupation from different sources were the annual income and activities of the respondent. For measuring extension media contact and perception of climate change, a four-point scale- frequently, occasionally, seldom and not at all was used and appropriate weights were assigned to quantify the variable. The experience of the mustard farmer was measured in terms of actual years of their involvement in mustard farming. To measure Impact of Climatic Stresses on Mustard Cultivation, a dichotomous scale was employed, where each respondent was asked to indicate their agreement or disagreement with each statement by choosing either "Yes" or "No." A "Yes" response indicated agreement or acknowledgment of the statement, while a "No" response signified disagreement or rejection .Focus Group Discussion (FGD) was conducted in the study area comprising selected model farmers of the study villages, Sub-Assistant Agriculture Officers of the respective blocks, and input dealers for collecting information regarding various crop production technologies which withstand in the climate change induced various hazards like flash flood, flood, cold and heat wave and drought. Necessary tables and categories were used to classify the data considering their nature and distribution. As per the objective of the study, statistical tests like frequency counts, percentage, mean, standard deviation were used for analysis and interpretation of data. Correlation coefficients were used for hypothesis testing and 0.05 and 0.01 level probabilities were used as the basis for exploring relationship between the concerned variables throughout the study.

Measurement of dependent variables

The dependent variable in this study is the Agronomic practices by the farmers to combat climate stresses in mustard cultivation in Hakaluki haor. To measure this, a structured questionnaire was designed, identifying key climate stressors such as insufficient moisture, heavy rainfall, hailstorms, disease and pest infestations. Farmers' responses regarding their adaptation strategies were collected, including practices such as artificial irrigation, water conservation techniques, seed selection, optimized planting time, and pest control measures. Responses were recorded in a binary format, where a "Yes" response was assigned a score of one (1), indicating farmers practiced these agronomic strategies, while a "No" response was assigned a score of zero (0), indicating not practiced. The cumulative practice score was then for each respondent calculated by summing the scores across all identified agronomic practices. These quantitative measures provided an overall index of each farmers practiced capacity, allowing for comparative analysis of the extent and effectiveness of climate stress management strategies among mustard growers in the study area.

Results and Discussion

Socio-economic profile of the respondent

The Data Table 1. revealed that a majority of the farmers were middle-aged (65.66%), compared to 28.15% who were young and 30.10% who were elderly. Similar observation was made by Islam et al. (2023). The findings indicate that 27.3% of the farmers had Read & write only and 26.3% famers had primary education. In terms of family structure, most of the respondents (66.67%) belonged to large families, whereas 20.20% of respondents came from medium-sized families and only 13.13% were from small families. A majority of mustard farmers (54.54%) reported agriculture as their main occupation. This finding is consistent with the study by Awazi and Quandt (2021), which reported that over 70% of the participants in Isiolo County, Kenya, and Northwestern Cameroon relied primarily on farming. According to statistical analysis from Table 1, the largest percentage of farmers (77.78%) make a medium income from agricultural and other activities, followed by those with low incomes (8.08%) and high incomes (14.14%). It also revealed that maximum farmers hold medium farm land (67.68%), which finding align with a research by Kumar and

Moharaj (2023) who emphasized the same findings. Due to challenging climatic conditions, most farmers had moderate experience (67.68%) in mustard farming, while 19.19% had limited experience. Furthermore, the farmers' perceptions about climate change were showed that the most of the farmers (84.84%) exhibited a medium level of perception, compared to 7.07 percent who were perceived poorly. Finally, 70.71% of farmer had frequent contact with extension services which were medium categories.

Table 1. Profile of the mustard growers

Characteristics	**Categories**	**Mustard grower (%)**	**Observed range**	**Mean**	**SD**
Age (year)	Young (up to 33)	18.18	18-80	45.60	12.37
	Middle (34 -58)	65.66			
	Old (>59)	16.16			
Education (score)	Illiterate (1)	22.2	1-7	3.15	1.54
	Can only sign (2)	8.1			
	Read & write only (3)	27.3			
	Primary (4)	26.3			
	Secondary (5)	5.1			
	Higher secondary (6)	3.0			
	Graduate (7)	3.0			
Family size (member number)	Small (up to 4)	13.13	3-20	7.29	2.82
	Medium (5-6)	20.20			
	Large (>7)	66.66			
Occupation	Agriculture	54.54	1-6	2.18	1.16
	Day Labor	12.12			
	Businessman	16.16			
	Fisherman	4.04			
	Job holder	10.10			
	Student	3.03			
Annual income (Tk.`000)	Low (up to 175)	8.08	41.35-1993	480.95	305.79
	Medium (176-787)	77.78			
	High (>788)	14.14			
Farm size (ha)	Marginal (up to 0.50)	3.03	0.06-6.26	1.90	1.11
	Small (0.51-1)	14.14			
	Medium (1.01-3)	67.68			
	High (>3.01)	15.15			
Experience (score)	Poor (up to 8.2)	19.19	2-50	17.87	9.28
	Medium (8.3-12.64)	67.68			
	High (>12.64)	13.13			
Perceptions about climate change (score)	Poor (up to 20)	7.07	17-61	25.65	5.32
	Medium (21 to 31)	8484			
	Large (>32)	8.08			
Extension media contact (score)	Low (5.68)	19.19	3-19	10.41	3.49
	Medium (5.69-11.42)	70.71			
	High (>11.42)	10.10			

Edaphic features of mustard fields

Table 2 presents the overall characteristics of the mustard fields located in the hakaluki haor area, evaluated across four key dimensions: soil type, field elevation, soil fertility status and water holding capacity. The results showed that the majority of mustard farmers (72.72%) reported having clay soil on their land, while 21.21% mentioned loamy soil and only 6.06% had sandy loam soil.

Table 2. Edaphic Characteristics of Mustard Fields in Hakaluki Haor

Characteristics	Categories	Mustard grower (%)	Observed range	Mean	SD
Soil type (score)	Loamy soil (1)	21.21	1-3	1.48	0.825
	Clay soil (2)	72.72			
	Sandy loam soil (3)	6.06			
Elevation of field (score)	High (1)	1.01	1-3	2.24	0.45
	Medium (2)	73.73			
	Low (3)	25.25			
Soil fertility (score)	Highly fertile (1)	18.18	1-3	1.93	0.54
	Medium fertile (2)	70.70			
	Low fertile (3)	11.11			
Water holding capacity (score)	High (1)	27.27	1-3	1.84	0.64
	Medium (2)	60.60			
	Low (3)	12.12			

It also reported that most of the mustard fields (73.73%) wew situated on medium-elevated land, while 25.25% were in low-lying areas and only 1.01% wre located on high land. In terms of soil fertility, 70.70% of mustard fields wew found to be moderately fertile, while 18.18% were highly fertile and 11.11% had low fertility. A similar pattern was observed by Choudhary *et al.* (2021), who found that medium-fertility soils dominate mustard-growing regions and are critical for achieving stable crop yields. Additionally, 60.60% of the mustard fields had moderate waterholding capacity, while 22.27% had high capacity and 12.12% had low capacity.

Impacts of Climatic Stressors on Mustard Production in Hakaluki Haor

Table 3 highlights the major climatic challenges that farmers in hakaluki haor face during mustard cultivation. Based on farmers reports, twelve specific issues were identified and organized into five main categories. These include problems like insufficient soil moisture, excessive rainfall, hailstorms, insects and disease infestation all of which significantly hinder the growth, development and productivity of mustard crops.

The findings indicated that a lack of adequate soil moisture was a major climatic stress impacting mustard farming in the hakaluki haor area. Farmers reported that this issue caused several problems, including reduced seed germination (63.64%), higher seedling death rates (22.22%), poor development of pods (7.07%) and ultimately yields loss (9.09%). These observations align with the study by Singh *et al.* (2020), which noted that when soil moisture is insufficient during key growth stages like germination and flowering, it disrupts enzyme function and nutrient absorption leading to limited growth and pods. Similarly, Akanksha *et al.* (2020) pointed out that mustard crops are especially vulnerable to dry conditions during crucial phase like pod setting, which can significantly cut down yields.

Table 3. Impact of Climatic Stresses on Mustard Cultivation in Hakaluki Haor

Climate stresses	Impact on mustard cultivation	Percent of answer "YES"	Percent of answer "NO"
Insufficient moisture in the soil.	i. Low seed germination rate	63.64	30.30
	ii. Excessive rate of seedling mortality	22.22	77.78
	iii. Poor pod development	7.07	92.93

	iv.	Yield loss	9.09	90.91
Heavy rainfall during the seed germination and emergence phase	v.	Extremely low germination	50.51	49.49
	vi.	Seed decomposition	82.83	17.17
	vii.	Excessive rate of seedling mortality	25.25	74.75
Heavy rainfall& Hailstorm during the pre-harvest period	viii.	Plant lodging	71.72	28.28
	ix.	Yield loss	86.87	13.13
Cutworm	x.	Collar zone severance in seedlings	82.83	17.17
Disease Infestation	xi.	Poor pod development	80.81	19.19
	xii.	Yield loss	83.84	16.16

Mustard cultivation in hakaluki haor region faced serious challenges due to heavy rainfall during the germination and early growth stages. Farmers reported very low germination rates (50.51%), a high percentage of seed rotting (82.83%) and elevated seedling mortality (25.25%) as a result. These outcomes are in the line with the findings of Saha *et al.* (2023), who observed that excessive rainfall during sensitive growth periods alters soil condition, leading to waterlogged fields and reduced oxygen availability. Such conditions interfere with normal conditions and increase the risk of seed decay and seedling loss. Additionally, Niwas and Khichar *et al.* (2016) noted that prolonged soil saturation from heavy rains weakens young root systems, making seedlings more prone to death and reducing overall plant strength.

In the pre-harvest stage of mustard cultivation, heavy rainfall and hailstorms emerged as significant climatic threats, leading to considerable plant lodging (71.72%) and substantial yield reduction (86.87%). Rainfall during this sensitive period destabilizes the crop, making it more prone to lodging due to weakened plant support. This observation is consistent with Saha *et al.* (2023), who found that prolonged wet conditions impair root strength and increase structural damage in mustard plants. Hailstorms worsen the situation by damaging leaves and pods, which often results in early pod breakage and further yield loss. Similarly, Niwas and Khichar (2016) noted that hail during the final growth stages can severely impact both pod formation and seed quality, reducing the overall harvest.

Cutworm attacks posed a major threat to mustard seedlings in hakaluki haor, with about 82.83% of seedling suffering damage at the collar region. This type of injury compromises seedling structure and hinders proper crop establishment. Khan *et al.* (2021) reported that black cutworms can cause extensive damage during the initial growth phase of crops like maize, reducing plant density by 30-40% under moderate infestation and up to 90% in severe cases.

In hakaluki haor, disease outbreaks had a serious impact on mustard cultivation, resulting in poor pod development (80.81) and considerable yield loss (83.84%). These observations are supported by Kumar *et al.* (2022), who found that biotic stresses like Alternaria blight and Scleractinia stem rot significantly reduce pod and seed yields in mustard, especially when crops are not protected. Their study noted losses up to 26.25% in vulnerable varieties. Similarly, Gupta *et al.* (2016) reported that disease pressure lowers both the number and weight of siliquae, ultimately affecting pod formation and overall productivity.

Agronomic Practices

Table 4 revealed that the agronomic practices taken by the farmers in the hakaluki haor area to cope with climate-related challenges in mustard farming. The nine agronomic strategies reflect the farmers practical responses to issue like insufficient soil moisture, excessive rainfall, hailstorms, pest attacks, and disease outbreaks, showcasing their resilience and adaptability in the face of climatic stress.

To address insufficient soil moisture, farmers in the hakaluki haor region adopted several agronomic practices, including utilizing post-flood alluvial soils (59.60), planting around the edges of waterlogged areas (36.36%) and implementing artificial irrigation methods (44.44%). These approaches reflect findings by Mashuri (2023), who noted that modern irrigation technique play a key role in improving water access and managing soil moisture. Likewise, Bhanwaria *et al.* (2022) highlighted the benefits of applying organic manures to boost soil moisture retention and enhance crop productivity, particularly in dry environments.

Table 4. Frequency of Agronomic Practices Among Surveyed Farmers

Climate stresses		**Agronomic practices**	**Percent of answer "YES"**	**Percent of answer "NO"**
Insufficient moisture in the soil.	i.	Post-flood alluvial soils utilized for mustard cultivation	59.60	40.40
	ii.	Mustard farming along the periphery of waterlogged areas	36.36	63.64
	iii.	Artificial Irrigation for mustard farming	44.44	55.56
Heavy rainfall during the seed germination and emergence phase	iv.	Seed planting between last week of October and first week of November to reduces the risk of water stress due to heavy rains.	74.75	25.25
	v.	Water-tolerant cultivars, BARI Sarisha-14 and BINA Sarisha-11, are used to mitigate excess rainfall effects.	63.63	36.37
Heavy rainfall& Hailstorm during the pre-harvest period	vi.	Seed sowing initiated at the start of November month.	64.65	35.35
Cutworm	vii.	Effective land preparation for cultivation.	20.20	79.80
	viii.	Pesticide use	82.83	17.17
Disease Infestation	ix.	Chemical use for disease control	69.70	30.30

To cope with excessive rainfall during germination phase, 74.75% of farmers adjusted their sowing time, opting to plant between the last week of October and first week of November. Additionally, 63.63% of them selected water-tolerant varieties such as BARI Sarisa-14 and BINA Sarisa-11. Similarly, Lewandrowski *et al.* (2016) found that modifying planting schedules can significantly improve seedling emergence during periods of intense rainfall.

To reduce pre-harvest damage caused by heavy rainfall and hailstorms, 64.65% of farmers practiced early sowing during the first week of November, allowing the crop to reach maturity before severe weather set in. This approach aligns with findings S. K. Singh *et al.* (2017) who reported adjusting sowing times helps minimize hailstorm-related yield reduction in wheat, which can be similarly beneficial for mustard cultivation.

Only 20.20% of farmers addressed cutworm problems through systematic land preparation and 82.83% using chemical pesticides. Chandel *et al.* (2021) noted that well-planned and land preparation can interrupt pest life cycle, helping to control cutworm populations. In the same vein, Khan *et al.* (2021) pointed out that combining biological and cultural control methods is effective in managing pressure and similar crops.

To manage disease outbreaks in mustard cultivation, 69.70% of farmers used targeted chemical treatments. This practice reflects the findings of Gupta *et al.* (2016), who emphasized that combining fungicides with cultural methods offers effective control over mustard disease.

Table 5. Correlation co-efficient of the selected characteristics of the respondents with the agronomic practices

Dependent Variable	Independent Variable	Computed value for 'r'	Table value of 'r'	
			0.05	0.01
Agronomic practices	Occupation	0.282**	0.197	0.248
	Age	0.258**		
	Level of education	0.279**		
	Family size	0.188[NS]		
	Farm size	0.254 **		
	Annual income	0.179[NS]		
	Source of information	0.183[NS]		
	Perception about climate change	0.216*		
	Experience	0.222*		

[NS] *Non-significant relationship*
**Significant at 0.05 level of probability*
***Significant at 0.01 level of probability*

Relationships between the selected characteristics of the respondents and the agronomic practices

Based on the above findings, it was conculcated that the farmer's occupation, age, education level and farm size were significantly associated with the agronomic practices they used to manage climate stress in mustard production, with the relationship being significant at the 0.01 level of probability. Similar results were observed by Awazi and Quandt (2021), who found that a farmer's occupation had significantly influence on their choice of farming practices. Additionally, a study by Alam et al., 2018 found that farmer's age had significant relationship with their cultivation practices for beans. (Uddin et al., 2021) stated that education level was strongly correlated with farming practices, as it plays a key role in influencing farmer's ability to adopt appropriate crop production techniques. Amin et al., 2016 found that farm size was not significantly linked to the outcomes of their research.

The findings imply that farmer's perception of climate change and their experience on mustard cultivation were significantly associated with the agronomic practices they used to cope climate stress in mustard production, with the relationship being significant at the 0.05 level of probability. Additionally, the results showed that greater experience in mustard cultivation helped reduce challenges. A Similar relationship was observed by Basher (2006) in mushroom cultivation.

Based on the findings table 5, the results revealed that family size, extension service and annual income of the farmer's were not significantly related to the agronomic practices used in mustard cultivation under vulnerable climate condition. Similar results were found in some respective studies (Deb and Islam, 2023; Amin et al., 2016). A study by Phiri *et al.* (2019) highlighted that extension service had significant impact on agricultural practices. Furthermore, Alamgir *et al.* (2020) found no significant relationship between farmer's annual income and with the strategies they use for crop cultivation.

Conclusion

Farmers who belong to haor region of fenchuganj upazila face several severe climate related challenges in mustard production. Climatic stresses like insufficient soil moisture during germination and critical growth stages, heavy rainfall during germination and hailstorms before harvest lead to poor plant growth, lodging and reduced yields. Furthermore, climate variability has contributed to increased insect infestation such as cutworms, and higher susceptibility to diseases, further threatening mustard cultivation. To cope with these climatic stresses, farmers had practiced several agronomic practices. To deal with lack of soil moisture, many farmers took advantage of the fertile soils left behind after flood, about 60% used these post-flood alluvial soils. Some (36%) chose to grow mustard along the edges of waterlogged areas, while 44% used artificial irrigation to keep their crops hydrated. When heavy rains disrupted seed germination, most farmers (75%) adjusted their sowing schedules, and around 63% sowed water-tolerant mustard varieties like BARI Sarisha-14 and BINA Sarisa-11. Early sowing such as late October and first week of November (65%)

helped minimize pre-harvest losses due to heavy rainfall and hailstorms. While disease control was widely practiced through chemical pesticides (83%), insect management remained inadequate, with only 20% employing systematic land preparation against cutworms. These findings show that while farmers are trying hard to adapt, their success often depends on their resources and support systems. So truly strengthen mustard production in this vulnerable region, there's a need for better access to technologies, training, financial help, and stronger extension services. With the right support, farmers can build resilience and continue to grow mustard even under tough climate conditions.

References

1. Ahatsham, M., Singh, S., & Dagar, C. S. (2018). Heat Use Efficiency of Indian mustard (Brassica juncea) at Different Phenophases in Western Haryana, India. *International Journal of Current Microbiology and Applied Sciences*, *7*(06): 1977–1981.
2. Alam, M.Z., Islam, M.S., and Kabir, M.H., 2018. Problems faced by the bean farmer in selected areas of Pabna district in Bangladesh. Research in Agriculture, Livestock and Fisheries, 5 (1), Pp. 11–18.
3. Amin, M.A., Bashar, M.A., Akhter, N., Afroj, M., Islam, M.Z., Rahman, M.M., and Baque, M.A., 2016. Constraints faced by the farmers in IPM practices in rice cultivation. Journal of Science, Technology and Environment Informatics, 4 (1), Pp. 245–250.
4. Ajewole, O. C., Abdu-Raheem, K. A., & Fadumila, A. L. (2023). Farmers' perception of climate variability effects on arable crop productivity in Ondo State, Nigeria. *Asian Journal of Research in Agriculture and Forestry*, 9(3): 65–74.
5. Akanksha, Srivastava, K., Srivastava, A., & Sinha, B. (2020). Analysis of Drought Susceptibility Index in Indian Mustard [Brassica juncea (L.) Czern and Coss]. *Indian Journal of Agricultural Research*, *Of.*
6. Alamgir, M. S., Furuya, J., Kobayashi, S., Mostafiz, R. B., & Ahmed, M. R. (2020). Farm income, inequality, and poverty among farm families of a flood-prone area in Bangladesh: climate change vulnerability assessment. *GeoJournal*, *86*(6): 2861–2885.
7. Awazi, N. P., & Quandt, A. (2021). Livelihood resilience to environmental changes in areas of Kenya and Cameroon: a comparative analysis. *Climatic Change*, *165*(1–2).
8. Bashar, M.A., 2006. Problem Confrontation of the Farmers in Mushroom Cultivation.M.S. (Agril Ext. Edu.) Thesis, Department of Agricultural Extension and Information System, Sher-e-Bangla Agricultural University, Dhaka
9. Bhanwaria, R., Singh, B., & Musarella, C. M. (2022). Effect of organic manure and moisture regimes on soil physiochemical properties, microbial biomass CMIC:NMIC:PMIC turnover and yield of mustard grains in arid climate. Plants, 11(6): 722.
10. Chandel, R. S., Verma, K. S., Rana, A., Sanjta, S., Badiyala, A., Vashisth, S., Kumar, R., & Baloda, A. S. (2021). The ecology and management of cutworms in India. *Oriental Insects*, *56*(2): 245–270.
11. Choudhary, M., Rana, K. S., Bana, R. S., Parihar, C. M., & Kantwa, S. R. (2021). Conservation agriculture practices and sulphur fertilization effects on productivity and resource-use efficiency of rainfed mustard (Brassica juncea). *The Indian Journal of Agricultural Sciences*, *91*(1).
12. Deb, B., Islam, M.A., 2023. Determinants of training need of the pineapple growers for boosting production in hilly areas of Sreemangal Upazila under Moulvibazar district. Asian Research Journal of Arts & Social Sciences, 20 (2), Pp. 14–25.
13. Dey, N. C., Parvez, M., & Islam, M. R. (2021). A study on the impact of the 2017 early monsoon flash flood: Potential measures to safeguard livelihoods from extreme climate events in the haor area of Bangladesh. *International Journal of Disaster Risk Reduction*, *59*: 102247.
14. Gupta, A. K., Raj, R., Kumari, K., Singh, S. P., Solanki, I. S., & Choudhary, R. (2016). Management of major diseases of Indian mustard through balanced fertilization, cultural practices and fungicides in calcareous soils. *Proceedings of the National Academy of Sciences India Section B Biological Sciences*, *88*(1): 229–239.
15. Hossain, M. S. (2019). Climate change affects wetland resources in Bangladesh: A case study on Hakaluki Haor. *Scientific Research Journal*, *10*(1): 37.

16. Islam, M.A., Simoon, G.H., Deb, B., 2023. Factors Affecting the Yield Gap of Brinjal Grown in Jhikargacha Upazila under Jashore District, Bangladesh. Asian Research Journal of Arts & Social Sciences, 21 (2),
17. Kaur, H. (2022). Terminal heat stress modulates growing degree days, heat use efficiency and yield stability index in brassica juncea. *Annals of Plant and Soil Research*, *24*(3): 415–423.
18. Khan, A. M. Z. H., Mir, S. S. P. S. H., Maqbool, K. R. S., & Kant, R. H. (2021). Larval Biology of Black Cutworm Agrotis ipsilon on Maize in Kashmir. *International Journal of Current Microbiology and Applied Sciences*, *10*(2): 3382–3388.
19. Khan, M. H., Kundu, B. C., Uddin, M. S., Islam, M. R., Aktar-Uz-Zaman, M., Ahmed, M., Uddin, R., Islam, M. R., Das, A. K., & Rahman, M. G. (2023). Yield potency assessment and characters association of promising lines of mustard (Brassica rapa L.) in southern region of Bangladesh. *Advances in Modern Agriculture*, *4*(2): 2216.
20. Kumar, H., Singh, S., & Yadav, A. (2022). Estimation of avoidable yield losses in Indian mustard (Brassica juncea L.) due to mustard aphid, Lipaphis erysimi (Kaltenbach) in Rewari district, Haryana, India. *Journal of Applied and Natural Science*, *14*(3): 914–920.
21. Kumar, K. K., & Moharaj, P. (2023). Farm size and productivity relationship among the farming communities in India. *Outlook on Agriculture*, *52*(2): 212–227.
22. Kumawat, P., Ram, M., Kumar, P., Kumari, V., & Khedwal, R. S. (2024). Maximizing productivity, profitability and water use efficiency in Indian mustard (Brassica juncea) through hydrogel and salicylic acid. *The Indian Journal of Agricultural Sciences*, *94*(2): 145–149.
23. Lewandrowski, W., Erickson, T. E., Dixon, K. W., & Stevens, J. C. (2016). Increasing the germination envelope under water stress improves seedling emergence in two dominant grass species across different pulse rainfall events. *Journal of Applied Ecology*, *54*(3): 997–1007.
24. Mashuri, M. (2023). Smart urban farming based on internet of things using soil moisture control and application of liquid fertilizer to mustard. *IPTEK Journal of Engineering*, *9*(3): 88.
25. Ndiwa, A. M., Mburu, J., Mulwa, R., & Chumo, C. (2024). Determinants of climate change adaptation strategies and intensity of use; micro level evidence from crop farmers in Kenya. *Frontiers in Sustainable Food Systems*, *8*.
26. Niwas, R., & Khichar, M. L. (2016). Managing impact of climatic vagaries on the productivity of wheat and mustard in India. *MAUSAM*, *67*(1): 205–222.
27. Phiri, A., Chipeta, G. T., & Chawinga, W. D. (2018). Information needs and barriers of rural smallholder farmers in developing countries. *Information Development*, *35*(3): 421–434.
28. Rahman, H. T., Robinson, B. E., Ford, J. D., & Hickey, G. M. (2018). How do capital asset interactions affect livelihood sensitivity to climatic stresses? Insights from the northeastern floodplains of Bangladesh. *Ecological Economics*, *150*: 165–176.
29. Rani, P., Rani, J., Mittal, A., & Sheoran, N. (2024). Assessment of Drought Tolerance of Two Cultivars of Indian Mustard (Brassica juncea) Using Morphological and Physiological Parameters. *Archives of Current Research International*, *24*(5): 437–450.
30. Saha, S., Banerjee, S., & Rahman, F. (2023). Assessing the impact of temperature and rainfall on mustard yield through detrended production index. *MAUSAM*, *74*(4): 921–928.
31. Saini, P. K., Yadav, R., & Pratap, M. (2017). Effect of Foliar Application of GA3, on Yield and Quality of Indian Mustard [Brassica juncea (L.) Czern. & Coss.] Under Sodic Soil. *International Journal of Current Microbiology and Applied Sciences*, *6*(12); 4156–4159.
32. Samanta, S., Maji, A., Das, M., Banerjee, S., Bhattacharjee, A., Pal, N., Bhowmik, P., Banerjee, S., & Mukherjee, S. (2024). An updated Integrated Pest Management System: a footprint for Modern-Day sustainable agricultural practices. *Uttar pradesh journal of zoology*, *45*(8); 71–79.
33. Singh, S. K., Saxena, R., Porwal, A., Neetu, N., & Ray, S. S. (2017). Assessment of hailstorm damage in wheat crop using remote sensing. *Current Science*, *112*(10): 2095.
34. Singh, S. P., Mahapatra, B., Pramanick, B., & Yadav, V. R. (2020). Effect of irrigation levels, planting methods and mulching on nutrient uptake, yield, quality, water and fertilizer productivity of field mustard (Brassica rapa L.) under sandy loam soil. *Agricultural Water Management*, *244*: 106539.

35. Sudadi, S. (2024). The use of biofilm biofertilizer to increase smart farming system in mustard yield and improve soil physical properties of vertisols. *Journal of Smart Agriculture and Environmental Technology*, *2*(1): 30–35.
36. Uddin, M.N., Kabir, K.H., Roy, D., Hasan, T., Sarker, A., and Dunn, E.S., 2021. Understanding the constraints and its related factors in tilapia (Oreochromis sp.) fish culture at farm level: A case from Bangladesh. Aquaculture, 530, Pp. 735927.