Article

Not peer-reviewed version

The Determinants of Farmers' Perceived Flood Risk and their Flood Adaptation Assessments: A study in a Char-land Area of Bangladesh

Md Omar Faruk and Keshav Lall Maharjan *

Posted Date: 11 August 2023

doi: 10.20944/preprints202308.0909.v1

Keywords: farmers; flood; char-land; perceived risk; adaptation

Article

The Determinants of Farmers' Perceived Flood Risk and Their Flood Adaptation Assessments: A Study in a Char-Land Area of Bangladesh

Md Omar Faruk [1,2] and Keshav Lall Maharjan [1,*]

[1] International Economic Development Program, Graduate School of Humanities and Social Sciences, Hiroshima University, Higashi-Hiroshima, Hiroshima 739-8529, Japan.

[2] Department of Agricultural Extension, Ministry of Agriculture, Dhaka 1215, Bangladesh; ranadae2703@gmail.com

* Correspondence: mkeshav@hiroshima-u.ac.jp; Tel.: (+81- 82-424-6947)

Abstract: Floods are the most frequent and devastating disasters in Bangladesh. The riverine islands, known as char-lands, are particularly vulnerable to flooding. As flooding poses a significant threat to the lives and livelihoods of residents, especially farmers, it is crucial to understand how they perceive flood risk and assess their adaptation strategies in this geographically susceptible context. However, the existing literature has not adequately addressed these issues. Therefore, this study aims to analyze the factors influencing farmers' perceived flood risk and their assessments of flood adaptation. In a survey of 359 farmers in Bangladesh's char-land region, located in the Chowhali sub-district of Sirajganj district, we used the protection motivation theory (PMT) to measure farmers' perceived flood risk and adaptation assessments. Multiple regression analysis was employed to identify factors influencing them. Farmers prioritized the risk to livelihoods (production and income) over psychological aspects (health and diseases). Larger farms, more flood experience, and greater risk awareness are associated with higher overall flood risk perception; and better flood adaptation, indicating higher self-efficacy, response efficacy, and response cost among farmers. Farmers perceived lower flood risk in exchange for greater house distance from the river and more trust in government actions. Hence, strengthening campaigns and programs is crucial to understanding flood risk in char-lands for improved adaptation to floods. The study highlights the application of PMT to assess farmers' perceptions of flood risk and their attitudes towards adaptation, suggesting further research opportunities.

Keywords: farmers; flood; char-land; perceived risk; adaptation

1. Introduction

Natural hazards pose significant threats worldwide, and it is projected that a substantial portion of the global population will be exposed to catastrophic events by 2050. Among various natural hazards, flood disasters stand out as a major cause of death and devastation, with significant economic and social consequences [1]. In fact, over 30% of all natural disasters in the last century have been attributed to floods [2]. Certain regions are more vulnerable to specific hazards, and Bangladesh, a densely populated nation in South Asia with low-lying terrain, is highly susceptible to flooding due to its geographical characteristics. Approximately 80% of the country consists of floodplains formed by rivers like the Ganges, Brahmaputra, and Meghna [3]. Moreover, the unique natural environment of Bangladesh, coupled with the characteristics of the tropical monsoon climate, significantly contributes to the country's elevated flood risk [4]. Among the flood-prone regions in Bangladesh, char-lands, which are riverine islands formed by the dynamics of erosion and accretion, are particularly susceptible to flooding. These islands periodically protrude from the riverbed, offering opportunities for settlement and agricultural activities. However, during the monsoon season, widespread flooding wreaks havoc on char settlements, agricultural crops, infrastructure, and communication networks.

In recent years, flood adaptation in char-lands has garnered significant attention in scholarly research [5-7]. Char-land farmers employ various adaptation strategies to mitigate flood damage, but

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 11 August 2023 doi:10.20944/preprints202308.0909.v1

the factors influencing the adoption of such measures vary among individuals. Previous studies have extensively explored the key drivers of flood adaptation [8-10]. This research focuses on analyzing the factors that influence perceived flood risk and adaptation assessments using the Protection Motivation Theory (PMT). Originally proposed by Rogers [11] to explain how people defend themselves against health risks, PMT has been adapted for studying flood risk by researchers such as Grothmann and Reusswig [9], Bubeck et al. [12], and Zaalberg et al. [13]. PMT has gained popularity to explain how locals take precautions against natural disasters. PMT involves two cognitive processes: threat appraisal and coping appraisal. Threat appraisal encompasses perceived risk, including perceived risk probability and consequences associated with a hazard [9,14]. When threat assessment reaches a certain level, coping appraisal, or consideration of adaptation assessments, is initiated to reduce or prevent the threat. According to PMT, individuals will adopt adaptive measures against a specific risk if they perceive it to be high (threat assessment). Poussin et al. [10] revealed that high coping appraisals or adaptation assessments occur when individuals rate their ability to adapt as high (self-efficacy), effectiveness (response efficacy), and cost-effectiveness (low response costs). High perceived risks can result in the adoption of a protective response if they are accompanied by high adaptation assessments, but they can also result in maladaptive responses like fatalism, denial, or wishful thinking if they are accompanied by poor adaptation assessments [15]. Previous studies [9,10,12,14] have examined the relationship between these PMT aspects and flood adaptation behavior. However, the literature lacks adequate exploration of how farmers perceive flood risk and evaluate their own adaptive measures, essential for understanding farmers' protective motivation and adaptive behavior.

Given the crucial role of perceived risk and adaptation assessments in influencing protection motivation and subsequent behavior, it becomes essential for policies aiming to enhance individual risk preparedness to understand the factors influencing these perceptions. Numerous studies have explored various factors related to risk perception [13,16,17,18,19]. However, there is limited understanding of how farmers perceive flood risks concerning different aspects of their lives, such as health; household assets; crops and livestock, and income. Although previous studies [9,10,14,20] have analyzed all flood adaptation assessments (self-efficacy, response efficacy, and response cost) to assess their impact on flood adaptation behavior, little attention has been given to how farmers rate their adaptation assessments. While Dang et al. [21,22] identified significant factors influencing farmers' perceived risk and appraisal of private adaptive measures to climate change in the Mekong Delta, Vietnam, there is limited research on the different influential factors affecting the two major components of PMT-threat appraisals (perceived risk) and coping appraisals (adaptation assessments) concerning flood adaptation in geographically vulnerable contexts like char-lands in Bangladesh. Considering the frequency of flooding in char-lands and the dependence on agriculture as the primary livelihood option in the region, understanding how flood risk is perceived and how various flood adaptive measures are appraised by char-land farmers becomes critical. To gain better insights into how individuals make decisions in the face of natural hazards, particularly floods, and to guide risk communication on encouraging adaptive behavior, systematic research into the factors linked to farmers' flood risk assessments and adaptation assessments is needed.

We conducted an empirical investigation to examine various sociodemographic and cognitive factors that may influence farmers' perceived flood risk and adaptation assessments. We analyzed data from 359 flood-affected char-land farmers using multiple linear regression analysis to gain a better understanding of these factors. This study contributes significantly by providing systematic insights into the key components of the Protection Motivation Theory (PMT), namely threat appraisals and coping appraisals, within the context of the char-land region, known for its vulnerability to recurrent flooding. The remainder of this article is structured as follows. Section 2 outlines the materials and methods emphasizing on data collection process, and analytical methods employed. Section 3 presents the results or main findings of the study, while Section 4 focuses on discussing the factors influencing perceived flood risk and flood adaptation assessments. Finally, Section 5 encompasses the conclusions and recommendations. This research provides valuable insights that can inform flood risk management strategies in vulnerable regions like char-lands.

 doi:10.20944/preprints202308.0909.v1

2. Materials and Methods

2.1. Description of the Study Area

Sirajganj, located in northern Bangladesh, is a flood-prone district predominantly consisting of char regions. The district is intersected by the Brahmaputra River, commonly known as the Jamuna River, which regularly experiences overflowing during the rainy season, resulting in inundation of various parts of Sirajganj. The Chowhali sub-district within Sirajganj district is particularly susceptible to severe flooding due to its location on the banks of the Jamuna River. Considering the significant impact of floods in the region, the Chowhali sub-district was chosen as the focus area for this investigation.

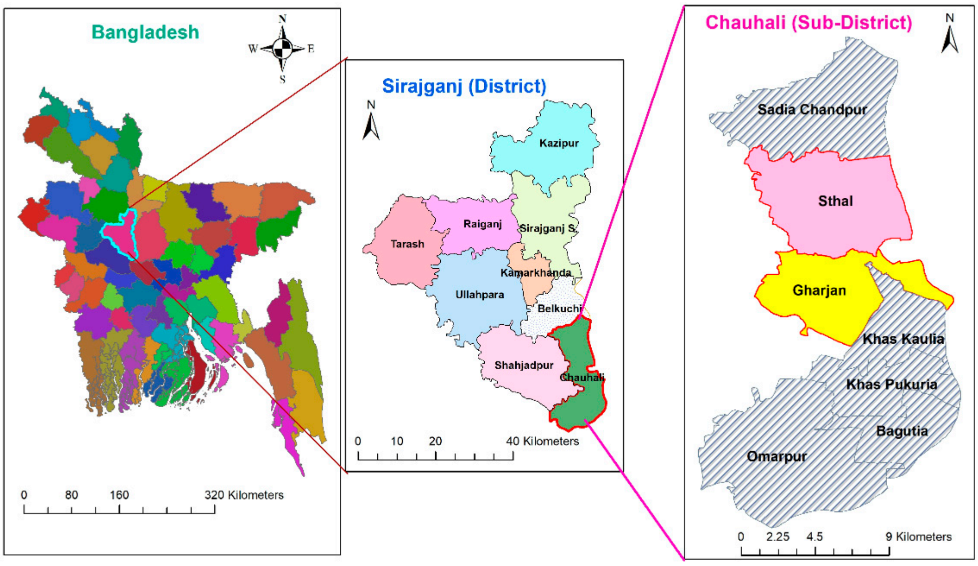

Figure 1. Map of the study area. Source: Faruk and Maharjan [7].

The Chowhali sub-district is geographically divided into two halves by the Jamuna River. In this region, the most prevalent and severe disasters are frequent floods and riverbank erosion. The land in this sub-district is regularly lost to the river due to riverbank erosion occurring at various intervals.

2.2. Sampling and Data Collection

A standardized questionnaire was used to conduct face-to-face farmer interviews. The questionnaire was initially intended to address three primary topics, such as flood risk perception, flood adaptation assessments, and several associated factors (e.g., socio-demographic, and cognitive factors). The questionnaire was improved and finalized using qualitative information from an earlier preliminary survey and different key informants (sub-assistant agricultural officer interviews, NGO workers, local leaders, etc.) in the study area. After that, it was pre-tested and modified to verify its relevancy and comprehensibility. The study ethics committee at the Graduate School of Humanities and Social Sciences, Hiroshima University, authorized the questionnaire for conformity with ethical concerns such as basic human rights, the protection of personal information, and data security prior to performing the final survey.

A multistage sampling procedure was used to determine the sample size. First, two unions, Ghorjan and Sthal, in Chowhali subdistrict were purposely designed based on the severity of the floods. Then, three villages from each union- Harghorjan, Boroghorjan, and Muradpur from the Ghorjan union and three villages from the Sthal union—South Nouhata, North Nouhata, and

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 11 August 2023 doi:10.20944/preprints202308.0909.v1

Chaluhara were selected at random. A list of farmers organized by village was obtained from the sub-district agricultural office. From each village, a random sample was chosen. Using these techniques, 359 people were chosen as the sample size from the limited population.

2.3. Variables and Description

The respondents were asked to rate on a five-point Likert scale how likely and severe they believed floods would impact different aspects of their lives, including valuable assets, crops and livestock, physical health, and income, if they did not implement any flood adaptation measures. The scale ranged from 1 (very unlikely) to 5 (very likely) for perceived probability and from 1 (not bad at all) to 5 (very bad) for perceived severity[14].

Table 1. Description of Variables.

Variables	Description	Measuring Unit
Explanatory variables		
Age	Age of respondents	Age in years
Gender	Gender of farmers	1 if Male, 0 otherwise
Years of schooling	Years of formal schooling received by respondents	No. of years
Family size	Members in the family	No. of family members
Children under 10 years	Children under 10 years old	No. of children
Farm size	Agricultural land under cultivation in decimal	Land size in decimal
Annual income	Total annual income (after cost)	Income in thousand BDT
Livestock ownership	How many livestock farmers owned?	No. of livestock
Distance from river	House distance from river in kilometer	Distance in kilometer
Flood experience	Flood severity experienced in the last 10 years	No. of flood severity
Trust in government actions	Respondents were asked to rate the frequency of showing trust on govt. flood protection measures (4 items)	1-very untrustworthy, 2-untrustworthy, 3-neutral, 4-trustworthy, 5- very trustworthy
Flood risk awareness	Respondents were asked their opinions on five flood related statements	1-strongly disagree, 2-disagree, 3-neutral, 4- agree, 5- strongly agree
Dependent variables		
Perceived flood risk	There are a total of eight components in this personal evaluation of the probability of a future occurrence (a) and the consequent damage (b)	(a) 1–very unlikely, 2–rather unlikely, 3–neutral, 4–rather likely, 5–very likely (b) 1–not bad at all; 2–rather not bad; 3–neutral; 4–rather bad; 5–very bad;
Self-efficacy	The respondent thinks that he/she is capable of taking off the described 21 measures.	1-Very unable, 2-Rather unable, 3-Neutral, 4- Rather able, 5-Very able
Response efficacy	Effectiveness of described 21 flood adaptation strategies	1-Very ineffective, 2-Rather Ineffective, 3-Neutral, 4-Rather effective, 5-Very effective

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 11 August 2023 doi:10.20944/preprints202308.0909.v1

Response cost	To what extent the adaptation measures are costly (21 items)	1–very costly, 2–rather costly, 3–neutral, 4–rather not costly, 5–very not costly;

To calculate the perceived risks associated with flood hazards for each dimension and the total perceived risk, the formulae suggested by Dowling [23] were employed. These formulas are based on attitude models widely used in marketing and psychology, providing an information-processing view of decision making [23]. The application of these formulas aligns with the concept of "threat assessment" discussed in the introduction part.

$$\text{Perceived Risk} = \text{perceived risk probability x perceived risk consequences}$$

$$\text{Overall Perceived Risk} = \sum_{i=1}^{n} \text{percieved risk probability x percieved risk consequences}$$

where n is the number of dimensions (i.e., household assets, crops and livestock, physical health, and income)

For each risk dimension that is believed to be impacted by flood, the perceived risk was calculated by multiplying the estimated risk probability by the perceived risk consequences. All four risk dimensions were added up to get the overall perceived flood risk. Each risk dimension and the overall perceived flood risk were determined for 359 char-land farmers. Overall perceived flood risk was used as dependent variable for multiple linear regressions in this study.

Initially, a list of 21 individual flood adaptation strategies was developed using the literature [10,14,22]. To check the validity of these flood adaptation measures, they were brought up for debate in FGDs during the preliminary survey. The adaptive measures were pretested before the final survey. Farmers were asked to assess their own ability to execute each adaptive measure, to rate the effectiveness, and to rate the perceived cost of implementing each adaptation strategy. Descriptive statistics and multiple regressions were used to explore how farmers perceived their risk (threat appraisals), appraised each flood adaptive measure (coping appraisals), and identified significant factors influencing those appraisals.

3. Results

3.1. Descriptive Statistics of the Study

The study's descriptive statistics are presented in Table 2. The results indicate that the average age of the farmers is 48.68, suggesting that older individuals are more likely to be engaged in agriculture. Males constituted over 70% of the survey respondents in the Char-lands. In the char-lands, the average number of years of schooling was relatively low (2.82), reflecting primary-level education, which is typical in the context of Bangladesh. This is consistent with similar findings in the Padma floodplain, where the average schooling years were 1.9 years [24]. Additionally, another study [25] found that 45% of the floodplain population had only primary education. On average, there are around six people per household, with approximately one child under the age of 10. The average land under cultivation is 131.79 decimal, indicating that agriculture is the primary livelihood option for char-dwellers. However, despite their reliance on agriculture, the farmers' average annual income was relatively low at 44,140 BDT.

Table 2. Descriptive statistics.

Variables	Mean	SD	Minimum	Maximum
Age	48.68	12.78	25	85
Gender	0.70	0.46	0	1
Years of schooling	2.82	3.05	0	12
Family size	5.61	1.77	0	12
Children under 10 years	1.33	0.87	0	4

Farm size (dm)	131.79	59.43	33	363
Annual income (000' BDT)	44.14	22.10	6	150
Livestock ownership	0.86	0.37	0	1
House distance from river (km)	1.68	0.79	0.25	4
Flood experience	2.50	0.74	1	4
Trust in government actions	2.78	0.49	1.6	4.6
Flood risk awareness	3.87	0.55	2.6	5

In the char-lands, most farmers (86%) owned livestock. Due to their location on riverine islands, farmers lived near the river, with an average distance of 1.68 kilometers. On average, farmers in the char-lands experienced 2.50 flood severity events in the last decades. Trust in government action was relatively low, with an average rating of 2.78, emphasizing the significance of private flood adaptation measures. The average flood risk awareness among farmers in the char-lands was 3.87.

3.2. Farmers' Adoption of Flood Adaptation Strategies

Table 3 presents the percentage of adoption for twenty-one flood adaptation strategies utilized by farmers in the char-lands. According to the preliminary survey, farmers tended to implement most of these strategies, both related to farming and non-farming practices. Each adaptation measure was scored 1 if adopted and 0 if not. Given that agriculture is the primary livelihood in the char-lands, local farmers have traditionally employed various agricultural and livelihood adaptation measures. For instance, 81.89% of farmers arranged fodder for their livestock, and about three-fourths (77.44%) raised their livestock to a safer place before the onset of floods, reflecting their concern for livestock safety. To minimize crop losses, more than half of the respondents (56.27%) adopted mixed cropping practices, and 52.92% adjusted planting and harvesting times. Regarding financial strategies, around 61.84% of farmers utilized informal sources for financing, while 52.09% used official sources to continue their farming livelihood.

Additionally, more than half of the respondents saved money for emergency requirements in anticipation of the impending flood disaster which may hamper their agricultural production. These findings highlight the proactive approach of char-land farmers in implementing various adaptation strategies to cope with flood risks.

Table 3. Farmers' adoption of flood adaptation strategies.

Variables	**Frequency and percentage of adoption**	
	Frequency	**Percentage**
Farming flood adaptation strategies		
Growing seedling in pot or sandbag	137	38.16
Mixed cropping	202	56.27
Changing crop variety	145	40.39
Adjustment of planting and harvesting time	190	52.92
Fodder arrangement	294	81.89
Raising of livestock place	278	77.44
Relocating livestock	166	46.24
Money savings	180	50.14
Informal credit	222	61.84
Formal credit	187	52.09
Alternative occupation during flood	160	44.57
Non-farming flood adaptation strategies		
Construction or raising the plinth of the house	150	41.78
Fencing house	137	38.16
Raising tube wells	164	45.68
Flood-proof sanitation	162	45.13
Portable stoves	303	84.40

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 11 August 2023 doi:10.20944/preprints202308.0909.v1

Arrangement of boat	135	37.60
Macha preparation	260	72.42
Dry food collection	207	57.60
Shifting family	209	58.22
Shifting valuable goods	212	59.05

Among the non-farming flood adaptation measures, a significant proportion of farmers (84.4%) installed portable cooking stoves before floods in the char-lands, as most homes with permanent cooking stoves have yards that become submerged during floods. Another crucial non-farming flood adaptation strategy is the construction of "macha," with 72.42% of farmers adopting this measure. A macha is a high stage or bed made primarily of low-cost material such as bamboo. During flooding, farmers take refuge on top of the macha and safeguard their essential belongings.

However, other structural improvements had lower adoption rates, including building or elevating the house plinth (41.78%), raising tube wells (45.68%), and implementing flood-proof sanitation measures (45.13%). These findings suggest that while some non-farming strategies are widely adopted, there is scope for further improvements in other structural measures to enhance flood resilience in the char-lands.

3.3. Farmers' Perceived Flood Risk

The overall perceived risk associated with floods is derived by summing up the four distinct perceived risks, calculated by multiplying perceived risk probability by perceived risk consequences for each risk dimension. The minimum and maximum values for each specific perceived risk are assumed to be 1 and 25, respectively, resulting in a range of 4 to 100 for the total perceived risk. In our sample, the overall perceived flood risk is regularly distributed, ranging from 28 to 100.

Table 4. Means, and standard deviations (SD) of perceived risk probability, perceived risk severity, and specific perceived risks.

Risk Dimensions	Perceived Risk Probability		Perceived Risk Consequences		Specific Perceived Risk	
	Mean	SD	Mean	SD	Mean	SD
Household assets	3.91	0.74	3.76	0.72	15.09	4.99
Crops and livestock	4.23	0.60	4.16	0.57	17.75	4.19
Income	4.13	0.72	4.05	0.69	17.04	5.19
Physical health and diseases	3.52	0.98	3.39	0.91	12.64	6.10

The average overall perceived flood risk is 62.52, which is above half of the maximum level of perceived flood risk. This suggests that among the surveyed farmers, there is a relatively high level of perceived flood risk. Farmers perceive flood hazards differently concerning various aspects of their lives. They tend to place higher importance on the probability of floods affecting their crops, livestock, and income, with average perceived risks at 17.75 and 17.04, respectively, compared to household assets and physical health, which have average perceived risks of 15.09 and 12.64, respectively.

In the context of perceived risk probability and perceived consequences, crops and livestock are considered to have the highest mean values (4.23 and 4.16, respectively) compared to the other dimensions when assessing the potential impact of floods. On the other hand, flood is perceived to have a lesser impact on farmers' physical health and diseases, as evidenced by the lowest mean values of perceived risk probability (3.52) and perceived severity (3.59) in Table 2. These findings suggest that farmers prioritize and perceive greater vulnerability to their crops and livestock compared to other aspects of their lives when it comes to the risks posed by floods.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 11 August 2023 doi:10.20944/preprints202308.0909.v1

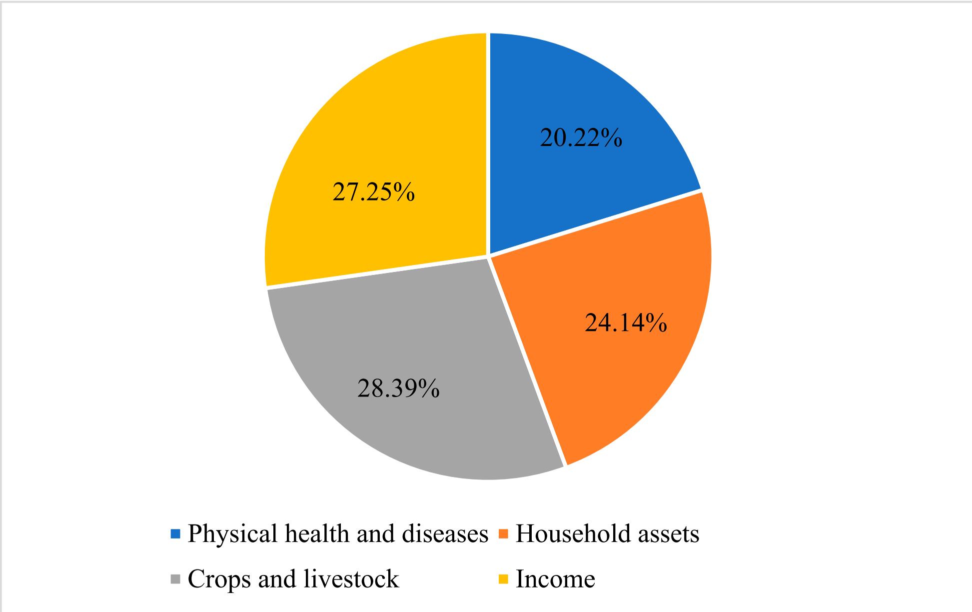

Figure 2. Proportion of specific risk dimensions to overall perceived risk.

Furthermore, we assessed the contributions of each perceived risk dimension to the overall perceived risk and compared their percentages. Among the risk dimensions, perceived risk on crops and livestock had the highest contribution, accounting for 28.39% of the overall perceived risk. It was followed by farmers' income at 27.25%, household assets at 24.14%, and physical health and diseases at 20.22%. These results indicate that farmers attribute the highest importance to the risks posed to their crops and livestock, followed closely by their income and household assets, while considering physical health and diseases to have a relatively lower impact on the overall perceived flood risk.

3.4. Farmers' Assessment of Flood Adaptation

Farmers' flood adaptation assessments encompass perceived self-efficacy, response efficacy, and response cost. Table 4 presents the means and standard deviations of these three variables. Regarding farming-related flood adaptation measures, farmers exhibited higher self-efficacy in activities like arranging fodder (3.78), raising livestock places (3.48), and practicing mixed cropping (3.29). Notably, farmers demonstrated greater self-efficacy in obtaining credit from formal sources (3.26) compared to informal sources (3.21).

For non-farming flood adaptation measures, higher levels of self-efficacy were observed among farmers for using portable stoves (4.42), preparing macha (3.95), and collecting dry food (3.70). In contrast, self-efficacy was relatively lower for structural measures such as house construction or elevation (2.78), raising tube wells (2.92), implementing flood-proof sanitation (2.92), and preparing boats (2.81). These findings highlight farmers' varying levels of confidence in different flood adaptation strategies, reflecting their perceptions of efficacy and potential outcomes associated with these measures.

In terms of response efficacy, farmers considered activities such as arranging fodder (4.07), saving money (4.00), and raising livestock places (3.83) as more effective in the context of farming-related flood adaptation measures. For non-farming adaptation measures, higher levels of response efficacy were reported by farmers for activities like house construction or elevation (4.21), flood-proof sanitation (4.13), using portable stoves (4.11), and preparing boats (3.99). These responses indicate that farmers perceive certain measures as more efficacious in mitigating flood-related challenges, highlighting their beliefs in the effectiveness of these strategies to adapt with flood risks.

Table 5. Farmers' assessments of flood adaptation strategies.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 11 August 2023 doi:10.20944/preprints202308.0909.v1

Flood Adaptation Measures	Self-Efficacy		Response Efficacy		Response Cost	
	Mean	SD	Mean	SD	Mean	SD
Farming flood adaptation measures						
Growing seedling in pot or sandbag	3.13	0.99	2.89	0.87	3.60	0.69
Mixed cropping	3.29	1.09	3.09	0.93	3.68	0.71
Changing crop variety	2.70	0.95	2.74	0.86	2.97	0.84
Adjustment of planting and harvesting time	3.03	0.95	3.06	0.84	3.37	0.73
Fodder arrangement	3.78	0.78	4.07	0.64	2.82	0.98
Raising of livestock place	3.48	0.98	3.83	0.67	2.96	1.05
Relocating livestock	3.18	0.87	3.30	0.79	3.15	0.75
Money savings	2.77	0.97	4.00	0.75	3.22	0.52
Informal credit	3.21	0.90	2.99	0.82	2.67	0.86
Formal credit	3.26	0.88	3.45	0.77	3.32	0.80
Alternative occupation during flood	2.95	1.02	3.74	0.73	3.23	0.72
Non-farming flood adaptation measures						
Construction or raising the plinth of the house	2.78	1.16	4.21	0.78	1.45	0.56
Fencing house	3.20	1.05	3.06	0.87	2.77	1.01
Raising tube wells	2.92	1.03	3.90	0.59	2.20	0.73
Flood-proof sanitation	2.92	1.06	4.13	0.61	1.97	0.57
Portable stoves	4.42	0.68	4.11	0.61	4.34	0.80
Arrangement of boat	2.81	1.05	3.99	0.70	2.18	0.74
Macha preparation	3.95	0.74	3.48	0.76	3.86	0.69
Dry food collection	3.70	0.90	3.40	0.80	3.60	1.00
Shifting family	3.35	0.90	3.54	0.86	3.48	0.77
Shifting valuable goods	3.37	0.82	3.54	0.66	3.25	0.80

Farmers perceived mixed cropping (3.68), growing seedlings in pots or sandbags (3.60), and obtaining formal credit (3.32) as more cost-effective in comparison to other farming-related adaptation measures. Among non-farming flood adaptation measures, portable stoves (4.34), macha preparation (3.86), and dry food collection (3.60) were considered more financially feasible by farmers, in contrast to other non-farming measures such as house construction or elevation (1.45), flood-proof sanitation (1.97), and boat arrangement (2.18). This indicates that farmers consider the affordability of different adaptation strategies when making decisions to address flood risks, considering the associated costs and benefits.

3.5. Factors Influencin Farmers' Perceived Flood Risk and Flood Adaptation Assessments

This section presents the results of multiple regression models that analyze the effects of socio-demographic and cognitive characteristics on farmers' perceived flood risk across four dimensions and their overall perceived flood risk. Additionally, multiple regression analysis was also conducted to identify factors influencing farmers' flood adaptation assessments in the categories of self-efficacy, response efficacy, and response cost.

Prior to conducting the regression analysis, a multicollinearity test was performed to assess variance inflation factors (VIFs). Result showed that most of the explanatory variables exhibited VIFs of less than 2, with a maximum VIF of 3.7 (Table 6). This suggests the absence of significant multicollinearity. A standard VIF cutoff value of 10 is often used to identify substantial multicollinearity [26]. Kehinde and Ogundeji [27] further suggests that variables with VIF exceeding 10 should be regarded as highly collinear and can potentially be excluded from the model.

Table 6. Multicollinearity test: variance inflation factor.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 11 August 2023 doi:10.20944/preprints202308.0909.v1

Variables	VIF	1/VIF
Age	1.21	0.83
Gender	1.09	0.92
Years of schooling	1.19	0.84
Family size	1.47	0.68
Children under 10 years	1.27	0.79
Farm size (dm)	2.12	0.47
Annual income	1.65	0.61
Livestock ownership	1.03	0.97
House distance from river	1.59	0.63
Flood experience	1.92	0.52
Flood risk awareness	2.24	0.45
Trust in government actions	1.25	0.80

Even when VIF is far below the cut-off criterion [26] or more than 5, the degree of multicollinearity should be carefully evaluated [28]. It is justified, nevertheless, to consider the multicollinearity problem beyond the cut-off point. In this situation, removing or combining variables might result in more severe issues.

3.5.1. Factors Influencing Farmers' Perceived Flood Risk

Table 7 displays the outcomes of the multiple linear regression analyses. The dependent variable is perceived flood risk, divided into four dimensions (perceived risk in physical health and diseases, household assets, crops and livestock, and income), as well as the overall perceived risk. The explanatory factors remain consistent across all five models (as presented in Table 2). The regression coefficients for the five regression models are presented in Table 7 those who indicate how much the perceived risk for each dimension and the overall perceived flood risk are expected to vary because of a change of one unit in each significant explanatory variable.

The R squared, adjusted R squared, and F-test are also present in Table 7. The explanatory factors in our models may account for between 36.6 and 63.6% of the variation in perceived flood risks, according to the R squares for the five models. All models are highly significant according to the F-test (P-value <0.01).

Among the socio-economic factors, age is negatively associated with perceived risk in all models except crops and livestock. The perceived risk in physical health and diseases, household assets, income, and overall risk perception increased with the decrease in farmers' age, which indicates that younger farmers were likely to have a higher perceived flood risk compared to older ones. Female farmers had significantly higher risk concerns for their health and valuable assets, whereas male farmers were found to have significantly higher perceived risks for crops and livestock than female farmers.

Table 7. Factors influencing farmers' perceived flood risk.

Variables	Physical Health and Diseases	Household Assets	Crops and Livestock	Income	Overall Perceived Flood Risk
Age	-0.111**	-0.081*	0.065	-0.009	-0.056
	(0.022)	(0.018)	(0.015)	(0.018)	(0.042)
Gender	-0.144***	-0.117**	0.079*	0.028	-0.065*
	(0.597)	(0.476)	(0.410)	(0.489)	(1.133)
Years of schooling	0.032	0.060	-0.006	0.034	0.043
	(0.093)	(0.074)	(0.064)	(0.077)	(0.177)
Family size	-0.028	-0.026	0.023	0.067	0.009
	(0.178)	(0.142)	(0.123)	(0.146)	(0.339)

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 11 August 2023 doi:10.20944/preprints202308.0909.v1

Children under 10 years	-0.005	-0.008	0.015	-0.062	-0.021
	(0.339)	(0.270)	(0.233)	(0.278)	(0.643)
Farm size (dm)	0.206***	0.244***	0.049	0.064	0.197***
	(0.006)	(0.005)	(0.004)	(0.005)	(0.012)
Annual income	0.119**	0.052	0.096*	-0.095*	0.059
	(0.015)	(0.012)	(0.010)	(0.012)	(0.029)
Livestock ownership	-0.069	-0.003	0.030	0.031	-0.010
	(0.763)	(0.608)	(0.525)	(0.626)	(1.450)
House distance from river	-0.057	-0.021	-0.164***	-0.174***	-0.134***
	(0.416)	(0.331)	(0.286)	(0.341)	(0.790)
Flood experience	0.174***	0.196***	0.204***	0.175***	0.249***
	(0.486)	(0.387)	(0.334)	(0.398)	(0.923)
Flood risk awareness	0.190***	0.232***	0.129**	0.336***	0.301***
	(0.712)	(0.568)	(0.490)	(584)	(1.353)
Trust in government actions	-0.069	-0.057	-0.118**	-0.070	-0.102***
	(0.593)	(0.472)	(0.407)	(0.486)	(1.126)
R squared	0.368	0.399	0.366	0.411	0.636
Adjusted R squared	0.346	0.378	0.344	0.390	0.626
F test (P value)	0.000	0.000	0.000	0.000	0.000

Note. Significance at *p<0.1, **p<0.05 and ***p<0.001. Standard error in parenthesis. Standardized coefficients are used in regression results.

However, the overall perceived risk was significantly higher for women compared to men. Farmers with higher amounts of farmland were found to have significantly higher overall perceived flood risk compared to farmers with a low amount of farmland, with significantly higher concerns about health, diseases, and valuable assets. Farmers who had higher annual income possessed more risk in their health and agriculture (crops and livestock) and exhibited lower risk in income compared to poor farmers, while the overall perceived risk was insignificant. Flood experience and flood risk awareness were found to be vital drivers affecting all specific flood risk dimensions and overall risk perception, indicating that farmers with higher flood experience and risk awareness were likely to perceive more risk compared to farmers with less experience and awareness. Farmers' overall perceived risk decreased with the increase in house distance from the river and trust in government actions.

3.5.2. Factors Influencing Farmers' Flood Adaptation Assessments

This section shows how important elements have an influence on how farmers evaluate their adaptation behavior. In the multiple regression models, the three dependent variables, namely, perceived self-efficacy, perceived response efficacy, and perceived response cost, were considered with the explanatory variables listed in Table 1. The estimated coefficients for farm size, flood experience, and flood risk awareness of char-land farmers were statistically significant for all three models. Farmers who owned or cultivated more land were more likely to have a higher ability to adopt flood adaptation, considered the adaptation measures more effective, and perceived less adaptation cost compared to farmers with fewer farmlands.

Table 8. Factors influencing farmers' flood adaptation assessments.

Variables	**Farmers' Flood Adaptation Assessments**		
	Self-Efficacy	**Response Efficacy**	**RESPONSE COST**
Age	-0.017	0.019	0.043
	(0.001)	(0.001)	(0.001)
Gender	0.013	0.000	0.012
	(0.032)	(0.027)	(0.029)
Years of schooling	0.028	-0.033	0.096**

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 11 August 2023 doi:10.20944/preprints202308.0909.v1

	(0.005)	(0.004)	(0.005)
Family size	0.069	-0.005	0.070
	(0.010)	(0.008)	(0.009)
Children under 10 years	0.019	0.017	0.018
	(0.018)	(0.015)	(0.017)
Farm size (dm)	0.259***	0.255***	0.098*
	(0.000)	(0.000)	(0.000)
Annual income	0.118**	0.037	-0.045
	(0.001)	(0.001)	(0.001)
Livestock ownership	0.047	0.050	0.046
	(0.041)	(0.035)	(0.037)
House distance from river	0.022	-0.079	0.085*
	(0.022)	(0.019)	(0.020)
Flood experience	0.112**	0.099*	0.128**
	(0.026)	(0.022)	(0.024)
Flood risk awareness	0.414***	0.331***	0.571***
	(0.038)	(0.032)	(0.035)
Trust in government actions	-0.017	-0.027	-0.005
	(0.031)	(0.027)	(0.029)

Note. Significance at *p<0.1, **p<0.05 and ***p<0.001. Standard error in parenthesis. Standardized coefficients are used in regression results.

Similarly, farmers who experienced more flood severity and had a higher level of risk awareness tended to possess higher perceived self-efficacy, response efficacy, and response cost. The year of schooling was significant for perceived response cost, which indicates that farmers who had a higher education level would have perceived less response cost. Farmers with higher annual income were found to have higher self-efficacy, indicating that they have more ability to implement the adaptation measures. House distance from the river was positively correlated with the perceived response cost, explaining that farmers who were far from the river perceived a higher response cost for adopting flood adaptation measures.

4. Discussion

In this study, the evaluation of farmers' perceived flood risk was conducted by measuring both the perceived risk probability and the consequences of risk. The research aimed to delve into how farmers perceive the various threats posed by floods across multiple facets of their lives, encompassing areas such as their physical well-being, household assets, crops and livestock, as well as their income. Given the distinct significance attached to different factors, farmers were prompted to assess flood risks differently within each dimension. The findings from our sample of farmers indicate a prevailing emphasis on perceiving heightened flood risks in relation to crop and livestock production, as well as income. This observation underscores the farmers' overarching priority for the psychological dimension like health and diseases concern relatively marginal importance. Examining the effects of various factors on perceived flood risk, socio-demographic variables, particularly age, exhibited a negative relationship with farmers' perceived flood risk in the majority of models. This suggests that younger farmers tended to perceive a higher flood risk compared to their older counterparts, which contrasts with the findings of Kellens et al. [29] that associate higher risk perception with older individuals. This discrepancy might be attributed to the greater flood experience of older farmers in the char-land region. Nevertheless, other studies have presented evidence indicating that age does not exert a significant influence on flood risk perception [19,30]. Gender is recognized as a pivotal factor that shapes farmers' perceived risk [31]. Notably, overall perceived risk and risks associated with specific dimensions, such as health and assets, were found to be significantly higher among women compared to men which is aligned with the previous studies [29,32,33]. However, men tended to perceive higher risk in relation to crops and livestock, given that

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 11 August 2023 doi:10.20944/preprints202308.0909.v1

agriculture constitutes the primary livelihood strategy in the char-land region and male farmers are extensively involved in farming activities. This study did not establish a relationship between risk perception and years of schooling, which aligns with the findings of Kellens et al. [18] and Armas et al. [30]. Farmers' annual income demonstrated positive significance in some models, even though the overall perceived risk remained insignificant, a pattern supported by earlier studies [17,19]. Notably, Dang et al. [21] identified agricultural land as a pivotal factor influencing perceived climate change risk. Given our focus on understanding farmers' risk perception, we included the size of the farming land as a critical factor impacting risk perception. The overall perceived flood risk increased notably with an augmented amount of farming land. This could be attributed to the assumption that farmers with larger land holdings in the char-land possess greater household assets, agricultural production, and income, thereby intensifying their perceived flood risk.

In terms of cognitive factors, farmers' flood experience and flood risk awareness emerged as significant predictors influencing perceived flood risk across all five models. Similar findings have been observed in earlier studies [18,34,35], where previous flood experience was identified as a significant determinant of flood risk perception. Given the varying degrees of flood severity experienced by individuals in the char-land, their perceptions may differ accordingly. Consequently, farmers exposed to a higher number of severe floods were more likely to possess elevated flood risk perceptions in the char-land. In char-land regions, flood awareness levels among farmers are not uniform, with those who exhibit a heightened awareness of flood vulnerability tending to have higher perceived flood risk, a finding that aligns with the study of Papagianakki et al. [36]. Farmers' trust in government actions exhibited a negative correlation with their overall perceived risk level. Farmers who perceive that government adaptive measures are well-coordinated tend to have a reduced overall perceived risk as well as lower perceived risks in crops and livestock production which is consistent with the findings of Dang et al. [21].

The significant factors influencing farmers' adaptation assessments include farm size, previous flood experience, and flood risk awareness. Given that agriculture is a primary livelihood strategy in the char-land, farmers are primarily concerned with mitigating flood damage. Those with larger agricultural land holdings tend to have a greater ability to adapt, perceive higher effectiveness of adaptation measures, and consider adaptation strategies to be less costly compared to farmers with smaller land holdings. This could be attributed to the fact that larger land holdings generally entail higher crop production, thereby increasing the susceptibility to flood-related risks.

Flood experience and flood risk awareness also emerged as crucial factors affecting self-efficacy, response efficacy, and response cost. As floods are recurrent events in the char-land, farmers are exposed to them frequently. However, the severity of floods experienced by individuals varies. Farmers who have encountered more severe floods in the past tend to possess higher levels of self-efficacy, response efficacy, and response cost. Similarly, those with a higher level of risk awareness also exhibit increased self-efficacy, response efficacy, and response cost. Because flood risk experience and risk awareness were both significant predictors of flood adaptation assessments, it is assumed to have a positive correlation between risk experience and risk awareness, which is supported by the study of Lindell and Hwang [32], where empirical evidence showed that individuals who had experienced a disaster were more aware of it compared to those who were unfamiliar with it. Consequently, awareness tends to increase alongside flood experience, a relationship affirmed by the research findings of Bradford et al. [37].

5. Conclusions

Understanding how farmers perceive flood risk and evaluate their private adaptive measures, as well as identifying the factors that shape their flood risk perception and adaptation assessments, is essential for comprehending their protective motivation and adaptive behavior in response to flooding in char-lands. However, research in this area, particularly in Southeast Asia, has been limited and largely absent.

Research conducted in the char-lands of Bangladesh has revealed that a significant number of farmers perceive flood risk primarily concerning agricultural production and income. In the

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 11 August 2023 doi:10.20944/preprints202308.0909.v1

subsequent phase, this study delves into how farmers evaluate their flood adaptation strategies in the char-land. This examination of the char-land context has unveiled that most farmers employ adaptive measures predominantly related to their farming practices, including actions like raising livestock shelters, arranging fodder, practicing mixed cropping, and adjusting planting and harvesting schedules. Among non-farming activities, the adoption of portable stoves and macha preparation emerges as common flood adaptation strategies among the farmers. Several socio-economic and cognitive factors, such as farm size, flood experience, and risk awareness, have been identified as influential in shaping both farmers' perceived flood risk and their assessments of flood adaptation strategies.

Given the significant influence of previous flood experience and risk awareness on both farmers' perceived flood risks and their flood adaptation assessments, it is recommended that authorities prioritize efforts to enhance awareness about the probabilities and severe consequences of floods. This could involve disseminating timely information and organizing various awareness-building programs. Implementing disaster-related education in schools is also highly advisable, as it establishes a direct and impactful channel of information from children to their parents.

The study's findings also provide valuable insights for shaping adaptation policies. Recognizing the potential impact of risk awareness on farmers' perceptions and assessments of their adaptive capabilities is crucial for enhancing flood risk awareness building programs. Moreover, it is important to acknowledge that successful adaptation strategies in char-lands hinge on the accessibility and utility of local services, particularly those related to agricultural extension and rural development.

Lastly, it's important to note that farmers' perceptions of flood threats and their evaluations of flood adaptation strategies are context-dependent and relative. The intention here was not to categorize these perceptions and assessments as universally high or low. Rather, the aim was to discern the relative importance of different facets of farmers' lives in relation to flood threats and how they gauge their adaptive capacity. Equally important was understanding the extent to which external factors influence farmers' perceived risks and assessments of adaptation. These insights can be instrumental in the development of targeted adaptation policies.

Author Contributions: Conceptualization, M.O.F. and K.L.M.; methodology, M.O.F.; validation, M.O.F. and K.L.M.; software, M.O.F.; formal analysis, investigation, resources, data curation, M.O.F.; writing original draft preparation, M.O.F.; writing review and editing, M.O.F. and K.L.M.; visualization, M.O.F.; supervision, K.L.M. All authors have read and agreed to the published version of the manuscript.

Funding: There is no funding for this research.

Institutional Review Board Statement: The study was conducted according to the guidelines and approved by the Ethics Committee of Graduate School for International Development and Cooperation (IDEC), Hiroshima University, Japan on 31 August 2021.

Informed Consent Statement: All farmers who took part in this study provided their informed consent.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

Acknowledgments: The authors would like to thank all the villagers who willingly responded to the face to face survey for this study.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Doocy, S.; Daniels, A.; Packer, C.; Dick, A.; Kirsch, T.D. The Human Impact of Earthquakes: A Historical Review of Events 1980–2009 and Systematic Literature Review. *PLoS Curr.* **2013**, 1–23, doi: 10.1371/currents.dis.67bd14fe457f1db0b5433a8ee20fb833.
2. Guha-Sapir, D.; Vos, F.; Below, R.; Ponserre, S. Annual Disaster Statistical Review 2011: The Numbers and Trends; CRED: Brussels, Belgium, **2012**.
3. Brouwer, R.; Akter, S.; Brander, L.; Haque, E. Socioeconomic Vulnerability and Adaptation to Environmental Risk: A Case Study of Climate Change and Flooding in Bangladesh. *Risk Analysis*, **2007**, *27*, 313-326, doi: https://doi.org/10.1111/j.1539-6924.2007.00884.x.

4. Elahi, K.M. Population Redistribution and Mobility Transition in South Asia. Dhaka: *Center for Population Studies. Dept. Geography*, Jahangirnagar University, Savar, Bangladesh, **2001**.
5. Naz, F.; Doneys, P.; Shahab E. S. Adaptation strategies to floods: A gender-based analysis of the farming-dependent char community in the Padma floodplain, Bangladesh. *International Journal of Disaster Risk Reduction* **2020**, 28:519-530, doi: http://dx.doi.org/10.1016/j.ijdrr.2017.12.016
6. Hossain, B.; Sohel, M.S.; Ryakitimbo, C.M. Climate change induced extreme flood disaster in Bangladesh: Implications on people's livelihoods in the Char Village and their coping mechanisms. *Progress in Disaster Science* **2020**, *6*, 100079, doi:https://doi.org/10.1016/j.pdisas.2020.100079.
7. Faruk, M.O.; Maharjan, K.L. Impact of Farmers' Participation in Community-Based Organizations on Adoption of Flood Adaptation Strategies: A Case Study in a Char-Land Area of Sirajganj District Bangladesh. *Sustainability* **2022**, *14*, 8959, doi: https://doi.org/10.3390/su14148959
8. Bubeck, P.; Botzen, W.J.W.; Aerts, J.C.J.H. A Review of Risk Perceptions and Other Factors that Influence Flood Mitigation Behavior. *Risk Analysis* **2012**, *32*, 1481-1495, doi:https://doi.org/10.1111/j.1539-6924.2011.01783.x.
9. Grothmann, T.; Reusswig, F. People at risk of flooding: Why some residents take precautionary action while others do not. *Natural hazards* **2006**, *38*, 101-120.
10. Poussin, J.K.; Botzen, W.J.W.; Aerts, J.C.J.H. Factors of influence on flood damage mitigation behaviour by households. *Environmental Science & Policy* **2014**, *40*, 69-77, doi: https://doi.org/10.1016/j.envsci.2014.01.013.
11. Rogers, R.W. A protection motivation theory of fear appeals and attitude change. *The Journal of Psychology: Interdisciplinary and Applied*,**1975**, 91 (1) 93-114, doi: http:// dx.doi.org/10.1080/00223980.1975.9915803.
12. Bubeck, P.; Botzen, W.J.W.; Kreibich, H.; Aerts, J.C.J.H. Detailed insights into the influence of flood-coping appraisals on mitigation behaviour. *Global Environmental Change* **2013**, *23*, 1327-1338, doi:https://doi.org/10.1016/j.gloenvcha.2013.05.009.
13. Zaalberg, R.; Midden, C.; Meijnders, A.; McCalley, T. Prevention, Adaptation, and Threat Denial: Flooding Experiences in the Netherlands. *Risk Analysis* **2009**, *29*, 1759-1778, doi:https://doi.org/10.1111/j.1539-6924.2009.01316.x.
14. Binh, P.T.; Zhu, X.; Groeneveld, R.A.; Van Erland, E.C. Risk communication, women's participation and flood mitigation in Vietnam: An experimental study. *Land Use Policy* **2020**, *95*, 104436, doi:https://doi.org/10.1016/j.landusepol.2019.104436.
15. Festinger, L. A Theory of Cognitive Dissonance. Row, Peterson, Evanston/III, **1957**.
16. Chauvin, B.; Hermand, D.; Mullet, E. Risk perception and personality facets. *Risk Analysis*, **2007**, 27, 171–185, doi: https://doi.org/10.1111/j.1539-6924.2006.00867.x.
17. Botzen, W.J.W.; Aerts, J.C.J.H.; Van Den Bergh, J.C.J.M. Dependence of flood risk perceptions on socioeconomic and objective risk factors. *Water Resour Res.*, **2009a,** 45, W10440, doi: https://doi.org/10.1029/2009WR007743.
18. Kellens, W.; Zaalberg, R.; Neutens, T.; Vanneuville, W.; De Maeyer, P. An analysis of the public perception of flood risk on the Belgian coast. *Risk Anal*, **2011**, 31,1055–1068, doi: http://dx.doi.org/10.1111/j.1539-6924.2010.01571.x.
19. Oasim, S.; Khan, A.N.; Shrestha, R.P.; Qasim, M. Risk perception of the people in the flood prone Khyber Pukhthunkhwa province of Pakistan. *International Journal of Disaster Risk Reduction*, **2015** 14:373–378, doi: http://dx.doi.org/10.1016/j.ijdrr.2015.09.001.
20. Bubeck, P.; Botzen, W.J.W.; Aerts, J.C.J.H. A Review of Risk Perceptions and Other Factors that Influence Flood Mitigation Behavior. *Risk Analysis* **2012**, *32*, 1481-1495, doi: https://doi.org/10.1111/j.1539-6924.2011.01783.x.
21. Le Dang, H., Li, E., Nuberg, I.; Bruwer, J. Farmers' Perceived Risks of Climate Change and Influencing Factors: A Study in the Mekong Delta, Vietnam. *Environmental Management*, **2014**, 54, 331–345. https://doi.org/10.1007/s00267-014-0299-6.
22. Le Dang, H.; Li, E.; Nuberg, I.; Bruwer, J. Farmers' assessments of private adaptive measures to climate change and influential factors: a study in the Mekong Delta, Vietnam. *Natural Hazards,***2014**, 71, 385–401, doi: https://doi.org/10.1007/s11069-013-0931-4.
23. Dowling, G.R. Perceived risk: the concept and its measurement. *Psychol Market*, **1986**, 3(3),193–210, doi: https://doi.org/10.1002/mar.4220030307.
24. Islam, M.N. Flood risks for the char community on the Ganges-Padma floodplain in Bangladesh. *International Journal of Environment* **2012**, *2*, 106-116.
25. Rahman, M.; Siddik, M. Livelihood Analysis of the Char Dwellers Using Capital Asset Framework. *Journal of Environmental Science and Natural Resources* **2018**, *11*, 27-36, doi:10.3329/jesnr.v11i1-2.43362.
26. Hair, J.F.J.; Black, W.C.; Babin, B.J.; Anderson, R.E. Multivariate data analysis. Prentice Hall, New Jersey, **2010**.
27. Kehinde, A.D.; Ogundeji, A.A. The simultaneous impact of access to credit and cooperative services on cocoa productivity in South-western Nigeria. *Agric. Food Secur.* **2022**, 11, 11, doi: doi:10.1186/s40066-021-00351-4.

28. Allen, P.; Bennett, K. PASW statistics by SPSS: A practical guide version 18.0. Cengage Learning Australia, London, UK, **2010**.
29. Kellens, W.; Terpstra, T.; De Maeyer, P. Perception and Communication of Flood Risks: A Systematic Review of Empirical Research. *Risk Analysis* **2013**, *33*, 24-49, doi:https://doi.org/10.1111/j.1539-6924.2012.01844.x.
30. Armas, I.; Ionescu, R.; Posner, C.N. Flood risk perception along the Lower Danube River, Romania. *Natural Hazards*, **2015**, 79, 1913–1931.
31. Ho, M.C.; Shaw, D.; Lin, S.; Chiu, Y.C. How do disaster characteristics influence risk perception? *Risk Analysis*, **2008**, 28, 635–643, doi: http://dx.doi.org/10.1111/j.1539-6924.2008.01040.x.
32. Lindell, M.K.; Hwang, S.N. Households' Perceived Personal Risk and Responses in a Multihazard Environment. *Risk Analysis* **2008**, *28*, 539-556, doi:https://doi.org/10.1111/j.1539-6924.2008.01032.x.
33. Bustillos Ardaya, A.; Evers, M.; Ribbe, L. What influences disaster risk perception? Intervention measures, flood and landslide risk perception of the population living in flood risk areas in Rio de Janeiro state, Brazil. *Int J Disaster Risk Reduct*, **2007**, 25, 227–237, doi: http://dx.doi.org/10.1016/j.ijdrr.2017.09.006.
34. Burningham, K.; Fielding, J.; Thrush, D. 'It'll never happen to me': understanding public awareness of local flood risk. *Disasters* **2008**, *32*, 216--238.
35. Keller, C.; Siegrist, M.; Gutscher, H. The Role of the Affect and Availability Heuristics in Risk Communication. *Risk Analysis* **2006**, *26*, 631-639, doi: https://doi.org/10.1111/j.1539-6924.2006.00773.x.
36. Papagiannaki, K.; Kotroni, V.; Lagouvardos, K.; Papagiannakis, G. How awareness and confidence affect flood-risk precautionary behavior of Greek citizens: the role of perceptual and emotional mechanisms. *Nat. Hazards Earth Syst. Sci.* **2019**, *19*, 1329-1346, doi:10.5194/nhess-19-1329-2019.
37. Bradford, R.A.; O'Sullivan, J.J.; van der Craats, I.M.; Krywkow, J.; Rotko, P.; Aaltonen, J.; Bonaiuto, M.; De Dominicis, S.; Waylen, K.; Schelfaut, K. Risk perception – issues for flood management in Europe. *Nat. Hazards Earth Syst. Sci.* **2012**, 12, 2299-2309, doi:10.5194/nhess-12-2299-2012.