Still bearing the burden

How poor rural women in Bangladesh are paying most for climate risks

Shaikh Eskander, Paul Steele, Mamunur Rashid, Nuzhat Imam and Sirazoom Munira

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Acronyms

BDT	Bangladesh taka
CHER	Climate household expenditure review
CPEIR	Climate public expenditure and institutional review
LPM	Linear probability model
UNDP	United Nations Development Programme

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Tropical storms, cyclones and monsoon floods are recurring events in Bangladesh, but are becoming more frequent and more severe with climate change. The study assesses the percentage of climate expenditure as a share of household income and expenditure in climate-vulnerable regions of Bangladesh, based on primary data. In particular, it investigates disaster and climate adaptation expenditure by rural households; the socioeconomic factors influencing disaster and climate adaptation expenditure; income shares of disaster and climate adaptation expenditure; and gendered differences in this expenditure. This study updates a 2019 review by IIED which used secondary data, and finds similar estimates of total rural household level expenditure.

Contents

Summary

This study by IIED, Kingston University and UNDP surveyed 3,094 households from the rural areas of ten selected districts in Bangladesh to assess their exposure to climate change and their spending patterns on reducing the risks of climate-related disasters. The data demonstrate that poor rural households are most affected by climate-related risks and are spending as much as 15% of their total household expenditure on risk reduction. This is even higher for female-headed households, which are spending as much as 30% of their household expenditure, double that of male-headed households.

More climate household expenditure reviews (CHERs) are needed in other countries to demonstrate how poor female-headed households are bearing the major costs of climate change. Collection of this expenditure data should be integrated into ongoing household income and expenditure surveys by governments and their development partners, such as the World Bank, who support these surveys.

Greater quantitative and gender disaggregated data on household climate expenditure patterns will also complement the government's climate public expenditure and institutional reviews (CPEIRs). The CHERs can recommend how government and development partners should align and support poor people's priorities, especially those of female-headed households on the frontline of climate change.

The study assesses the percentage of climate expenditure as a share of household income and expenditure in climate-vulnerable regions of Bangladesh, based on primary data. In particular, it investigates:

- Disaster and climate adaptation expenditure by rural Bangladeshi households
- The socioeconomic factors influencing disaster and climate adaptation expenditure
- Income shares of disaster and climate adaptation expenditure, and
- Gendered differences in disaster and climate adaptation expenditure.

Based on primary data collection, this study found that 42.6% of rural households reported exposure to flood, 40.7% exposure to storm, and 82.6% were affected by at least one slow-onset climate-related disaster. Exposure and household vulnerability vary significantly with gender. Out of a total of 2,427 male-headed households (78% of the sample), 36.9%, 42.9% and 83.3% reported exposure to flood, storm, and other disasters,[1] respectively. Among the 668 female-headed households (22% of the sample), 63.5%, 32.9% and 80.2% reported exposure to flood, storm, and other disasters, respectively. Households from the northern districts of Gaibandha (93%), Jamalpur (87.7%) and Kurigram (94.2%) reported high exposure to floods. Storm exposure was mostly found in the southern coastal districts: Bagerhat (84.6%), Barguna (88.3%) and Satkhira (96.3%). While both male- and female-headed households experience a similar exposure to other disasters, female-headed households have a greater percentage exposure to floods, and a lower percentage exposure to storms than male-headed households. This is because the most flood-affected districts are in northern areas, such as the Greater Rangpur region, where seasonal migration and absent male heads are more common.

Exposure to disaster causes considerable damage to the assets and livelihood opportunities of affected households. In response, households adopt private defence measures, investing their own private resources in climate disaster prevention. Impacted households spend a considerable share of their annual expenditure on climate-related disaster recovery – an average of 14.47% of their annual expenditure on floods, 14.9% on storms, and 8.15% on other disasters.

Expenditure on climate change adaptation also varies by gender and poverty. In general, female-headed households are more likely to undertake disaster protection measures than male-headed households. However, male-headed households typically spend more in absolute terms than female-headed households, and their total average income and expenditure is higher. So, similar to the 2019 study which used secondary data (Eskander and Steele, 2019), in relative terms, the present study finds that female-headed households spend a higher share of their income on adaptation than their male counterparts. In particular, compared to male-headed households, female-headed households spend two percentage points more on flood adaptation, and around three percentage points more on adaptation

[1] Other disasters include extreme heat, extreme cold, excessive rain, drought or lack of rain, river erosion, water logging, water salinity and soil/land salinity.

to other disasters, and a strikingly high figure of over 30 percentage points more as a share of income on storm adaptation.

Results also confirm that more affluent households spend a lower share of their total expenditure on disaster risk reduction activities. In particular, households with 10% higher (lower) total expenditure spend lower (higher) on flood, storm and other disaster-related risk reduction action by 5.25%, 9.65% and 3.50%, respectively. Results also show that female-headed households spend a larger share of their incomes – 2%, 31% and 3% more than male-headed households – on protection against floods, storms and other disasters, respectively.

Disaster action and expenditure on disaster risk reduction vary by type of disaster:

- **Floods:** Among the 1,320 households exposed to floods, 31.1% raised their floors to save their homestead from flood waters. They also invested in protecting their agricultural lands (2.5%), household materials (7.35%), birds (mostly chickens) and animals (22.9%), and took other action (4.7%). Altogether, a total of 545 households (41%) undertakes at least one protective measure at an average cost of BDT9,243 (roughly equivalent to US$108.8 at the exchange rate of US$1=BDT84.95).
- **Storms:** Among the 1,260 storm-affected households, 11.3% raised their floors, while they also invested in protecting their agricultural lands (6.03%), household materials (6.11%), birds and animals (16%) and other action (2.22%). A total of 344 households (27%) undertakes at least one protective measure at an average cost of BDT10,822 (US$127.4). Compared to flood prevention, a lower percentage of households (27% compared to 41%) undertake storm risk prevention, since storms are mostly sudden and rarer, unlike floods.
- **Other disasters including slow-onset disasters:** Reducing the harm of slow-onset disasters included taking action on agricultural lands, household materials, birds or animals, and other.

The initial 2019 review estimated that 24 million households spent an average of US$79 per household or US$1.9 billion a year on climate-related disaster preparedness. This 2021 study found similar figures for the most prevalent disaster or `other disaster' which affected an average of 83% of rural households who spent about BDT7,493 (US$88.2), or about US$1.7 billion per year.

1 Introduction

Climate expenditure is investment aimed at both adaptation and mitigation activities in the wake of an increased number of climate-related disasters and slow-onset climate change impacts. This includes events such as storms and cyclones, temperature increases leading to drought, erratic rainfall, sea-level rise, river erosion, and soil and water salinisation. This study focuses on adaptation and risk reduction to climate-related disasters – which we treat as two related responses.

Tropical storms, cyclones and monsoon floods are recurring events in Bangladesh, but are becoming more frequent and more severe with climate change (eg Dastagir, 2015). In line with the priorities of the government of Bangladesh, this study assesses rural household expenditure on disaster risk reduction and addresses the risks of slow-onset climatic events.

Using primary data, this working paper highlights the high levels of household climate expenditure by women and men on the frontline of climate change impacts. This study updates a 2019 study by IIED (Eskander and Steele, 2019) which used secondary data and finds strikingly similar estimates of household level expenditure.

This study supports the government of Bangladesh and development partners in their funding decisions to align with the priorities of poor rural women and men most exposed to climate change risks. It is also consistent with IIED's broader work programme on `money where it matters' – channelling climate finance to those who need it the most.

Study objectives

The study assesses the percentage of climate expenditure as a share of household income and expenditure in climate-vulnerable regions of Bangladesh, based on primary data. In particular, it investigates:

- Disaster and climate adaptation expenditure by rural Bangladeshi households
- The socioeconomic factors influencing disaster and climate adaptation expenditure
- Income shares of disaster and climate adaptation expenditure, and
- Gendered differences in disaster and climate adaptation expenditure.

2 Methodology

Survey design

IIED and Kingston University, in consultation with UNDP Bangladesh, developed the survey questionnaire to focus on the issues raised in the objectives of the study. In doing so, we identified locations that were not affected by either the 2020 flood or the 2020 Cyclone Amphan (unaffected regions) and locations impacted by only flood (flood-affected regions), only cyclone (cyclone-affected regions), and both (flood- and cyclone-affected regions).

Surveyed households were asked to recall their income and expenditure data from before these disasters (pre-exposure data) and current data (post-exposure data). Bangladesh, like the rest of the world, was suffering from the ongoing COVID-19 pandemic, and both the pre- and post-exposure periods are affected by the pandemic and, therefore, our results should not be biased due to COVID-exposure.

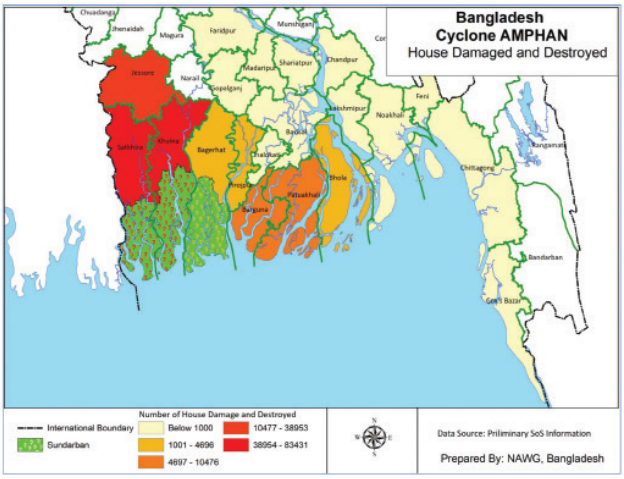
Cyclone Amphan affected 76 *upazilas*[2] in 19 districts, with eight districts having severe to moderate impact in terms of lives lost and livelihoods destroyed. In total, 26 people lost their lives, affecting 2.6 million people, with more than 0.2 million houses damaged. The government estimated BDT11,000 million in damages (roughly equivalent to US$129.5 million).[3] In addition, more than 176,000 hectares of productive land with standing crops and fish/shrimp farms were washed away (Government of Bangladesh, 2020).

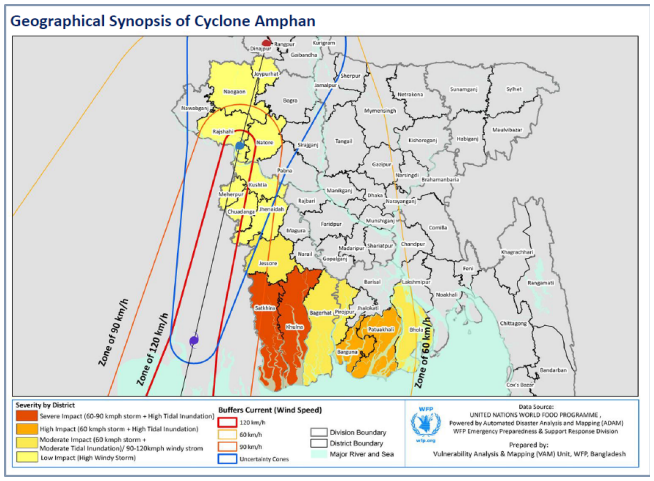
The super flood of July/August 2020 was the most protracted flooding since 1988, which put nearly one third of Bangladesh under flood water, affecting 21 districts in the northern and north-eastern parts of the country. Other major floods with considerable damage to lives and livelihoods include the floods of 1988 and 1998.

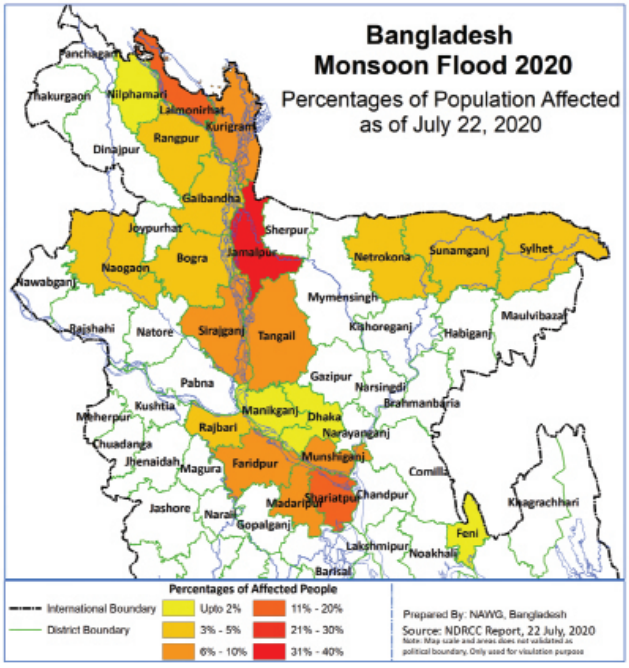
For least developed countries like Bangladesh. where insurance and many other important markets are either absent or underdeveloped, recovery from floods and storms takes a significant toll. As climate-related disasters hit, it is highly likely that household pre- and post-disaster incomes will be different. Therefore, the comparison of expenditure on disaster risk reduction activities will be in terms of the proportion of total expenditure in addition to absolute expenditure, and data are needed on household income and expenditure for both the pre- and post-disaster periods. For this study, it was critical to define which climate-related disasters affect a household and how much they spend on reducing the risks of such events. It is not possible to capture or quantify all the factors involved in this given situation. For instance, some losses like death of a family member cannot be quantified. In addition, we do not estimate the post-disaster expenditure of rural households for returning to their normal economic activities. Our estimates therefore provide a very conservative limit of disaster and climate adaptation expenditure by rural households.

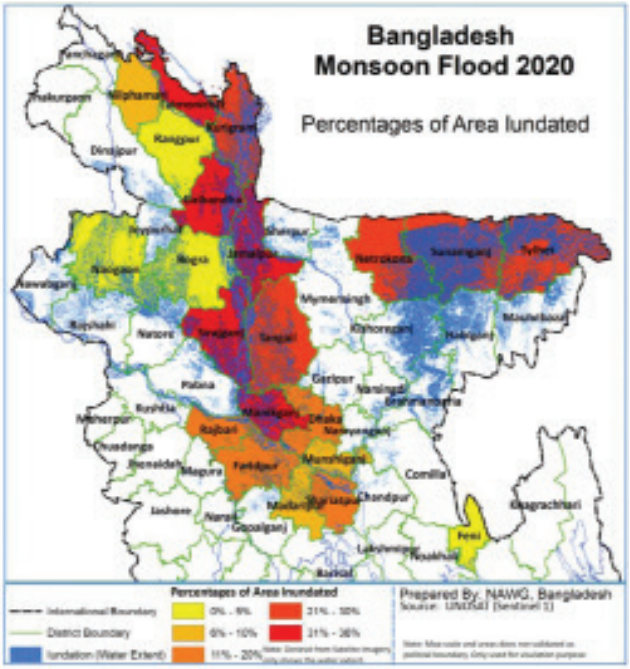
[2] An upazila formerly called thana, is an administrative region in Bangladesh, functioning as a sub-unit of a district.
[3] Calculated at the rate of US$1=BDT84.95 according to Bangladesh Bank (2020) data.

Maps showing impacts of recent cyclone and monsoon floods









Source: Government of Bangladesh, 2020

Components of disaster and climate expenditure and topics of the questionnaire

Based on the design parameters set out above, a survey questionnaire was developed to investigate:

- The exposure to disaster by rural households
- The extent of disaster and climate expenditure in selected rural areas
- The socioeconomic determinants of climate expenditure, such as gender, income, location, and
- The welfare impacts of climate change and the potential income impacts created by climate expenditure.

Surveyed households were asked about their exposure to disasters in the last two years. Among others, this survey collected household-level data on education, different components of income, expenditure, savings and debt, exposure to different types of disaster, and expenditure related to adaptation and coping strategies to reduce the damage from disasters.

Data collection strategy

We first developed the questionnaire for the field survey, which was then shared with UNDP Bangladesh for comments and suggestions. A revised questionnaire was sent out for field testing to identify whether any further revision would be necessary. A total of 51 households were surveyed in this pre-test.

A finalised questionnaire, including all necessary questions for the study, was then sent to the field. We remotely trained the enumerators to familiarise them with our expectations and also to receive suggestions and feedback from them to improve the survey.

Different UNDP projects were ongoing in all the 64 districts of Bangladesh, which allowed us to target UNDP project beneficiaries who were more likely to be willing to respond to a survey. Altogether, there were around 240,000 UNDP project beneficiaries, with the Strengthening Women's Ability for Productive New Opportunities (SWAPNO) and Local Government Initiatives on Climate Change (LoGIC) projects ongoing in 11 districts. Of these, the six southern/coastal districts were affected by Cyclone Amphan, whilst five northern districts were affected by the 2020 monsoon flood.

For sampling, we first divided the entire study into two parts: affected and unaffected districts. Affected districts are then divided in terms of type of disasters, ie flood and cyclone. We then chose three affected districts for each disaster and four unaffected districts.

For the cyclone, three affected districts from the coastal regions – Barguna, Khulna and Bagerhat – were chosen. For the flood, we chose three northern districts – Jamalpur, Kurigram and Gaibandha – which were affected by the 2020 flood. For unaffected districts, we chose Gazipur, Mymensingh and Khagrachari. For unaffected districts, we chose Khagrachari, Moulvibazar, Mymensingh and Noakhali, which were not exposed to the 2020 flood or cyclone.

Allowing for 5% margin of error and at 99% confidence level, we needed between 610 and 650 samples to be collected from each of the three strata, so we surveyed a minimum of 750 samples from each stratum. Note that in these districts the enumerators interviewed only UNDP project beneficiaries. Within each stratum, we then allocated the number of samples according to population weight and rounded them up. Altogether, we surveyed 3,095 households from ten districts. Enumerators interviewed either the head of the household, or the next decision maker, or the senior most member. Gender is an important aspect which required further investigation, since women are more likely to be exposed to disaster risks than men (Cutter, 2017).

Data analysis

Data were analysed by first assessing the extent of climate expenditure in selected rural areas of Bangladesh. Different regions of the country are prone to different types of climate disasters. For example, southern coastal regions are more exposed to tropical storms and cyclones (the most recent example being Cyclone Amphan), whereas the northern regions frequently experience floods. Different disasters also have different levels of impact on lives and livelihoods. Therefore, there can be different types and levels of action and corresponding expenditure in different regions of Bangladesh. Chapter 10 reports on regression analyses.

Table 1. Sampling strategy

DISTRICT	NO. OF SAMPLES	AFFECTED BY CYCLONE AMPHAN?	AFFECTED BY THE 2020 JULY/AUGUST FLOOD?
Bagerhat	313	Yes	No
Barguna	334	Yes	No
Gaibandha	115	No	Yes
Jamalpur	212	No	Yes
Kurigram	447	No	Yes
Khagrachari	504	No	No
Moulvibazar	384	No	No
Mymensingh	300	No	No
Noakhali	390	No	No
Satkhira	110	Yes	No

3

Basic household characteristics

Household characteristics

The survey mainly covered UNDP project beneficiaries from rural areas of ten districts in Bangladesh. In total, 2,214 surveyed households are project beneficiaries and the remaining 880 are non-beneficiaries.

Although only 667 households were female headed, compared to 2,426 male-headed households, the respondents were often women in the male-headed households. In total, there were 1,880 female and 1,214 male respondents.

In terms of religion, most households were Muslim (2,525), followed by Hindu (303), Christian (228), Buddhist (35) and others (3). Only 281 households speak a language other than Bengali, whereas 287 households declare their ethnicity to be other than Bengali.

Table 3 shows the age distribution of surveyed households. Household heads are on average 46 years old, and average household size is 4.69 with a similar number of male and female members (2.31 males and 2.38 females). Most household members are at an economically active age, with almost 3 out of 4.69 in the age range of 15 to 64 years.

Table 2. Basic characteristics of the households surveyed

DESCRIPTION	CODES	NUMBER OF OBSERVATIONS
Is the surveyed household a UNDP project beneficiary?	No	880
	Yes	2,214
Gender of the main interviewee	Female	1,880
	Male	1,214
Religion	Islam	2,525
	Hinduism	303
	Buddhism	35
	Christianity	228
	Other	3
Language	Bangla	2,813
	Others	281
Ethnicity	Bengali	2,807
	Others	287
Gender of the household head	Male	2,426
	Female	667
	Other	1

Notes. Author's calculation based on UNDP climate expenditure survey.

Table 3. Age distribution

VARIABLES	MEAN (SD)
Age of the household head	45.78 (12.98)
Household size	4.69 (2.11)
Number of males	2.31 (1.39)
Number of females	2.38 (1.24)
Number of members aged 0–5	0.48 (0.71)
Number of members aged 6–14	0.96 (0.94)
Number of members aged 15–64	2.96 (1.52)
Number of members aged 65 and older	0.28 (0.54)

Notes. Author's calculation based on UNDP climate expenditure survey. We report average values for all the variables, whereas standard deviations are reported in parentheses.

Household income

Although the surveyed households receive their incomes from multiple sources, they are predominantly farm households with the majority of their income coming from agricultural activities. Other sources of income include wages received from non-farm labour supply, incomes from salaried employment, business income, remittances, and other sources. Table 4 presents the components of household income, expressed in BDT.

Table 4. Components of household income, BDT.

	ALL HOUSEHOLDS		MALE-HEADED HOUSEHOLDS		FEMALE-HEADED HOUSEHOLDS		DIFFERENCES	
SOURCE OF INCOMES	2021	2020	2021	2020	2021	2020	2021	2020
Farm income, latest season	10539.36 (21639.36)	9953.47 (23577.14)	12406.98 (23004.76)	11818.67 (25561.97)	3756.65 (13732.56)	3179.57 (11979.45)	8650.34***	8639.11***
Farm wages, latest season	3458.95 (8586.51)	3240.94 (8411.05)	3821.62 (8964.43)	3618.79 (8875.55)	2142.37 (6893.43)	1868.71 (6265.26)	1679.25***	1750.07***
Non-farm wages, last month	3802.44 (5894.38)	5623.42 (15170.84)	4142.87 (6311.19)	6270.68 (16707.73)	2566.09 (3787.76)	3272.75 (6731.76)	1576.78***	2997.92***
Salaried incomes, last month	1985.60 (6509.51)	5145.60 (51081.87)	2181.02 (6981.10)	6016.12 (57484.05)	1275.90 (4320.17)	1984.13 (8572.66)	905.12***	4031.99*
Business incomes, last month	2229.91 (10536.41)	3653.48 (19880.36)	2556.39 (11750.81)	4298.23 (22022.00)	1044.21 (3314.29)	1311.92 (7909.12)	1512.18***	2986.31***
Remittance incomes, last year	3735.62 (28608.86)	3851.97 (28024.57)	3790.60 (29231.59)	3962.08 (28630.85)	3535.93 (26242.89)	3452.10 (25719.03)	254.67	509.98
Other incomes, last year	17478.61 (38767.53)	14560.86 (36763.01)	17246.75 (40321.43)	14783.85 (38768.61)	18320.66 (32518.54)	13751.05 (28318.73)	-1073.91	1032.80

Notes. Author's calculation based on UNDP climate expenditure survey. We report average values for all the variables, whereas standard deviations are reported in parentheses. Differences are calculated as the differences between average incomes for male-headed and female-headed households. ***, ** and * represent statistical significance at 1%, 5% and 10% levels, respectively.

Male-headed households have significantly higher incomes than female-headed households for both the years for which we have data. The highest differences are observed for agricultural incomes, whereas the lowest differences are in remittances. Moreover, while observed differences in farm income and farm wages remain at a similar level for both years, for other sources, the differences have been reduced considerably. In fact, due to the COVID-19 pandemic, both the male- and female-headed households have experienced slumps in their incomes from non-farm wages, salaried income and business income, with those reductions being higher for male-headed households.

Total household expenditure

Table 5 presents household's monthly total and food expenditures over 2020–2021.

The findings showed that male-headed households have a significantly higher total and food expenditure than female-headed households for both years. Differences have increased in the most recent year due to the COVID-19 pandemic, indicating female-headed households' lack of access to credit, in addition to lower incomes.

Table 5. Monthly household expenditure, BDT.

TYPE OF EXPENDITURE	ALL HOUSEHOLDS		MALE-HEADED HOUSEHOLDS		FEMALE-HEADED HOUSEHOLDS		DIFFERENCES	
	2021	2020	2021	2020	2021	2020	2021	2020
Total expenditure, latest month	8959.36	8862.94	9799.77	9549.32	5907.20	6372.22	3892.57***	3177.11***
	(25726.80)	(9372.51)	(28828.17)	(9762.61)	(5985.08)	(7275.58)		
Food expenditure, latest month	5592.87	5275.77	6118.20	5729.85	3685.76	3626.66	2432.44***	2103.19***
	(3633.59)	(3783.42)	(3690.11)	(75.99)	(2659.41)	(133.85)		

Notes. Author's calculation based on UNDP climate expenditure survey. We report average values for all the variables, whereas standard deviations are reported in parentheses. Differences are calculated as the differences between average expenditures for male-headed and female-headed households. ***, ** and * represent statistical significance at 1%, 5% and 10% levels, respectively.

5

Experience of different types of disaster

Table 6 presents the percentage of surveyed households reporting exposure to flood, storm, and other disasters over 2020–2021. Out of 3,094 households, 42.6% and 40.7% reported exposure to floods and storms, respectively. In addition, 82.6% reported being affected by at least one slow-onset disaster.

Table 6 also breaks down disaster exposure by the gender of the household head. In relation to Table 6, Figure 1a represents the percentage of affected households by various disasters over 2020–2021. In Figure 1b, the total number of male- and female-headed households is shown, with 2,426 male-headed households – of which 36.9%, 42.9% and 83.3% reported exposure to flood, storm, and other disasters, respectively – while among the 668 female-headed households, 63.5%, 32.9% and 80.2% reported exposure to flood, storm, and other disasters, respectively.

While both male- and female-headed households have similar exposure to other disasters, female-headed households have a greater percentage exposure to floods, and a lower percentage exposure to storms, than male-headed households. This is due to the fact that most flood-affected districts are in the northern areas, such as the Greater Rangpur region, where seasonal migration and absent male heads are more common than in other regions.

Table 6. Percentage of households affected by different disasters (2020–2021)

TYPE OF DISASTER	ALL HOUSEHOLDS	MALE-HEADED HOUSEHOLDS	FEMALE-HEADED HOUSEHOLDS
Flood exposure	42.7	36.9	63.5
Storm exposure	40.7	42.9	32.9
Other disasters	82.6	83.3	80.2
No. of obs.	3,094	2,426	668

Notes. Author's calculation based on UNDP climate expenditure survey.

Figure 1a. Percentage of affected households by different disasters during 2020 and 2021

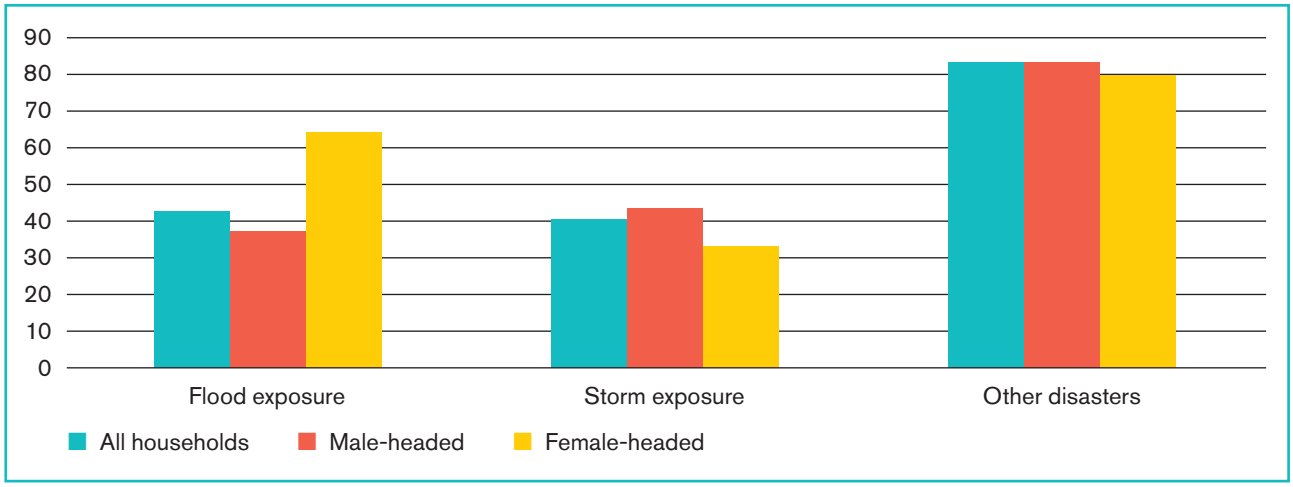


Figure 1b. Ratio of male- to female-headed households surveyed

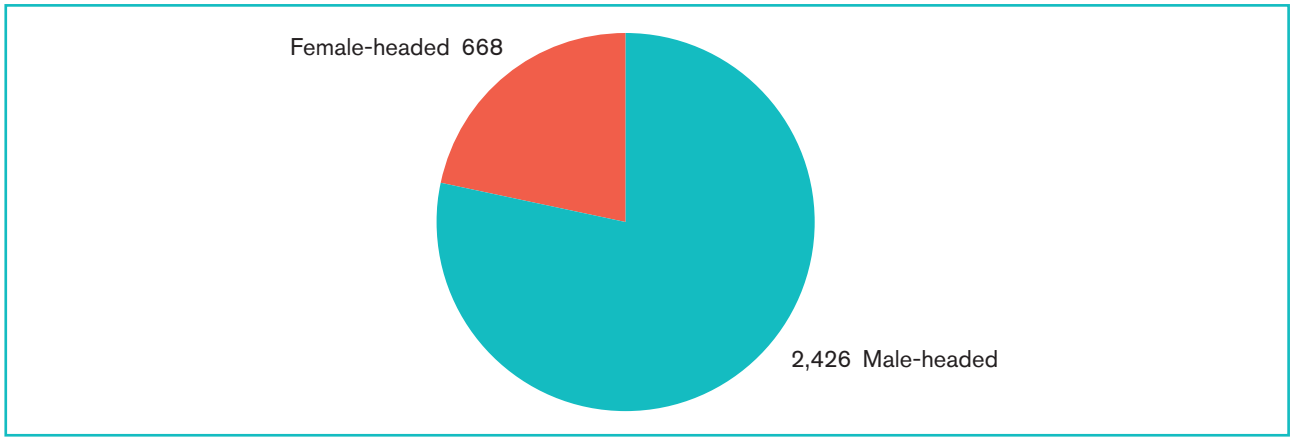


Table 7 presents disaster exposure by district. Households from the northern districts of Gaibandha (93%), Jamalpur (87.7%), and Kurigram (94.2%) reported a very high exposure to floods. On the other hand, Khagrachari and Satkhira have a very low reporting of flood exposure. Other districts have a moderate reporting of flood exposure (ranging between 20.4% in Noakhali to 59% in Barguna).

On the other hand, storm exposure was mostly concentrated in the southern coastal districts of Bagerhat (84.6%), Barguna (88.3%), and Satkhira (96.3%). In addition, Gaibandha (47%), Moulvibazar (60.4%), and Noakhali (31.2%) had a considerably higher reporting of storm exposure during 2020 and 2021.

Table 7. Disaster exposure by district

VARIABLES	BAGERHAT	BARGUNA	GAIBANDHA	JAMALPUR	KHAGRACHARI	KURIGRAM	MOULVIBAZAR	MYMENSINGH	NOAKHALI	SATKHIRA
Flood exposure	33.1	59	93	87.7	3.78	94.2	32.3	25	20.4	11.1
Storm exposure	84.6	88.3	47	13.2	11.5	17.4	60.4	11.3	31.2	96.3
Other disasters	97.4	85.5	100	58	83.5	74.7	100	70	73.2	98.1
No. of obs.	305	332	115	212	503	447	384	300	388	108

Notes. Author's calculation based on UNDP climate expenditure survey.

6 Floods

Flood risk reduction action

Table 8 presents the percentage of households undertaking protective action to reduce damage from flood, and this is illustrated in Figure 2a, with Figure 2b presenting the figures by male- and female-headed households. Among the 1,320 flooded households, 31.1% raised their floors to save their homestead from flood waters. In addition, they also invested in protecting their agricultural lands (2.5%), household materials (7.35%), birds and animals (22.9%), and undertook other actions (4.7%).

There are large differences by gender for the flood risk reduction action, with a statistically significantly greater percentage of female-headed households undertaking different actions to reduce flood risks. In particular, female-headed households raised their floors by 19.32 more percentage points, protected their household materials by 5.50 more percentage points, protected birds and/or animals by 14.24 more percentage points, and invested in other flood protection measures by 8.72 more percentage points.

Table 9 presents flood reduction action by district. As one would expect, districts with a greater reporting of flood exposure have a greater number of households undertaking flood risk action.

Table 8. Flood risk reduction action (% of affected households and total observations)

VARIABLES	ALL HOUSEHOLDS	MALE-HEADED HOUSEHOLDS	FEMALE-HEADED HOUSEHOLDS	FEMALE-MALE DIFFERENCE
Raised floor	31.1	24.9	44.2	19.32***
Agricultural lands	2.5	3.01	1.42	-1.60*
Household materials	7.35	5.58	11.1	5.50***
Birds/ animals	22.9	18.3	32.5	14.24***
Others	4.7	1.9	10.6	8.72***
No. of obs.	1,320	896	424	

Notes. Author's calculation based on UNDP climate expenditure survey.

Figure 2a. Percentage of households undertaking protective action to reduce damage from flood

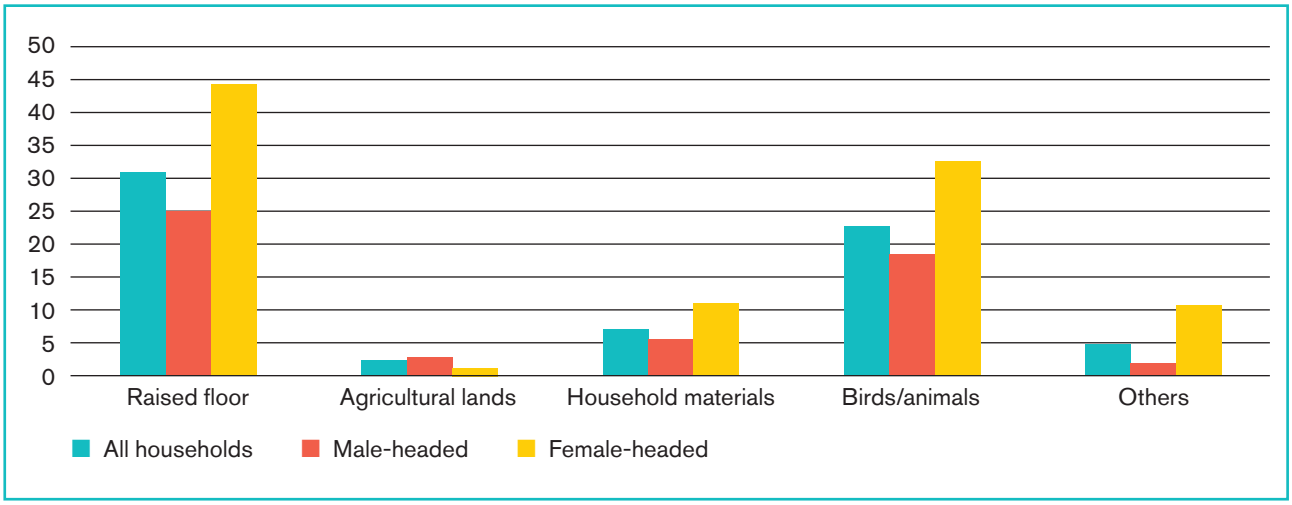


Figure 2b. Ratio of male- to female-headed households surveyed

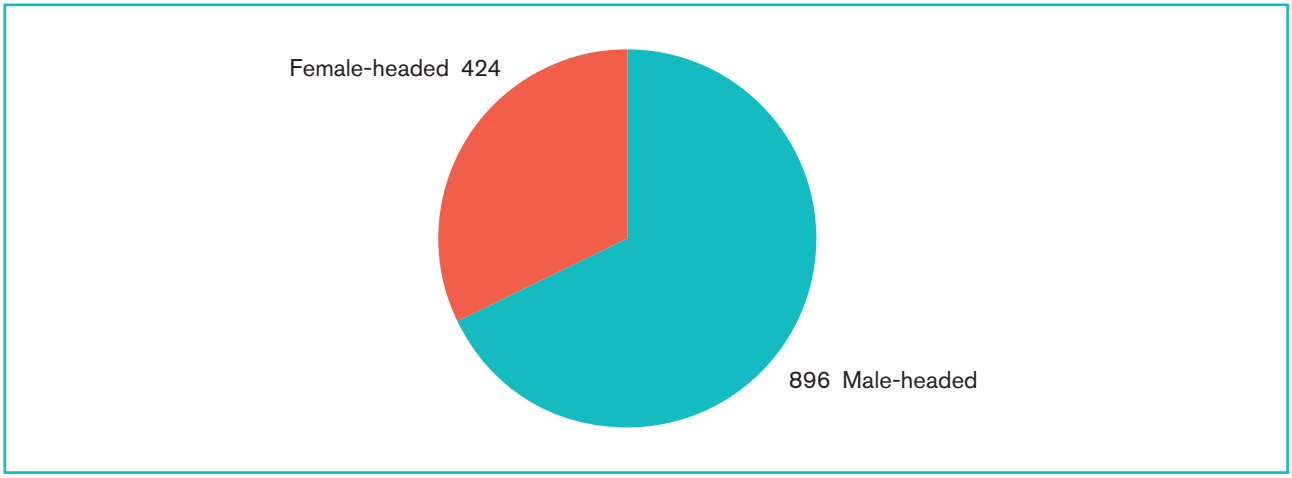


Table 9. Flood risk reduction action by district

VARIABLES	BAGERHAT	BARGUNA	GAIBANDHA	JAMALPUR	KHAGRACHARI	KURIGRAM	MOULVIBAZAR	MYMENSINGH	NOAKHALI	SATKHIRA
Raised floor	45.5	24	71	55.4	5.26	24.5	6.45	5.33	27.8	0
Agricultural lands	3.96	6.12	0.935	0.538	21.1	0	1.61	2.67	8.86	0
Household materials	10.9	9.18	7.48	21	5.26	4.28	0	0	2.53	0
Birds/ animals	49.5	13.3	42.1	47.3	10.5	17.3	0.806	1.33	19	8.33
Others	7.92	0.51	9.35	18.8	0	1.43	0	1.33	1.27	0
No. of obs.	101	196	107	186	19	421	124	75	79	12

Notes. Author's calculation based on UNDP climate expenditure survey.

Flood spending

Table 10 presents the expenditure on different protective actions undertaken by flood-affected households. Figures 3a and 3b relate to Table 10 and show the total expenditure on flood risk reduction for male- and female-headed households. The numbers of male to female households surveyed for this purpose were 227 and 318 households respectively. Male-headed households spent BDT10,597 (US$132) on raising their floor, which was the maximum amount spent for all protective measures. Altogether, a total of 545 households undertakes at least one protective measure at an average cost of BD 9,243 (US$115). The total funds spent on flood risk reduction vary considerably by gender: male-headed households spend almost twice that of female-headed households, and their flood spend is statistically significantly different. This is consistent with the fact that male-headed households have greater adaptive capacity than female-headed households due to their higher incomes (eg Crick et al., 2018).

Table 10. Total spend on flood risk reduction

VARIABLES	ALL HOUSEHOLDS	MALE-HEADED HOUSEHOLDS	FEMALE-HEADED HOUSEHOLDS	FEMALE-MALE DIFFERENCE
Raised floor	8,325	10,597	5,616	-4981.27***
	(11,266)	(12,926)	(8,131)	
No. of obs.	*410*	*223*	*187*	
Agricultural lands	6,194	6,767	3,617	-3150.00
	(6,134)	(6,312)	(4,889)	
No. of obs.	*33*	*27*	*6*	
Household materials	2,883	2,598	3,653	1055.12
	(4,978)	(3,597)	(7,667)	
No. of obs.	*63*	*46*	*17*	
Birds/ animals	4,272	5,966	1,756	-4210.03***
	(9,440)	(11,734)	(2,628)	
No. of obs.	*256*	*153*	*103*	
Others	4,976	6,554	3,694	-2860.10
	(10,543)	(13,663)	(7,364)	
No. of obs.	*29*	*13*	*16*	
Total flood spend	9,243	11,520	6,053	5467.42***
	(13,335)	(15,282)	(9,107)	
No. of obs.	*545*	*318*	*227*	

Notes. Author's calculation based on UNDP climate expenditure survey. Male-female differences are calculated as the differences between average expenditures for male-headed and female-headed households. ***, ** and * represent statistical significance at 1%, 5% and 10% levels, respectively.

Figure 3a. Amount spent on different protection action undertaken by flood-affected households

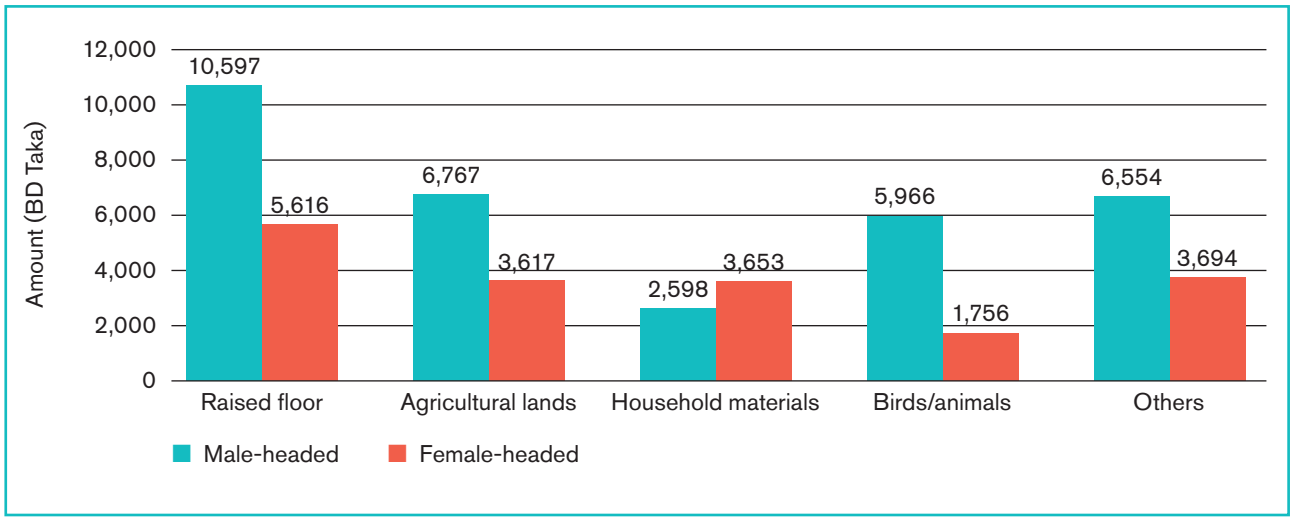
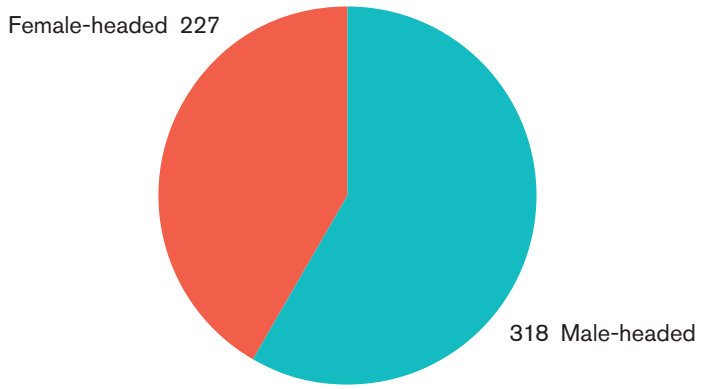


Figure 3b. Ratio of male- to female-headed households surveyed



Similarly, itemised expenditure varies by gender. With the exception of household materials, to which females tend to be more closely attached, male-headed households spend more than female-headed households. Table 11 presents annual per-household flood spend by district.

Overall, we calculated household-level flood expenditure by gender and by district. In general, female-headed households were more likely to undertake flood protection measures than male-headed households. However, as absolute amounts, they spend less than male-headed households on those actions. This is analysed in section 9.

Table 11. Annual per-household flood spending by district, BDT

VARIABLES	BAGERHAT	BARGUNA	GAIBANDHA	JAMALPUR	KHAGRACHARI	KURIGRAM	MOULVIBAZAR	MYMENSINGH	NOAKHALI	SATKHIRA
Raised floor	14,522	8,989	4,068	5,471	30,000	8,515	8,625	8,675	19,977	
	(16,948)	(11,678)	(3,579)	(7,369)		(10,301)	(8,863)	(5,641)	(18,621)	
No. of obs.	*46*	*47*	*76*	*103*	*1*	*103*	*8*	*4*	*22*	
Agricultural lands	9,175	2,583	1,500	1,000	11,050		2,750	7,500	9,929	
	(7,784)	(3,496)			(7,349)		(3,182)	(3,536)	(6,367)	
No. of obs.	*4*	*12*	*1*	*1*	*4*		*2*	*2*	*7*	
Household materials	4,191	1,306	1,462	962.5	15,000	4,740			3,250	
	(6,702)	(987.3)	(1,612)	(641.3)		(7,248)			(2,475)	
No. of obs.	*11*	*18*	*8*	*8*	*1*	*15*			*2*	
Birds/ animals	6,452	6,577	1,421	1,318	7,500	3,804	2,000	5,000	13,400	10,000
	(10,058)	(10,374)	(1,109)	(1,548)	(6,364)	(11,834)			(16,727)	
No. of obs.	*50*	*26*	*45*	*54*	*2*	*61*	*1*	*1*	*15*	*1*
Others	6,250	1,000	1,360	1,667		3,940		50,000	5,000	
	(10,202)		(705.8)	(288.7)		(6,206)				
No. of obs.	*8*	*1*	*10*	*3*		*5*		*1*	*1*	
Total flood spend	16,767	9,985	4,347	5,687	26,050	7,842	8,500	14,957	21,864	10,000
	(19,841)	(11,849)	(3,662)	(7,348)	(20,010)	(11,617)	(8,916)	(18,168)	(22,161)	
No. of obs.	*67*	*65*	*92*	*114*	*4*	*153*	*9*	*7*	*33*	*1*

Notes. Author's calculation based on UNDP climate expenditure survey.

7 Storms

Storm damage reduction action

Table 12 presents the percentage of households undertaking protective action to reduce damage from storm. However, households do not undertake many preventative actions since storms are mostly sudden, relatively rare events, unlike floods. Figure 4a shows the percentage of households undertaking protective actions in order to reduce storm damage. These protective measures include raising the floor of the household, investment in agricultural lands, household materials, birds or animals, etc. Figure 4b shows the numbers of male to female households surveyed, which were 1,040 and 220 households respectively. From the graphical representation it can be seen that the highest number of female-headed households invested in raising floors, whereas the lowest percentage of female-headed households spent on protecting agricultural lands. Among the 1,260 storm-affected households, 11.3% raised floors, and they also invested in protecting their agricultural lands (6.03%), household materials (6.11%), birds and animals (16%), and other actions (2.22%).

Table 12. Storm action

VARIABLES	OVERALL	MALE-HEADED HOUSEHOLDS	FEMALE-HEADED HOUSEHOLDS	FEMALE-MALE DIFFERENCE
Raised floor	11.3	10.4	15.5	5.07**
Agricultural lands	6.03	6.92	1.82	-5.10***
Household materials	6.11	6.73	3.18	-3.55**
Birds/ animals	16	17.3	10	-7.31***
Others	2.22	2.21	2.27	0.06
No. of obs.	1,260	1,040	220	

Notes. Author's calculation based on UNDP climate expenditure survey. Male-female differences are calculated as the differences between the values for male-headed and female-headed households. ***, ** and * represent statistical significance at 1%, 5% and 10% levels, respectively.

Figure 4a. Percentage of households undertaking protective action to reduce storm damage

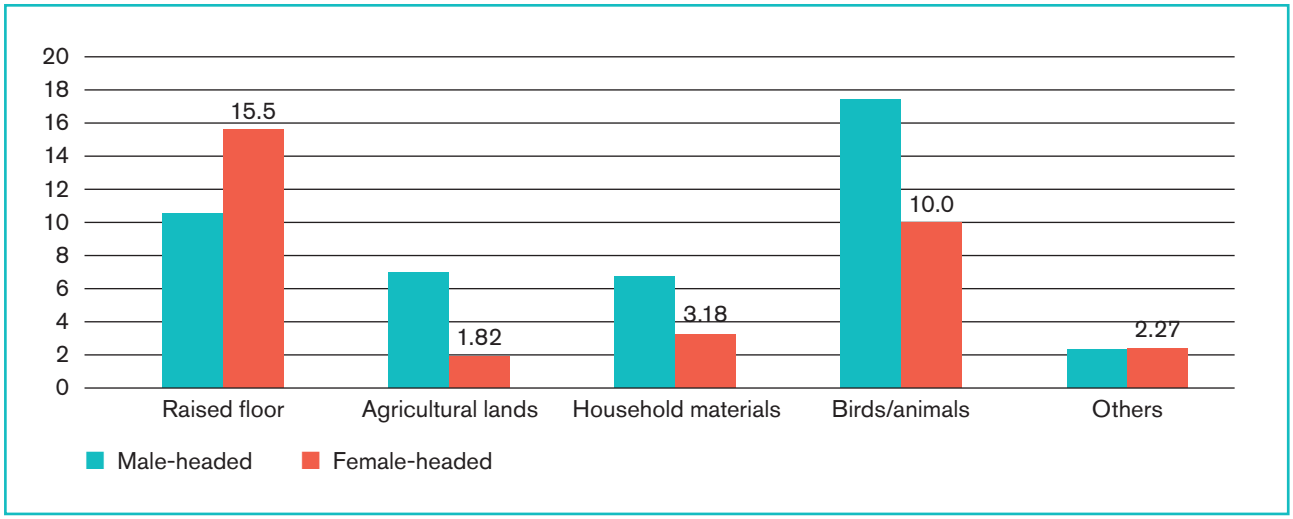
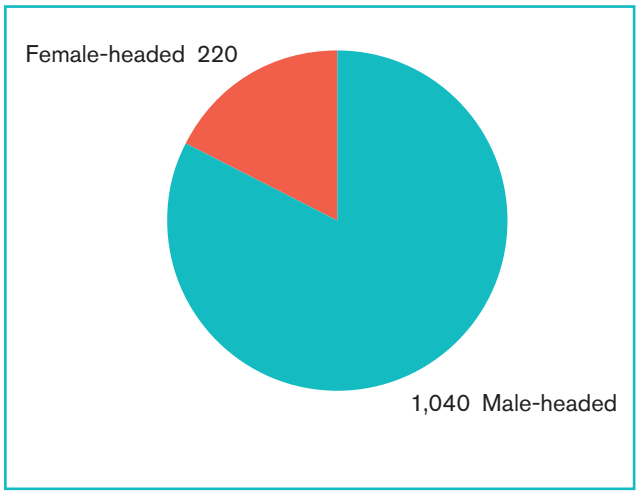


Figure 4b. Ratio of male- to female-headed households surveyed



Gendered differences are profound and statistically significant, but in the opposite direction compared to flood action. For storms, female-headed storm-affected households are more likely to raise floors, but are less likely to undertake other storm actions compared to male-headed households.

Table 13 presents storm action by district. Again, as expected, the districts with greater reporting of storm exposure are the ones with the greater percentage of households undertaking storm risk prevention.

Table 13. Storm action by district, % of storm-affected households

VARIABLES	BAGERHAT	BARGUNA	GAIBANDHA	JAMALPUR	KHAGRACHARI	KURIGRAM	MOULVIBAZAR	MYMENSINGH	NOAKHALI	SATKHIRA
Raised floor	20.5	11.6	27.8	0	1.72	3.85	3.02	0	19	5.77
Agricultural lands	6.2	4.1	3.7	0	51.7	0	1.72	2.94	9.09	0
Household materials	8.53	9.56	3.7	0	0	0	2.16	2.94	14	1.92
Birds/ animals	32.6	8.19	20.4	7.14	53.4	1.28	4.31	0	25.6	7.69
Others	4.26	1.02	5.56	0	0	0	1.29	0	4.96	1.92
No. of obs.	258	293	54	28	58	78	232	34	121	104

Notes. Author's calculation based on UNDP climate expenditure survey.

Storm spend

Table 14 presents the expenditure on different protective actions undertaken by storm-affected households. This is also shown in Figure 5a, with Figure 5b presenting the number of male- and female-headed households surveyed: out of a total of 344 households, 296 were male-headed and 48 were female-headed. The data shows that in households affected by storms the maximum amount of money spent by both male- and female-headed households was on raising the floor. Altogether, a total of 344 households undertakes at least one protective measure at an average cost of BDT10,822 (US$135).

Table 14. Annual per-household storm spend, BDT

VARIABLES	OVERALL	MALE-HEADED HOUSEHOLDS	FEMALE-HEADED HOUSEHOLDS	FEMALE-MALE DIFFERENCE
Raised floor	13,078	14,145	9,715	- 4430.04
	(14,807)	(14,806)	(14,521)	
No. of obs.	*137*	*104*	*33*	
Agricultural lands	5,217	5,417	1,625	-3791.67
	(5,461)	(5,541)	(853.9)	
No. of obs.	*76*	*72*	*4*	
Household materials	6,100	6,100	6,100	0.00
	(11,505)	(11,647)	(10,796)	
No. of obs.	*77*	*70*	*7*	
Birds/ animals	4,419	4,466	4,041	-425.57
	(5,856)	(5,935)	(5,294)	
No. of obs.	*198*	*176*	*22*	
Others	6,779	7,122	5,200	-1921.74
	(10,094)	(10,871)	(5,833)	
No. of obs.	*28*	*23*	*5*	
Total storm spend	10,822	10,939	10,098	-841.27
	(14,804)	(14,181)	(18,345)	
No. of obs.	*344*	*296*	*48*	

Notes. Author's calculation based on UNDP climate expenditure survey. Male-female differences are calculated as the differences between average expenditures for male-headed and female-headed households. ***, ** and * represent statistical significance at 1%, 5% and 10% levels, respectively.

Figure 5a. Amount spent on different protective actions undertaken by storm-affected households

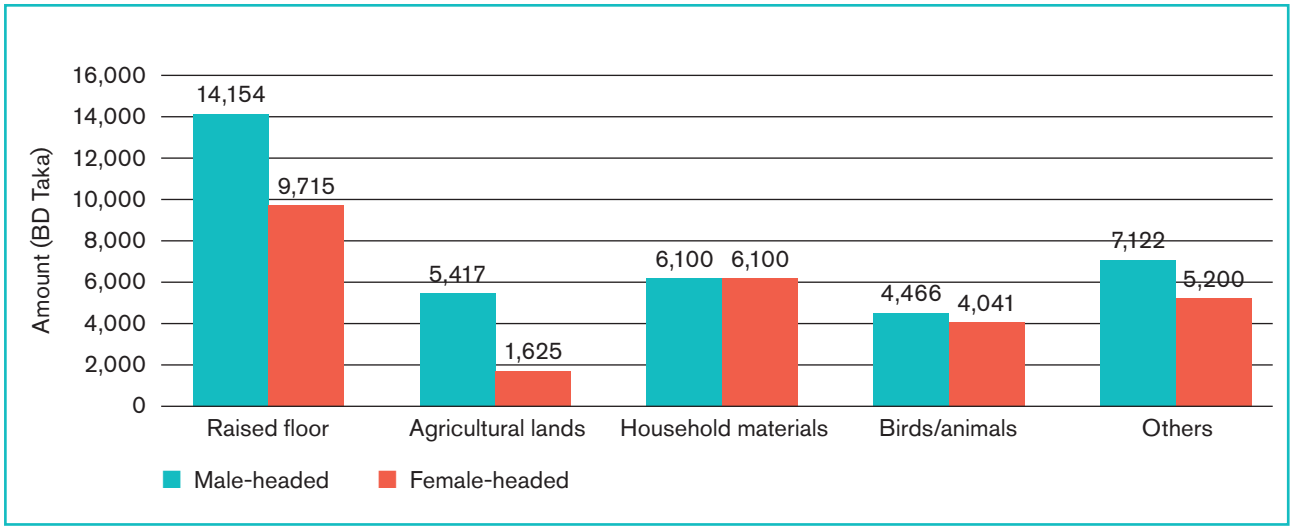
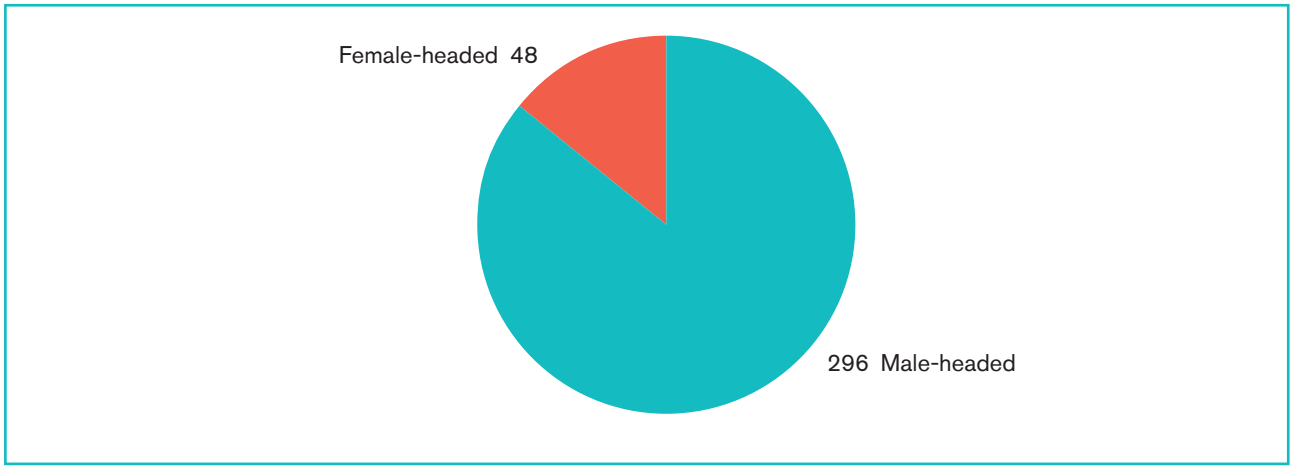


Figure 5b. Ratio of male- to female-headed households surveyed



Male-headed households spend higher than female-headed households on storm protection measures. However, unlike in the case of floods, their spends are not statistically significantly different, with total storm spends by both male- and female-headed households very similar. Table 15 presents the storm spend by district.

Table 15. Annual per-household storm spend by district, BDT

VARIABLES	BAGERHAT	BARGUNA	GAIBANDHA	JAMALPUR	KHAGRACHARI	KURIGRAM	MOULVIBAZAR	MYMENSINGH	NOAKHALI	SATKHIRA
Raised floor	16,200	11,412	2,193		6,000	1,700	5,740		14,087	32,833
	(14,788)	(15,092)	(2,759)			(1,082)	(4,122)		(13,679)	(19,292)
No. of obs.	*50*	*34*	*15*		*1*	*3*	*5*		*23*	*6*
Agricultural lands	11,875	1,917	1,500		3,240		2,375	10,000	5,800	
	(7,940)	(1,395)	(1,414)		(2,117)		(1,493)		(2,946)	
No. of obs.	*16*	*12*	*2*		*30*		*4*	*1*	*11*	
Household materials	7,364	1,393	1,500				13,100	2,000	11,529	1,100
	(8,654)	(864.5)	(1,414)				(26,226)		(16,206)	(141.4)
No. of obs.	*22*	*28*	*2*				*5*	*1*	*17*	*2*
Birds/ animals	6,180	2,479	1,691	1,000	2,674	2,500	1,010		3,997	11,100
	(4,951)	(2,552)	(1,594)	(0)	(1,665)		(851.7)		(4,802)	(23,963)
No. of obs.	*83*	*24*	*11*	*2*	*31*	*1*	*10*		*30*	*6*
Others	11,400	1,333	1,667				2,400		7,917	350
	(14,415)	(577.4)	(986.6)				(1,442)		(4,821)	(212.1)
No. of obs.	*11*	*3*	*3*				*3*		*6*	*2*
Total storm spend	15,932	8,023	3,125	1,000	4,136	1,900	6,050	6,000	12,520	19,036
	(16,743)	(11,899)	(4,085)	(0)	(2,505)	(969.5)	(13,318)	(5,657)	(16,044)	(23,025)
No. of obs.	*113*	*64*	*20*	*2*	*45*	*4*	*20*	*2*	*60*	*14*

Notes. Author's calculation based on UNDP climate expenditure survey.

8

Other disasters

Action to protect against other disasters

Table 16 presents the percentage of households undertaking protective action to reduce damage from slow-onset climate-related disasters. Figures 6a and 6b also present this data. Figure 6b shows the number of male- and female led households surveyed for this purpose – 2,021 and 536, respectively. The percentage of households undertaking protective actions in order to reduce the damage of slow-onset disasters included taking action on agricultural lands (3.36%), household materials (1.52%), birds or animals (7.58%), and others (1.37%). Among these, for both male- and female-led households, the percentage of households undertaking protective action for birds or animals was the highest (Figure 6a).

Table 17 presents the action taken for other disasters by district.

Table 16. Preventative action for other disasters, % of affected households

VARIABLES	OVERALL	MALE-HEADED HOUSEHOLDS	FEMALE-HEADED HOUSEHOLDS	FEMALE-MALE DIFFERENCE
Agricultural lands	3.36	3.71	2.05	-1.66*
Household materials	1.52	1.63	1.12	-0.51
Birds/ animals	7.58	7.96	6.16	-1.81
Others	1.37	1.34	1.49	0.56
No. of obs.	2,557	2,021	536	

Notes. Author's calculation based on UNDP climate expenditure survey. Male-female differences are calculated as the differences between the values for male-headed and female-headed households. ***, ** and * represent statistical significance at 1%, 5% and 10% levels, respectively.

Figure 6a. Percentage of households undertaking protective action to reduce damage from slow-onset disasters

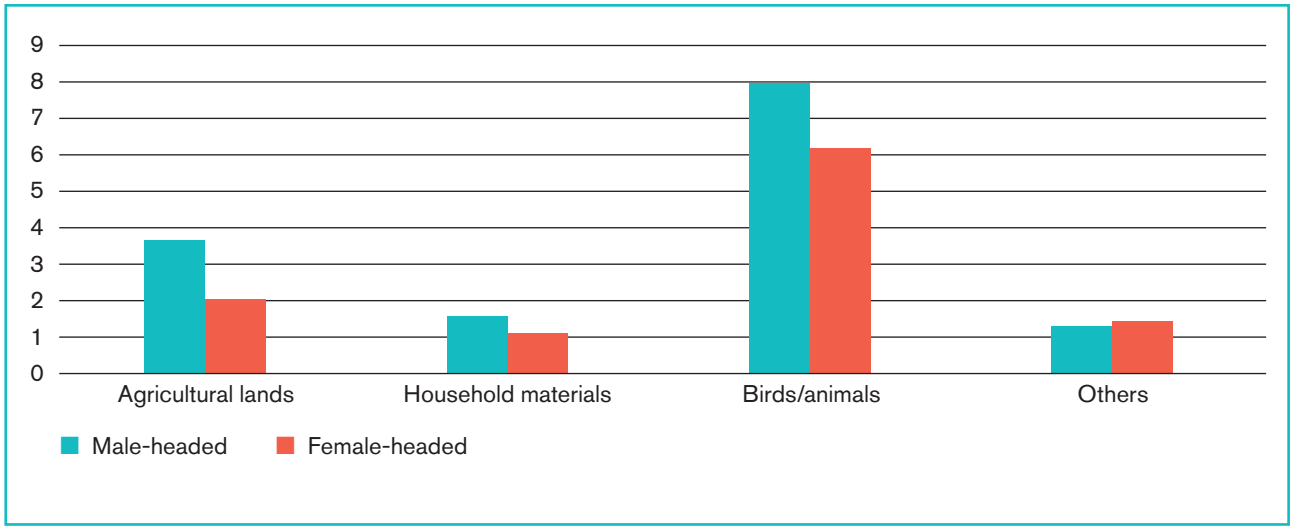


Figure 6b. Ratio of male- to female-headed households surveyed

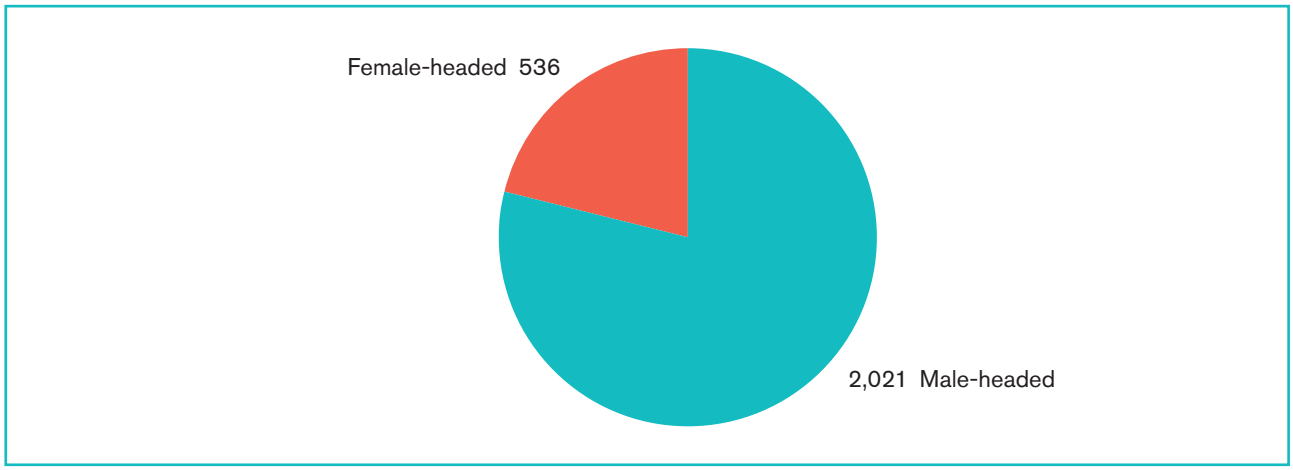


Table 17. Other disaster action by district

VARIABLES	BAGERHAT	BARGUNA	GAIBANDHA	JAMALPUR	KHAGRACHARI	KURIGRAM	MOULVIBAZAR	MYMENSINGH	NOAKHALI	SATKHIRA
Agricultural lands	5.39	1.41	1.74	0	9.29	0.299	1.56	1.43	4.58	1.89
Household materials	5.05	1.41	3.48	0	0	1.2	0	0	4.23	0
Birds/ animals	24.6	1.41	16.5	4.88	8.81	1.5	2.34	0	12.7	4.72
Others	4.38	0.352	2.61	0.813	1.19	0	0	0.476	3.52	0.943
No. of obs.	297	284	115	123	420	334	384	210	284	106

Notes. Author's calculation based on UNDP climate expenditure survey.

Spend on other disasters

Table 18 and Figures 7a and 7b present expenditure on different protective actions undertaken by households affected by different slow-onset disasters, with 230 male-headed households and 46 female-headed households surveyed. Altogether, a total of 276 households undertakes at least one protective measure at an average cost of BDT7,392 (US$92). This total spend varies considerably by gender: male-headed households spend almost twice that of female-headed households.

Table 18. Annual per-household spend on other slow-onset disasters, BDT

VARIABLES	OVERALL	MALE-HEADED HOUSEHOLDS	FEMALE-HEADED HOUSEHOLDS	FEMALE-MALE DIFFERENCE
Agricultural lands	7,175	7,028	8,164	1135.26
	(8,101)	(7,452)	(12,027)	
No. of obs.	*85*	*74*	*11*	
Household materials	5,005	5,022	4,917	105.21
	(6,959)	(6,493)	(9,847)	
No. of obs.	*38*	*32*	*6*	
Birds/ animals	5,258	5,832	2,462	-3370.16*
	(9,662)	(10,435)	(2,980)	
No. of obs.	*194*	*161*	*33*	
Others	6,286	7,767	1,288	6479.17
	(9,977)	(10,937)	(1,487)	
No. of obs.	*35*	*27*	*8*	
Total spend	7,392	7,954	4,583	3370.65*
	(10,759)	(11,072)	(8,595)	
No. of obs.	*276*	*230*	*46*	

Notes. Author's calculation based on UNDP climate expenditure survey. Male-female differences are calculated as the differences between average expenditures for male-headed and female-headed households. ***, ** and * represent statistical significance at 1%, 5% and 10% levels, respectively.

Figure 7a. Amount spent on protective action by households affected by different slow-onset disasters

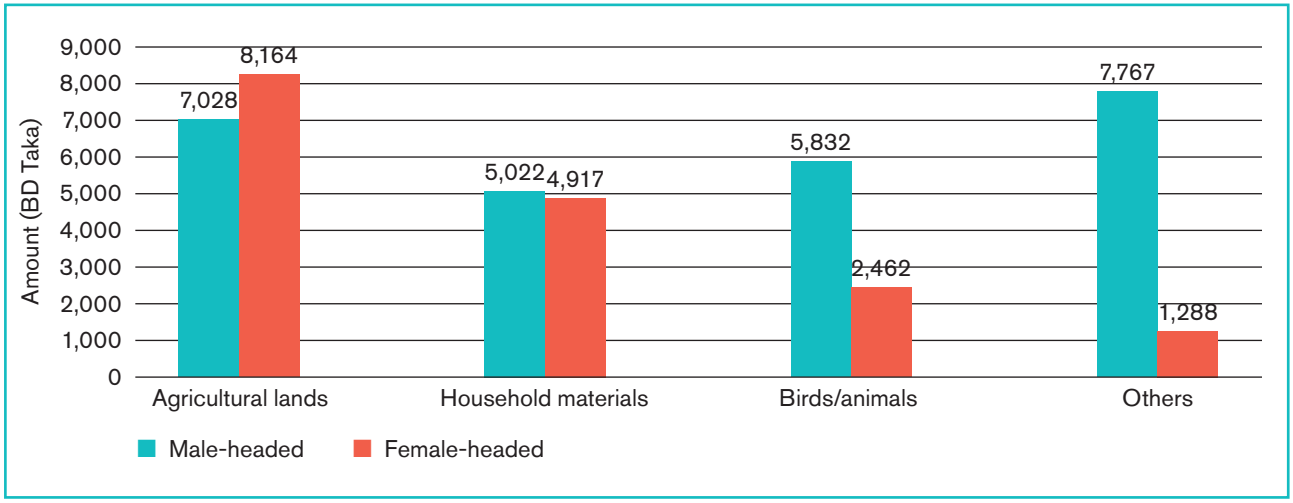


Figure 7b. Ratio of male- to female-headed households surveyed

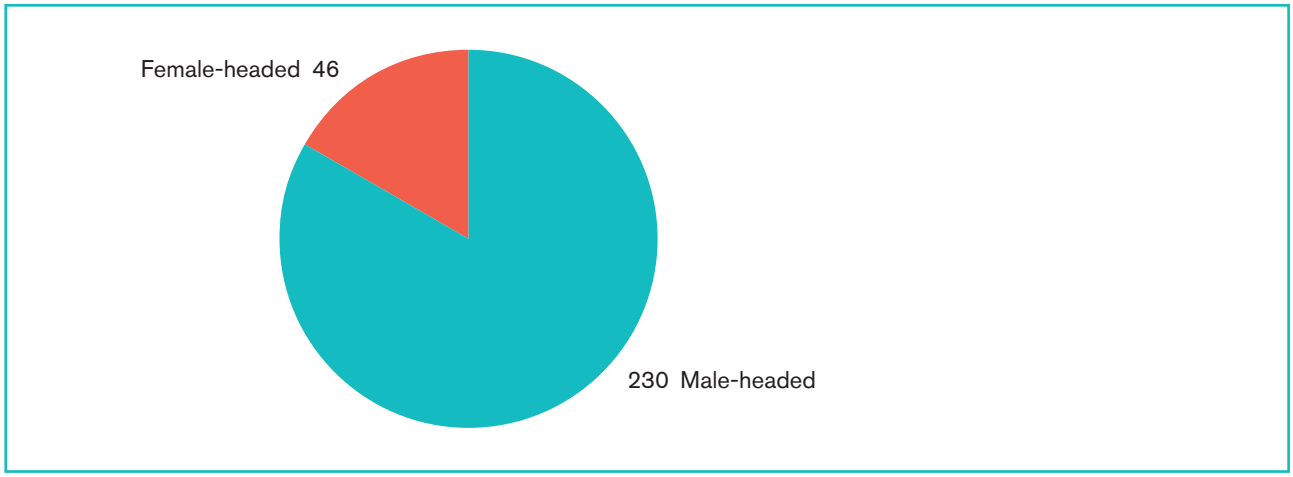


Table 19 presents spend on other disasters by district.

Table 19. Annual per-household spend on other disasters by district, BDT

VARIABLES	BAGERHAT	BARGUNA	GAIBANDHA	JAMALPUR	KHAGRACHARI	KURIGRAM	MOULVIBAZAR	MYMENSINGH	NOAKHALI	SATKHIRA
Agricultural lands	8,812	1,250	1,750		6,936	2,000	5,517	8,000	10,577	650
	(7,780)	(645.5)	(353.6)		(8,191)		(7,999)	(2,828)	(10,004)	(495.0)
No. of obs.	*16*	*4*	*2*		*39*	*1*	*6*	*2*	*13*	*2*
Household materials	5,333	2,167	900			2,900			7,375	
	(8,140)	(2,466)	(522.8)			(1,763)			(7,767)	
No. of obs.	*15*	*3*	*4*			*4*			*12*	
Birds/ animals	6,121	2,750	1,205	2,255	4,119	1,620	12,778		5,175	12,820
	(8,781)	(1,708)	(875.9)	(2,889)	(3,993)	(1,256)	(27,889)		(6,464)	(26,381)
No. of obs.	*73*	*4*	*19*	*6*	*37*	*5*	*9*		*36*	*5*
Others	2,992	30,000	933.3	500	12,400			300	8,350	2,000
	(2,800)		(513.2)		(6,542)				(14,952)	
No. of obs.	*13*	*1*	*3*	*1*	*5*			*1*	*10*	*1*
Total spend	7,599	5,833	1,562	2,338	7,577	3,100	10,579	5,433	9,535	9,629
	(9,500)	(12,178)	(1,213)	(2,852)	(9,007)	(2,861)	(22,580)	(4,875)	(10,866)	(22,233)
No. of obs.	*93*	*9*	*21*	*6*	*64*	*7*	*14*	*3*	*52*	*7*

Notes. Author's calculation based on UNDP climate expenditure survey.

9

Additional burden for females

Females tend to care more about reducing damage from climate-related disasters, apparent from their greater participation in protective measures. But in almost all cases, the female-headed households are poorer, and due to their limited financial capacity, they cannot spend at the same level as male-headed households. However, consistent with Eskander and Steele (2019), female-headed households spend a greater share of their income on climate adaptation. There can be alternative explanations, however, lower income together with minimum required levels of adaptation financing and women's caring roles in the family can be among the reasons behind this phenomenon (eg Crick et al., 2018; Codjoe et al., 2012).

Table 20 presents the total spend on adaptive measures to reduce damage from flood, storm and other disasters by gender of the household head. Figure 8 gives a graphical representation of this, showing the expenditure as a percentage of annual household income. Flood-affected male- and female-headed households spend 16.41% and 18.42% of their annual income on average, respectively. Figures for storm-affected households are 10.32% and 40.99%, respectively; whereas those for other disasters are 7.81% and 10.61%, respectively.

However, the high standard deviation implies that some households outspend their income, and they might debt-finance their adaptation expenditure.

Figure 8. Disaster spend as a percentage of annual household income and expenditure

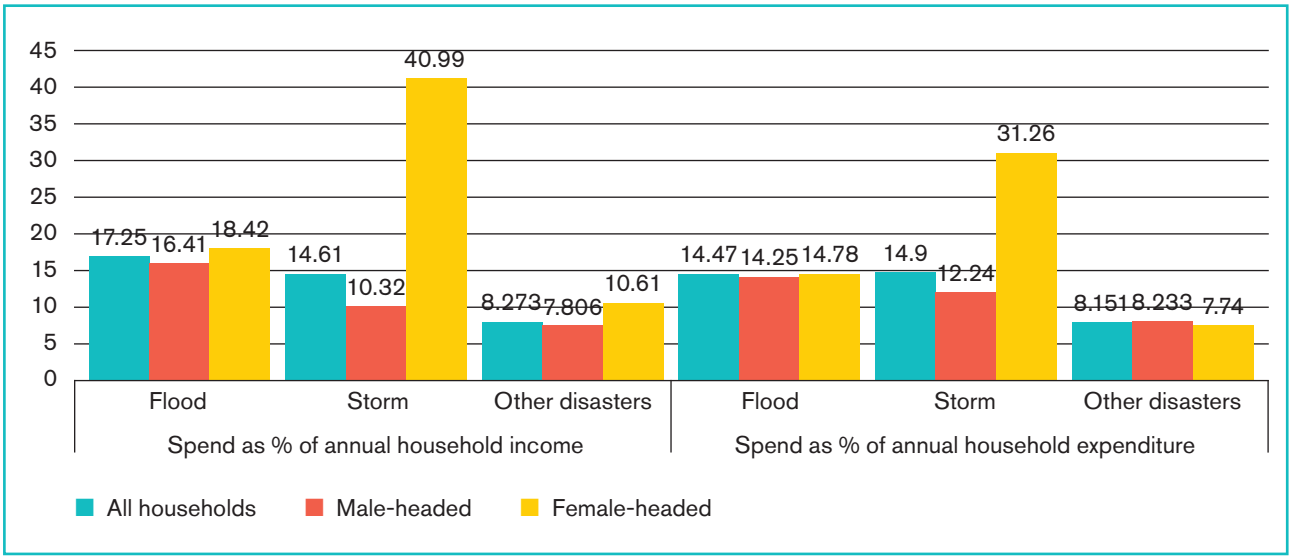


Table 20. Disaster spend as a percentage of annual household income

	SPEND AS % OF ANNUAL HOUSEHOLD INCOME			SPEND AS % OF ANNUAL HOUSEHOLD EXPENDITURE		
VARIABLES	FLOOD	STORM	OTHER DISASTERS	FLOOD	STORM	OTHER DISASTERS
All households	17.25	14.61	8.273	14.47	14.90	8.151
	(55.07)	(52.18)	(23.42)	(38.90)	(47.74)	(10.77)
Male-headed households	16.41	10.32	7.806	14.25	12.24	8.233
	(41.26)	(20.66)	(22.78)	(18.33)	(16.61)	(10.76)
Female-headed households	18.42	40.99	10.61	14.78	31.26	7.740
	(69.95)	(127.7)	(26.51)	(56.26)	(120.8)	(10.93)
Difference (Female – male)	2.01	30.67***	2.80	0.53	19.02**	-0.493
No. of male-headed households	315	295	230	317	296	230
No. of female-headed households	227	48	46	227	48	46

Notes. Author's calculation based on UNDP climate expenditure survey. Male-female differences are calculated as the differences between average burden for female-headed and male-headed households. ***, ** and * represent statistical significance at 1%, 5% and 10% levels, respectively.

On average, female-headed households spend a higher share of their income than male-headed households on adapting to exposure to different types of disaster. Although the differences are small and statistically insignificant for flood and other disasters, the female-headed households spend 2.01 more percentage points on flood protection measures and 2.80 more percentage points on protection from other disasters. On the other hand, they spend 30.67 more percentage points on the share of income on storm protection.

There are multiple potential reasons why women allocate a greater share of their household incomes to disaster preparedness. Related literature has emphasised that social relations define roles and access to resources differently for men and women (Nyukuri, 2016; Omolo, 2010), therefore resulting in differences in adaptation behaviour and preferences by gender (Codjoe et al., 2012; Djoudi and Brockhaus, 2011; Jost et al., 2015). In fact, while their lower adaptive capacity hinders their participation in adaptation practices (eg Crick et al., 2018), women's traditional role as providers of household food and water security influences the greater effort of those who are actively participating (eg Codjoe et al., 2012).

10

Regression analysis: determinants

We began an econometric investigation by identifying how important factors such as expenditure, gender of the household head, and diversity in income affect participation in and the volume of disaster spend. In doing so, we controlled for regional heterogeneity (through upazila fixed effects), education levels, household size, land ownership, and ownership of important assets (eg tractor or plough-yoke, and homestead).

Participation decisions

Our discussion so far clearly indicates that disaster-affected households have significant variabilities in their participation in risk reduction activities. However, identifying causal relationship requires econometric investigation controlling for other important factors. Therefore, we employ:

$$f_i = \alpha_0 + \alpha_1 \ln expend_i + \alpha_2 female_i + \alpha_3 HHI_i + \delta X' + \rho_p + \epsilon_i,$$

where the outcome variable f_i takes the value 1 if the household participates in disaster risk reduction activities and 0 if not for household i. We are interested in its relationship with ln $expend_i$ (ie natural log of annual total expenditure, which is calculated as the average over two reporting years), $female_i$ (an indicator variable for gender: 1 if female-headed household and 0 if male-headed household), and HHI_i (Herfindahl-Hirschman Index (HHI) provides a measure of diversity in income, calculated as the sum of squared share of each source of income so that the value ranges between 0 and 1 where 0 implies complete diversity and 1 implies no diversity).

Control variables in the vector X' include some household-level attributes from the last year, ie the earliest data available from the survey, to control for base year characteristics of the surveyed households. In particular, we control for household size (ie number of members in the household in the last year), land ownership (ie acres of lands owned), education levels, ownership of tractor or plough-yoke, and ownership of homestead. Finally, inclusion of upazila fixed effects is necessary to control for unobserved location-specific heterogeneity.

We adopted a linear probability model (LPM) with robust standard errors to control for heteroscedasticity associated with binary dependent variable. The advantage of an LPM model is that the estimated coefficients are directly interpreted as marginal effects, which is our main interest. We were particularly interested the estimated coefficients α_1, α_2, and α_3.

Table 21 presents the results of participation decisions in risk reduction activities related to flood, storm, and other disasters. We absorb fixed effects for upazila, education levels, ownership of tractor or plough-yoke, and ownership of homestead, which are not presented here.

Table 21. Participation decisions

VARIABLES	FLOOD	STORM	OTHER DISASTERS
ln (expenditure)	-0.029	-0.039	-0.009
	(0.033)	(0.028)	(0.014)
Female household head	-0.081**	-0.048	-0.013
	(0.037)	(0.039)	(0.018)
Diversity in income	0.044	0.046	0.034
	(0.113)	(0.086)	(0.047)
Household size	0.001	-0.001	-0.002
	(0.008)	(0.007)	(0.003)
Land ownership	-0.008	-0.029	0.010
	(0.021)	(0.025)	(0.010)
Constant	0.766**	0.731**	0.224
	(0.368)	(0.313)	(0.151)
Observations	1,270	1,226	2,474
R-squared	0.334	0.335	0.301

Notes: Robust standard errors are shown in parentheses. ***, ** and * represent statistical significance at 1%, 5% and 10% levels, respectively.

We did not identify many significant effects on participation decisions, however, both expenditure and gender have negative influences. Therefore, conditional on household-level attributes, households with higher expenditure and female-headed households are less inclined to participate in disaster risk reduction activities.

Spend as percentage share

We applied a Poisson pseudo-maximum likelihood (PPML) estimation strategy to investigate the determinants of spend as a share of income. The PPML model estimates a Poisson regression by pseudo-maximum likelihood to identify and drop regressors that may cause the nonexistence of the pseudo-maximum likelihood estimates (Santos Silva and Tenreyro, 2006; 2010). Based on the maximum-likelihood estimation method, PPML can be used for any kind of outcome variable, provided that the mean function is correct (Wooldridge, 1999). The specification is:

$$y_i = \alpha_0 + \alpha_1 \ln expend_i + \alpha_2 female_i + \alpha_3 HHI_i + \delta X' + \rho_p + \epsilon_i,$$

where the outcome variable is the share of income spent on disaster risk reduction actions by household . All other variables follow the definitions that have already been described.

Table 22. Spend as percentage of income

VARIABLES	FLOOD	STORM	OTHER DISASTERS
Ln (expenditure)	-0.525**	-0.965***	-0.350
	(0.215)	(0.224)	(0.235)
Female household head	0.425	0.761*	0.298
	(0.407)	(0.430)	(0.436)
Concentration of the sources of income	2.799***	2.254***	2.585***
	(0.559)	(0.818)	(0.837)
Household size	0.088	-0.070	-0.171*
	(0.055)	(0.060)	(0.092)
Land ownership	-0.463	-0.375	-0.237
	(0.398)	(0.311)	(0.243)
Constant	8.077***	13.467***	6.192**
	(2.337)	(2.541)	(2.618)
Observations	1,110	941	1,282

Notes: Robust standard errors are shown in parentheses. ***, ** and * represent statistical significance at 1%, 5% and 10% levels, respectively.

The estimated coefficient for expenditure can be interpreted as the expenditure elasticity of spend share. Results confirm that more affluent households spend a lower share of their total expenditure on disaster risk reduction activities. In particular, households with 10% higher (lower) total expenditure have lower (higher) flood, storm, and other disaster related risk reduction spends by 5.25%, 9.65%, and 3.50%, respectively. Extreme climate events affect rural households alike, irrespective of their income levels. While the richer households may spend a lower share of their incomes on disaster risk reduction and management, relatively poorer households allocate a larger share of their incomes to necessary protection against the impacts of disaster using private costs.

Consistent with literature (eg Eskander and Steele, 2019) and our earlier findings in Chapter 9, female-headed households allocate a larger share of their total income for disaster risk reduction related activities. While all the affected households need to spend a critical minimum amount in disaster preparedness, lower income results in female-headed households spending less in absolute terms but more in percentage share of their incomes on disaster preparedness. In particular, while their additional burdens are statistically insignificant for floods and other disasters, they allocate a significantly higher share of their incomes on privately funded storm protection action than male-headed households. These results indicate the additional vulnerability of female-headed households and the unequal burden that they bear in the wake of a disaster.

In addition, we found that households with concentrated incomes allocate a higher share of their incomes on disaster spend. This justifies the notion that diversification is necessary to withstand disaster risks, since those with greater income diversification spend less of their incomes on disaster risk reduction and management. Since different ministries and departments of the government of Bangladesh have their own programmes and funding for reducing disaster risks, better coordination aimed at achieving income diversification can reduce the vulnerability of the livelihood options for the communities at risk. Any disaster risk reduction initiatives in future need to address this suggestion.

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Tropical storms, cyclones and monsoon floods are recurring events in Bangladesh, but are becoming more frequent and more severe with climate change. The study assesses the percentage of climate expenditure as a share of household income and expenditure in climate-vulnerable regions of Bangladesh, based on primary data. In particular, it investigates disaster and climate adaptation expenditure by rural households; the socioeconomic factors influencing disaster and climate adaptation expenditure; income shares of disaster and climate adaptation expenditure; and gendered differences in this expenditure. This study updates a 2019 review by IIED which used secondary data, and finds similar estimates of total rural household level expenditure.

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