Capturing the effectiveness of Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA) interventions of SHOUHARDO III

Written by
Muhammad Abdur Rahaman
Mia Abdur Rashid
Zereen Saba

Review
Zinat Ara Afroze, Senior Team Leader-Knowledge Management, Research & Learning SHOUHARDO III, CARE Bangladesh

Md. Rafiqul Islam, Team Leader, DRR & Resilience SHOUHARDO III, CARE Bangladesh

"This report is made public with support from the U.S. Agency for International Development (USAID). The author's views in this publication do not necessarily reflect the views of Care Bangladesh, USAID or the Government of the United States of America"

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF MAPS

LIST OF TABLES

ACRONYMS

AWD	Alternate Wet and Dry
BBS	Bangladesh Bureau of Statistics
BDT	Bangladesh Taka
BMD	Bangladesh Meteorological Department
BWDB	Bangladesh Water Development Board
CCA	Climate Change Adaptation
CCAM	Climate Change Adaptation and Mitigation
CRA	Community Risk Assessment
CLF	Community Level Facilitator
DAE	Department of Agriculture Extension
DCRM	Disaster and Climate Risk Management
DDM	Department of Disaster Management
DPHE	Department of Public Health Engineering
DRR	Disaster Risk Reduction
DRRO	District Relief and Rehabilitation Officer
EW	Early Warning
ESDO	Eco-Social Development Organization
FFWC	Flood Forecasting and Warning Center
FGD	Focus Group Discussion
FY	Fiscal Year
GDP	Gross Domestic Product
GCRI	Global Climate Risk Index
HHS	Household Survey
HYV	High Yielding Variety
IGA	Income Generating Activities
IPCC	Intergovernmental Panel on Climate Change
KII	Key Informant Interview
KM	Kilometre
LGED	Local Government Engineering Department
LGI	Local Government Institution
LSP	Local Service Provider
MJSKS	Mahideb Jubo Somaj Kallayan Somity
NDP	National Development Programme
NGO	Non-government Organization
PEP	Poor and Extreme Poor
PID	Pelvic Inflammatory Disease
PIO	Project Implementation Officer
POPI	People's Oriented Programme Implementation
PWD	Person with Disability
RCC	Reinforced Cement Concrete
RIMES	Regional Integrated Multi-Hazard Early Warning System
SAAO	Sub Assistant Agriculture Officer
SBTB	School-Based Teenage Brigade
SHOUHARDO	Strengthening Household Ability to Respond to Development Opportunities
SKS	Samaj Kallyan Sangstha

SSN	Social Safety Net
UDMC	Union Disaster Management Committee
UDV	Union Disaster Volunteer
UHC	Upazila Health Complex
UISC	Union Information Service Center
UP	Union Parishad
USD	United States Dollar
UTI	Urinary Tract Infection
UzDMC	Upazila Disaster Management Committee
VDC	Village Development Committee
VSLA	Village Savings and Loan Association
WASH	Water Sanitation and Hygiene

EXECUTIVE SUMMARY

“Strengthening Household Ability to Respond to Development Opportunities” (SHOUHARDO III) is a program that has been operating since 2015 in eight districts of the Haor and Char regions in Bangladesh (Kurigram, Gaibandha, Sirajganj, Jamalpur, Kishoreganj, Netrokona, Habiganj, and Sunamganj). This study evaluates the program’s impact on strengthening communities in these regions to overcome the worsening situation of disaster and climate change through Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA) activities.

All of the studied districts are environmentally vulnerable to floods. Particularly, the district of Sunamganj is highly susceptible to flash floods, and the districts of Kurigram, Gaibandha, and Sirajganj are vulnerable to monsoon floods. Additionally, although hailstorms are not yet recognized as hazardous, the damage caused by hailstorm and lightning is increasing in the Haor region. Similarly, strong winds and sandstorms are causing damage in the Char region.

Moreover, the study respondents fall under the poor and extreme poor (PEP) category. The per capita monthly income in both regions ($119.33 USD in Char and $137.84 USD in Haor) is lower than the national monthly per capita income ($140 USD). Most of the people in the studied area depend on multiple income-generating activities.

At the household level, women and children were found the most vulnerable to disaster. At the community level, farmers and laborers are more susceptible to climate-induced disasters than any other occupation.

All economic activities, including agricultural production, livestock, and poultry production are impacted by disasters, which affects food security and employment rates in communities. Physical, mental, and reproductive health problems and disabilities are increasing, and disaster-induced displacement is evident in all eight districts. Women are particularly affected by disaster, with increasing trends of women who are abandoned by their husbands, gender-based violence, and rising school dropout rates among females. In both the Char and Haor districts, sanitation systems collapse during disasters.

In response to the increasing challenges of climate change, SHOUHARDO III has implemented interventions to improve lives and livelihoods in these regions. The program facilitates trainings, has introduced community-led Local Service Provider (LSP) and Community Level Facilitator (CLF) mechanism, provides early warnings and climate advisories, and supports the construction of climate-resilent infrastructure. These interventions are contributing to climate change adaptation, disaster resilience, and women empowerment.

The study found that almost all respondents (99%) of the studied population currently have an awareness of DRR, however, this number was much lower (17.8%) before the SHOUHARDO III intervention. According to respondents, DRR refers to a preparedness to reduce disaster loss and damage, being able to save livestock and

poultry during emergency periods, and having access to flood and drought-tolerant crop varieties. It also signifies having access to relief and disaster information, being able to access government services for disaster management, ensuring savings to use during and after disaster periods, having accessible and safe disaster-resilient infrastructure, and involving in sustainable income-generating opportunities.

Among the SHOUHARDO III beneficiaries, 96.6% of respondents reported practicing disaster coping strategies. The majority of those that practice coping strategies, (66%) reported implementing positive coping strategies, such as taking out loans from Village Savings and Loan Associations (VSLA), maintaining risk recovery savings, and preserving dry food for crisis periods. However, 30.6% of respondents reported that they practice negative techniques, such as reducing food intake, decreasing child education costs, taking out high-interest loans, and reducing costs by not seeking treatment for health issues.

Although most study respondents reported that they are currently aware of DRR, their disaster preparedness, capacity, and awareness were low before the program implementation. Only 32% of respondents practiced preparedness activities before SHOUHARDO III, this amount has now increased to 95%. The most notable preparedness activities are preserving dry food, saving money for the emergency periods, securing Water, Sanitation, and Hygiene (WASH) infrastructure, storing drinking water, and storing emergency first aid supplies.

DRR leaders are key agents in disseminating disaster information and climate advisories at the community level, which has increased the studied population's preparedness capacity. Along with DRR leaders and religious leaders, Union Disaster Volunteers (UDV) are highly important actors in disseminating early warning and climate advisory messages. These services have reduced disaster-induced loss, increased agricultural production (crops and livestock), and decreased the human health burden caused by climatic extremes. Early warnings and climate advisory services have also reduced human, livestock, and poultry death tolls.

DRR and CCA capacity building initiatives (i.e., trainings, community awareness sessions, and the formation of DRR leaders) have actively contributed to enhancing community preparedness. Currently, 67% of SHOUHARDO III beneficiaries practice climate-smart agriculture, compared to only 6.6% before program intervention. Climate-smart agricultural practices include homestead gardening, homestead livestock and poultry rearing, sack farming, inter-cropping and third cropping, and floating bed farming. Beneficiairies also have access to climate-resilient seeds and seedlings.[1] Climate-smart agricultural practices have positively impacted people's financial situations and well-being. Household income and emergency savings have increased, which in turn increases purchasing capacity and stimulates the community economy. Additionally, climate-resilient activities empower women to involve in decision-making at the household level. The study found that women's decision-making capacity has increased (94.4%) compared to before the SHOUHARDO III intervention. As a result of increased household income, 73.8% of respondents

[1] Seeds and seedlings that are climate resistant can endure the harsh climatic circumstances brought on by a changing environment. These seeds may be resistant to disease and pests, drought and flooding, and both.

reported using their income to build a savings, and 77% reported that they are engaged with a VSLA. Generally, the study found that participants invest their savings in building and repairing disaster-resilient houses.

As a result of the SHOUHARDO III interventions, 62.4% of the population in the study areas now has access to disaster-resilient infrastructure, including raised plinths, protection mounds, and school cum flood shelters. Plinth raising at the household level is an effective disaster-resilient intervention, and under SHOUHARDO III, 681 household plinths were raised. Community members continue raising plinths without the program's aid due to their effectiveness and sustainability. Other disaster-resilient infrastructure interventions include brick mound protection walls and school cum flood shelters. Brick mound protection walls are effective for disaster resiliency, and 100% of study respondents (59% from the Haor region) expressed satisfaction with these walls as protection from flash floods. School cum flood shelters are also sustainable and flood-resilient. However, there is currently not enough space for vulnerable community members, who must take shelter with their utensils, livestock, and poultry during floods.

The study found that implementing climate-smart and disaster-resilient practices reduced climate-induced losses for 71.65% of respondents. The following shows the calculated decreased production loss for each household due to these practices. On average, crop and vegetable production loss decreased by 17.6 kg and 16 kg per decimal, respectively. Cattle production loss decreased by an average of 1.17 per year; goat production loss decreased by an average of 1.28 per year; sheep production loss decreased by an average of 1.12 per year, and poultry production loss decreased by an average of 6.32 per year. By reducing the amount of losses, the yearly household income loss also decreased, detailed as follows. Average decreased income loss from decreased crop production loss totalled USD 5.42 per year; for vegetable production, it totalled USD 8.09 per year; for cattle farming, it totalled USD 354.06 per year; for goat and sheep farming, it totalled USD 73.98 and USD 3.53 per year, respectively; and from hen and duck production it totalled to USD 21.66 per year. Finally, the decreased production loss totalled an average of USD 466.74 per year for each household through climate-smart practices.

Table 1: Decreased Production loss due to climate-smart and disaster resilient practises

Crop production loss decrease (Kg/ decimal)	Vegetable production loss decreases (Kg/ decimal)	Cattle production loss (Number/ Year)	Goat production loss decreases (Number/ Year)	Sheep production loss (Number/ Year)	Poultry production loss (Number/ Year)
17.6	16	1.17	1.28	1.12	6.32

Table 2: Average decreased income loss due to climate-smart and disaster resilient practises

Average decreased income loss from reduced crop production loss (USD/Year)	Average decreased income loss from decreased Vegetable production loss (USD/Year)	Average decreased income loss from Cattle production loss (USD/Year)	Average reduced income loss from Goat production loss (USD/Year)	Average decreased income loss from Sheep production loss (USD/Year)	Average reduced income loss from hen and duck production loss (USD/year)
$5.42	$8.09	$354.06	$73.98	$3.53	$21.66

SHOUHARDO III developed LSPs to provide essential services to community members. LSPs include micro-seed retailers, livestock vaccinators, Sanchay Sathis, and more. The program also developed CLFs, including DRR and Village Development Committee (VDC) leaders, to promote climate- and disaster-resilient communities. CLF activities include disseminating relevant disaster awareness information, capacity building, review of community risk reduction and adaptation contingency plans, linkage development with Local Government Institutions (LGI), and identification of safe places for shelter during a disaster. The LSPs and CLFs provide their communities with climate advisories and early warnings to attain services before, during, and after the disaster. The LSP and CLF service models are innovative and effective models to ensure communities' climate adaptation and disaster resilience.

SHOUHARDO III has empowered women to participate in DRR and CCA activities through ensuring their access to finance through Income Generating Activities (IGA), access to technology, and access to government support systems. The study found that household income increased when women adopted climate-smart practices, such as homestead gardening, sack farming, and livestock and poultry rearing. The adoption of mobile technology had a remarkable contribution to household and community resilience as it allowed women to receive early warnings and climate advisories. Additionally, women's involvement with VSLAs strengthened their economic capacity and disaster risk management. Women were also empowered in decision-making at household and community levels through access to LGIs and the Union Disaster Management Committee (UDMC). The study found that women are involved with decision-making with savings for disaster risk management (87%), preserving food for the emergency period (86%), decision-making for taking shelter (83%), and receiving training on disaster management (58%).

SHOUHARDO III increased communities' access to the UDMC, government social safety net (SSN), state-owned cultivable land, and government services. Before SHOUHARDO III, disaster-vulnerable households received very little support from government agencies, but now 86.7% have access to this support. Additionally, due to the program's intervention, currently 89.7% of beneficiaries of Char and 79.2% of Haor receive support from SSN packages. UDMC participation has notably increased

in community DRR planning, and 63% of the UDMC consists of beneficiaries from SHOUHARDO III, with 65.4% of them from Haor, and 62% from Char.

Before SHOUHARDO III, only a small percentage of people had access to government officers, including the Department of Agriculture Extension (DAE), Department of Public Health Engineering (DPHE), and the Upazila Health Complex (UHC). After the SHOUHARDO III intervention, communities report having access to these government offices, with notable support (97.1%) from government offices (DAE, DPHE, UHC). Before SHOUHARDO III, 82% of the community members did not receive any disaster preparedness, rescue, and rehabilitation services, and now, 68% report receiving support from different agencies, including the government support system. Government organizations and LGIs are notably responsive to disasters to reduce the vulnerabilities of PEP households,

Disaster and climate resilience in the community is achieved through community resilience, institutional resilience, financial resilience, and infrastructural resilience. SHOUHARDO III covered almost all four of these components that are crucial for resilient communities, however, there are certain key points that should be addressed in the future, which are as follows:

- Plot-to-plot (farmers' land, village, or union) specific early warning and climate advisory development and promotion
- Sustainability of local-level DRR mechanisms
- Women and adolescent-friendly flood shelters

1. INTRODUCTION

Climate change has recently been receiving significant attention from development professionals and political figures. Due to it's geographic location, Bangladesh is one of the world's most susceptible nations to the effects of climate change. Bangladesh is the seventh most climate change-affected country in the world, according to the Global Climate Risk Index 2020 and the Intergovernmental Panel on Climate Change (IPCC) 2011 reports. (Islam, 2021) Bangladesh experiences the effects of climate change through a variety of natural disasters, including frequent floods, cyclones, thunderstorms, torrential rain, saline intrusion, rising temperatures, precipitation, rising sea levels, and variations in cyclone intensity, timings, and path (Sattar et al., 2020). Bangladesh has experienced at least one big disaster each year, and over the past ten years, the nation has lost a yearly average of 3.02% of its Gross Domestic Product (GDP) and maintains the highest disaster fatality rate in the world. (Mohammad & Huq, 2016) Large spherical floodplain depressions known as Haor frequently experience floods from extreme events like intense rainfall. Due to changes in rainfall and temperature patterns, these Haors are anticipated to undergo stress. (Hasan, 2014) Pre-monsoon flooding, which happens in April and May, is a risk to the Haor region's economic, social, and environmental sectors and results in the loss of crops throughout the entire year. (Suman & Bhattacharya, 2015) In northern Bangladesh, especially along the Jamuna and Teesta basin, monsoon floods, riverbank erosion, and other climatic catastrophes commonly afflict Char communities, making them susceptible to losing their sources of income and possessions. (Al Mamun et al., 2022) Natural disasters deprive Char people of the same possibilities for economic and social benefits that mainland residents enjoy, and harm the communication infrastructure. (Alam et al., 2017) Char communities have very little access to services provided by the public and private sectors, such as banking, healthcare, education, and law enforcement. (Kabir, 2006) On the island of Chilmari in the Kurigram district, there is only one primary school and one madrasah (Islamic school). Most Chilmari residents are illiterate and can hardly write their names, depriving the Char community of even the most fundamental education. (Samsuzzaman, 2018)

2. BACKGROUND OF THE STUDY

According to the Fifth Assessment Report of IPCC (2014), South Asia's climate is changing, and the impacts are already being felt. Bangladesh is a low-lying delta region formed at the junction of the Ganges and Brahmaputra River systems. It is considered the world's largest delta with a riverine country that is highly vulnerable to climate and weather-related hazards due to its topography and geographical location. The country has long been exposed to various climatological (i.e., drought), hydrometeorological (i.e., cyclones, storm surge, flood), and other geophysical (i.e., landslides and erosion) hazards. Its funnel-shaped southern coast makes it susceptible to cyclones and storm surges, high soil salinity levels, and rising sea-levels. (Reliefweb, 2021) According to the Global Climate Risk Index (GCRI), Bangladesh ranked 9th on the list of the 10 most affected countries and placed 7th on

the long-term (1998-2017) risk index because of extreme climatic events. (Eckstein et al., 2020) Haor, Char and the coastal belt of Bangladesh are the most vulnerable areas of the country. Nearly every year, flooding occurs in the Haor and Char regions. Additionally, in 2020, a widespread flood in the northwestern and eastern parts of Bangladesh led to the loss of crops, livestock, shelter, and employment opportunities, significantly impacting overall livelihoods and income, especially for PEP. The most marginalized people have also struggled in the face of river erosion, cold waves, droughts, and intense bouts of rainfall.

SHOUHARDO III is a USAID Resilience Food Security Activity program that has run since 2015 and is led by CARE Bangladesh. The program covers eight districts (Kurigram, Gaibandha, Sirajganj, Jamalpur, Kishoreganj, Netrokona, Habiganj, and Sunamganj), 23 Upazila (sub-districts), 115 unions, and 947 villages in Bangladesh's Char and Haor areas. (**Map 1**, page 18) The program covers a total of 725,611 participant from 170,298 vulnerable families. To ensure a long-term impact on the lives of PEPs, CARE Bangladesh has been granted a two-year extension period for long-term sustainability through Fiscal Year (FY) 2022. The SHOUHARDO III Program supports community members directly in disaster preparedness, risk mitigation, and risk reduction activities through interventions to improve climate-resilient livelihoods for PEP households, improve DRR strategies for families, communities, and local government, increase civil society and government institutions' DRR and CCA capacities, improve gender equitable food security, nutrition, and resilience, and increased advocacy. The program's most significant interventions are 1) building the DRR and CCA capacity of UDVs, Community Level Leaders, LSPs, Religious Leaders, households, communities, and other groups, (2) establishing a system for the community-wide dissemination of early warnings and weather information, (3) construction of women-friendly disaster resilient infrastructure, (4) promotion of climate-smart technologies, and (5) capacity building of UDMCs and Upazila Disaster Management Committees (UzDMCs).

3. OBJECTIVES OF THE STUDY

The overall objective of this study was to capture the effectiveness of the SHOUHARDO III program's capacity-building efforts, risk reduction, and contingency systems, CCA measures, and disaster-resilient infrastructure interventions within the lens of women's empowerment. The specific objectives of the study are as follows:

- To assess the contribution of DRR and CCA activities towards positive changes in households, communities, and institutions regarding risk reduction and adaptation procedures.
- To document the extent of women's capability in decision-making regarding DRR and CCA-related practices for risk identification and reduction in the communities.
- To assess the extent of SHOUHARDO III DRR and CCA activities to reduce the impacts of flooding and other shocks during the last six years.
- To assess the effectiveness and sustainability of the DRR infrastructure in mitigating flooding and other shocks.

- To assess the effectiveness and barriers of the program and market-based DRR and CCA outcomes, approach, interventions, and service models and the way forward to continue beyond the program period.
- To assess how USAID/BHA investment has saved lives and assets against flooding and other disasters in the working district.

4. STUDY METHODS AND LIMITATIONS

4.1. Study Methods

The study was conducted using a participatory and multi-disciplinary data collection and analysis approach. The study followed secondary and primary information collection, analysis, and blending. The secondary information was collected through **reviewing documents and strategies related** to the program, and primary information was collected using **participatory research to get data, perspectives, and knowledge** through Household Surveys (HHS), Key Informant Interviews (KII), and Focus Group Discussions (FGD). Three villages were selected purposively from each union of the program area. The household survey respondents were selected using the Probability Proportionate to Size (PPS) procedure from the list provided by CARE Bangladesh SHOUHARDO III management team.

4.1.1. Household Survey

The household sample size of this study was estimated within a 5% margin of error with a 95% confidence interval using design effect five (considering diversification in Char and Haor region, district, sub-district, union and village) as follows:

$$n = \frac{z^2.p.q.N}{e^2 (N-1) + z^2 p.q} XD$$

Where,

N = Size of population=725,611

n = Size of sample to be determined.

p = Proportion of the target population estimated to have a particular characteristic=0.5.

q = 1-p;

e = Margin error =5%.

z = Standard variant at a given confidence level=1.96.

D= Design effect= 5

Overall, the project beneficiaries (households) of the project are 725,611 (ToR, p. 1).

Using the formula mentioned above, the sample size was determined as 1,921. The study team distributed the sample over 343 villages (out of 947) using PPS. For simplification, sample size was rounded up to 2028 (Table 3). To ensure homogeneous distribution of a surveyed sample, the study team randomly selected

three villages from each union. As a result, the study team selected 344 villages (out of 947) from 115 unions.

Table 3: Household sample distribution

Region	District	Number of village	Total	Men	Women	Percentage of Male	Percentage of Female
Char	Kurigram	66	402	202	200	50.2%	49.8%
	Gaibandha	81	480	238	242	49.6%	50.4%
	Sirajganj	68*	390	196	194	50.3%	49.7%
	Jamalpur	33	198	100	98	50.5%	49.5%
Haor	Kishoreganj	30	168	57	111	33.9%	66.1%
	Netrokona	27	156	51	105	32.7%	67.3%
	Habiganj	18	108	41	67	38.0%	62.0%
	Sunamganj	21	126	42	84	33.3%	66.7%
	Total	**344**	**2028**	**927**	**1101**	**45.7%**	**54.3%**

*One village is missing due to river bank erosion.

The questionnaire survey was conducted with men, women, and youth participants using a mobile-based data collection app (Kobo). Two supervisors (one for the Char region and the other for the Haor region) were deployed during the field survey period to monitor data collection and ensure data quality. Supervisors checked 5% of the respondents as a spot check, and expert team members also rechecked 5% of the surveyed respondents (60% of each questionnaire) randomly over the telephone. No major misinformation was found in the spot check and back check except for spelling mistakes of respondents' names and villages.

4.1.2. Focus Group Discussions

FGDs were conducted with community people, including (both men and women) farmers, LSPs, and infrastructure beneficiary groups in the program area. A total of 41 (**Table 4**) FGDs were conducted by applying a checklist.

Table 4: List of FGDs

District	Upazila	FGD Participants			
		Male	Female	Mixed	Total
Sunamganj	Tahirpur	1 (5)	1 (5)	0	2 (10)
	Dowarabazar	1 (5)	1 (5)	0	2 (10)
Habiganj	Ajmeriganj	0	1 (5)	1 (M=2, F=3)	2 (10)
	Baniachang	1 (5)	1 (5)	0	2 (10)
Netrokona	Madan	1 (5)	1 (5)	0	2 (10)
	Khaliajuri	1 (5)	1 (5)	0	2 (10)
	Kalmakanda	1 (5)	1 (5)	0	2 (10)
Kishoreganj	Mithamain	0	0	1 (M=2, F=3)	1(5)
	Austagram	0	1 (5)	1 (M=2, F=3)	2 (10)

	Itna	1 (5)	1 (5)	0	2 (10)
	Nikli	0	0	1 (M=2, F=3)	1(5)
Kurigram	Nageshwari	1 (5)	1 (5)	0	2 (10)
	Phulbari	0	0	1	1
	Char Rajibpur	1 (5)	1 (5)	0	2 (10)
	Rajarhat	0	0	1 (M=2, F=3)	1(5)
Gaibandha	Fulchari	1 (5)	1 (5)	0	2 (10)
	Saghata	1 (5)	1 (5)	0	2 (10)
	Sundarganj	1 (5)	1 (5)	0	2 (10)
Jamalpur	Bakshiganj	0	0	1 (M=2, F=3)	1(5)
	Islampur	1 (5)	1 (5)	0	2 (10)
Sirajganj	Belkuchi	1 (5)	1 (5)	0	2 (10)
	Chouhali	1 (5)	1 (5)	0	2 (10)
	Shahjadpur	1 (5)	1 (5)	0	2 (10)
	Total	**16 (80)**	**18 (90)**	**7 (M=14, F=21)**	**41 (205)**

4.1.3. Key Informants Interviews

Key informant interviews were conducted with key stakeholders at the national and local levels. Stakeholders include the following: Care Bangladesh, the Department of Disaster Management (DDM), DAE, District Relief and Rehabilitation Officer (DRRO), Project Implementation Officer (PIO), Regional Integrated Multi-Hazard Early Warning System (RIMES), Flood Forecasting and Warning Center (FFWC), Bangladesh Meteorological Department (BMD). Project partners included Samaj Kallyan Sangstha (SKS) , Mahideb Jubo Somaj Kallayan Somity (MJSKS), Eco-Social Development Organization (ESDO), National Development Programme (NDP), and the People's Oriented Programme Implementation (POPI). Local stakeholders included VDC, UDMC, UDV, DRR leaders, and LSPs. A total of 52 KIIs (Table 5) were conducted locally and nationally.

Table 5: List of KII

District	KII Participants	Total
Sunamganj	DRRO, PIO, FFWC, UDMC, UDV, LSP, DRR Leader, VDC Leader	8
Habiganj	UDMC, UVD, LSP, DRR Leader, VDC Leader	5
Netrokona	UDMC, UDV, LSP, DRR Leader, VDC Leader	5
Kishoreganj	UDMC, UDV, LSP, DRR Leader, VDC Leader	5
Kurigram	DRRO, DD-DAE, PIO, FFWC, UDMC, LSP, Religious Leader, DRR Leader, VDC Leader	11
Gaibandha	PIO, UDMC, UDV, LSP, DRR Leader, VDC Leader	6
Jamalpur	UDMC, UDV, LSP, Religious Leader, DRR Leader	5
Sirajganj	UDMC, UDV, LSP, Religious Leader, DRR Leader	5
National Level	CARE Bangladesh (2), RIMES, BMD, DDM	5
	Total	**55**

4.2. Limitations of the Study

Early flood preparedness activities in the Char areas restricted the availability of respondents. The unavailability of male respondents also hampers equal allocation of FGD participants. Accessing respondents in isolated areas was not easy in some cases. Due to riverbank erosion, respondents from the Baykhola village of Jalalpur union under Shahajadpur Upazila of Sirajganj district were missed.

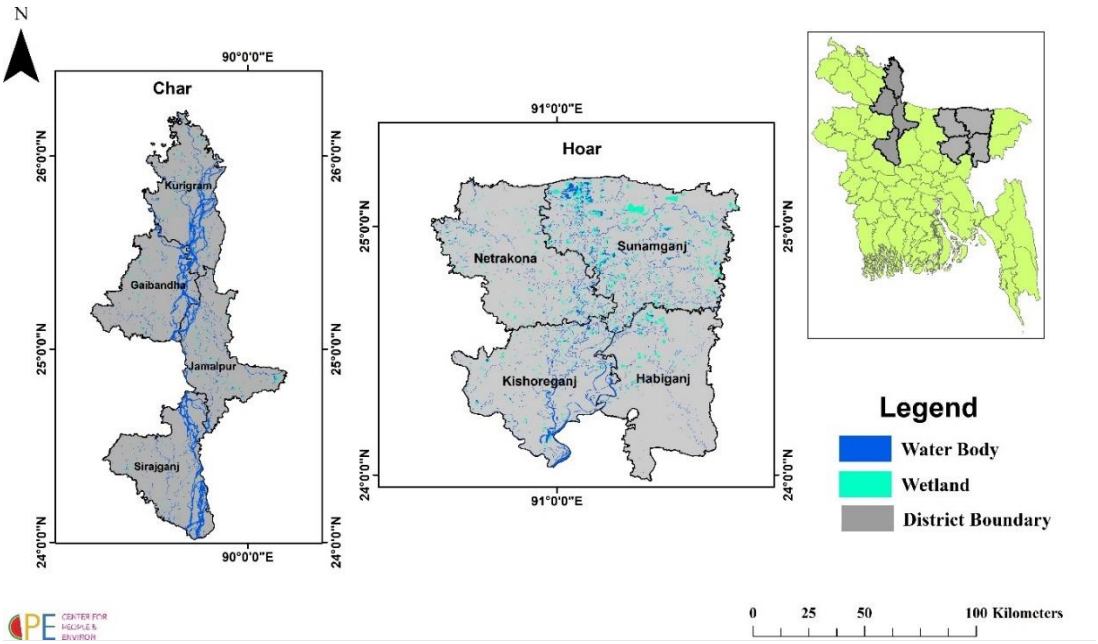
5. FINDINGS OF THE STUDY

5.1. Geophysical and Sociodemographic Characteristics

5.1.1 Study Area

The study was conducted in SHOUHARDO III implementing areas in Char and Haor regions. All eight districts (23 sub-districts) were covered from Char (Kurigram, Gaibandha, Jamalpur and Sirajganj) and Haor (Kishoreganj, Habiganj, Sunamganj and Netrakona) (**Map 1**).

Map 1: Study area



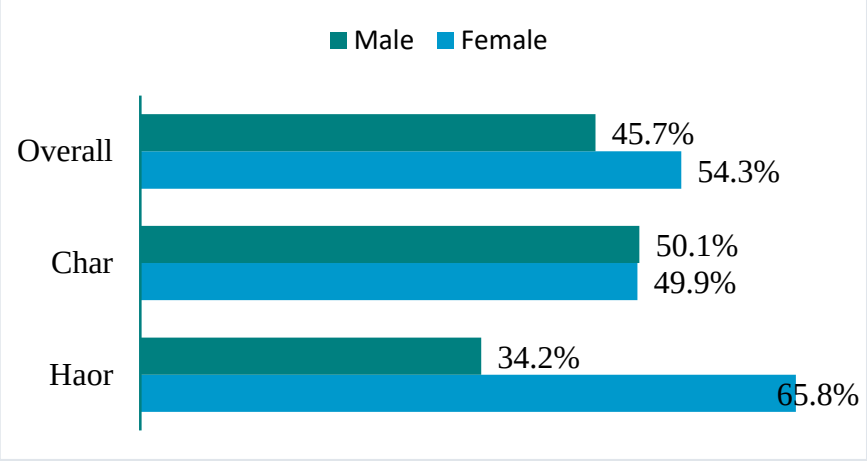
5.1.2. Studied Population Distribution by Gender and Region/District

The study covered 2,028 individuals who benefited from SHOUHARDO III interventions. The number of respondents from Char is 1,470 (72.5%), and Haor is 558 (27.5%). Among the studied households, 45.7% of respondents are male, and 54.3% are female. The number of villages under the program in Haor (363) is lower than in Char (584). Of these villages, 245 villages were from the Char, and 93 villages were from the Haor. The number of respondents in Haor was lower than from Char

because it was the harvest peak time and the possibility of early flood, male respondents in the study area were engaged with high crop harvesting in the Haor region. For this reason, the study covered only 31.6% of male respondents in the Haor region, which is lower than Char (50.1%). (**Figure 1**)

FGDs were conducted with mixed groups (male and female) because of the unavailability of male participants in the Ajmeriganj Upazila of Habiganj, Austagram Upazila of Kishorganj, Nikli Upazila of Kishorganj, Mithamain Upazila of Kishorganj, Taherpur Upazila of Sunamganj, and Khalijuri Upazila of Netrokona. In these FGDs, it was found that male family members were busy and engaged with crop harvesting.

Figure 1: Gender distribution of the participants



5.1.3. Household Income of the Respondents

Both regions' monthly income is lower than Bangladesh's national per capita income, which is $140, whereas the national monthly average is 235.33 USD (BBS, 2021). The average monthly income for Char and Haor regions is USD 119.33 and USD 137.84, respectively (Table 6, Figure 2). Compared with the national average, the Sunamganj, Kurigram, Kishorganj, Habiganj, and Gaibandha districts are considered under the poverty line. Asset loss is highest in the Char area because most of the studied population migrates due to river erosion, and there are fewer opportunities to participate in income-generating activities. The studied population recorded the lowest monthly income (USD 124.39) in Kurigram district, and the highest monthly income (USD 184.97) was recorded in Netrokona district.

“Almost yearly, we must migrate from one place to another because of riverbank erosion. As a result, we have to spend lots of money on house and asset repairments. We don’t have a permanent house, and the flood washes away our domestic assets, livestock, and utensils, which means that we must buy all new ones every year.” – FGD participants of Fulchari, Shahzadpur, Belkuchi, Chouhali, Char Rajibpur Upazila.

Figure 2: Average monthly income (USD) of the respondents

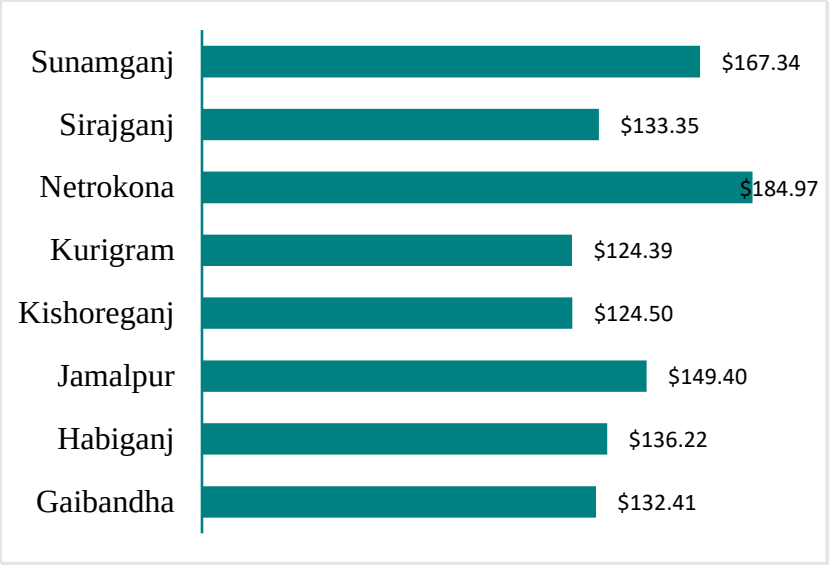


Table 6: Monthly income of the respondents'

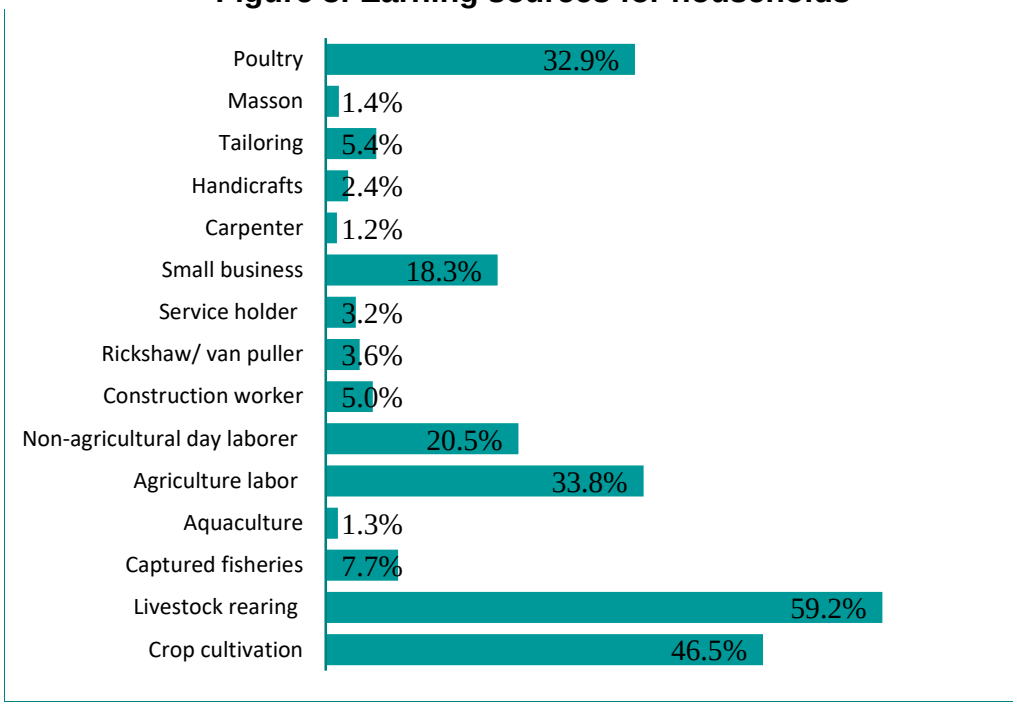
Mean Income	National Average	Char	Haor
BDT	12,460	10,620.85	12,268.10
USD	140	119.33	137.84

The study counted three income-generating activities that each respondent engaged in for at least three months to support their household. Figure 3 demonstrates that the primary income source was livestock rearing (59.2%) in the study area. The other wage-earning sources include crop cultivation (46.5%), agricultural labor (33.8%), and poultry (32.9%).

The FGDs from both Char and Haor regions revealed that homestead gardening is a primary income-generating activity for almost 20% of the participants. Boat renting and hawking as income-generating activities were reported by FGD participants of the Haor region. A limited number (5%) of FGD participants in both areas also identified earning income from forestry resource collection, restaurant businesses, religious activities, village doctor (paramedic), boat renting, market mediation, artisan activities, and cash from renting out land. Other respondents (approximately 10%) worked as a barber, migrant laborer, fish seller, driver, electrician, potter, rickshaw puller, worker of twine, and land cutter. In addition, a limited number of people were found working as vaccinators, seed sellers, and masons to make income for their households. In both Char and Haor regions, a group of people engaged in fish capture and making fish traps (net, chai).

The KIIs with vaccinators revealed that through SHOUHARDO III's intervention, vaccination, seed retail, and improved cook stove production became earning sources for people from the program areas.

Figure 3: Earning sources for households



5.2. Disaster and Climate Vulnerability

The Haor and northern Bangladesh, especially the Char regions, have individual climates. With an average annual rainfall of 4,080 mm, Haor is one of Bangladesh's wettest areas. From 1988 to 2014, the water level in the Sunamganj district consistently remained over the Bangladesh Water Development Board's 'danger levels' in the event of a flood. Floods in 1988, 1989, 1993, and 1996 in the Haor region were within danger limits for 60, 25, 43, and 18 days, respectively (BWDB, 2014). Flash floods and high rains are all typical climate-related disasters in the Haor region. From 2010 to 2020, the Haor region has been hit by climate-related disasters such as floods, flash floods, hailstorms, and thunderstorms. Long-term trend analysis of climate data predict that the temperature in the northwest region from 2030 to 2070 will rise to 1.3°C and 2.6°C, respectively. (Mallick & Hossain, 2019). Although the northern part of Bangladesh is mostly drought-prone, increasing rainfall is being observed by 11.15 mm/year (Shahid, 2022). As a result, monsoon flooding and riverbank erosion in the Char lands along the Jamuna River (**Map 2, Table 7**) have been typical climate-induced disasters over the past couple of years. In some years, the region experiences recurring floods in the span of the year. The combined effects of climate change-induced extreme natural events such as flash floods, hailstorms, droughts, and changes in upstream river discharge pose a severe threat to the natural resource base and livelihood opportunities in vunerable Char and Haor areas (Jakariya & Islam, 2017).

Map 2: Existence of study area along the river

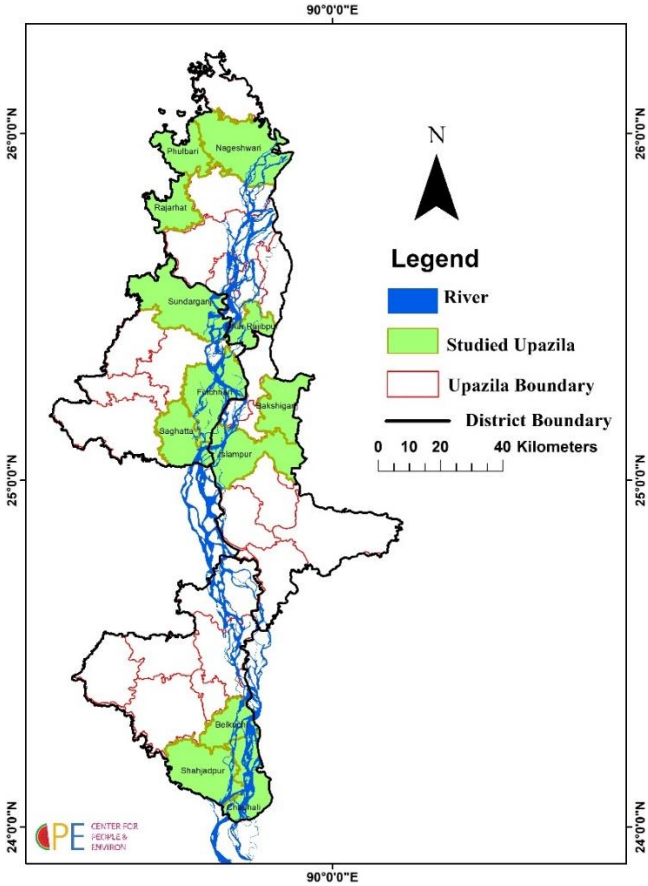


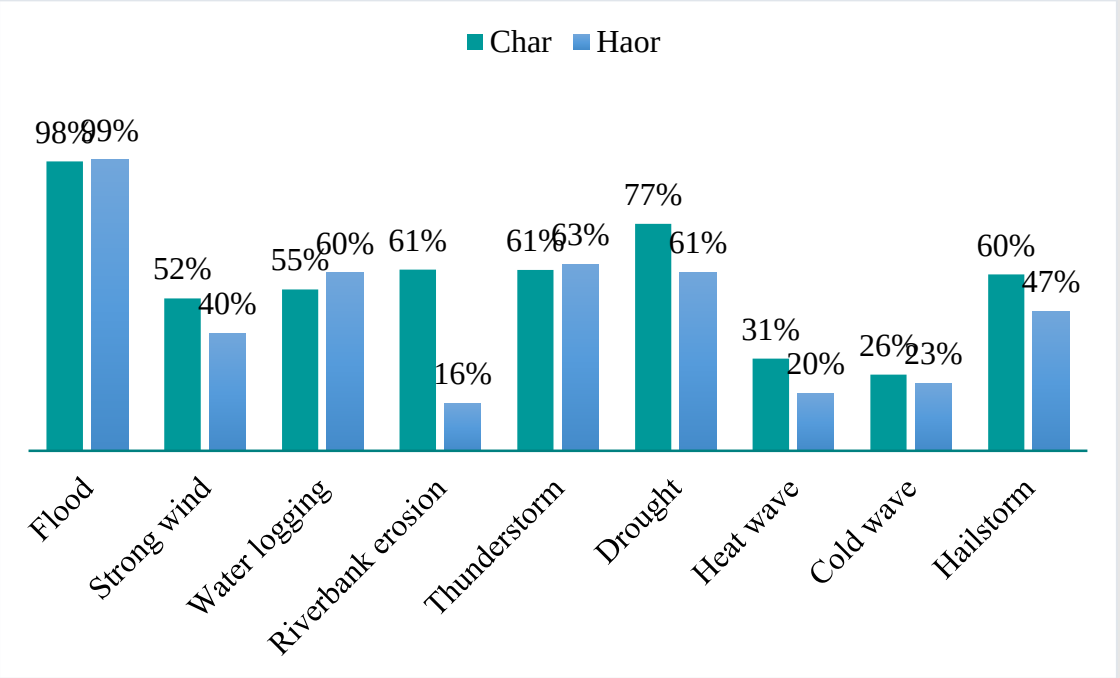
Table 7: Proximity of char lands (study area) to river

Upazila	River name	Distance from the river (km)
Bakshiganj	Jamuna	2.85
Belkuchi	Jamuna	0
Char Rajibpur	Jamuna	0
Chauhali	Jamuna	0
Fulchhari	Jamuna	10.34
Islampur	Jamuna	0
Nageshwar	Brahmaputra	0
Phulbari	Brahmaputra	0
Rajarhat	Brahmaputra	11.22
Saghatta	Jamuna	0
Shahjadpur	Jamuna	0
Sundarganj	Jamuna	0

According to the survey respondents and relevant stakeholders consulted during the study, the changing rates of precipitation, erratic rainfall, rising temperatures, landslides, waterlogging, floods and flash floods, thunderstorms, heat waves, cold waves, and agricultural droughts are climate change-related disasters. Participants consider Char and Haor regions highly vulnerable to disasters. In the last decade, all

eight districts in Char and Haor, have been affected by floods in terms of occurrence and severity (**Figure 4**).

Figure 4: Disasters faced by the studied people in 2011-2021

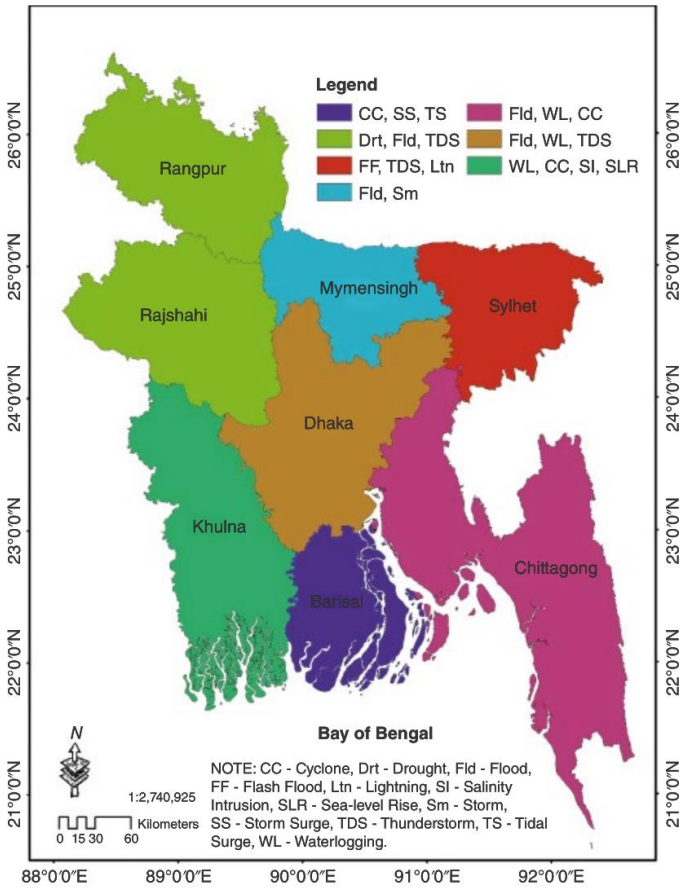


The District Relief and Rehabilitation Office (DRRO) of Kurigram shared that windstorms and sandstorms have been unavoidable disasters each year for the last couple of years. During the summer, people in the Char region suffer from strong winds and sandstorms, which cause many houses to collapse. Similarly, in the Haor region, the DRRO of Sunamganj reported that thunderstorms and hailstorms are unprecedented disasters that have recently been increasing loss and damage.

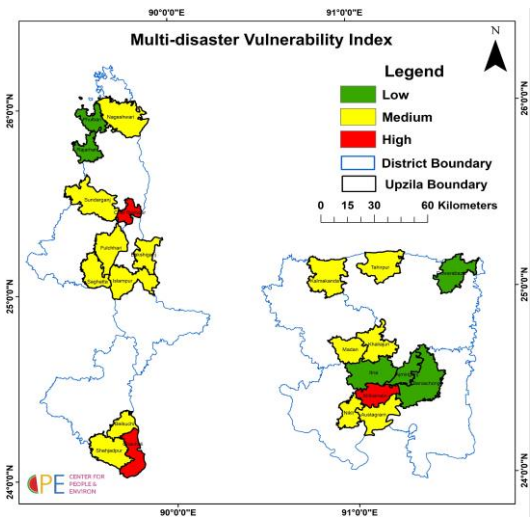
Data from 2016 extracted from the Department of Disaster Management (DDM) shows that Habiganj and Sunamganj are highly vulnerable districts to flash floods, thunderstorms, and lightning. Netrokona, in the same ecological region, is susceptible to floods and storms, and Kishoreganj is vulnerable to floods, waterlogging, and cyclones. In the Char region, Jamalpur is vulnerable to floods and storms, while Kurigram, Gaibandha, and Sirajganj are districts that are highly vulnerable to drought, flood, and thunderstorms (Rahaman et al. 2020) (**Map 3**).

The study attempted to understand the existing vulnerabilities of SHOUHARDO III implementing areas according to the opinions of beneficiaries.

Map 3: Multi-hazard vulnerability in Bangladesh (data adapted from DDM, 2016)



Map 4: Multi-Disaster Vulnerability Index



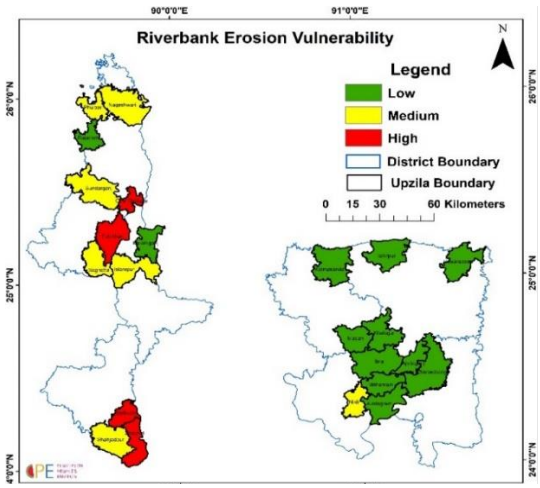
Based on participant responses, a **Multi-Disaster Vulnerability Index** was developed. (**Map 4**) Responses were interpreted and translated into normalized values with high, medium, and low vulnerability categories. According to the multi-disaster risk index, most flood-vulnerable Upazilas are in the Char region. The Char regions that are most vulnerable to multi-disasters are Char Rajibpur Upazila (Kurigram district), Chauhali Upazila (Sirajganj district), and Mithamain Upazila (Kishoreganj district).

In the Haor region, districts were found to be most vulnerable to flash floods, including the Ajmiriganj and Baniachong Upazilas (Habiganj district), the Dowarabazar and

Tahirpur Upazilas (Sunamganj district), the Kalmakanda, Khaliajuri and Madan Upazilas (Netrokona district), and the Mithamain, Austagram and Nikli Upazilas (Kishorganj district). (**Map 4**)

Riverbank erosion is a significant concern for the study areas, especially in the Char region. Although riverbank erosion is not considered a disaster by itself, it accelerates disasters like floods. The socioeconomic effects of riverbank erosion include displacement and landlessness, which results in higher social insecurity for communities. Riverbank erosion is also responsible for the increasing number of women abandoned by their husbands. The Riverbank Erosion Vulnerability Index was developed using study participants' responses. **(Map 5)** The study found that Char Rajibpur Upazila of Kurigram, Chauhali Upazila of Sirajganj, Fulchhari Upazila of Gaibandha and Islampur Upazila of Jamalpur are all highly susceptible to riverbank erosion.

Map 5: Riverbank erosion vulnerability



In addition to interpreting the participants' responses, the study attempted to understand the amount of land lost due to riverbank erosion. The study team used land use and land cover mapping between 2011 and 2021. The study found that the Chauhali Upazila of the Sirajganj district has lost 1457.50 hectares (ha) of land from riverbank erosion. (**Map 6**, **Table 8)**

Map 6: Land cover change

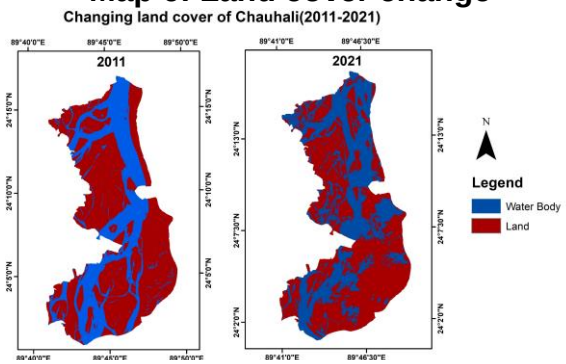


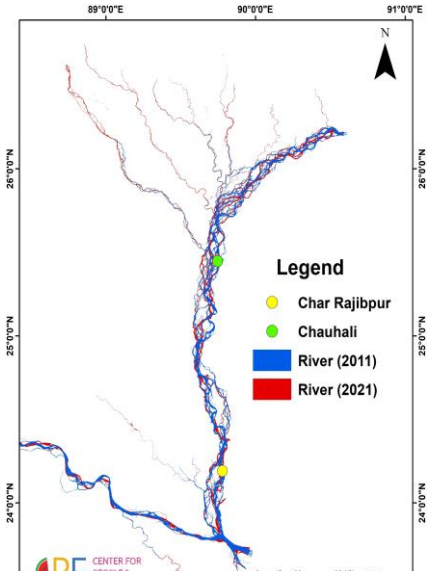
Table 8: Land use change of Chauhali for the period of 2011-2021

Land Type	2011 (ha)	2021 (ha)	Increase (ha)	Decrease (ha)
Water Body	8699.90	10157.50	1457.60	-
Land	15336.80	13879.30	-	1457.50

The Flood Forecasting and Warning Center (FFWC) showed that river trajectory is the most important element in managing hydro-meteorological disasters. The nature of hydro-meteorological disasters changes with the nature of river trajectories. Thus, changing the nature, extent, and severity of river trajectory is crucial for managing hydro-meteorological disasters and watershed management. The study looked at the

river trajectory of the Haor basin and northern Char lands to understand the vulnerability of the studied upazilas to floods.

Map 8: River trajectory in Char Rajibpur Upazila (Kurigram district) and Chauhali Upazila (Sirajganj district) from 2011 to 2021



The study found that in the highly flood-vulnerable Chauhali Upazila of the Sirajganj district and Char Rajibpur Upazila of the Kurigram district, the river is highly dynamic and changes its trajectory with time. **(Map 8)**

To measure the shifting river trajectory of these two Upazilas, this study considered geographical positions of 24.19^0 E and 89.77^0 N (Right bank), 24.19^0 E and 89.77^0 N (Left bank) of Chauhali; 25.44^0 N and 79.74^0 E (Right bank) and 25.44^0 N and 79.74^0 E for (Left bank) for Char Rajibpur. The study found that the riverbank shifting rate is high in the Upazilas, as depicted in **Table 9**.

Table 9: Riverbank shifting of Char Rajibpur, Chauhali and Mithamain Upazilas from 2011 to 2021

Upazila	Right bank (M)	Left bank (M)
Char Rajibpur	360.10	28.30
Chauhali	151.06	360.66
Mithamain	55.95	67.08

5.2.1. Disaster and Climate Impact

Disaster and climate change impacts are evident in both Char and Haor regions. Climate change and disasters significantly impact freshwater availability, agriculture, economic growth, and livelihoods. (NAPA 2005; Rahaman et al. 2019) The most devastating effects arise from flash floods, flooding, drought, riverbank erosion and heat stress that both regions are experiencing (World Bank 2013; Rahaman et al. 2019). The adverse effects on agricultural yield and the availability of fresh water are now apparent. For example, according to Rahaman et al. (2019), due to drought, floods, and flash floods, the production of crops, perennial trees, and livestock is damaged and experiences loss each year. In the flash flood of 2017, 4,667,000 people were affected in the six districts of Haor (Sunamganj, Sylhet, Netrokona, Kishoreganj, Habiganj, and Moulvibazar). (DDM, 2017) The Centre for Policy Dialogue (CPD) (2017) estimated the loss of Boro rice production from this flood to be about 1.58 million metric tons, which is equivalent to 8.3% of the national average yield. In monetary terms, the estimated loss equated to approximately USD 623.5 million (53 billion BDT[2]), equal to 3.7% of the GDP in the agriculture crop sector. (CPD, 2017)

[2] 1 USD=85 BDT

In the same year (August 2017), heavy monsoon rains caused intense flooding across over one-third of Bangladesh, including the districts of Kurigram, Gaibandha, Jamalpur and Sirjagaj. The monsoon affected more than 8 million people, who experienced a significant loss of crops, livestock, infrastructure, and water sources. (NDRCC, 2017) Approximately 9% of the cultivated cropland was damaged, equating to a gross value of about USD 317.6 million (27 billion BDT). (CPD, 2017) The CPD also stated that the estimated monetary impact from the loss of rice production was between $82.4 – USD 211.8 million (7–18 billion BDT). (CPD, 2017)

The effects of natural disasters and climate change have environmental and economic impacts on all districts in the Char and Haor regions. Disasters impact economic activities, so the study team created a **Composite Disaster Impact Matrix** to normalize participants' responses into seven impact sectors. (**Figure 5**) The matrix included Gender (Domestic violence, abandoned women, gender discrimination), Education (Enrollment rate, dropout rate), Security (Displacement, landlessness), Food security (Agriculture production loss, land loss, crop suitability, malnutrition), Livelihood (IGAs, availability of alternate livelihood options, unemployment rate), WASH (water quality, water availability, water infrastructure), and Health (reproductive health, physical health, disability, death, mental health).

Figure 5: Disaster Impact Matrix

Index	Gaibandha	Habiganj	Jamalpur	Kishoreganj	Kurigram	Netrokona	Sirajganj	Sunamganj
Gender								
Education								
Security								
Food security								
Livelihood								
WASH								
Health								

Value	Impact
0	No
0.1-0.33	Low
0.34-0.66	Medium
0.67-1.00	High

In the FGD, with women and men from all eight districts, issues around disability, reproductive health problems, and school dropout rates were high. The school dropout rate is increasing in the Char region, particularly in the Char Rajibpur and Nageswari Upazilas of the Kurigram district, the Fulchari Upazila of the Gaibandha district, and the Chouhali and Shahzadpur Upazilas of the Sirajjagnj district. This was echoed by almost 60% of the FGD participants. It was also found that there are increasing rates of mental disability for those suffering from riverbank erosion. In the FGD from the Nageswari Upazila of the Kurigram district and Fulchari Upazila of the Gaibandha district, at least 50 participants shared that they had been displaced more than ten times. Notably, household heads suffer the most from mental health problems. The

recurrent disasters have increased hopelessness and frustration among the community members.

Female FGD participants from Haor (almost 50%) and Char (nearly 60%) regions responded similarly that in terms of disability, by-born disability is the highest. They also shared different reproductive health problems, including reproductive tract infection, irregular menstruation, early or delayed menarche, recurrent pregnancy loss, compromised pregnancy, low birth weight babies, premature delivery, Leucorrhea, Pelvic Inflammatory Disease (PID), Urinary tract infection (UTI), obesity, and disabled childbirth. FGD women participants from Char and Haor also shared that during disasters, women and adolescents use dirty cloths while menstruating, and they have a common tendency to hide their menstruation events as a part of social taboos. Pregnant mothers are already physically and mentally drained, exacerbated during floods. When families cannot move to safe areas during the flood, they risk losing all of their belongings. The anxiety from this takes a physical and mental toll on pregnant women, which can cause complications during child delivery and has a long-term material impact. Moreover, Aschengrau et al. (2020) found that frequent use of contaminated water for drinking and bathing is associated with several reproductive health problems, including delayed pregnancy, congenital disabilities, and reproductive organ-related abnormalities.

In the FGD with female groups in both regions, participants shared that SHOUHARDO III has supported the health of individuals during COVID-19 through Community Clinics, Family Welfare Centers, and the Upazila Health Complex. Nonetheless, there is a persistent lacking of support regarding reproductive health. The FGD participants urge for reproductive health support to ameliorate the worsening situation.

Recurring floods and droughts also restrict crop production in the Char and Haor regions. Most people in these areas depend on natural resource bases for their livelihoods, such as fishing from natural water bodies, crop production, and livestock rearing. However, climate change impacts the production capacity of agricultural land; for example, during the rainy season, ground water is depleted, and crops are damaged. FGD participants from both regions shared that agricultural labor ceases during the flood, cold waves, and heat waves, as workers cannot go outside in extreme conditions. In addition, female FGD participants shared that their husbands abandoned approximately 10% of women during the disaster. Due to a lack of work opportunities in their locality, husbands must migrate to Dhaka and Chattogram (the capital and second largest divisional town) to search for income. However, some men either do not return or divorce their wives. As a result, women are getting abandoned during these stressful times.

Many women shared in their FGDs that during flooding, male counterparts might get ill-tempered due to their unemployment and inability to meet household demands. As a result, women may experience physical and mental abuse from their spouses. Heat stress, in addition to flooding, was also reported to cause anger in men. The participants also commented that they are not interested in enrolling their children in school, as this would decrease income-generating opportunities. Families expect their children to earn income to support household expenditures. As a result, the school

enrollment rate is decreasing, and the dropout rate is increasing. Disasters and climate change also contribute to malnutrition due to reduced income and food intake, particularly among women and children. Each year during the flood, most of the WASH infrastructure is damaged and submerged under water, which causes water pollution and water-borne diseases from the lack of clean water. Moreover, during the dry season, most water sources (surface and groundwater) become contaminated and dry up, so people obtain polluted water from contaminated sources. Additionally, some people experience injury and disability during floods from the collapsing trees and houses – an impact that the FGD participants in the Nageswari mentioned, Char Rajibpur, Chauhali, Dwarabazar, Khaliajuri, Fulchair and Islampur Upazilas.

Climate change is a crucial concern in the study area. The study participants reported that the increasing trends of flooding (83%) and inconsistency in rainfall (85%) are visible impacts of climate change. The effects of climate change in both regions (Char and Haor) are similar but vary slightly in the type of disaster. In the Haor region, flash floods are of significant concern (87%), while in the Char region, flooding (88%) is the most concerning the effect of climate change.

Nowadays, people in study areas face heat waves that severely impact crops. An estimated 41% of people in the Haor region and 49% in the Char region are affected by heat waves, primarily from March to April. Additionally, for three months of the year, people of the Char area are engulfed in heavy fog. Respondents from the Haor and Char regions expressed that health problems increase for livestock, poultry, and people during the cold wave. Approximately 45% of respondents from both areas mentioned that rates of disease incidence increase during cold, heat, and flood periods. The study team developed the **Composite Impact Matrix**, which translated participants' responses into normalized values to demonstrate the impact level of each disaster. **(Figure 6)**

Figure 6: Climate change impact MATRIX

Impact	Gaibandha	Habiganj	Jamalpur	Kishoreganj	Kurigram	Netrokona	Sirajganj	Sunamganj
Increased flood								
Increased flash flood								
Inconsistent rainfall								
Increased temperature								
Increased heat wave								
Increased cold wave								
Increased thunderstorm								
Increased fog								
Increased nor'wester								
Increased drought								
Reduced livelihood opportunities								

Increased riverbank erosion								
Decreased groundwater								
Destroy crops								
Seasonal variation in weather								
Increased diseases and illness								
Displacement/migration								

Value	Impact Level
0	No
0.1-0.33	Low
0.34-0.66	Medium
0.67-1.00	High

5.2.2. Disaster Risk Reduction and Climate Change Adaptation

Disaster Risk Reduction and Climate Change Adaptation and Mitigation (CCAM) are the primary concerns of SHOUHARDO III. Through the activities depicted in **Table 10**, SHOUHARDO III has supported the PEP households to increase their CCAM through capacity building, the construction of disaster-resilient infrastructure, and linkage development.

Table 10: List of interventions under SHOUHARDO III toward disaster and climate resilience community

Type	Resilience Activities by SHOUHARDO III
Capacity Development Training	Capacity development training to Union Disaster Management (UDMC) Members on Disaster and Climate Risk Management (DCRM)
	Capacity development training for Upazila Disaster Management Committee (UzDMC) on DCRM
	Capacity development training for Union Disaster Volunteer (UDV) on DCRM
	Capacity-building training for the DRR leaders
	Capacity-building training for Religious Leaders to provide risk reduction and early warning messages at the community level using their platform
	Formation of SBTB and capacity development training on DCRM issues and school safety plan
Infrastructure Support	Construction of brick mound protection wall
	Raised homestead plinth
	Construction of U-drain[3]
	Construction of school cum flood shelter
	Installed hand-washing station
Other Support	Supporting UDMC to develop and update Union Disaster Management Plan

[3] U-shaped drainage culvert

	Developing Community Risk Assessment (CRA) and Contingency Plan
	Equipped UDMC through supporting search and rescue materials
	Support for the most disaster-prone village (VDC/DRR leader) using megaphones to disseminate resilience/DRR messages at the community level
	Facilitation of Union Information Union Information Service Center (UISC) entrepreneurs to collect Early Warning (EW) messages from the website of BMD/FFWC and disseminate them to UDMC/UDV/DRR leaders, who convey those to the broader community
	Facilitation of farmers to use climate adaptation technology (short during and flood tolerance crop variety, raised plinth, prepare latrine above highest flood level) to mitigate the risk of flood
	Support at household and community levels for disaster preparedness (preserve dry food, cattle feed, firewood, etc.) to use during flooding situations; and save money to mitigate the risk of flood
	Providing voice messages through RIMES to people in a working union
	Providing grant support to Extreme poor(EP) households to overcome the losses that occurred by COVID19
	Providing multi-purpose cash transfers to the PEPs to cope with the emergency
	Engaging local service providers to disseminate risk awareness messages to the producer

Disaster preparedness is one of SHOUHARDO III's focus areas, and this study aimed to define the contributions of DRR and CCA activities towards risk reduction and adaptation at the household, community, and institutional levels. The study found that the community-led DRR and CCA mechanisms, disaster and climate governance, access to DRR and CCA support services, women's empowerment, and community capacity building to respond to disasters played roles in building resilience to tragedy and climate change. In terms of holistic disaster risk reduction, the study found the following factors to be integral: disaster preparedness, disaster early warning, disaster resilient infrastructure, local support services for backwards-forward linkages, capacity building of community facilitators, and facilitation of disaster governance. Similarly, the study found that climate advisory services, climate-smart agriculture, low carbon energy, and improved cooking stoves enhanced adaptation and risk mitigation at the community level.

The study found that disaster preparedness, capacity, and awareness were low before the program, and only 0.7% of the communities implemented such practices. However, after SHOUHARDO III's intervention, 62.4% of respondents increased their preparedness activities. Capacity-building initiatives, awareness-raising activities, early warnings, and climate advisories have increased the preparedness capacity of people represented in this study. The study also revealed that people have become

familiar with preserving food, saving money, securing tube wells, storing drinking water, storing medicine for emergencies, and reserving fuel wood after getting an early warning for floods and other disasters. Preserving food was the highest practiced (95.4%) behavior among the respondents, increasing from only 31.6% before the SHOUHARDO III intervention. (**Table 11**) The program has successfully built individuals' motivation to help their community implement disaster preparedness practices, which was reported by 25.8% of the respondents.

Table 11: Different preparedness measures are taken by the studied population

Preparedness activities	Before SHOUHARDO III	After SHOUHARDO III
Preservation of food	31.6%	95.4%
Money savings	17.4%	90%
Construction of secure tubewells	1.3%	32.6%
Helping the community with preparedness	0.5%	25.8%
Storing drinking water	10.3%	65.4%
Storing medicine	5.2%	21.4%
Preparing torches, rope, etc.	1.0%	36.0%
Preparation of evacuation routes and areas	0.2%	5.5%
Preservation of fuel wood	6.6%	37.7%
Protection measures for belongings	0.6%	15.8%
Transportation of livestock and poultry to safe areas	4.9%	53.0%
Strengthened and resilient houses	4.5%	52.5%
Contact with DRR leaders and LGI	0.3%	11.7%
Preparation measures taken	0.7%	63.1%

As a result of SHOUHARDO III's DRR and CCA interventions, communities in the Char and Haor regions are much more prepared to reduce damage and loss caused by the disaster and climate change (**Table 8**). After SHOUHARDO III, 63.1% of the population took preparedness measures, less than 1%.

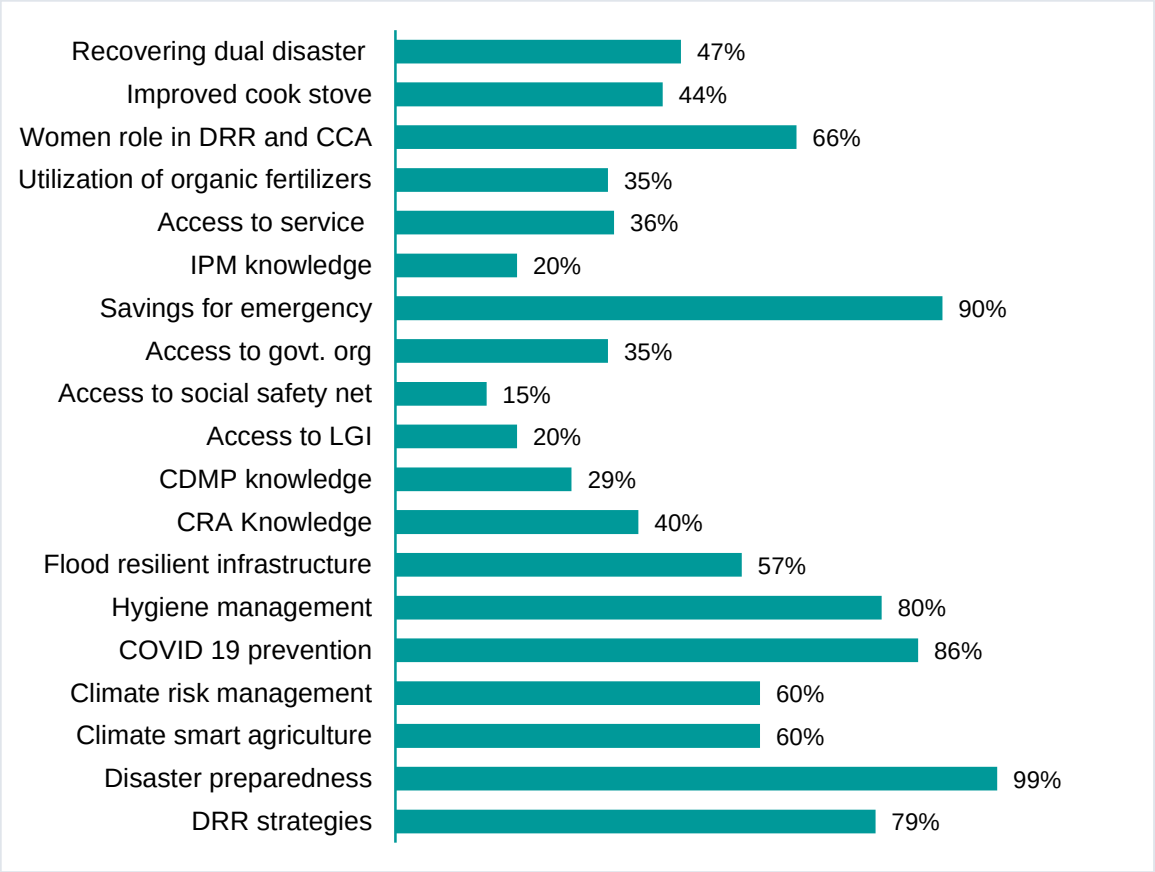
The FGD participants from both regions shared that they have significantly changed their disaster preparedness measures. Notable prevention measures include strengthening houses to become more resilient, transporting livestock and poultry to safe areas before floods, storing medicine, storing food, and saving money to overcome flood emergencies. SHOUHARDO III has contributed to these enhanced disaster preparedness activities through training and capacity building, awareness raising, and the development of support mechanisms. Despite these efforts, FGD participants noted that they still need more support to be considered as disaster-ready communities. The participants proposed the following actions be taken: capacity development to build evacuation plans, support in selecting safe places for evacuation, and linkage development with relevant Upazila departments.

Communities have also enhanced their DRR and CCA capacity through disaster contingency planning, early warnings and climate advisories, and resilient infrastructure. Resilient infrastructure includes the WASH systems, brick mound flood protection walls, access to flood- and drought-tolerant seeds, and livestock and poultry vaccination support.

SHOUHARDO III has prioritized community-led development through the facilitation of DRR leaders, UDVs, and VDCs. The program also engaged vaccinators and religious leaders to become key agents for DRR and CCA. Program participants have learned how to recover from dual disaster impacts, prepare resilient flood infrastructure, practice climate-smart agriculture, and access government support services. As a result, 99% of study respondents reported that they are aware of DRR and CCA activities, and they are implementing these practices to increase resilience. **(Figure 7**) Moreover, 47% of respondents reported that they have recovered from the dual impacts of flooding and COVID-19 using learnings from the SHOUHARDO III dual disaster management trainings.

In line with the program's objectives for women's empowerment, 66% of respondents reported that women have become key DRR and CCA agents in their households and communities.

Figure 7: Training outcomes in DRR and CCA



The FGD participants in Char and Haor regions shared that they had learned about disaster management, early action, and CCA planning from DCRM training led by UDV

and DRR Leaders. The FGD participants also reported learning about the impacts of disasters and climate change from their participation in a CRA, where they developed a Community Contingency Plan.

FGD participants in the Tahirpur Upazila of Sunamganj district, Fulchair Upazila of the Gaibandha district, Kalmakanda Upazila of the Netrokona district, Shahzadpur Upazila of the Sirajganj district, and Islampur Upazila of the Jamalpur district shared that the School-Based Teenage Brigade (SBTB) had played a vital role in disaster preparedness by disseminating early warnings and climate advisories in their communities. SBTB also worked on hygiene management at the school, community, and household levels during and after flood disasters. However, since the schools have been closed for the past two years due to COVID-19 lockdowns, the SBTB students are applying their learnings in the community.

The FGD participants from both regions noted that they practice several preventive mechanisms to protect their food, seeds, livestock, poultry, fish and other important assets, using the knowledge they gained in DCRM trainings and CRAs. Participants receive support in DRR areas including: preservation of dry food and other documents in containers polythene bags, stockpiling fodder for livestock, stockpiling fuel wood, preservation of fuel and candles, preservation of seeds in bags and mait[4], saving cash for emergencies, and preservation of drinking water in pitchers. During the FGD with male participants from Char Rajibpur Upazila of Kurigram district and Belkuchi Upazila of the Sirajganj district, it was found that seed preservation, food preservation, and livestock rescue were of the highest priority for farmers during flood disasters. They usually practice traditional interventions to preserve food and protect livestock. An exciting intervention that was discovered is the use of vela[5] as a rescue strategy. Livestock, children, and elderly people are able to float on the vela to travel to safer areas during floods. Another intervention that was shared by FGD participants from Chauhali Upazila of the Sirajganj district is the practice of preserving seeds and essential documents by burying them under the soil. Participants shared that most of the flood-affected people in the Char regions dig wells, fill them with mud and sand, and then keep their seeds and crucial documents underground. After the flood, they dig up what they had buried.

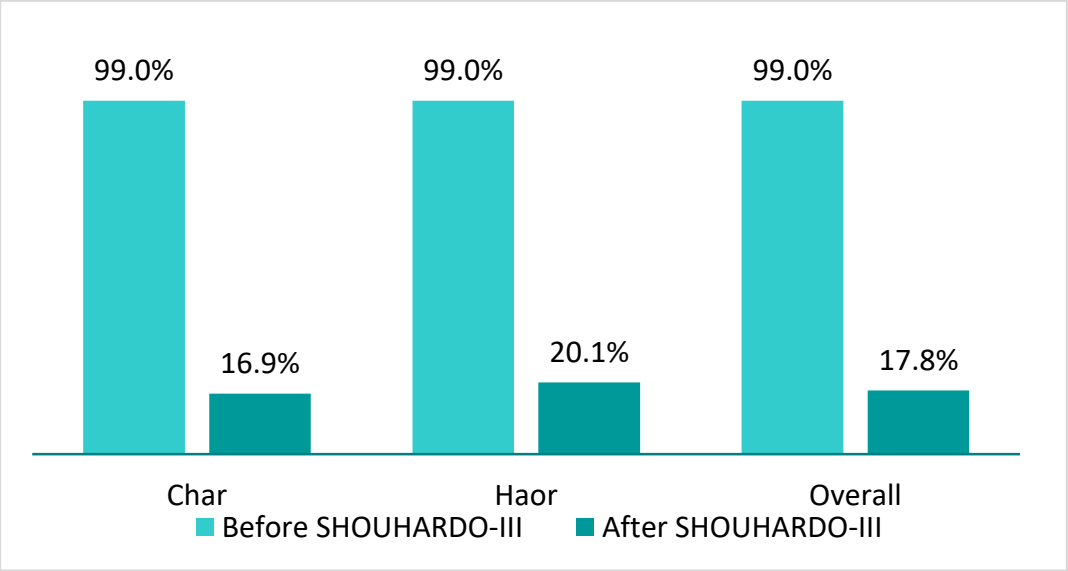
The FGD participants from both regions also adopted a community-level disaster management plan based on the CRA and Contingency Plan. Although communities did not previously keep disaster management plans, after the SHOUHARDO III intervention, they have assembled several plans to protect crops, livestock, poultry, fish, and other assets. Strategies in these plans include resilient crop farming, early harvesting, construction of the semi-scavenger slatted house, construction of poultry houses in raised plinths, development of evacuation routes to safe shelter during the flood, early warning and climate advisories from the Union Information Service Center (UISC), facilitation of community-level leaders, saving money, raising homestead plinths, and receiving assistance from the Union Parishad and local support mechanisms.

[4] Large pot made of mud
[5] Raft made with banana tree

In both the Char and Haor regions, having access to government services before, during, and after disaster is a priority DRR activity. Participants from both regions also shared that making women and adolescent-friendly flood shelters are importnat DRR activities.

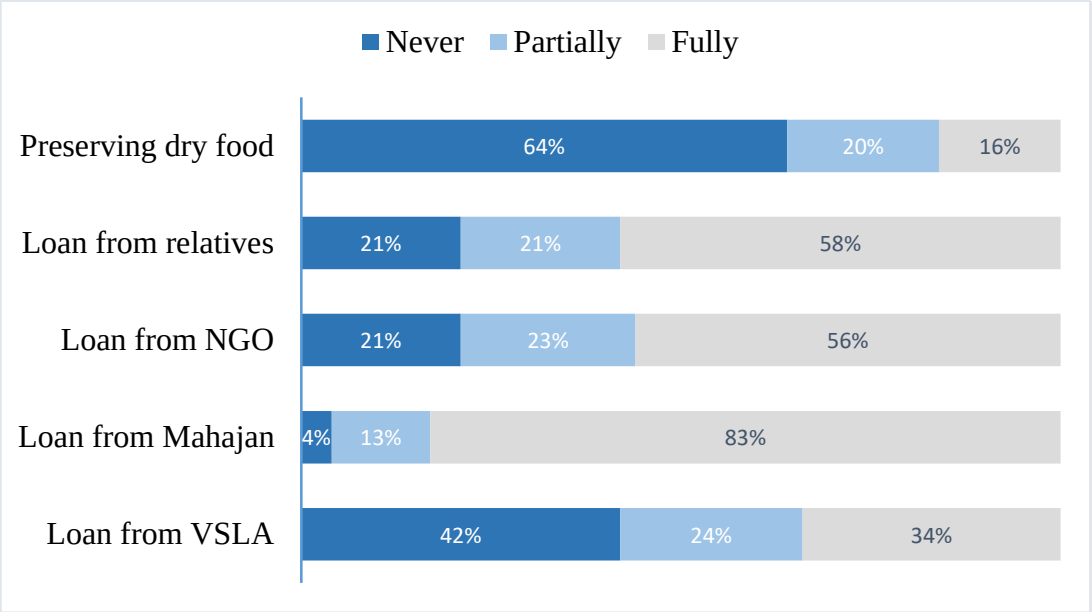
With increased learning and capacity, disaster-affected people have become more resilient, resulting in a decrease in negative coping strategies. Currently, 17.8% of the studied population practice disaster coping strategies, which was 99% at the inception of SHOUHARDO III. (**Figure 8**)

Figure 8: Comparison of coping strategy practices before and after SHOUHARDO III



According to the study respondents from Haor and Char regions, coping practices during disaster include saving money, preserving dry food, and taking loans from various actors, such as Non-Government Organizations (NGO), relatives, or Mahajan (a local lender with high-interest rates). Multiple coping strategies were recorded from each respondent as methods that they practiced either partially or fully, and a composite matrix was then developed for each practice. The study found that saving money was the principle coping strategy, and preserving dry food was practiced by 16% of respondents. Presently, VSLA is the most important coping mechanism and is fully practiced by 34% of the respondents. **(Figure 9).** VSLA plays a vital role in DRR as financial support during emergencies. Before SHOUHARDO III, most respondents depended on NGOs and Mahajan for loans, but now they can save on their own with VSLAs.

Figure 9: Coping strategies of studied beneficiaries



Majeda Begum is a participant from Fulchari Upazila of the Gaibandha district whose husband is a day laborer. During the 2020 dual disasters of flooding and COVID-19, her husband could not go outside for work. Fortunately, Majeda had previously received training on homestead farming and began to produce vegetables on her homestead. During this time when her husband was unable to work, she sold vegetables to people in the community. This allowed her family to recover from the dual disasters of the flood and COVID-19.

Bulu is a haylage[6] entrepreneur from Phulbari Upazila. With her work, she is helping her livestock, as well as the livsestock farmers in her village to recover from the flood crisis period by ensuring a food supply. She learned about and was trained on haylage production from SHOUHARDO III.

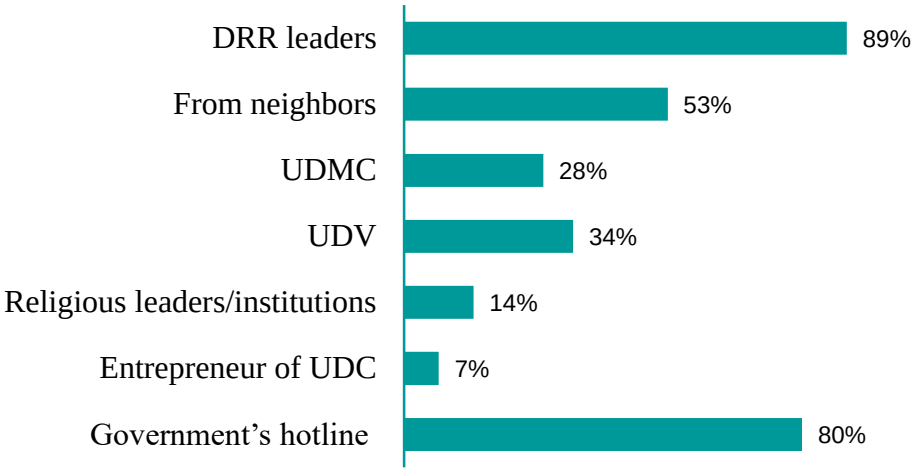
5.2.3. Early Warnings, Climate Advisories, and Preparedness

The studied population was very familiar with early warning and advisory services. Almost all (98%) respondents receive an early warning and advisory services, which is very helpful for disaster preparedness and CCA.

SHOUHARDO III facilitated the development of multiple early warning mechanisms in the study area, including the engagement of community-based early warning actors (i.e., DRR leaders, UDMC, UDV, UDC, Imam). SHOUHARDO III activated and popularized a government early warning mechanism and a hotline number to ensure an effective early warning system at the community level. 89% of participants from both regions reported that they rely on DRR leaders, and 80% rely on government hotline numbers to receive early warnings **(Figure 10).**

[6] Haylage is a nutritious, organic and homemade cattle feed produced from banana stem

Figure 10: Sources of early warning services



The results of the FGD in the Char and Haor regions indicate that a hotline number is an effective early warning mechanism among community members because it is easily accessible and toll-free.

Eleven DRR leaders in the Char and Haor regions shared that they work within their communities, meaning that community members have easy access to their DRR leaders. This also increases their social responsibility to help their communities. FGD participants from the same communities expressed that they rely on their DRR leaders to receive early warnings, climate advisories, information regarding resilient seeds, and information on the SSN.

In the Char and Haor regions, the voice message is the central platform to disseminate early warnings. (**Table 12**) DRR leaders use megaphones to make early warning announcements in the communities, including notices on water levels, flooding, rainfall, cyclones, cold waves, and fogginess. Participants shared that during the flood, warnings are disseminated through portable hand devices and from religious institutions.

During a KII with an Imam (religious leader) in Islampur, he shared that he delivers a message on Friday, the weekly prayer day, before Khutba (recitation from the holy Quran before prayer) to raise awareness on disaster preparedness.

According to the Director of the DDM, although early warnings reduce loss and damage, those are only 90% effective in the Haor region, because flood lead time is only three days, and there are no early warnings for flash floods. He also added that although SHOUHARDO III developed Upazila-specific early warnings and climate advisories, no land-specific early warnings were created. This is significant, because inundation depends on altitude, and not all lands are uniform throughout each Upazila or union. Some lands are lowlands and some are highlands, yet currently all early warnings are disseminated to the entire river basin or district. Thus, there is a need to develop an early warning system based on land and altitude specifications, which the FFWC and RIMES agree would be more effective.

Table 12: Types of Warning Messages

District Name	Voice message	Hand microphone	Mosque microphone
Gaibandha	51%	12%	23%
Habiganj	23%	25%	18%
Jamalpur	61%	6%	26%
Kishoreganj	44%	16%	19%
Kurigram	46%	16%	22%
Netrokona	28%	6%	16%
Sirajganj	54%	6%	17%
Sunamganj	43%	9%	19%

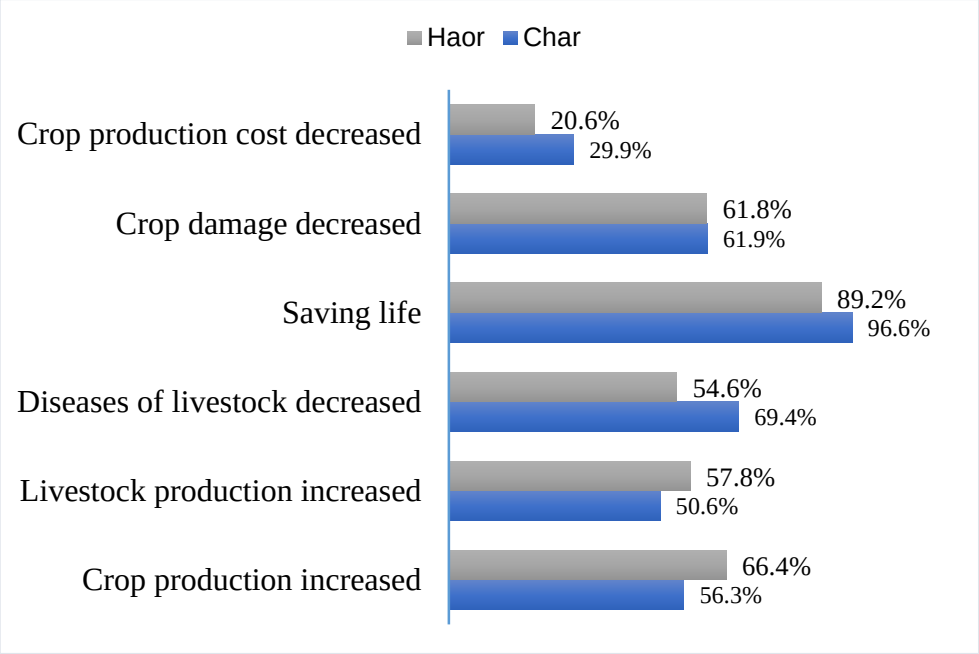
The FGD participants from the Char and Haor regions shared that early warning and climate advisories are effective in increasing climate resilience and reducing disaster-induced losses and damage. In both regions, it was found that climate advisories and early warnings helped people's savings, poultry, and livestock. In the Char and Haor regions, 96.6% and 89.2% of study respondents respectively said that climate advisories and early warning services played a vital role in saving their lives, livelihoods, and assets.

The FGD with villagers from the Vatpara village of Kaijuri union under Shahjadpur Upazila discussed the effects of the 2004 flood, where seven children had tragically drowned. However, since 2016, although the village still regularly experiences flooding, no children's lives have been lost because villagers can now prepare themselves after receiving early warnings. After they receive the flood warnings, community members don't allow children to play outside and evacuate children to nearby safe places to stay during the emergency. Climate advisories have been very successful, particularly in livestock protection. The advisories provide information on heat-sensitive, cold-sensitive, and water-sensitive livestock diseases and the appropriate protection measures that farmers must adopt. During an FGD in the Mazi Tari village of Baro Vita union under the Phulbari Upazila, a respondent shared that their household had lost 32 ducks in 2015 during a cold wave. This incident happened because the women were not aware of the risk of disease for ducks during cold waves. As a result of the climate advisories, the women are now informed and successful duck farmers and reported that none of their ducks has since died from following cold waves.

The study found that climate advisories have also increased crop production and allowed the introduction of improved seed varieties and intelligent technologies. This finding was echoed by participants from the Haor (20.6%) and Char regions (29.9%). (**Figure 11**) For example, the study found that wheat and crop production increased in the Kurigram district, which was also observed in the national database. During the FY 2015 to 2016, the average production in the Kurigram district was 1,338 kg per acre but increased to 1,433.2 kilograms per acre during the FY 2020 to 2021 (BBS, 2017 and 2021). Similarly, the district had increased production of Aush (pre-monsoon seasonal rice). From FY 2015 to 2016, the average Aush production in the district was

568 kg per acre, which increased to 940.4 kg per acre from FY 2020 to 2021. (BBS, 2017; BBS, 2021) Although this was not validated at the field level, climate advisory services may have contributed to the increased wheat production in four out of the nine Upazilas of the Kurigram district.

Figure 11: Benefits of climate advisory services

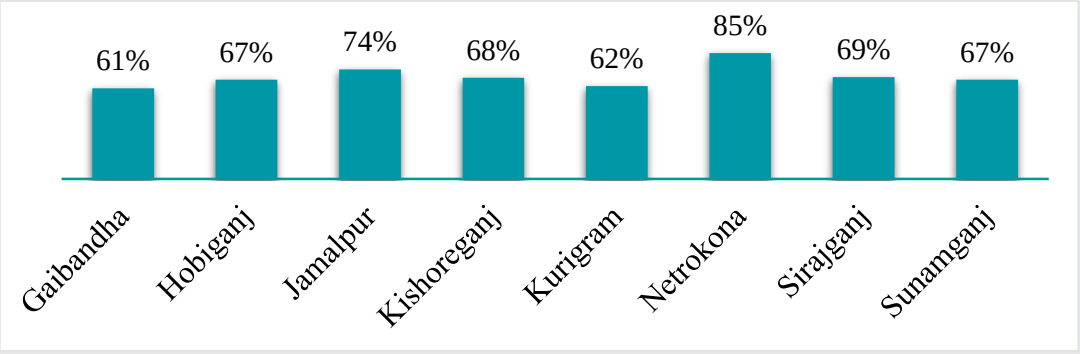


5.3. Climate Smart Agricultural Practices

In the Char and Haor areas, socioeconomic conditions, family well-being, and household well-being were positively impacted by adopting climate-smart practices. At the family level, food security increases, savings for emergency periods, purchasing capacity, and, most importantly, women's participation in decision-making. As income and production rise due to climate-smart practices, 73.8% of SHOUHARDO III participants from Char and Haor save money from their increased earnings, and 77% of households engage in VSLAs. Generally, the studied population invested their saved money in repairing houses as a DRR mechanism.

Farmers experience losses and damages because they are located in areas vulnerable to disasters for almost the entire year. SHOUHARDO III promotes climate-smart crop varieties and agricultural practices using planned and indigenous technologies. The study depicts that 67% of respondents from all eight SHOUHARDO III districts are practicing climate-smart agriculture with the support and knowledge gained from the program. **(Figure 12)** Although 67% of total respondents reported being involved with climate-smart agriculture, the highest engagement is in Netrokona (85%), and the lowest is in Gaibandha (61%).

Figure 12: Climate-smart agricultural practices



Homestead farming is popular climate-smart agriculture introduced by SHOUHARDO III and mentioned by 83% of the respondents. (**Figure 13**) Some farmers practice farming third crops,[7] intercropping,[8] sack farming,[9] and floating bed farming[10] using learnings gained from SHOUHARDO III training. SHOUHARDO III has also promoted farmers' access to resilient seeds and government services.

The KII with the DAE at Kishorganj and Kurigram revealed some commonly available rice varities in the study area.

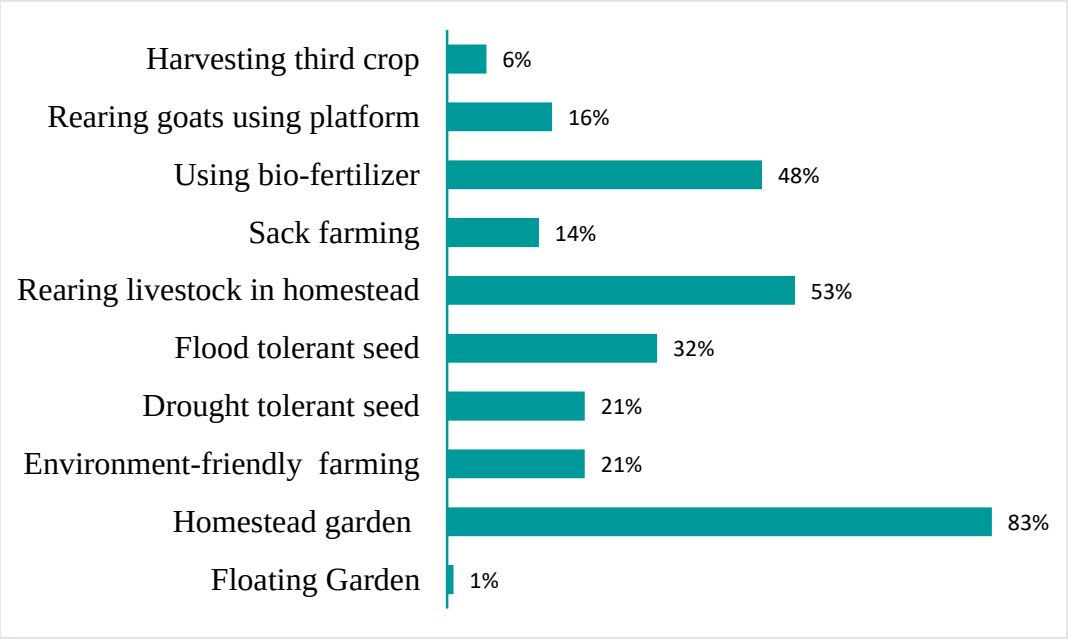
Table 13: Commonly available rice Varieties in Kurigram and Kishoreganj district

Name of District	Commonly available rice Varieties
Kishoreganj and Kurigram	BRRI Dhan 51 and 52; Bina dhan 11 and 12, submersion-tolerant rice varieties BRRI Dhan 51 and 52, Bina dhan 11 and 12, T. Aman BR 22 and BR 23; short duration rice variety Bina shail, BRRI Dhan 33, 56, 57, and 62, Bina dhan 7 and 16, BRRI Dhan 47, 61, and 67, Bina dhan 8 and 10, T. Aman BRRI Dhan 40, 41, 53, and 54, Aus BRRI Dhan 65, T. Aman BR-22 and BR-23

The Sub Assistant Agriculture Officer (SAAO) of Kharnai union in the Kalmakanda Upazila of the Netrokona district shared that with the support of the DAE, farmers of Kharnai are practicing the Alternate Wet and Dry (AWD) method (farming to conserve irrigation water) as an experimental irrigation technology for the dry summer season.

[7] Intermediate crop between two seasonal crops (For example, Aman-Pulse/Oil crops/vegetable-Boro) which is also known as the relay crop.
[8] The cropping method by which two or more crops are grown together on the crop land in phases or at the same time.
[9] Method of growing crops in soil-filled polythene bags, containers, or plastics.
[10] Farming in floating rafts made by water hyacinth in waterlogged areas to raise seedlings and grow vegetables during thr monsoon.

Figure 13: Types of climate-smart agriculture practices



During the FGD in Kuti Bamandanga village under Nageswari Upazila of the Sunamganj district, it was found that villages remain inundated almost every year during the monsoon, meaning the villagers cannot rear cattle and poultry. In response, SHOUHARDO III raised homestead plinths and built capacity for homestead farming by rearing livestock and poultry on the raised plinths. The villagers produce vegetables on their raised plinths using improved varieties of seeds. As a result of these measures, the villagers have increased resiliency and earn income from selling vegetables, eggs, ducks, and hens.

Floods and flash floods are common disasters in the Patabuka village of Tahirpur Upazila of the Sunamganj district. Each year, the village is flooded during the monsoon. However, the FGD participants in this village shared that they have been producing vegetables for the past few years using sack farming, a resilient farming technology introduced by SHOUHARDO III. With this alternative farming method, they can grow vegetables during the flood season, despite their submerged homesteads. Participants reported that they can now meet their household nutritional demands during the monsoon by consuming some of their vegetables and earning income by selling the rest of their produce.

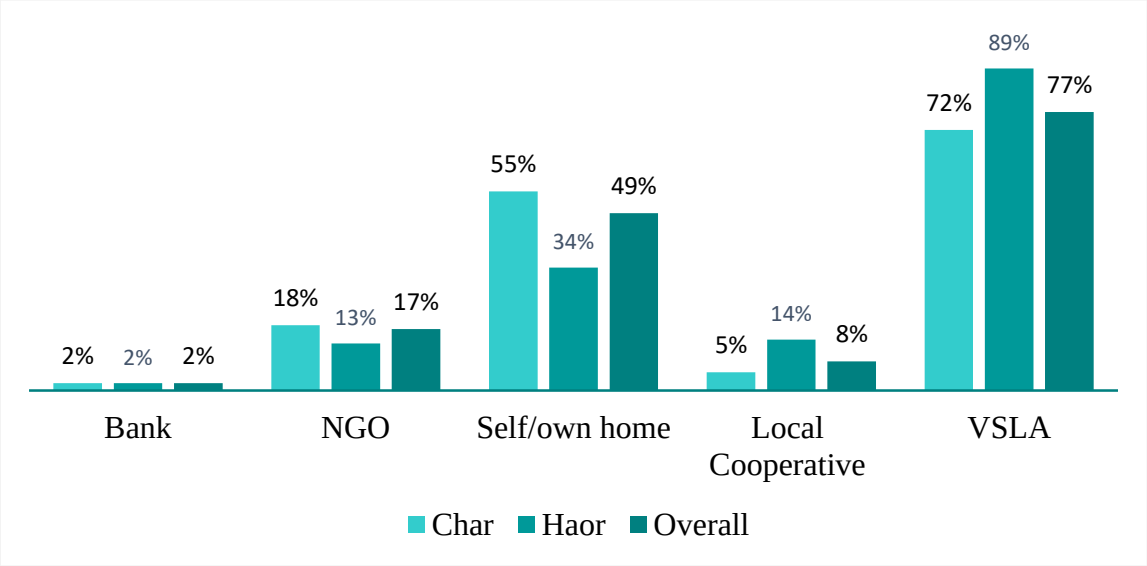
5.3.1: Increased savings as a result of increased income earned from using climate-smart agriculture

In SHOUHARDO III areas, women's participation in disaster resilient farming practices and livestock/poultry production has contributed to rising household incomes.

Previously, households struggled to meet their demands with their earnings. However, with the increased income earned from climate-smart agriculture, families are receiving surplus income, catalyzing a mentality amongst individuals to save money to recover from emergencies.

VSLA is a trusted savings mechanism amongst the respondents, and 77% **(Figure 14)** of them reported saving their money in VSLAs. VSLA is a mechanism managed by the saver, owned by the saver, and lent by the saver. However, 49% of respondents reported that they choose to save money in their own homes for quick access, as sharing and borrowing from VSLAs takes time. Some other savings agents recorded by the study include NGOs, banks, and local cooperatives.

Figure 14: Savings of earning



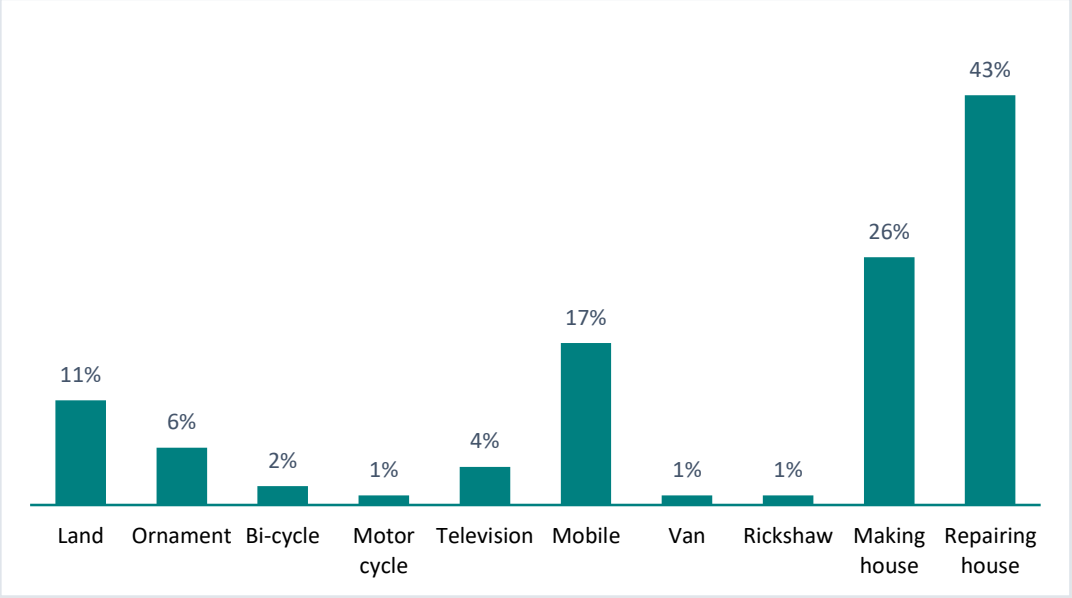
According to the Sanchay Sathi of the Surma union in Dwarabazar Upazila of the Sunamganj district, VSLA is a flexible platform that can increase the capacity to save amongst disaster-vulnerable poor and PEP people. The Sanchay Sathi also added that VSLAs create cohesion among the members, which leads to collective action and social network building for DRR.

In FGDs in the Haor and Char regions, participants expressed that they feel safe saving with VSLAs. They also noted that VSLA is a trustworthy mechanism in DRR and assists people in several ways. For example, it has reduced the school dropout rate among disaster vulnerable and impoverished families. More than 90% of the FGD participants mentioned that VSLA provides emergency loan support. VSLA has moreover reduced the high-interest loan burden that accompanies loans taken from NGOs and Mahajan. Additionally, VSLA has enhanced women's empowerment, as women are now capable of contributing to their household income generation with a low-interest loan from VSLA, thus increasing their influence in the family decision-making.

Respondents do not only use their earnings to save, but also spend it on their well-being. The respondents mentioned repairing and/or building new houses to protect them from disaster is the best way to ensure their well-being and safe shelter. The study found that 69% of respondents spend their money on their homes (26% on building a house and 43% on repairing their home). **(Figure 15)** A remarkable example from the study is that 11% of study respondents bought their land with earnings from climate-smart practices. This information comes from the Char area, where many

people lose their land to riverbank erosion each year. Respondents also reported purchasing ornaments, televisions, mobile phones, luxury products, and livestock with their income.

Figure 15: Expenses of income from climate-smart practices



FGD participants from the Islampur, Bakshiganj, Nageswari, Phulbari, Tahirpur, Madan, Nikli, Austagram, and Baniachong Upazilas stated that some of them have constructed new houses on raised plinths. Nearly 70% of participants have repaired their homes with resilient measures, including Reinforced Cement Concrete (RCC) pillars, screws to tighten the roof, and strong colored tins for the top.

5.4. Disaster Resilient Infrastructure

Disaster resilient infrastructure (including raised plinths,[11] school cum flood shelters,[12] and brick mound protection walls[13]) is highly important for disaster-proofing a community. Among the studied population, 62.4% have access to disaster-resilient infrastructure at either the household or community level. (**Figure 16**) Disaster resilient infrastructure, especially plinth raising, has become a popular and effective infrastructural service in the study area.

Through field observation and KIIs with DRR leaders and SHOUHARDO III partner NGO MJSKS, it was found that, although SHOUHARDO III has provided plinth-raising support, in Kuti Bamandnga union of Nageswari Upazila under the Kurigram district,

[11] Raising homestead using mud considering the historical highest flood level.

[12] Multipurpose houses/buildings which are used as school and flood shelter for community people in the flood affected areas.

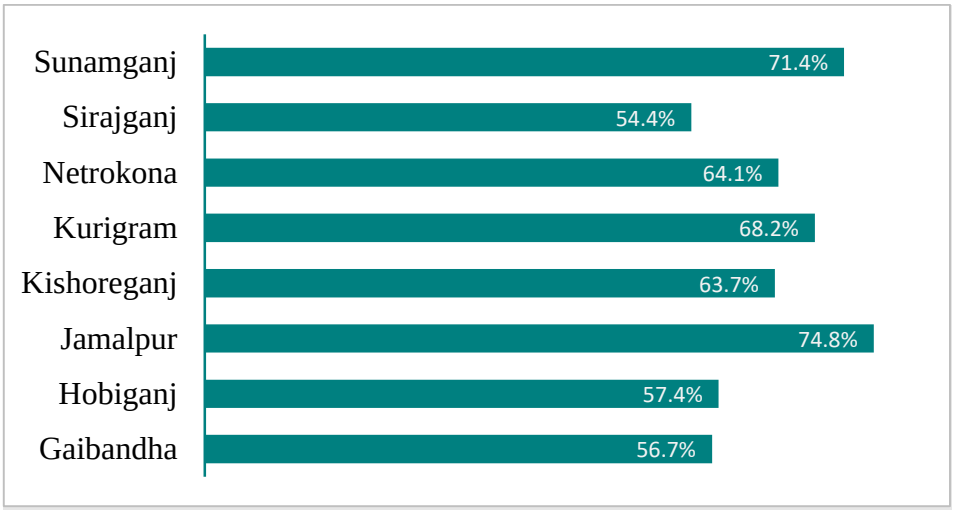
[13] Brick made wall around the earthen formation of isolated island to protect from wave erosion.

most of the community members have taken the initiative to raise their plinths, following SHOUHARDO III guidelines.

The FGD participants from Nikli, Mithamain, and Baniachang Upazilas mentioned that brick mound protection walls effectively protect Haor people from floods. In Baniachang Upazila of the Habiganj district, more than 200 households were rescued from flood and erosion in Matikata union, which the FGD participants of Matikata reported. Md. Shafiq (VDC leader) of the Matikata union informed the study that they would lose almost USD 50,000 annually after the rainy season to reconstruct their homesteads before the brick mound wall construction. All of the men and women in the community had to engage in excavation and reconstruction. After the construction of the brick mound, they were no longer affected by flood and erosion. The FGD participants also mentioned that they have partnered with a government agency for wall reparations and look after the brick mound protection wall on a rolling basis. If any fractures appear on the wall, they inform either SHOUHARDO III or go directly to the Local Government Engineering Department (LGED) to repair the wall. They also added that they are satisfied with the LGED services in repairing the brick mound wall.

Although flood resilient infrastructures are effective and sustainable, all FGD respondents from each of the eight districts reported a need for disaster resilient infrastructure. Most FGD participants mentioned that community-based flood shelters are insufficient for community members to take shelter during floods. The FGD participants also noted that some of the community-based flood shelters are not women, adolescents, and persons with disabilities (PWD)-friendly; this finding was evident during the field observation in Fulchari Upazila of Gaibandha and Chouhali Upazila of Sirajganj. The FGD participants from the Char and Haor regions insisted on the importance of more flood shelters for women, adolescents, and persons with disability-friendly spaces.

Figure 16: Accessibility to disaster resilient infrastructure in different districts



The communities have several types of disaster-resilient infrastructure: disaster-resilient houses, flood-free homesteads, flood shelters, school and college cum flood shelters, flood-free neighbors' houses, community flood shelters, hospitals, and other facilities. As shown in **Table 14**, in the Netrokona district, 60% of respondents reported having access to a disaster-resilient place. On the other hand, only 31% of the beneficiaries in the Jamalpur district reported having access to a disaster-resilient house, which was the lowest amount in the study area. According to the FGD participants of Jamalpur, Char land is unstable and most of the plinths wash away during the flood, which means that safe shelter construction is insufficient here and reduces the community's accessibility to disaster resilient houses. It was further found that 55% of the beneficiaries of Jamalpur have access to flood-free homesteads, but the community does not have sufficient flood shelters. The community also uses neighbours' houses, hospitals, and college cum flood shelters as disaster resilient infrastructure.

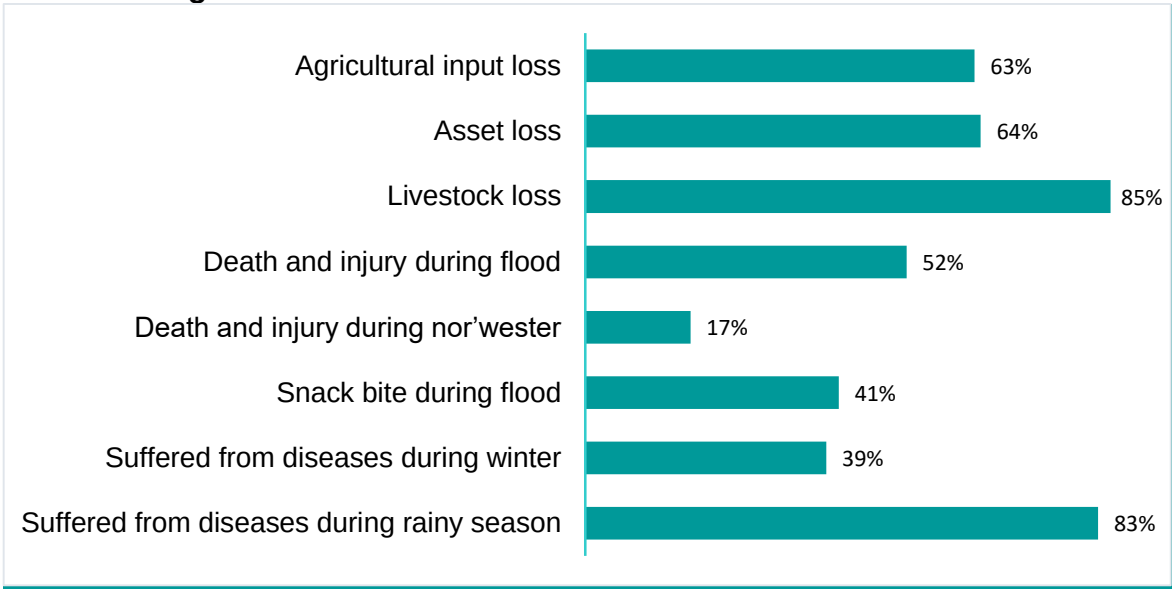
Table 14: Accessible disaster resilient infrastructure facilities

	Gaibandha	Habiganj	Jamalpur	Kishoreganj	Kurigram	Netrokona	Sirajganj	Sunamganj	Overall
Disaster resilient house	34%	56%	31%	32%	34%	60%	50%	36%	39%
Flood-free homestead	45%	60%	55%	70%	60%	50%	55%	44%	54%
Flood shelter	13%	6%	6%	15%	16%	24%	13%	40%	15%
School cum flood shelter	52%	81%	57%	74%	54%	70%	52%	57%	58%
Flood-free neighbor house	32%	2%	29%	20%	32%	47%	44%	51%	34%
Community flood shelter	7%	0%	1%	2%	13%	11%	5%	22%	8%

FGD participants from both regions expressed that they have access to flood resilient infrastructure, whether being their own disaster-resilient, flood-free houses or flood shelters or a neighbour's flood-free house. They also shared that SHOUHARDO III has ensured disaster-resilient infrastructure at the household and community levels.

All respondents reported that before receiving support and knowledge of disaster resilient infrastructure, they experienced several problems during floods, including the loss of livestock and agriculture, death and injury, snake bites, and a high burden of disease during winter. (**Figure 17**)

Figure 17: Problems faced before SHOUHARDO III intervention

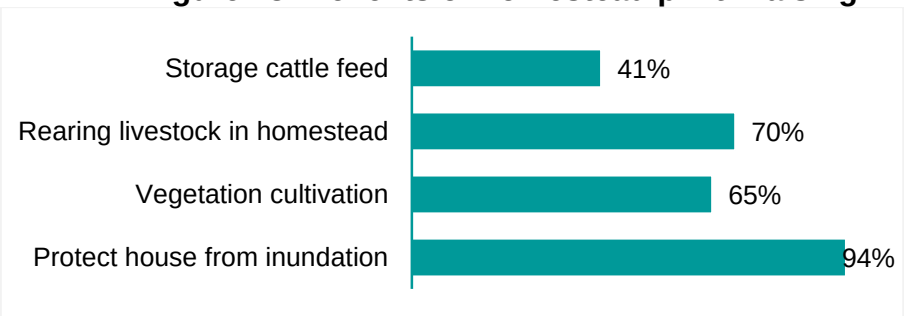


To support disaster resiliency, plinth raising was provided to low-lying houses under SHOUHARDO III. The significant benefits of the plinth raising, as per respondents, include: protection from inundation, preservation of cattle feed for times of flood crisis, the opportunity to rear livestock throughout entire year, and nutrition support due to vegetable cultivation at the homestead.

FGD participants of plinth beneficiary groups in Nageswari Upazila and Fulchari Upazila of the Kurigram district shared that homestead plinth raising increased social cohesion because neighbors could offer shelter to each other during the flood. Human and animal diseases are also decreased among households with raised plinths.

Although raised homestead plinths have multifaceted benefits, 94% of the respondents agreed that they are protected from inundation. **(Figure 18)** Household income and well-being also increased among households that raised plinths in order to improve livestock and poultry rearing and reduce the cost of treatment for water-borne diseases.

Figure 18: Benefits of homestead plinth raising

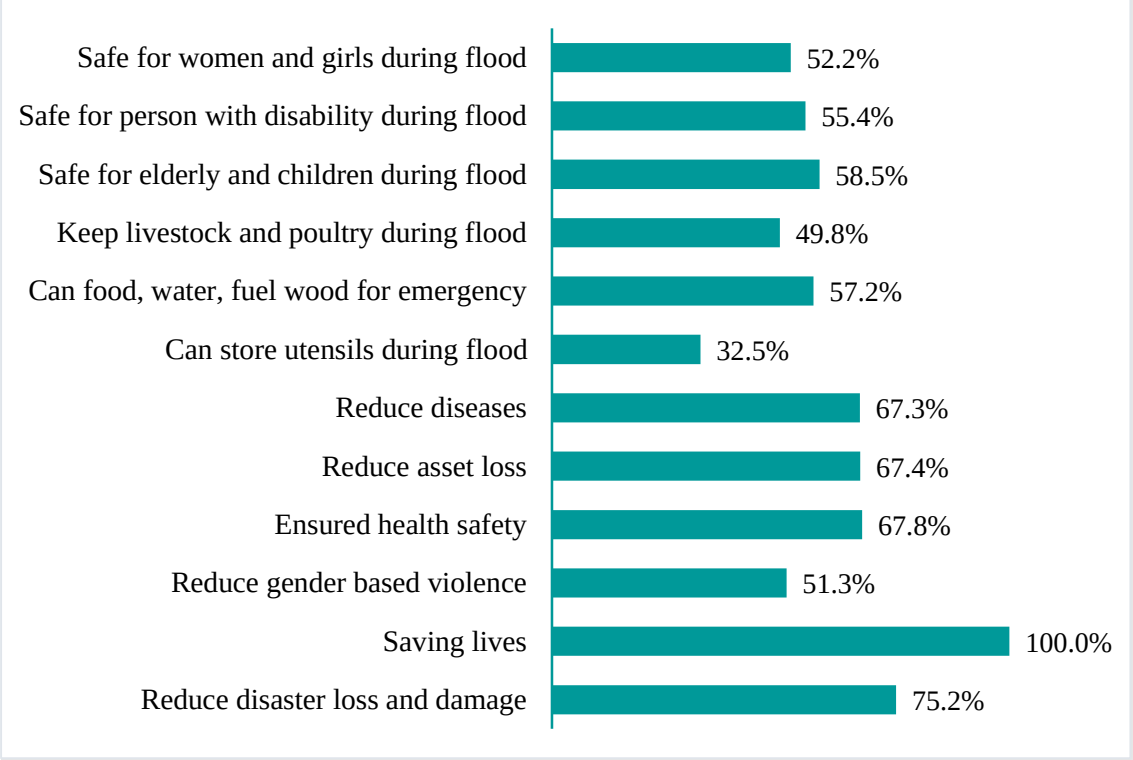


A flood shelter is a community-based intervention and disaster-resilient infrastructure. SHOUHARDO III has constructed some flood shelters in the Char regions, and there

are other flood shelters that were constructed by the government and various NGOs in both regions. Respondents from Char and Haor regions had a positive response towards flood shelters. Flood shelters have multiple benefits for flood vulnerable people, including saving lives, reducing agricultural loss, and reducing diseases. All (100%) of respondents echoed that the flood shelter had saved their lives during the flood and further, 75.2% stated that the flood shelter helped to reduce disaster-induced damage and loss. (**Figure 19**) The study learned that in the Kuti Bamandga union of Nageswari, almost 300 people had taken shelter with their livestock for three days in a nearby flood shelter during the 2020 flood.

Community members store food, fuel, wood, and fodder during times of flooding in nearby raised plinths. The Assistant Head Teacher of Natun Char Beparitari Government Primary School shared that women, children, and the elderly have access to safe shelter during flood surges in their nearby neighborhood-raised plinths.

Figure 19: Community-level benefit of flood shelter



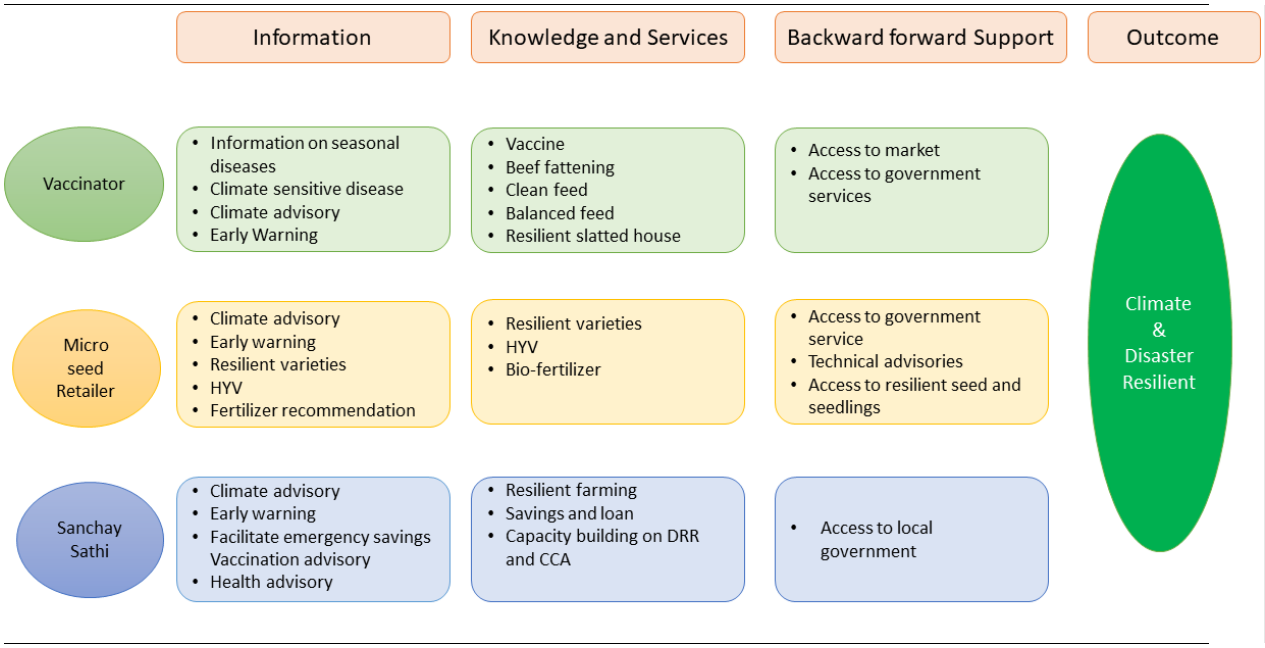
5.5. Support Services for DRR and CCA

The program has developed LSPs in areas where the government services are insufficient. For example, due to various limitations, certain government departments are not fully equipped to provide essential services. SHOUHARDO III developed the LSPs/CLFs (micro-seed retailer, vaccinator, Sanchay Sathi, DRR leaders, and more) to provide services in their localities. The program facilitated LSPs to provide climate information to the community to increase preparedness before, during, and after a disaster. For example, livestock vaccinators inform livestock owners to take risk mitigation actions (i.e., house reparations, clean feed, vaccinations). In the same way,

seed retailers give climate advisories and information on climate resilient seeds and seedlings to agricultural producers.

SHOUHARDO III also developed Sanchay Sathis (VSLA Agents) as another LSP who facilitate the collection of emergency funds in the form of a VSLA. They also provide climate advisories, early warnings, health information, and vaccination advisories in their communities to overcome climate and disaster-induced shocks. A schematic diagram has been developed based on the findings from KIIs with the micro-seed retailers, vaccinators, and Sanchay Sathis in Char and Haor regions. (**Figure 20**)

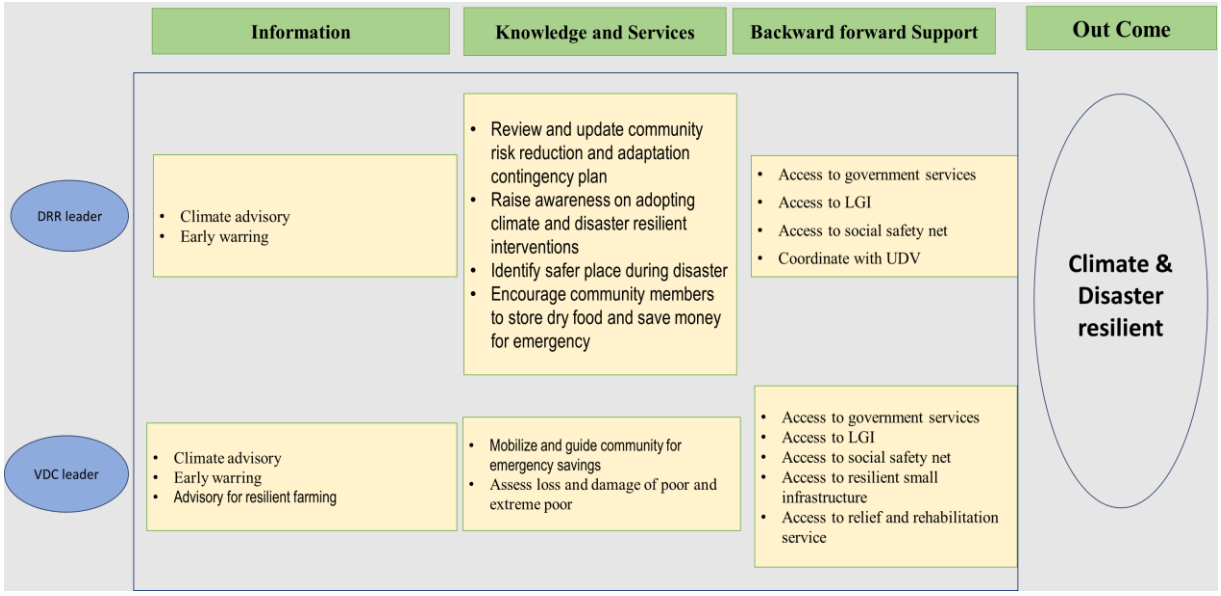
Figure 20: Schematic diagram of the contribution of LSPs to climate and disaster resilience



Source: Adapted from KIIs and FGDs with LSPs/CLFs/participants and secondary literature

The program also developed CLFs to develop climate and disaster resilient communities through information dissemination, capacity building, and linkage development with the local support system (LGI) and government agencies. Under this mechanism, CLFs (DRR leaders and VDC leaders) were developed in the program areas. DRR leaders disseminate climate advisories and disaster early warnings, review and update community risk reduction and adaptation contingency plans, raise awareness on adopting climate and disaster resilient interventions, develop linkages with LGI and government services, ensure access to the SSN, coordinate with UDV, identify safe places during disasters, and encourage community members to store dry food and save money for emergency preparation. VDC leaders support the disaster-vulnerable poor community members to access the SSN, build resilient infrastructure, receive health and family planning services, access relief and rehabilitation services of local government, assess loss and damage, and mobilize the community for emergency savings, and advise on resilient farming. (**Figure 21**)

Figure 21: Schematic diagram of the contribution of CLF to climate and disaster resilience



Source: Adapted from KIIs and FGDs with LSPs/CLFs/participants and secondary literature

In the FGD with participants from remote Char lands (including Char Rajibpur, Nageswari, Chouhali and Fulchari Upazilas), it was found that farmers receive agricultural inputs, develop better linkages with the DAE, and are introduced to flood and drought tolerant farming methods due to their association with LSPs. With the vaccinators' services, the livestock and poultry death toll has reduced drastically, which was found at Mithamain Upazila. However, because these are vulnerable and remote areas, the current number of LSPs is insufficient. There is a need for more support to develop LSPs of all sectors, especially vaccinators, to ensure sustainable services for the community; this was mentioned by the FGD participants at Char Rajibpur, Nageswari, Chouhali and Fulchari Upazilas. During the flood, vaccinators cannot travel far from their village to serve the remote communities, so more vaccinators must be developed within remote areas.

In terms of satisfaction, community members shared that they are satisfied with the support from DRR leaders. The FGD participants of Islampur and Bakshiganj Upazilas of the Jamalpur district said that the DRR leaders motivate them to use early warnings and climate advisories. They also shared that DRR leaders organize communities to raise demands to the Union Parishad (UP) and government service providers, which is highly efficient for disaster governance.

The LSP and CLF model of SHOUHARDO III has a strong potential for sustainability beyond the length of the program. This strategy means that even after the completion of program activities, participants will remain engaged with their community platforms (LSP and CLF). The FGD participants in the Char and Haor regions affirmed that they would continue their VSLA engagement beyond the length of the program because the VSLA contributes to their economic empowerment and DRR. The Sanchay Sathi

of Dowarabar Upazila of Sunamganj and Fulchari Upazila of Kurigram stated that the number of VSLAs and members of each VSLA is increasing in their community.

VDC leaders from the Kalmakanda Upazila of the Netrokona district, Rajarhat Upazila of the Kurigram district, and Islampur Upazila of Jamalpur district shared that they are working to ensure resilience in their communities. The VDC leaders also added that, with the involvement with SHOUHARDO III, they have strengthened their capacity and contributed to their communities. They are respected and will serve their communities beyond the length of the SHOUHARDO III program.

In the Haor and Char regions, five vaccinators from Mithamain, Rajarhat, Chauhali, Bakshiganj and Austagram Upazilas mentioned that vaccination is an income-generating activity that allows them to contribute to their communities by providing poultry and livestock vaccination services to the PEP. The vaccinator from Mithamain also stated that he had bought a motorbike to offer vaccines to communities outside of Mithamain. All five vaccinators shared that they will continue to provide vaccination services beyond SHOUHARDO III because this service enables them to earn income for their household and contribute to PEP in their communities. They also added that their services made them respected in their communities, and they feel a responsibility to serve.

DRR leaders work at the community and system levels, for example, helping the community with preparedness and raising demands to the UP to get DRR support. As a result of their negotiations, the communities have received various supports from the UP, such as the SSN installation of tube wells and latrines, construction of culverts, and road reparations. The community respect will inspire DRR leaders to continue their work after the program ends.

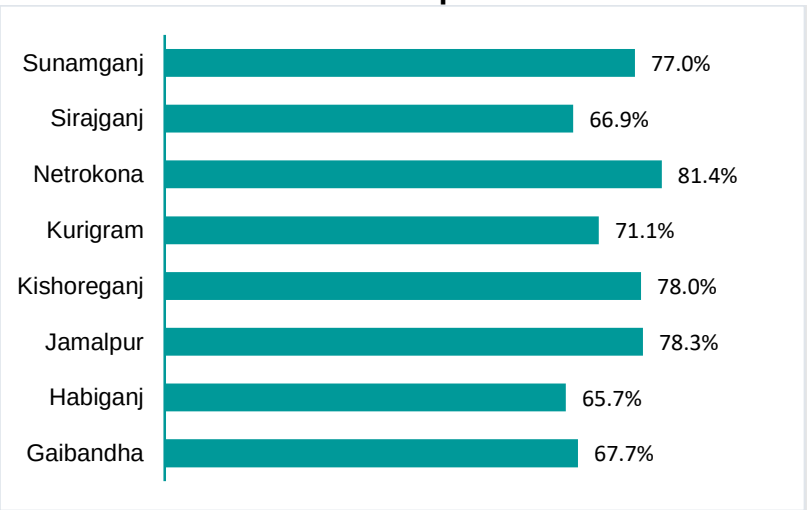
5.6. Reducing Loss and Damage by Resilient Practices

The KIIs with DRR leaders in Char and Haor found that disaster information, early warnings, and climate advisories are necessary. DRR leaders shared that they receive early warnings and climate advisories and disseminate these in their communities. As a result, climate and disaster-induced loss and damage have been significantly reduced.

The impacts of climate change and disaster are responsible for economic loss, lives and livelihoods loss, environmental loss, education loss, health loss, and more. CCA and disaster resilient interventions can reduce loss and damage. (Bhowmik eds. al, 2020) The study investigated how SHOUHARDO III has contributed to lowering agricultural loss and saving lives.

Since practicing climate-smart agriculture, livestock, and poultry rearing, 71.65% of the total respondents reported reduced production loss. It was reported by 76.3% of respondents from the Haor region and 69.9% from the Char region. The highest percentage of respondents who reported a reduced loss from implementing climate-smart practices was from the Netrokona district (81.4%), and the lowest was from the Habiganj district (65.7%). (**Figure 22)**

Figure 22: Decreased crop production loss from adopting the climate-smart practice



The study investigated the quantitative trend of decreased production loss after the respondents' implementation of climate-smart crop, livestock, and poultry production. The study found that in the Sunamganj district, on an average, the crop production loss decreased by 27.6 kg per decimal and vegetable production loss decreased by 31.6 kg per decimal. Similarly, in the Netrokona district, cattle production loss decreased by an average of 1.39 numbers per year, 1.79 goats in number per year. In Gaibandha, 0.29 sheep production loss decreased for each household each year in Sirajganj, and 8.35 poultry production loss decreased on average for each home in Netrokona **(Table 15).**

In the Mithamain Upazila, the female FGD participants shared that before SHOUHARDO III, at least an average of 10 ducks per household died from diseases every winter and summer, as communities were not aware of the need for vaccination. Now, they vaccinate their ducks every year before the winter and summer, which has resulted in increased duck production in Mithamain.

Table 15: Quantity of production loss decrease (mean)

Districts	Kg per decimal/year		Number per year			
	Crops	Vegetable	Cattle	Goat	Sheep	Hen/duck
Sunamganj	27.6	31.6	0.98	0.99	0.19	6.42
Sirajganj	15.6	17.2	1.26	1.13	0.29	5.73
Netrokona	21.6	22.8	1.39	0.85	0.16	8.35
Kurigram	12.4	8.0	1.03	1.37	0.05	5.86
Kishoreganj	14.8	6.8	1.23	1.24	0.04	6.79
Jamalpur	16.4	15.2	1.23	1.47	0.04	6.50
Habiganj	16.4	13.2	1.10	1.36	0.18	6.31
Gaibandha	14.4	12.8	1.15	1.79	0.00	4.57

Similar to the production loss trends, yearly household income loss has decreased among the households that practiced climate-smart agriculture, livestock, and poultry rearing. In the Netrokona district, the average amount of decreased income loss from

crop production for each home was $6.57 USD/year and $28.21 USD/year from hen/duck production respectively. The study extracted the yearly amount of decreased income loss from all the program districts, the calculated values are depicted in **Table 16**.

Table 16: Yearly decreased income loss after adopting climate-smart practices (Mean, USD/Year)

Districts	Crops	Vegetable	Cattle	Goat	Sheep	Hen/duck	Total
Sunamganj	6.54	13.96	374.12	62.62	9.55	25.63	492.41
Sirajganj	5.43	11.68	487.61	80.86	14.62	24.16	624.37
Netrokona	6.57	9.68	394.25	71.81	1.40	28.22	511.93
Kurigram	4.43	7.09	277.55	69.92	0.22	20.45	379.65
Kishoreganj	5.47	5.53	275.42	63.46	0.08	24.21	374.17
Jamalpur	6.15	6.87	394.63	84.08	2.36	21.28	515.38
Habiganj	3.89	4.39	277.85	67.32	0.00	12.20	365.66
Gaibandha	4.85	5.53	351.05	91.77	0.00	17.13	470.34

The brick mound protection wall also reduced economic loss, which was echoed by the participants of the FGD in Baniachang Upazila. In the FGD, it was found that almost $2,000 USD was needed each year to repair the embankment. With the mound, there is no need to pay such a large amount for the repairs.

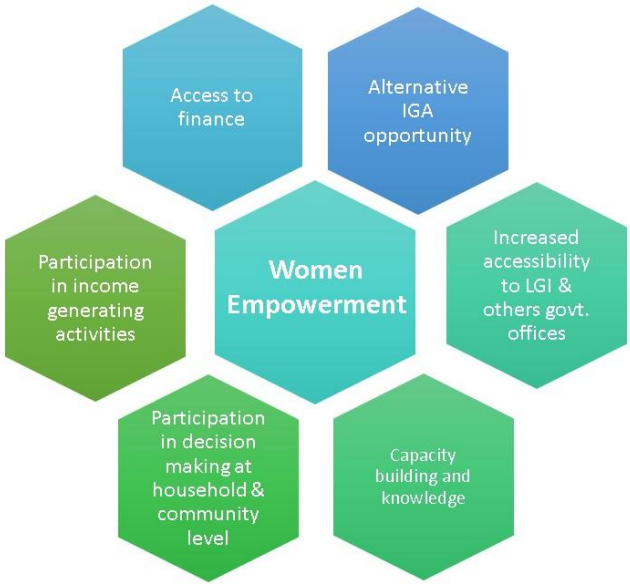
Plinth raising was another strategy that reduced loss and damage during the flood, which was mentioned by the FGD participants of Fulchair Upazila of the Gaibandha district. The participants noted that before they rose plinths, they lost household assets, livestock, and poultry during each flood. However, with the plinth raising, they are now able to save assets, livestock, and poultry from destruction during disasters.

VSLAs are also effective in reducing the economic loss for flood-affected people. Previously, flood-affected people had to depend on high-interest loans that they took out with micro-credit. However, now they can recover from emergencies using their VSLA savings, which was echoed by the FGD participants from all eight districts.

5.8. Women's Empowerment and Decision-Making Regarding DRR & CCA

Women have a significant role and responsibility to protect family members and household assets during disasters. Therefore, women's engagement in decision-making and DRR planning is highly important. (Hemachandra et al. 2017) Women are the key beneficiaries of SHOUHARDO III, and the program has contributed to women's empowerment through ensuring access to IGAs, developing linkages to the LGI and government support systems, building capacity and knowledge on disaster-resiliency and CCA, and ensuring their participation at different levels. (**Figure 23**) The development of VSLAs has had a remarkable impact on women's empowerment, including by ensuring their access to finance, supporting their involvement with alternate IGAs at the homestead level (through the provision of climate-resilient homestead gardening and resilient seeds), strengthening their capacity to seek help from the LGIs, and increasing their economic contribution to household earnings.

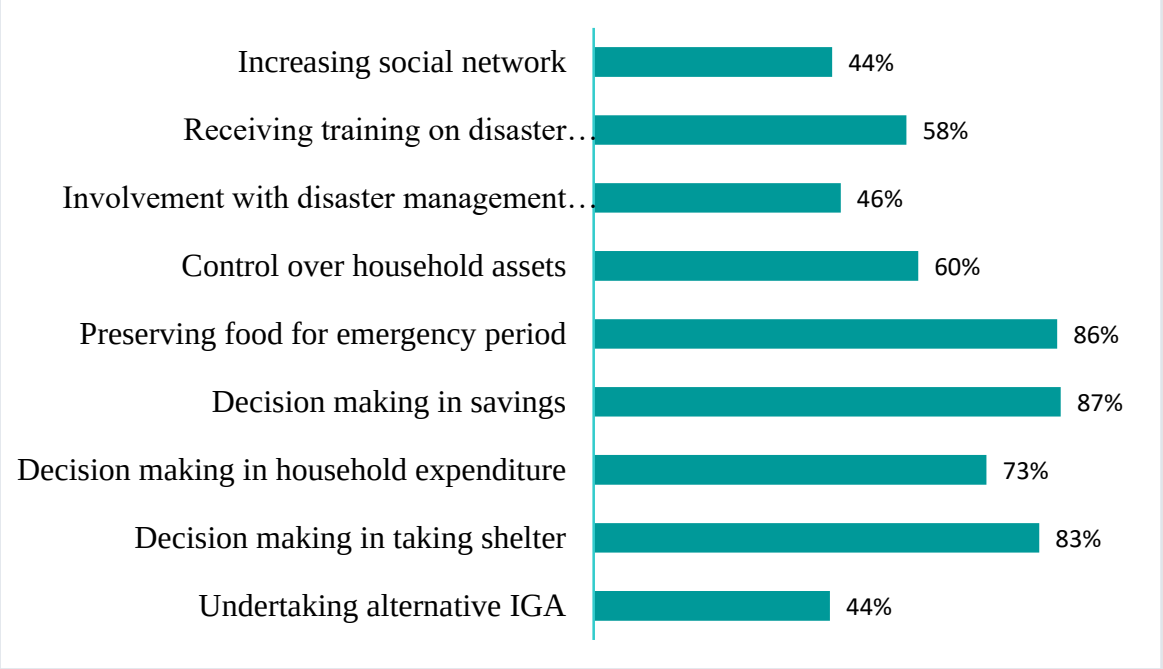
Figure 23: SHOUHARDO III's contribution to women's empowerment



In the FGD with women participants from the Char and Haor regions, the study found that women participate in climate-smart homestead gardening, sack farming, and livestock and poultry rearing. Through these interventions, agriculture-based income has increased at the household level through the active participation of women. Not only this, but women are also economically empowered and take out loans to form VSLAs, using climate-smart IGAs, such as sewing and tailoring.

Women have also begun using mobile phones to receive early warnings and climate advisories to contribute to their households and communities in disaster preparedness. VSLAs are organized and managed by women, which was found to be an effective and unique mechanism to empower women in DRR. Trainings and capacity-building interventions have increased women's knowledge of CCA and DRR, as well as facilitated community support systems such as VDCs, UDVs, and VSLAs. Women also utilize their local governments and UDMCs to receive disaster and climate resilient support. As DRR change agents, the study found that women in project areas are involved in decision-making regarding savings (87%), taking shelter (83%), and household expenditures (73%). They also take action to preserve food for during the emergency periods (86%), and are receiving training on disaster management (58%). **(Figure 24)**

Figure 24: Women's contribution to disaster and climate resilience decision making



Khadija Begum from Rajarhat Upazila of the Kurigram district shared that before SHOUHARDO III, she could not participate in household decision-making on flood shelter access during the flood which has changed now. Again, after receiving training on flood-resilient farming and vaccination advisories, she began duck rearing. By selling her ducks and eggs, she earns an average of $50 USD each month. Now she contributes to her family earnings and is involved in decision-making.

5.9. DRR and Climate Resilience Governance

Disaster governance includes the important notions of decentralization, transparency, democratization, climate resilience, disaster preparedness, and accountability of government departments and local institutions. (Jones et al., 2014) This study attempted to identify the changes in the responsibility of the LGIs and local government departments in service provision. Most respondents shared that there had been a remarkable improvement in DRR governance and access to government and LGI services. According to the percentage estimation, 86.7% of respondents (from both Char and Haor regions) expressed that they have access to the LGIs, and 60.2% shared that they have access to government departments for DRR and CCA services. **(Figure 25**) Nonetheless, this percentage was lower before the program activities.

SHOUHARDO III's support increased the UDMC's dissemination of information on climate-resilient seeds and seedlings, vaccinations for livestock and poultry, climate advisories, climate-resilient livestock and poultry rearing, WASH technology, water purification during floods, and health services during disaster periods.

Access to the UDMC, government SSN, uncultivated state-owned land, and government services has increased due to the SHOUHARDO III program activities. **Table 17** depicts the change scenario.

Table 17: DRR support from UDMC and government departments

	Char	Haor	Overall
Access to UDMC			
Before SHOUHARDO III	4.2%	15.9%	7.5%
After SHOUHARDO III	89.7%	79.2%	86.7%
Access to Government Department			
Before SHOUHARDO III	1.2%	2.5%	3.7%
After SHOUHARDO III	62%	55.4%	60.2%

The FGD participants of river bank erosion-prone Fulchari, Shahzadpur, Belkuchi, Chouhali, Char Rajibpur Upazilas shared that access to the SSN and relief and rehabilitation services was strengthened through climate-smart agricultural support, climate-resilient seed support, vaccinations for livestock and poultry, and climate-resilient livestock and poultry rearing.

Figure 25: DRR & CCA support from government departments and LGI

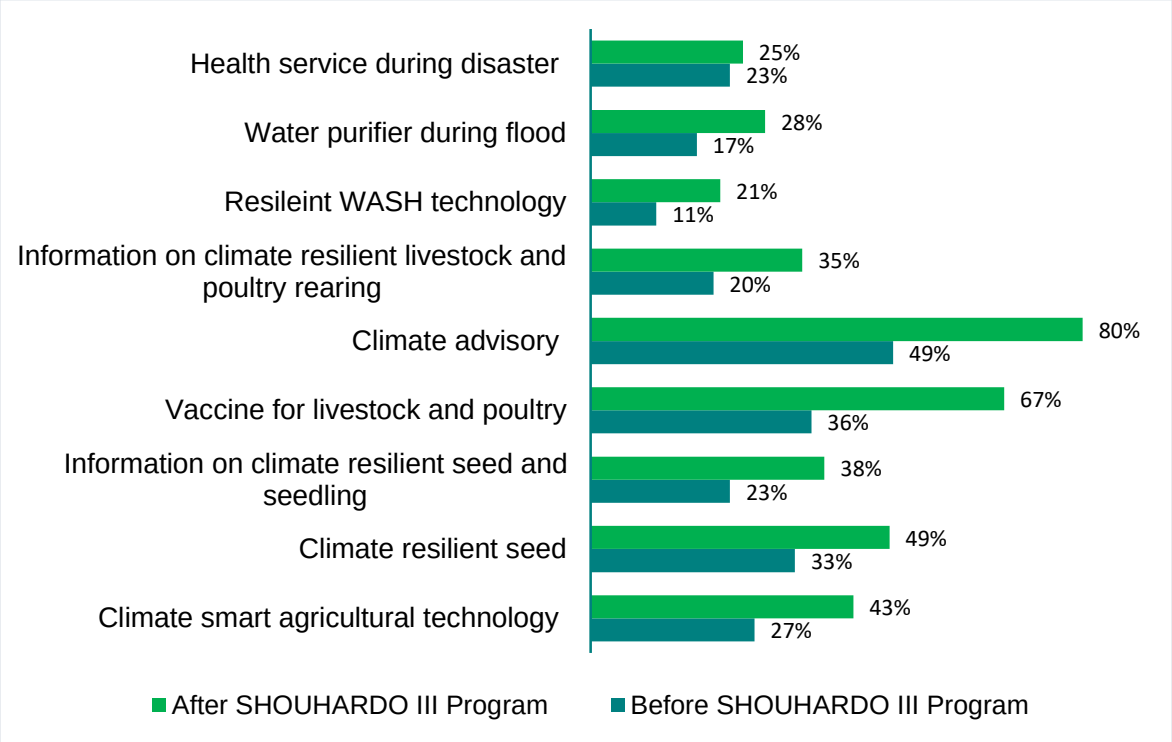


Figure 25 depicts that 80% of respondents receive climate advisory services from government departments and the UDMC. Other services that the LGI and local governments provide include climate-smart agricultural technology (43%), climate-resilient seed support (49%), information on climate-resilient seeds and seedlings (38%), vaccinations for livestock and poultry (67%), information on climate-resilient

livestock and poultry rearing (35%), climate-resilient WASH technology (21%), water purification during the flood (28%), and health services during disaster (25%).
Leaders in DRR, VDCs, and UDCs have active roles in ensuring governance and access to these supports for their community. The active participation of DRR leaders strengthens community.access to the SSN and relief and rehabilitation services.

6. DISCUSSION

The following section discusses the study findings in line with the SHOUHARDO III program activities.

6.1. Institutional Resilience

Community-based support mechanisms have been observed in the Char and Haor regions, including LSPs and CLFs, for increased agricultural resilience and DRR fund management support. During critical situations, the VSLAs formed by SHOUHARDO III are involved in community-based and women-led emergency fund management. Seed retailers supported communities by providing information and resilient seeds and seedlings to farmers, which increased production in the study area. Community members received DRR and climate resilience support for disaster preparedness, CCA, and livelihood improvement. Emergency relief from NGOs, Local Government Institutions, and government agencies has contributed substantially to enhanced community resilience. One study found that these types of community support systems are effective mechanisms for community resilience. (Islam, 2015) In the SHOUHARDO III intervention, community leaders raise awareness on the adoption of DRR and CCA practices. Kirschenbaum (2004) and Gaillard (2010) suggest that people affected by disasters are often the first to respond, using existing resources within the community to save themselves and others. In this context, the study finds that LSPs and CLFs work to protect their communities and respond first during any disaster. Community members in the study area were found to be more aware of disaster risk, climate risk, early warnings, and climate advisories, and have achieved a better understanding of what to do before, during, and after disasters to reduce economic loss.

6.2. Community Resilience

According to Kuhlicke and Steinführer (2010), social cohesion is an inherent characteristic of communities, that needs to be strengthened to promote social bonding in the field of natural hazards. The study reveals that school cum flood shelter and homestead plinth raising activities enhance community cohesion in DRR and resilience-building interventions. During the flood, it was found that the community members who did not have raised homestead plinths took shelter in nearby raised plinths to protect themselves and their livestock, poultry, utensils, and food. As a result, social kinship and cohesion increased in the community. In addition, in school cum flood shelters, community people of all ages, genders, occupations, and religions take shelter simultaneously and without discrimination. This social kinship is sustained even after the disaster.

6.3. Financial Resilience

Micro-credit organizations take advantage of disasters because of the widespread need for financial support to start over in the aftermath of disaster. (Kreibich, 2015) High interest is responsible for accelerating poverty among disaster-affected communities. VSLAs are an effective mechanism for recovering from disaster-induced loss and damage without taking on high interest rates. As a result, disaster management expenditure has reduced among the communities, and the monthly average income for the families in Char has increased to $124.95 USD and in Haor has increased to $144.30 USD. It is likely for this reason that most of the community members have access to resilient agricultural support and are also able to invest in resilience building on their own.

6.4. Infrastructural Resilience

In Bangladesh, many infrastructural interventions have been undertaken by government agencies and NGOs to protect communities from disasters such as floods, storm surges, and inundation. These interventions include homestead plinth raising, embankment construction, and polders. However, some studies reveal that embankment breaches occur at various points during the monsoon and cause damage to crops and household structures. (Gupta, 2003) In addition, cultivable lands gradually lose productivity due to enclosed embankment boundaries. (Brammer, 1990) In this study, no negative impact was found from the brick mound protection wall, a new and unique intervention for wave erosion protection in the Haor area. The brick mound protection wall should be considered an effective and sustainable infrastructure to protect homestead and home garden livestock from flooding and wave erosion. A study from Uzzaman (2014) found that raised homestead plinths positively impact the household in flood-affected areas to protect livestock, assets, women, and children. This study also found that raised plinths protect flood-affected people and their livestock, poultry, inputs, utensils, and essential documents from the flood. Considering the changing severity, along with the water height of the flood, homestead plinths and brick mound protection walls were found to be efficient during the floods of 2020.

Under SHOUHARDO III, the LGED has maintened more than 60 structures using the fund provided by the Government of Bangladesh. These structures were originally constructed under Integrated Food For Development (IFFD), Integrated Food Security Program (IFSP), and different phases of Strengthening Households Ability to Respond to Development Opportunities (SHOUHARDO) programs from CARE Bangladesh and USAID. Structures included are the maintenance of rural roads, school cum flood shelters, rural markets, UP complexes, drainage, culverts, and mound/wave protection walls. Based on increasing flood levels as an impact of climate change in the Haor area, the LGED increased the height of some mound protection walls during the maintenance of those that were inundated during the flood. During the devastating flood in June 2022, those raised mound protection walls supported the community from household inundation and erosion. Mound protection walls also improve social bonding and security, and protect the lives and assets of poor people during severe flooding. Maintenance of rural markets enhances the mobility and accessibility of PEP people to the rural markets and facilitates an improved environment for their financial activities. Maintenance of school cum flood shelters makes the structures functional

and enhances facilities for community shelter during the flood, simultaneously providing improved educational facilities for PEP children during non-crisis periods. Maintenance of rural roads and culverts improves the communication and transportation facilities where PEP farmers, school-going children, and all others benefit when transporting agricultural products and traveling to schools, health centers, markets, and other institutions. Maintenance of structures helps the PEP people to improve their adaptation and coping capacity.

6.5. Women's Empowerment

The United Nations Office for Disaster Risk (2015) found that the women who were directly involved with disaster management as members of their VDMCs protected their lives and livelihoods by their own initiative, without the intervention of government agencies or NGOs. This study found similar results. The women who are involved with VDCs, VSLAs and who are also DRR leaders, have empowered themselves to participate in decision-making with household matters, adopt disaster and climate-resilient interventions in terms of crop variety selection, take shelter during disaster, engage in IGAs, enroll their children in school, and are able to access services from the UP and LSPs.

7. RECOMMENDATIONS

Knowledge, capacity building, multi-level practices of climate and disaster resilience activities, and disaster resilient infrastructure are all crucial elements for disaster and climate vulnerable societies. (Mysiak, 2021). SHOUHARDO III has almost covered all four of these components, however it still has some key points that need to be addressed in order to promote climate and disaster resilient communities.This study thus proposes three major recommendations.

Recommendation 1: Location-specific flood early warning and climate advisory development and promotion.

Through observations and discussions with different stakeholders, it became evident that the Upazila-specific early warning system has been strengthened in the program areas. Still, this is not a fully efficient system, because early warnings and climate advisories are developed for the whole district or river basin. This is a problem, because entire districts and river basins do not inundate uniformly. Inundation depends on altitude, but there are no early warnings developed based on land-specific height. As a result, households or crop fields of a district have been submerged due to ineffective warnings, increasing mistrust in the early warning system among certain community members. Thus, a land-to-land specific early warning mechanism should be developed to be fully efficient in flood-affected communities.

Additionally, climate advisories are being developed at the national level. However, at the local level, most people are illiterate and do not understand the national language. As a result, climate advisories are not fully effective at the community level. As such, advisories should be translated into the local language.

Recommendation 2: Local level DRR mechanism sustainability
SHOUHARDO III has developed different support systems and community-led DRR mechanisms, including DRR leaders, VDCs, and UDVs. The program should provide more organized capacity building on the new risk and rescue mechanism, as well as rescue materials as they work on disaster preparedness and response. The program can engage communities in economic activities, such as developing LSPs. DRR leaders work in disaster preparedness, but no disaster rescue team exists yet. SHOUHARDO III can develop Disaster Response Teams in the program areas to ensure a prompt DRR response.

Recommendation 3: Women and adolescent-friendly sufficient flood shelters
In flood-vulnerable areas, flood shelters are essential for the community to protect themselves and their assets during disasters, but there are no sufficient flood shelter in the localities. Additionally, some other flood shelters that had been constructed by other agencies are not women and adolescent-friendly. More flood shelters should be built and repaired with women and adolescent-friendly supports, with the involvement of the LGED.

8. CONCLUSION

Focusing on two different SHOUHARDO III regions, this study has captured the effectiveness of various structural and non-structural measures to enhance community resilience regarding disaster and climate change.

In the Haor region, varying implications of the brick mound flood protection walls have been observed on infrastructural resilience. While the impact of flood and wave erosion has considerably declined, homestead-based livelihood interventions have intensified. Similarly, homestead plinth raising and school cum flood shelter interventions have been effective for disaster resilience in the Char area.

The non-structural interventions, led by community members, are influential in enhancing community resilience, including flood early warnings, climate advisories, awareness raising, household and community level preparedness and response actions, and creating community disaster contingency plans.

In both regions, the connectedness among community members during disaster periods is an inherent characteristic that establishes social resilience and cohesion.

DRR and CCA trainings are provided to the communities. Under this training, increased disaster preparedness and capacity have improved household-level food security, livelihoods, and overall well-being. By practicing climate-smart and disaster resilient activities, household income has increased, while losses and damage have remarkably decreased.

The organization of community-led and managed mechanisms such as the UDMC, VDC, and VSLA is effective and has the potential for sustainability beyond the program duration. Climate resilience is also an effective and sustainable model and is the driving force behind facilitating DRR and CCA. These community-based support

systems are working at the community level to ensure disaster resilient communities and facilitate disaster preparedness and adaptation activities. The participation of the LSPs and CLFs has been very effective and fruitful. Both of these models have efficiently engaged local stakeholders (UP, Upazila Parishad, DAE, Department of Livestock Services) by building a rapport with community members and ensuring different kinds of support. As a result, access to these services will run beyond the length of SHOUHARDO III through the continued efforts of LSPs and CLFs.

There was a focus on improving the skills of women participants, which fostered their participation in decision-making processes. DRR and CCA could also be increased with the sustainable management of climate-smart livelihoods interventions, such as resilient farming, livestock and poultry rearing, access to the SSN, and access to technology. As a result, the participation of the women participants in different activities has increased. Women's participation in disaster-resilient interventions has contributed to ensuring disaster-resilient communities, which was the core focus of SHOUHARDO III. In the future, women are expected to be capable of contributing more to their household and community with the learnings gained from SHOUHARDO III.

The SHOUHARDO III activities and outcomes will be sustained beyond the phase-out because even after the completion of the activities, program participants will remain members of their existing community platforms and may continue awareness and development activities. The participants are likely to continue their community platforms like LSPs and CLFs, as the participants have realized how the activities benefit them in many areas, including: early warnings, climate advisories, income generation through access to climate-smart farming, women empowerment, economic improvement, access to resilient WASH infrastructure, access to shelter, access to the Social Safety Net, and access to government services.

REFERENCES:

Al Mamun, A., Rokeya, B., Alam, G. M., Sheikh, A., Rahman, M., Nazirul, M., Sarker, M., Erdiaw-kwasie, M., Bhandari, H., Mallick, J., Alam, M., & Islam, A. R. M. (2022). Livelihood Vulnerability of Char Land Communities to Climate Change and Natural Hazards in Bangladesh: An Application of Livelihood Vulnerability Index. https://doi.org/10.21203/rs.3.rs-1238670/v1.

Alam, G.M.M., Alam, K., Mushtaq, S., Clarke, M.L., 2017. Vulnerability to climatic change in riparian char and river-bank households in Bangladesh: Implication for policy, livelihoods and social development. Ecol. Indic. 72, 23–32.

Ann Aschengrau, Michael R Winter, Lisa G Gallagher, Veronica M Vieira, Lindsey J Butler, M Patricia Fabian, Jenny L Carwile, Amelia K Wesselink, Shruthi Mahalingaiah, Patricia A Janulewicz, Janice M Weinberg, Thomas F Webster, David M Ozonoff (2020) Reproductive and developmental health effects of prenatal exposure to tetrachloroethylene-contaminated drinking water, Environ Sci Process Impacts, 2020, 1;22(3):555-566.

BBS (BangladeshBureau of Statistics) 2021. Estimates of Aus, 2015-16. http://bbs.portal.gov.bd/sites/default/files/files/bbs.portal.gov.bd/page/16d38ef2_2163_4252_a28b_e65f60dab8a9/Aus-16.pdf.

BBS (Bangladesh Bureau of Statistics(2017). Estimates of Wheat, 2015-16.Estimates of Wheat,2015-16,1–2. http://bbs.portal.gov.bd/sites/default/files/files/bbs.portal.gov.bd/page/16d38ef2_2163_4252_a28b_e65f60dab8a9/Wheat-16.pdf.

BBS (Bangladesh Bureau of Statistics) 2021. Estimates of Aus, 2020-21. http://bbs.portal.gov.bd/sites/default/files/files/bbs.portal.gov.bd/page/16d38ef2_2163_4252_a28b_e65f60dab8a9/2021-04-13-11-40-596a7e0bfc28d983083074c2bec703ac.pdf.

BBS (Bangladesh Bureau of Statistics) 2021. Estimates of Wheat, 20-21. http://bbs.portal.gov.bd/sites/default/files/files/bbs.portal.gov.bd/page/16d38ef2_2163_4252_a28b_e65f60dab8a9/2021-09-29-06-19-650159c5a0e6d7e1100c029383e5ddf7.pdf.

BBS (Bangladesh Bureau of Statistics) 2021. Preliminary census findings, BBS, GoB, 2021.

Brammer, H. (1990). Floods in Bangladesh: II. Flood mitigation and environmental aspects. Geographical Journal, 158-165.

BWDB (2014). Annual Flood report. http://www.ffwc.gov.bd/images/annual14.pdf.

CPD (2017). Flood 2017: Assessing Damage and Post-Flood Management. Dhaka: Centre for Policy Dialogue.

Department of Disaster Management (DDM), (2017) D-forms, 11 May 2017, DDM, GoB, Dhaka, Bangladesh.

Eckstein, D., Künzel, V., Schäfer, L., & Winges, M. (2020). Global Climate Rate Index 2020: Who suffers most from extreme weather events? Weather-related loss events in 2018 and 1999 to 2018. In Germanwatch e.V. https://germanwatch.org/sites/germanwatch.org/files/20-2-01e Global Climate Risk Index 2020_14.pdf.

Gaillard, J.C. Vulnerability, capacity and resilience: Perspectives for climate and development policy. J. Int. Dev. 2010, 22, 218–232.

Gupta, A. (2003, January). Flood and floodplain management in North East India: an ecological perspective. In Proceedings of the 1st International Conference on Hydrology and Water Resources in Asia Pacific Region (Vol. 1, pp. 231-236).

Hasan, S. N. (2014). Changes of rainfall extremes around the haor basin areas of

Bangladesh using multi-member ensemble RCM. Theoretical and Applied Climatology.

Hemachandraa, K; Amaratungaa, D & Haigha, R (2017) Role of women in disaster risk governance, Procedia Engineering 212 (2018) 1187–1194.

Islam, R., & Walkerden, G. (2015). How do links between households and NGOs promote disaster resilience and recovery?: A case study of linking social networks on the Bangladeshi coast. Natural hazards, 78(3), 1707-1727.

IPCC. (2014). IPCC Fifth Assessment Report: Climate Change 2014. In Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. https://doi.org/10.1017/CBO9781107415324.

Jakariya, Md., & Islam, Md. N. (2017). Evaluation of climate change induced vulnerability and adaptation strategies at Haor areas in Bangladesh by integrating GIS and DIVA model. Modeling Earth Systems and Environment, 3(4), 1303–1321. https://doi.org/10.1007/s40808-017-0378-9.

Jaroslav Mysiak (2021) Integrating Disaster Risk Reduction and Climate Change Adaptation for Risk-informed and Climate-smart Development, Issue-based Coalition on Environment and Climate Change Task Team on Disaster Risk Reduction and Climate Change Adaptation, September 2021.

J. Bhowmik, H. Md. Irfanullah, S. Ahmed Selim, Empirical Evidence from Bangladesh of Assessing Climate Hazard-related Loss and Damage and State of Adaptive Capacity to Address them, Climate Risk Management (2021)

Kabir, R. D. (2006). The state of char education in Bangladesh: Focus on selected chars of Gaibandha district. Asian Affairs, 28(3), 5–24.

Kirschenbaum, A. Generic sources of disaster communities: A social network approach. Int. J. Sociol. Soc. Policy 2004, 24, 94–129.

Kreibich, H., Bubeck, P., Van Vliet, M., & De Moel, H. (2015). A review of damage-reducing measures to manage fluvial flood risks in a changing climate. Mitigation and adaptation strategies for global change, 20(6), 967-989.

Kuhlicke, C., & Steinführer, A. (2010). Social capacity building for natural hazards: A conceptual frame. EC CapHaz-Net Project Research Report.

Mallick, D., & Hossain, Z. (2019). Climate change, food security and our vulnerability. The Daily Star. https://www.thedailystar.net/environment/climate-change/news/climate-change-food-security-and-our-vulnerability-1800865, 17 September, 2019.

Md. Nazrul Islam, S. T. (2021). Climate Change Impact and Comprehensive Disaster Management Approach in Bangladesh: A Review. Springer Climate .

Md. Rabi Uzzaman (2014) Homestead Plinth Raise: An Effective Means of Adaptation to Climate Change: A case study, PKSF, 2014.

Mohammad, S., & Huq, S. (2016). Community based disaster management strategy in Bangladesh: Present status, future prospects and challenges. European Journal of Research in Social Sciences, 4(2), 22–35. https://www.idpublications.org/wp-content/uploads/2016/03/Full-Paper-COMMUNITY-BASED-DISASTER-MANAGEMENT-STRATEGY-IN-BANGLADESH.pdf.

NAPA (2005) National Adaptation Plan of Action, Ministry of Environment and Forest, GoB, Dhaka

National Disaster Response and Coordination Center (NDRCC) (2017) NDRCC Report, 23 October 2017, NDRCC, MoDMR, GoB, Dhaka, Bangladesh.

Rahaman, M. A; Chakraborty, T. R; Bijoy, M. R; Kayes, A. S. M. I & Rahman, A (2019) Climate Information Services and Its Potential on Adaptation and Mitigation, Local Adaptation Plan of Action (LAPA), Intended Nationally Determined Contributions (INCD) and Bangladesh Climate Change Strategy and Action Plan (BCCSAP): Experience from Flood Affected Regions of Bangladesh accepted for the Handbook of Climate Services, Springer, 2019

Rahaman, M. A., & Rahman, M. M. (2021). Climate Justice and Food Security: Experience from Climate Finance in Bangladesh. Environmental Policy: An Economic Perspective, Wiley Blackwell

Relifweb.(2021) Bangladesh : ClimateProjections. https://reliefweb.int/report/bangladesh/bangladesh-climate-and-disaster-risk-atlas-exposures-vulnerabilities-and-risks.

Samantha Jones, Katie J Oven, Bernard Manyena, Komal Aryal (2014) Governance struggles and policy processes in disaster risk reduction: A case study from Nepal, Geoforum, Volume 57, Pages 78-90, 2014.

Samsuzzaman, M. (2018). Impact of Flood and River Bank Erosion on Livelihood Pattern: A Case Study on Brahmaputra River Bank at Sakhahati Char in Kurigram, Bangladesh. https://doi.org/10.13140/RG.2.2.21247.76962

Sattar, M. A., Biswas, A. A. A., Islam, M. T., Hossain, M. A., Siddeqa, M., Rahim, M. A., Amin, M. N., Touhiduzzaman, M., Rahman, M. A., & Aktar, S. (2020). Disaster vulnerability and mitigation of humanitarian issues in coastal Bangladesh: Local evidence and knowledge gaps. Progress in Disaster Science, 8, 100138. https://doi.org/10.1016/J.PDISAS.2020.100138.

Shamsuddin Shahid (2012), Rainfall variability and changes in Bangladesh during the last fifety years, Geoscience, 2012

Suman, A., & Bhattacharya, B. (2015). Flood characterisation of the Haor region of

Bangladesh using flood index. Hydrology Research.

TANGO. (2020). Five Rounds Longitudinal Study Report. April, 49.

The United Nations Office for the Disaster Risk Reduction (2015), Women's Leadership in Risk-Resilient Development: Good Practices and Lessons Learned, United Nations Office for Disaster Risk Reduction (UNISDR) Asia & Pacific Office - Bangkok, Thailand, 2015.

World Bank, 2013: Warming Climate to Hit Bangladesh Hard with Sea Level Rise, More Floods and Cyclones, Washington DC