

# Resilience through Disaster Risk Reduction Initiative: A Case Study on Disaster Resilient Habitat in Coastal Region of Bangladesh

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## ABSTRACT

Due to spatial geomorphological and climatological conditions, Bainpara is susceptible to tropical cyclones along with tidal surge. Most adverse effects of climate change are anticipated here in the form of extreme weather events like tropical sea cyclones along with tide flow. The study area is carrying a huge burden of population as compared to its resource potentialities and employment opportunities. Cyclone Aila hit the south-western coast of Bangladesh leading to large scale damages to lives, infrastructures, livelihoods and economy of the area. Moreover, weak economic condition along with inadequate infrastructure and higher dependency of natural resources in this area makes the situation more vulnerable. Within this context, CDMP-II has come forward to rebuild the community with the new concept of Disaster Resilient Habitat (DRH)-Bainpara Model Village (BMV). This research investigates the multifaceted relationship between resilience and disaster risk reduction (DRR) in the context of coastal Bangladesh, highly vulnerable to climatic disasters. Employing a mixed-methods approach involving quantitative and qualitative techniques, this study explores how localized DRR strategies influence community resilience in disaster-prone habitats. Primary and secondary data was collected to meet the objective of the study. However, primary data has been collected through questionnaire survey, Focus Group Discussions (FGD), Key Informant Interview (KII) and case study. Relevant published and unpublished document has been analyzed in brief for collecting secondary data. The research assesses community vulnerability to hazards such as cyclones, tidal surge, coastal erosion, water logging and salinity intrusion as well as explores the adaptive capacities of households and communities. Central to this inquiry, identification of effective DRR practices can mitigate disaster risks and improved livelihoods, ultimately leading to sustainable development. It is evident that implementation of BMV bring positive changes in the lives and livelihood for the beneficiaries of the BMV. It is revealed that DRH holds significant promise for protecting poor and excluded people against current and future weather extremes and tackling increasing levels of risk and vulnerability. It is found from the study that the community of BMV transformed themselves from being vulnerable victims of disasters to examples of resilience. It is now the reality that BMV project provides a sustainable solution, which tackle up deep-rooted disadvantage of coastal poverty and underlying vulnerability of the community. This could be the example of Build Back Better (BBB) the fourth priority of Sendai Framework for Disaster Risk Reduction (SFDRR) 2015-2030 after Hyogo Framework for Action (HFA) 2005-2015. The findings highlight the importance of community involvement, incorporating local knowledge and considering socio-economic factors in shaping resilience outcomes. Moreover, the research underscores the necessity for inclusive policies that align DRR and CCA efforts, ensuring sustainable development in vulnerable coastal regions. It is expected that this study will contribute to the growing body of literature on disaster management, providing actionable insights for policymakers, development partners and practitioners working for strengthening resilience in similar contexts. BMV-the DRH model could be replicated in another vulnerable coastal areas as this represents a positive change in the lives and livelihood of the community.

**Key words:** Vulnerability, DRR, CCA, DRH, BMV, Resilience, Livelihood, Sustainable Development.

## BACKGROUND

Geographically, coastal region of Bangladesh is vulnerable to climate change, faces threats from tropical cyclones, tidal surge, coastal erosion and saline intrusion (World Bank, 2006; Ahmed et. al., 2019).

Livelihoods of the community mostly depends on the climate as the area is home to diverse ecosystems. The study area Bainpara is a village situated on the conjunction of the river Sutarkhali on the east and the Nalian on the west. This village is adjacent to “Sundarban” and under the administrative boundary of Sutarkhali Union under Dacope Upazilla of Khulna District. Due to the presence of the Bay, this area is prone to tropical cyclone along with tidal surge and water logging. However, Bainpara is carrying a huge burden of population as compared to its resource potentialities and employment opportunities. Due to spatial geo-morphological and climatological conditions, marginalized coastal community is likely to become one of the worst victims of climate change (Hossain and Khan, 2023). Moreover, higher incidence of poverty in the coastal area makes the situation more vulnerable. Most adverse effects of climate change are anticipated in the form of extreme weather events like tropical sea cyclones along with tidal surge. On 25 May 2009, Cyclone Aila hit the south and southwest coast of Bangladesh badly leading to large scale damages to crop, employment, livelihoods and economy of the area. It devastated 80% habitat, livelihood options, and infrastructure as well as water and sanitation facilities of the Bainpara village (CDMP, 2013). Inhabitants of Bainpara village are especially vulnerable to climate change because of their geographic exposure, low incomes and greater reliance on climate sensitive sectors, particularly agriculture and fishing. Here, people exposed to the most severe climate-related hazards. They were gradually recovering from the long-term impact of category-4 cyclone Sidr (2007) but again set back to previous position due to Aila. Coastal community often not able to cope with the associated impacts of hazards, due to their limited adaptive capacity. In this situation, Climate change Adaptation (CCA) measures are needed to escape from the disastrous event.

It is found from a report of CDMP-II that 208 families of Bainpara village had to seek shelter either on embankment or by fleeing to cities (CDMP, 2015). It also came to know from the report that Union Disaster Management Committee (UDMC) prepared a list of 84 affected and destitute families. However, 26 families have migrated from the area as there was no safe habitat and livelihood opportunity left with them. It is believed that safe housing is one of the main pillars of Disaster Risk Reduction (DRR). In this situation UDMC finalized 58 families who are in need of home assistance for their living and disseminated the information to Upazilla Disaster Management Committee (UzDMC). Getting the formal information from UzDMC, District Disaster Management Committee (DDMC) consulted the issue with the authority of Comprehensive Disaster Management Programme (CDMP-II) for providing the safe housing of the said 58 families (CDMP, 2015). Within this context, CDMP-II has taken initiative to rebuild the community with the new concept of Disaster Resilient Habitat (DRH). Here people are considered at the center of development and planning. Now Bainpara Model Village (BMV) is the reality under the DRH concept with whole of community approach. However, CDMP-II was a programme run by the Ministry of Disaster Management and Relief of the government of Bangladesh and 06 foreign Development Partners (DP). CDMP-II took a pilot project for the severely affected 58 families to provide Disaster Resilient Habitat, which is cognizant of cyclone risks, tidal surge and salinity. Finally, a Disaster Resilient Habitat-BMV has been established with the combined effort of all involved including local public representatives, GO, NGOs and DPs. BMV transformed lives of the rehabilitated people of Bainpara through positive changes in the lives and livelihood. This is not only changing the lives of the beneficiaries of the BMV but also inhabitants of the adjacent area. However, the initiatives aligned with Sendai Framework for Disaster Risk Reduction (SFDRR) 2015-2030. Poverty, inadequate infrastructure, and limited access to essential services and decision-making process twisted the marginalized coastal community like an octopus. These challenges exaggerate the impact of disasters, making resilience a crucial focus for sustainable development. However, community participation in disaster resilience is crucial as local populations possess valuable traditional knowledge and experience that can inform ecological and architectural strategies for developing resilient habitats (Azad et. al, 2020). Furthermore, increasing frequency and intensity of extreme weather events necessitate for resilient habitat, schools, hospitals and roads. However, climate-resilient technologies blended with local and modern knowledge need to be developed and demonstrated for the economic empowerment of vulnerable coastal community and DRR to make development sustainable (Nasreen et. al., 2023). However, resilient habitat refers to living spaces designed to withstand and adapt to changing climatic conditions. This study investigates structural and nonstructural solutions that contribute in establishing resilient habitats. In connection with this, understanding governance role is essential in facilitating the development of resilient habitat. However, analyzing existing policies is crucial for disaster management, which provides insight into existing frameworks. There is a need for focused research on the practical aspects

of resilient habitats, specifically regarding community-led initiatives and sustainable practices in the context of coastal Bangladesh while numerous studies exist on disaster management.

It is found that total land area of the BMV (7.40 Acres) has been developed up to 3.5 ft height considering the highest water level during “Aila” as part of the structural measure. Each of the 58 families of BMV project got 6 Decimals land along with one cyclone resilient house having the capacity to withstand 260 Km/hr wind speed, solar panels for providing lights through 2 bulbs at night as well as charging option for mobile and watching TV as well. Each household has been facilitated with Rain Water Harvester with the capacity of 3000 liters water and sanitary latrine for ensuring hygiene as well as improved cook stoves made of concrete having system to exhaust smoke (CDMP, 2015). It is believed that a community will be better protected when the structures are more resilient to the impacts of disasters and climate change. If a project takes into the account of a community’s aspirations, needs and capacities, and includes analysis of the full range of hazards it faces, it is more likely to lead to community ownership of activities and to more sustainable outcomes (Gaillard, 2021). It is also coming to know that all participants actively engaged and took ownership of the BMV building process from the very beginning towards resilience. However, the fighting spirit of the 290 people of 58 families in constructing disaster resilient village was remarkable (CDMP, 2015). Here, local people become a respected part of decision-making processes. Their unique perspective is taken into account in the planning and implementation of actions. It is believed that a DRR initiative could increase resilience when a project is designed and operate in a community-centered manner. From the study it is also realized that appropriate planning and implementation are vital for the socio-economic improvement of the at-risk community. It is expected that this original piece of work will help in advancing theoretical frameworks on resilience and DRR initiatives specific to coastal settings. This research provides actionable recommendations for policymakers, development partners and local communities for developing disaster-resilient habitats. Finally, this research can serve as a knowledge base for future research on integrating local insights into formal disaster management practices.

## CONCEPTUAL FRAMEWORK OF THE STUDY

### Disaster Risk Reduction (DRR)

DRR is multidisciplinary in nature recognizing the importance of links in between the hazards and wider environment (Wisner et.al, 2004). DRR is defined as the concepts and practice of reducing disaster risk through systematic efforts to manage the causal factors (UNISDR, 2016). DRR is characterized by tackling vulnerability to natural hazards and extremes. It encompasses strategies and interventions aimed at minimizing risks, enhancing preparedness, and improving recovery processes through proactive initiatives, including risk assessment, early warning systems, and community preparedness. It assists in reducing vulnerability and impact of hazards, thereby protecting lives and livelihoods. It is believed that successful DRR creates resilient communities through development initiatives (DFID, 2005).

### Climate Change Adaptation (CCA)

Climate change is one of the most significant economic, social, developmental and environmental challenges. CCA is characterized by tackling vulnerability to changing distribution of extreme climatic events. It is an adjustment in natural or human system in response to actual or expected climate stimuli, which moderates harm or exploits benefit opportunities (IPCC, 2007). CCA is critical in enhancing community resilience against climatic hazards such as cyclones and tidal surge.

### Resilience

Resilience is the ability of individuals, households and communities to resist, absorb, adapt, recover and to manage change by maintaining or transforming living standards in the face of shocks or stresses, without compromising their long-term prospects. Building resilience is an ongoing and never-ending process that should be a priority for all development and humanitarian actors. However, resilience building requires a multi-faceted approach, which includes different dimensions such as economic, social, and environment.

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## Hazard

Hazard is an extreme geophysical event that is capable of causing a disaster (Alexander, 2000). Ariyabandu (2003) defined “Hazard” as the probability of the occurrence of a dangerous phenomenon at a given place within a given period of time. Natural hazards become disasters if they bring a serious disruption in functioning of a community or a society causing widespread human, material, economic or environmental losses that exceed the ability of the affected community to cope using its own resources (UNISDR, 2007). For example, climatic hazards like flood, cyclone, drought, storm surge etc. are meteorological risk but these turn into disasters when the structural and non-structural infrastructures of affected area are too shabby to cope with these risks (Bhatti, 2003).

## Vulnerability

Adger (2006) and Gallopi'n (2006) stated vulnerability, as a combination of sensitivity, exposure and response capacity. However, capacity of response is the system's ability to respond to or cope with the disturbance (Akter and Mallick, 2013). Vulnerability is defined as the degree of susceptibility to a hazard, or the lack of capacity to absorb the impact of a hazard and recover from it (Ariyabandu, 2003). Vulnerability also refers to a set of prevailing and consequential conditions which adversely affect the ability of a person, group or community to prevent, mitigate, prepare for and respond to hazardous events and recover from impact of natural hazards (Bhatti, 2003; O'Brien *et al.*, 2006). It is related not only to physical factors, but also to a range of social, economic, cultural and political factors (Ariyabandu, 2003).

## Disaster

Generally, disaster is described as combination of hazard and vulnerability. Therefore, a disaster is an outcome of a hazard impacting on vulnerable populations. Hazard is not a disaster unless there are vulnerable populations who do not have the capability to combat it and who are unable to cope with it. UNDP (2007) described disaster as a function of the risk process. It is the combination of hazards, conditions of vulnerability and insufficient capacity or measures to reduce the potential negative consequences of risk. Disasters are the situations that really require mobilization of resources according to the local need for effective response. (Yamin *et al.*, 2005).

## Household

Economic decision-making units sometimes called Households (Ekejuba, 1984), that is, those who share common eating arrangements which coincide with production units. Some income opportunities provided them with better quality of life including capital, rare skills, or costly physical infrastructure. Each household makes a choice or is constrained to take up one or more income or livelihood opportunities. However, some households have better choice than others that qualifies them for a better life.

## Livelihood

Livelihood is the combination of resources utilized and activities undertaken for living (DFID, 2002). Additionally, it is the sum of the income opportunities of its constituent. Here, resources basically consist on land, water (natural capital<sup>1</sup>); road networks, embankment (physical capital<sup>2</sup>); personal skills and experiences (human capital<sup>3</sup>); savings (financial capital<sup>4</sup>) and social bond and cohesion (social capital<sup>5</sup>). Activities mean

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<sup>1</sup> The natural resources stocks from which resource flows useful for livelihoods are derived (i.e. land, water, wildlife, biodiversity, environmental resources).

<sup>2</sup> The basic infrastructure (transport, shelter, water, energy and communications) and the production equipment and means which enable to pursue their livelihoods.

<sup>3</sup> The skills, knowledge, ability to labour and good health important to the ability to pursue different livelihood strategies.

<sup>4</sup> The financial resources which are available to people (whether savings, supplies of credit or regular remittances or pensions) and which provide them with different livelihood options.

what people do for income to survive based on these resources. Some households structure their income opportunities in such a way that avert the risk of threatening events by employing coping mechanisms and adaptation strategies for their survival.

## Community

There are two philosophical definitions of community. One school of thought defined community as "people from same group of profession, cast or religion madding up the community". The other thought is "people living in one geographical area with more or less same economic condition consist of a community". The second thought is more appropriate in terms of development and disaster management practice. Communities have the potential to function effectively and adapt successfully in the aftermath of disasters (Norris *et al.*, 2008). It is stated that having no other choice economically, the poor stayed in coastal area by knowing the risk (Cannon, 2014). They are the first people who were affected by any disaster and the first group of people who responded first. Scholars emphasize interconnectedness of DRR and CCA in building resilience, particularly within communities vulnerable to climatic disasters. Integrating DRR and CCA is vital for fostering resilience within communities. Disaster management initiatives will be successful if hazards, vulnerability, and livelihoods at the individual, household and community levels could be addressed properly.

## Scope of the study

- The study integrates the concept of disaster resilient habitat and particularly the available options such as provision of training for disaster risk reduction as well as livelihood support by providing funds along with specific training.
- The research concentrated on specific coastal regions of Bangladesh known for their vulnerability to natural disasters, allowing for in-depth case studies and localized analysis.
- The study has been completed by involving diverse fields such as environment, structural and nonstructural measurers to provide a holistic understanding of disaster risk and resilience.
- The research actively engaged with local communities to captures indigenous knowledge and perspectives.
- Examination of existing disaster risk reduction policies assessed the effectiveness and identify potential areas for improvement.
- The research examined factors such as structural integrity, community involvement and accessibility to resources with aim to identify best practices that align with local needs and geo-environmental contexts.
- Longitudinal approach has been taken to assess changes over time regarding community resilience, policy impacts and the effectiveness of disaster risk reduction initiatives.
- Focusing on specific case studies, the research considers how findings and recommendations can be scaled up to other vulnerable coastal regions in similar contexts.
- The research pursues not only contribute in academic discourse but also provide actionable strategies that enhance disaster resilience, promote sustainable development and ultimately protect communities vulnerable to disasters.

## Rationale

- The purpose of this study is to investigate the effectiveness of the concept of Disaster Resilient Habitat whether it can assist in enhancing the adaptive capacity of coastal communities in the face of climate change effect or not.
- The arguments concerning vulnerability of coastal communities and their livelihoods is assessed and the concept of adaptive capacity was critically evaluated.
- The community of Bainpara was chosen based on the proposition of the community who are vulnerable to climate change impacts and depend on primary natural resources to sustain their livelihoods.
- Coastal Bangladesh is vulnerable and prone to frequent and severe natural disasters so understanding the underlying factors contributing to vulnerability and resilience is critical.

<sup>5</sup> The social resources (networks, membership of groups, relationships of trust, access to wider institutions of society) upon which people draw in pursuit of livelihoods. (Source: DFID, 2002)

- Sustainable and resilient habitat designs are critical for minimizing risk and safeguarding communities' lives and livelihoods as climate change exacerbates natural hazards.
- The aim of the research is to identify best practices that contribute to sustainable living in disaster-prone areas.
- The research seeks to integrate adaptive strategies of traditional knowledge and experiences with effective disaster risk reduction approaches for better outcomes.
- The study aims to provide evidence-based recommendations for enhancing overall disaster resilience.

The research emphasizes the interconnection between disaster risk reduction, resilience, and habitat design in the context of coastal Bangladesh. Finally, the study aims to contribute to the broader discourse on disaster resilience in coastal Bangladesh

## LITERATURE REVIEW

There have been a number of studies regarding resilience building in facing disaster on different aspects. There is growing evidence that climate change is increasing the frequency and intensity of climate-related hazards, exacerbating levels of vulnerability of the poor and excluded people (IPCC, 2007). It is found that disaster poses multiple threats to economic growth and sometimes limits the poverty reduction initiatives (ADB et al., 2003; Stern et al., 2006). Poverty and social impacts, though generally not well-understood, are likely to be profound and will impact humans through a variety of direct (changes in climate variables) and indirect pathways (Heltberg et al., 2008a). Indirect pathways include pests and diseases; degradation of natural resources; food price hike and employment risks; displacement. Risks and uncertainties, often associated with seasonality, are typically embedded in agricultural practices. It is realized that reliance on subsistence agriculture means that the impact of climate shocks and stresses are likely to have negative implications for their food and livelihood security, human capital and welfare. For this the community needs to be supported by institutional structures that are charged with ensuring their welfare. Devereux (2006) looked at Social Protection through a Livelihoods Lens. O'Brien and O'Keefe (2014) mentioned CCA measures might be taken beyond fragmented response in order to achieve resilience. However, this study examined relevant literature on cyclone resilient shelter to get the right direction in analyzing the effectiveness of Bainpara Model Village (BMV). People of Bainpara often have considerable experience of coping and risk management strategies, which need to be built upon in developing more resilient livelihoods. There is growing recognition of the potential role of social protection as a response to the multiple risks and short and long-term shocks and stresses associated with climate change. Stern (2008) argues that social protection could become one of the priority sectors for adaptation in developing countries. Cyclone Aila (2009) devastated almost everything of Bainpara including habitats and livelihood bases. The whole of community approach has come into forth where community is considered as nucleus. Luna (2014) emphasized on community based DRR. Active participation of all community members is important in this regard. However, gender aspect is critical in reducing risk of disaster (Fordham and Meyreles, 2014). Participation is the collective action by the various strata of people or interest groups (UN, 1970). Community participation is a dynamic group process in which all members of a group contribute, share or are influenced by the interchange of ideas and activities toward problem-solving or decision-making (Banki, 1981 cited in Samad, 2002). The core of community participation is the exercise of 'voices and choices' of the community and the development of human, organizational and management capacity to solve problems as they arise in order to sustain the improvements made over the time (Sastry, 2001). The Asia Pacific Regional Human Development Report 2016 declared People should be at the center of planning and the 2030 agenda pledges to leave no one behind. Collins (2009) emphasized on development, which will be disaster resilient. However, there are still considerable knowledge gaps in implementing DRR project. In this situation, appropriate action is needed for bridging the identified gaps by which DRR will be achieved (Gaillard and Mercer, 2013). The study intended to analyze the effectiveness of the Bainpara Model Village (BMV) project.

### Objectives of the Study

1. To evaluate the effectiveness of DRH approach on enhancing community resilience in coastal Bangladesh to withstand cyclone and associated tidal surge.

2. To analyze the socio-economic and environmental vulnerabilities in disaster-prone areas, and how these vulnerabilities affect resilience.
3. To investigate the role of indigenous knowledge and local practices in shaping disaster preparedness and adaptation strategies.
4. To assess the existing institutional frameworks and policies related to disaster risk reduction and their influence on community resilience and adaptive capacity.
5. To examine the interplay between livelihood strategies and resilience in the face of climatic hazards, focusing on how DRR initiatives can support sustainable livelihoods.
6. To formulate actionable recommendations for improving DRR approaches and resilience-building practices in the contexts of coastal communities.
7. To contribute to the academic and policy discourse on linking DRR and CCA as essential components of sustainable development in vulnerable regions.

By achieving these objectives, the research aims to provide a comprehensive understanding of the resilience dynamics in disaster-prone habitats, ultimately contributing to more effective and inclusive disaster management strategies.

### Research questions

1. What are the primary disaster risks faced by coastal communities in Bangladesh?
2. How the disaster risks impact local livelihoods and resilience?
3. How existing DRR strategies influence the adaptive capacity and resilience of households in disaster-prone regions of coastal Bangladesh?
4. In what ways local knowledge and community participation in decision making process enhance the effectiveness of DRR initiatives in the studied habitat?
5. What socio-economic factors contribute to vulnerability in coastal communities and how those interact with DRR efforts?
6. How formal and informal institutional frameworks shape the implementation and efficacy of DRR practices in coastal Bangladesh?
7. How integration of climate change adaptation and disaster risk reduction enhance the resilience of vulnerable coastal communities?
8. What lessons can be learned from successful case studies of DRR that can be applied to improve resilience in coastal Bangladesh?

The above questions aim to explore the interconnectedness of resilience, disaster risk reduction, and community dynamics in a vulnerable coastal context.

### METHODOLOGY

This study employed a mixed method approach involving qualitative and quantitative techniques for collecting required data. The study analyzed the data collected from primary and secondary sources. Secondary data collected from the relevant books/booklets, journals, scientific articles/reports etc. published nationally and globally. The collected literatures were sorted and prioritized to get a concrete synthesis of the program and other interventions like DRR and CCA that are practiced by different nations to boost their resiliencies to climate change threats. However, secondary data has been analyzed for literature review. However, questionnaire survey was conducted for quantitative analysis. Beside this, Key Informant Interview (KII) and Focused Group Discussion (FGD) has been conducted for collecting for qualitative primary data. Several KIIs have been conducted with different officials including Deputy Commissioner (DC) of Khulna district, District Relief and Rehabilitation Officer (DRRO) of Khulna, Upazilla Nirbahi Officer (UNO) of Dacope upazila under Khulna district, Project Implementation Officer (PIO) of Dacope upazil of Khulna district and Satchidananda Biswas, Assistant Director of Shushilo NGO based on Khulna. However, DC and DRRO act as President and Member Secretary to the District Disaster Management Committee (DDMC) respectively. One FGD has been arranged by involving Chairman of Sutarkali Union Parishad, Member of Bainpara Ward under Sutarkali Union Parishad, President and General Secretary of Bainpara Model Village, 4 female and 4 male beneficiaries of Bainpara Model village. However, Chairman of concerned Union act as President of the Union

Disaster Management Committee (UDMC). Similarly, UNO and PIO act as Vice President as well as Member Secretary to the Upazilla Disaster Management Committee (UzDMC) respectively. Furthermore, one case study has been conducted for highlighting diverse coastal communities, assessing various resilience strategies and habitat adaptations. Consultation meetings were also conducted with relevant stakeholders like program staffs who worked with related tasks in Government Organization (GO) and Non-Government Organization (NGO) at district and upazila levels. Views and opinions were also collected from the beneficiaries of Bainpara Model village, whose livelihoods were affected by cyclone and associated tidal surge. Finally, impacts, limitation, challenges and potential of Bangladeshi experience in integrating DRR initiative, CCA measures have been analyzed.

**Data analysis**

Required data has been collected from the field and analyzed those by using standard statistical software to reveal standard result from the data. Other than primary data a series of documents were examined (Detailed in the reference list). Utmost importance was given for the reliability and validity of the data. The researcher was personally involved in the data collection process to ensure its quality. Triangulation method was applied for the cross check of the collected data. Then key findings from the study and some recommendations were incorporated in a separate section. In BMV, each of 58 families got cyclone resilient housing along with other sustainable facilities. Besides, 2 storied RCC structured Cyclone Resistant Shelter (CRS)-cum-primary school has been established for the people of the area though their houses can withstand heavy wind forces. Children’s easy access to education facility help the community to be updated with impending hazard information. Another time it used as Community Multipurpose Building (CMB). However, size of the most of the family is small (Detailed in Table: 01).

**Table: 01: Types of family**

Family size	Number of family	
	Sample	Percentage
Single /small	33	56.90%
Joint/Big	25	43.10%
Total	58	100%

There are female headed families also, though the number is negligible in relation with male (Detailed in Table: 02). However, all the heads of the female headed household are widow. They had to embrace this as their husbands died in earlier catastrophic disasters.

**Table: 02: Household by Gender**

Head of Household	Number of Household	
	Sample	Percentage
Female	04	06.90%
Male	54	93.10%
Total	58	100%

However, the shelter is being used as place of pre-primary school-important consideration of Disaster Resilient Habitat (DRH), community gathering and community health center as well. The pre-primary school facilitates education to the children of BMV as well as surrounding area. The pre-primary school of BMV helps to achieving the path of progress as the sound come out from the CRS-CMB with the cacophony of children. Furthermore, community market place has been created for promoting business on the entry point of the BMV for providing livelihood support to the beneficiaries of the villagers and other people as well. It is also found that there is provision of mosque, graveyard and playground, in the village premises towards healthy lifestyle of the beneficiaries of the BMV.



Beside structural, some non-structural measures have been taken for providing different types of long-term and short-term training (Table: 03 and Table: 04) towards secured livelihood. The training helped to develop skill, knowledge and attitude towards livelihood security through capacity development of the villagers as well as prepared them in facing disaster like Aila.

**Table: 03: Long-term training for livelihood support**

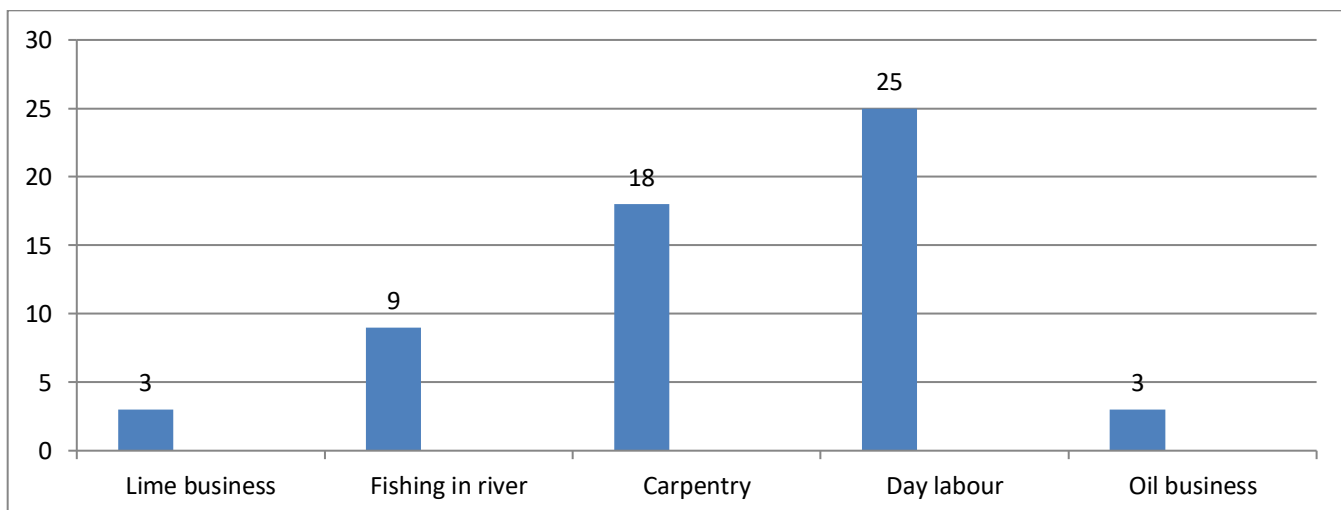
Name of training	Duration	Recipient
Paramedics	06 months	01 person
Veterinary	06 months	01 person
MLF	06 months	01 person

**Table: 04: Short-term training for disaster preparedness**

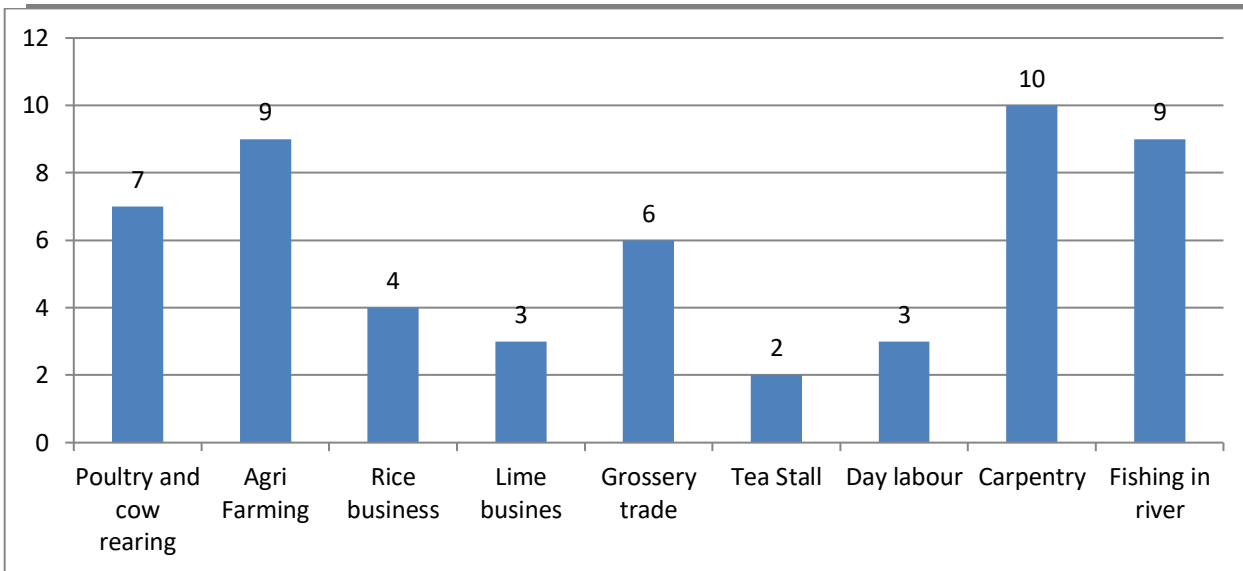
Name of training	Duration	Recipient
Early Warning System	3 days	25 persons
Disaster preparedness	5 days	25 persons
Agricultural technology transfer	3 days	25 persons
Organizational Development	6 days	25 persons

It is revealed that other than the above training at least one adult member from each household received skill enhancement training on various trades cattle and poultry rearing as well as cow fattening, homestead gardening etc. “Khandapati”-local name of vegetables and fruits production from homestead gardening help them for year-round household consumption. Moreover, they could earn some money by selling surplus products. Training was provided by Center for Natural Resource Studies (CNRS) engaged by CDMP-II. Along with provision of training each family of BMV received TK 12000 as financial assistance so that they could restore their livelihood (CDMP, 2015).

There was provision of Income Generating Activities (IGA) for livelihood support of the BMV project beneficiaries to increase the capacity of household. Before Aila the villagers had less opportunity in doing business. Most of the rehabilitated household head were engaged in laborious work (Detailed in Column Chart: 01). However, each of the 58 household of BMV actively engaged in different IGA activities (Detailed in Column Chart: 02). It is revealed that some households are able to enhance their income by strengthening or redesigning traditional income activities. However, most of them are bound to involve in second occupation as the earnings from one occupation is not enough in meeting their family needs.

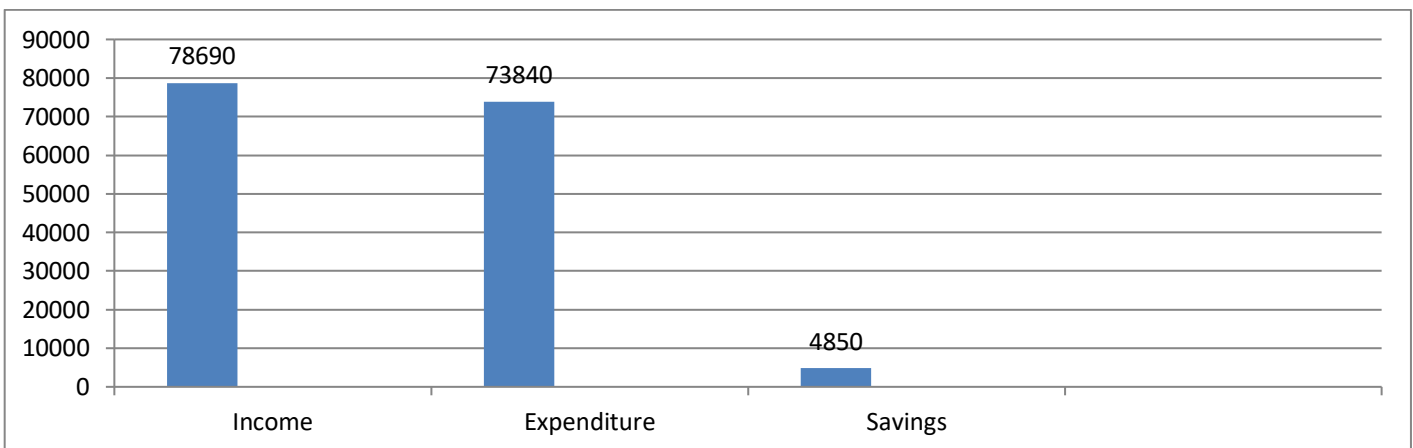


**Column Chart: 01: Occupation of the villagers before Aila**

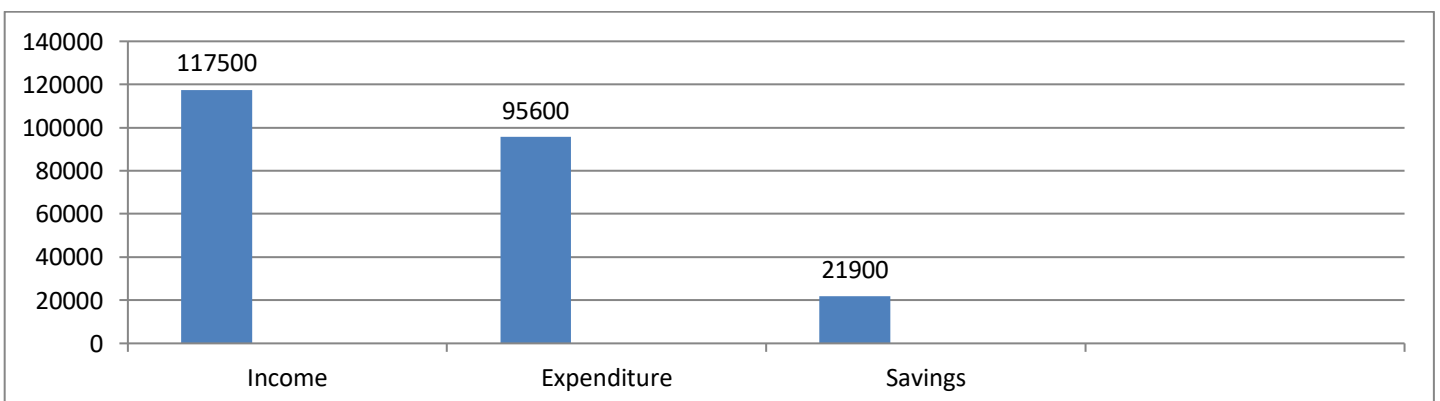


**Column Chart: 02: Occupation for maintaining livelihood after rehabilitation**

Furthermore, training provided on the enhancement of knowledge towards disaster preparedness and early warning Risk Reduction might save life in time of disaster like “Aila”. Before Aila most of the people of Bainpara have engaged with day labour activities, which was seasoned base. There was no guaranty for consistent earnings from that. Sometimes they had to migrate to cities for their earning leaving family behind. It is revealed from the statistics that rehabilitated people have diversified their livelihood options in comparison with before Aila situation. By diversifying livelihood as well as IGA activities people of the BMV project raised their income as well as savings. However, comparison has showed in Column: 03 and Column: 04.



**Column: 03: Average yearly Income-Expenditure-savings scenario before Aila**



**Column: 04: Average yearly Income-Expenditure-savings scenario after rehabilitation**

It is found from the study that most of the villagers engaged in wooden mechanic, some are doing business independently while others are making and selling bamboo and cane craft at community market place. Rests of the beneficiaries live their lives as day laborer. However, the enterprising attitude of the villagers benefited them and impacted the neighboring settlement (CDMP, 2015). It is believed that individual and community resilience could be achieved if communities and families are empowered to mitigate identified risks of disasters and understand climate change impacts. However, through different kind of assistance rehabilitated people of the BMV have gained positive change in their livelihood activities. It is found that comprehensive alternative and sustainable solutions to complement the conventional DRR have been introduced here. Finally, it could be said that a holistic DRR model applied here to build the BMV, which helps to avoid fragmenting community structures. It is found that some aged and female headed family is suffering from inconsistent livelihood pattern. They have engaged themselves in cattle rearing by which they have milk and earning some money by selling the product. They also fatten cows and rear poultry as well as cultivate “Khandapati” for their earning. They become helpless in disaster situation. So, continuous flow of Social Safety Net Programs such as Vulnerable Group Development (VGD), Vulnerable Group Feeding (VGF), Allowance for the aged, widowed and disabled, Food for Work (FFW), Provision of Employment Generation Program for the Poorest (EGPP), Test Relief (TR), Gratuitous Relief (GR) etc. are of great importance. The entire program mentioned above could be provided for the empowerment of the community as well as reduced the disaster risk at an acceptable level.

The height of the BMV project provides a second defense embankment for the villagers. In addition to that green belt has been created through plantation of different types of fruit bearing and some timber varieties as well. Commonplace is covered with 334 saline tolerant deep-rooted trees for reducing the wind pressure and each house by some fruit species, which can provide nutritional support to the beneficiaries of the project (Detailed in table: 05). However, each household is covered with 6 fruit bearing trees (naturally short in nature) so that these couldn't create another problem by breakdown on it.

**Table: 05: Planted tree species and number**

Trees for Household	Number of trees	Trees at commonplace	Number of trees
Safeda	01/HH	Coconut	75
Guava	01/HH	Neem	80
Boroi	01/HH	Chambole	85
Coconut	02/HH	Pulm	54
Lemon	01/HH	Babla	40
Total=6×58 HH	348	Total	334

Furthermore, 3 sweat water ponds have been created for the villagers (Detailed in table: 06). 2 ponds have been created at the east and west corners of the model village for bathing, washing and small-scale farming while 1 pond is preserved at the middle of the village. This is fixed for the water source of PSF, which is fixed for fulfilling the water need required for household use.

**Table: 06: Measurement and usage of pond**

Pond location	Usage of pond	Measurement	Dike height
Pond-1 situated in the east of village	Multipurpose use of the community	130×77×13.5 sqft	3ft
Pond-2 situated in the middle of the village	Water for PSF	130×113×16.5 sqft	5ft
Pond-3 situated in the west of village	Multipurpose use of the community	130×77×13.5 sqft	3 ft

It is explored that in the dry season families from the neighboring village come to collect drinking water from Pond Sands Filter (PSF) as well as household Rain Water Harvester (RWH) to meet their needs. With the availability of the safe water (free from iron and saline) the hygiene habit of the inhabitants of BMV has been improved. This is also helping to reduce the risk of overall disease burden of the community. It is found that Community Risk Assessment (CRA) has been conducted at BMV as part of the Disaster Resilient Habitat project. Furthermore, Risk Reduction Action Plan (RRAP) has been developed according to the CRA to minimize the loss and damage in the face of future disasters.

## FINDINGS

It is found from the study that the community of Bainpara Model Village (BMV) transformed themselves from being vulnerable victims of disasters to examples of resilience. It is realized that Disaster Resilient Habitat (DRH) holds significant promise for protecting poor and excluded people against current and future weather extremes and tackling risk and vulnerability lies with them. BMV-an example of DRH provides sustainable solution, which has capability to tackle deep-rooted causes of coastal poverty and underlying vulnerability of the community. However, appropriate planning, designing as well as effective monitoring and evaluation systems are critical towards resilient and sustainable development. It is evident that BMV project works with the families, women, community leaders and others to draw on their existing knowledge, increase understanding and access to information, and create safer environments for all. BMV model represent a positive change and this is the reality now. This could be the example of Build Back Better (BBB) the fourth priority of Sendai Framework for Disaster Risk Reduction (SFDRR) 2015-2030 after Hyogo Framework for Action (HFA) 2005-2015 (UNISDR, 2015). Different types of structural and non-structural measures have been introduced for resilience building in the BMV. Those are outlined below:

### Structural measures

- Considering the highest water level during “Aila” total area of the project (7.40 Acres) has been developed up to 3.5 ft height;
- Market place has been established for business promotion on the entry point of the BMV;
- Establishment of one PSF and RWH for each House Hold ensure supply of water for household use as well as pure drinking water for the beneficiaries round the year;
- Installation of environment friendly modern oven (made of concrete and having system to exhaust smoke) for each House Hold help to remove few health hazards;
- Sanitary Latrine has been installed at each House Hold for ensuring hygiene so that diseases originated from unhygienic atmosphere could be avoided;
- Provisions of electric light at night as well as charging option for uninterrupted mobile communication have been ensured by Installation of solar system;
- Two storied RCC structured Cyclone Resilient Shelter-Community Multipurpose Building has been established for the people of the area though their houses can withstand heavy wind forces;
- Provision of playground, mosque, graveyard and two ponds for bathing help the beneficiaries towards healthy life;
- Tree Plantation covering every house and common area developed a green belt, which can reduce the wind pressure of impending cyclones.

### Non-structural measures

- Provision of training on skill development that might be helpful for the livelihood security;
- Provision of training on early warning and things to do in the face of coming hazard for the enhancement of knowledge towards disaster preparedness and response;
- Provision of IGA for livelihood support so that household’s economic capacity could be increased.

### Limitations

The researcher faced the following limitations in doing the research work:

**Geographic Focus:** The findings of the study revealed facts of the study area only, not the whole cyclone affected area so this can limit the generalizability of the findings to other regions with different socio-environmental contexts.

**Access to data:** Access to comprehensive data regarding DRR initiatives, CCA strategies and disaster resilience was challenging due to time consuming communication system.

**Ethical Considerations:** Receiving informed consent and safeguarding the well-being of research participants needed to address with thoughtful and responsible approaches.

**Data analysis and interpretation:** Ensuring a nuanced understanding on DRR, CCA and resilience to disasters was challenging in data analysis and interpretation.

**Resource Constraints:** The research required careful planning to cope with available resources.

## RECOMMENDATIONS

- Height of the project area should be increased up to the embankment height so that it could be the second safeguard other than the embankment;
- Training on entrepreneurship development and practical knowhow could be given to the beneficiaries of the project for ensuring secured livelihood;
- More investments are needed in the development of human resources and the physical infrastructure that facilitates human resource-based activities;
- Promotion of business facility in the area should be the first priority;
- Provision of employment for at least one person per family under national services program for sustainable living;
- Ensure continual meaningful participation of representatives from all 58 Household in discussions and decisions making where they are directly affected;
- Special arrangement of different allowance could be taken for the aged people and widowed and person with disability who have no alternative means of living.

## CONCLUSION

The research identifies significant opportunities for enhancing community resilience through targeted disaster risk reduction (DRR) strategies. The study highlights that existing DRR policies and frameworks often face challenges in local implementation due to inadequate resources, lack of community engagement and insufficient risk awareness. However, local communities have developed innovative coping strategies and practices that enhance resilience. These include adaptive housing designs, community networks for emergency response and traditional knowledge systems. But in reality, formal recognition and integration of these practices into governance structures are often lacking. It is evident that education on disasters affairs plays an important role in building resilience. The findings emphasize the need for awareness campaigns and provision of training that empower communities to engage in DRR effectively and utilize local knowledge. The research underscores the importance of blending local knowledge with scientific and technical approaches in designing disaster-resilient habitats. Effective interventions should be context-specific, involving community collaboration in planning and execution. The ultimate goal of the research is to inform policymakers, development partners, and community stakeholders about effective methods for enhancing disaster resilience, ensuring safer and more sustainable living conditions in the vulnerable coastal regions of Bangladesh. It is possible to mitigate disaster risks and strengthen community capacities for a resilient future through collaborative efforts. However, implementation of DRR policies by allocating more resources and facilitating better coordination among government agencies, NGOs, and local communities is needed. Frameworks development for involving communities in the planning and decision-making processes related to disaster resilience through facilitation of dialogue between citizens and authorities is also important. Beside this, Arrangement of educational programs focused on disaster preparedness and resilience through training, workshops, simulation exercises tailored to community needs are essential for achieving community resilience.

This research encourages further research and documentation of successful local practices and innovations that enhance disaster resilience. Creating partnerships with universities, NGOs, and local organizations to foster collaboration in knowledge sharing is valuable. It is a must to construct disaster-resilient habitats by providing grants, interest free loans, and technical support for construction that consider local ecological conditions and traditional architectural practices. Provision of awareness campaigns by utilizing local media, social networks, and community events to disseminate information effectively to educate communities about disaster risks and resilience strategies. Furthermore, regular monitoring and evaluation of DRR initiatives and community resilience strategies must be implemented. A feedback loop should be established to assess the effectiveness of interventions and adapt strategies accordingly. It is expected that the experience of BMV would act as inspiring example of resilience building as well as build back better of SFDRR aftermath of a disaster. Finally, this DRH model could be replicated in other coastal areas for enhancing resilience towards sustainable development.

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