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World Rural Observations

MARSLAND PRESS
Multidisciplinary Academic Journal Publisher

Popularizing Early Warning Systems for Effective Ecosystem-based Adaptation among Flood-Vulnerable Communities in Bangladesh

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Abstract: Climate change has made different communities of Bangladesh vulnerable to frequent disasters like floods by threatening ecosystem. The tendency of floods has increased among the river-adjacent communities of northern parts of Bangladesh in last few years as natural and anthropogenic climate change had introduced in Hindu Kush Himalaya (HKH) regions. So, the vulnerable community people need effective ecosystem based adaptation to cope with climate change and reduce the impacts of floods. The study was conducted at two flood-prone communities located in northern Bangladesh to assess the effectiveness of the community-based flood early warning system to reduce the economic loss and to measure the system as exemplary, replicable and popular at the other flood-prone areas. Both qualitative and quantitative approach from anthropological points of view was applied in the study. The study revealed that community-based flood early warning system helped the community people to reduce their economic loss during flood. The community people were able to preserve, manage and restore their natural resources by very short time before, during and after flood. The study revealed that in 2017, the average economic loss of each household of the two communities was 38,627 BDT (Bangladeshi Taka). After initiating the flood warning system, the loss of flood 2019 reduced to 17,859 BDT (Bangladeshi Taka). The study suggested that the community based flood early warning system should be popular among other communities and regions of HKH as effective ecosystem-based adaptation technique to reduce flood loss.
[Md Ashik Sarder. **Popularizing Early Warning Systems for Effective Ecosystem-based Adaptation among Flood-Vulnerable Communities in Bangladesh.** *World Rural Observ* 2020;12(3):31-36]. ISSN: 1944-6543 (Print); ISSN: 1944-6551 (Online). http://www.sciencepub.net/rural. 3. doi:10.7537/marswro120320.03.

Keywords: Climate Change, Ecosystem, Adaptation, Flood, Early Warning.

1. Introduction

Bangladesh is one of the most vulnerable countries to climate change and will be among the countries in South Asia most affected by an expected 2°C rise in the world's average temperatures in the coming decades (Intergovernmental Panel on Climate Change, 2014). The geo-graphic location and geo-morphological conditions, frequent natural disasters, high population density and growth and low resilience to economic shocks have made the country particularly vulnerable to climatic risks. Flood is considered as one of the greatest threats to social security and sustainable development which is a recurrent event in Bangladesh. Most of its land mass consists of floodplains and up to 30% of the country experiences annual flood during the monsoon season, while extreme flood events tend to spread over 60% of the country (Majumdar, S. 2013). The country is flood-prone due to being situated on the Ganges Delta and being the basin for several tributaries flowing down into the Bay of Bengal. In Bangladesh, floods accounted for 40% of the total number of natural disasters that occurred between 1985 and 2009 which resulted in massive destruction in terms of economic loss and persons affected. At least one-third areas of the country are vulnerable to flood. On an average, every year, floods engulf roughly 20.5% of Bangladesh. A combination of geo-graphical locations, high rainfall, flat topography with very low elevation and extreme climate variability, made Bangladesh vulnerable to floods (The Fletcher School, USA, May 2016).

The Hindu Kush Himalaya (HKH) included eight countries with thousands of kilometers are one of the key natural resources hubs of the world and sources of life and livelihoods for billion people contributing to agriculture, safe drinking water and producing energy for income generating activities. The impacts of climate change like around the world have already been visible surroundings the HKH regions. The HKH is the origin of 10major river basins and encompasses over 4.2 million km^2 area (Bajracharya and Shrestha 2011). The region provides ecosystem services like water, food, energy that

directly sustain the livelihoods of 240 million people in the mountain and hills. The region is also home to some of the most diverse cultures, languages, religions, and traditional knowledge systems in the world (Sharma. K, Molden. M, Rahman. A, Khatiwada. Y. R, Zhang. L, Singh. S. P, Yao. T and Wester. P; 2019). Climate change has kept effects on the ecosystems of the HKH force people to change their livelihoods and use land-based resources differently, encouraging new cultivation techniques and new crops (Smyer Yü and Michaud 2017). Temperature across the mountains of the HKH is projected to increase by about 1–2 °C by 2050 and by even more at higher elevations. Winters are expected to grow warmer at a faster rate than summers in most places. The likely increase in frequency and magnitude of extreme weather events leading to flash floods, landslides and debris flow can have serious consequences (Shrestha, 2015). These events would most likely affect various productive sectors in the HKH countries, particularly the natural resources systems that provide the livelihoods for poor and marginal communities and impede the development process (Moors and Stoffel 2013).

There is also the recognition that climate-related population dislocation will be significant in Bangladesh, China, India, and Pakistan (Asian Development Bank 2012). Climate change made the communities socially, economically and culturally vulnerable and their ecosystem is being threatened in Bangladesh. Globally, the country is ranked to natural hazards as 7 out of 171 in the World (Global Climate Risk Index, German Watch, 2019). The intensity of damages caused by floods due to climate change has increased in many areas of Bangladesh, especially in the northern parts and among river-adjacent communities depending on natural resources and ecosystem for their livelihoods in Bangladesh. Bangladesh has faced mega floods in 2017 and 2019 which caused huge damages. More than 7 million people in Bangladesh were affected by the flood in 2019 and the numbers of flood-affected people in 2017 were about 6 million. (Bangladesh Government Report on Floods, 2019). The Northern areas of Bangladesh are affected firstly when flood occurs as water comes from upstream through Teesta[1] river. The people living surroundings the Teesta river are dependent on the natural resources and ecosystem centric the river. The Teesta river is facing acute shortage of water in dry season, and in monsoon it overflows and is creating flood almost every year. Tackling the climate change impacts and coping with the changing situation, the communities living around in Bangladesh practice some adaptation strategies that help them to cope with the changing situation of the climate change.

1.2 Ecosystem-based Adaptation in Bangladesh

Adaptation is the process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate harm or exploit beneficial opportunities. In natural systems, human intervention may facilitate adjustment to expected climate and its effects (IPCC[2] Fifth Assessment Report, 2014). Success of adaptation depends critically on the availability of necessary resources, not only financial and natural resources, but also knowledge, technical capability and institutional resources. The types and levels of required resources, in turn, depend fundamentally on the nature and abruptness of the actual or anticipated environmental change and the range of considered responses. Greater wealth and improved technology also extend the resources and perhaps the capabilities to adapt to climate change (Rashid. M, 2009).

Ecosystem-based Adaptation (EbA) integrates the use of biodiversity and ecosystem services in an overall adaptation strategy that includes the sustainable management, conservation and restoration of ecosystems to provide services that help people adapt to the adverse effects of climate change (The Convention on Biological Diversity, CBD, 2009). EbA uses approaches that already exist in the practices of biodiversity and ecosystem conservation, climate change adaptation and livelihood development. EbA draws from the related approaches of Community Based Natural Resource Management (CBNRM), Community Based Adaptation (CBA), and climate change-integrated conservation strategies, but is unique in that it aims for the combined achievement of all three outcomes (Midgley et al. 2012). EbA enables effective adaptive management and the embedding of climate change into local planning and implementation, including into service delivery, land use and infrastructure planning and natural resources management (Bourne et al., 2016.) Communities dependent on environmental services and natural resources always have ecosystem, human and management/governance components to them (Berkes et al., 2016). EbA promotes sustainability across a range of sectors, including agriculture, forestry, energy and water, and as such could help countries meet their Sustainable Development Goals (Seddon et al. 2016). In addition, by increasing the capacity of vulnerable communities to extreme events such as flooding and landslides, EbA helps countries to meet the goals of the Sendai Framework for Disaster Risk Reduction (Renaud et al. 2013).

[1] Teesta river rises in the eastern Himalayas, flows through India and Bangladesh.

[2] International Panel on Climate Change

In Bangladesh, the community people apply their indigenous adaptation strategies as well as innovated by government, private sector and other organizations. To cope with the changing climate and extreme events like disasters and flood they need to have some ecosystem-based adaptation techniques. As disaster due climate change has direct impacts on the ecosystem of respective community areas the community needs some ecosystem-based adaptation techniques that help them to cope with climate change. The early warning system is one of the ecosystem- based adaptation techniques that create room for the community people to protect their elements of ecosystem of ecosystems and take sufficient measurements to reduce the disaster risk.

1.3 Research Objectives

The study was conducted following the research objectives:

- To assess the effectiveness of the community-based flood early warning system to reduce the economic losses at communities.
- To measure the suitability of community-based flood early warning system for applying it as ecosystem-based adaptation technique and making the system as exemplary, replicable and popular at flood-prone areas.

2. Material and Methods

The study was conducted from both qualitative and quantitative research perspective from anthropological point of view. To understand ecosystem-based adaptation; different frameworks, reports, research and policy papers were reviewed. Collected data from both primary and secondary sources were used for the study purpose. The primary source of data contained of household survey, key in-depth interview, key informant interview and focus group discussion. The secondary data included different national and international documents, policy papers, books and articles and peer-viewed documents on climate change, adaptation, disaster and flood vulnerability, ecosystem-based adaptation techniques, climate vulnerability in Bangladesh and HKH region etc.

2.1 Study area

The study was conducted at two flood vulnerable communities located at the bank of Teesta river in northern Bangladesh. One community was in Nilphamari District and another community was in Lalmonirhat District. The Dighir Par community is located at the edge of Teesta river at Tepa Kharibari Union [3] of Dimla Upazila [4] which is around50kilometres from Nilphamari district Sadar. The people of Dighir Par community live with flood vulnerability as Teesta river is much closer to their houses and flood affects them almost every year.On the other hand, the Sheikh Para community is located at the edge of Teesta river at Khuniagachh Union which is 10 kilometers south from Lalmonirhat District Sadar. Agriculture and fishing were the main means of the livelihoods of the two-community people. About half of the people of the two community's people had no formal education. Poverty and socio-economic factors pushed the male members of the two communities to earn from very early age. The community people also use boat as their mode of transportation in Teesta river from May to September of the year.

3. Results and Discussion

3.1 Community based flood early warning system at two communities

The community people were experienced with the flood almost every period. In monsoon period, the communities face even two- or three-times flood. In late monsoon, the communities have also potentiality to be affected by flood. CBFEWS[5] was developed at the two communities in collaboration with community people and Upazila and District Water Development Board under a development programme. Before establishing the system, necessary instructions and orientations were provided to community people in this regard. Flood markers with explanatory signboards were established at the appropriate points of the two communities so that the community people can measure the level of the water looking at green, yellow and red level of the markers. The community people could contact the Upazila and District Water Development Board to know about the possibility and situation of the flood. In this regard, they had communicated with them by using mobile. A good relationship was established among the community people in this regard.

3.2 Implementation of early warning system and communities' preparation before flood in 2019

The community people were oriented with CBFEWS was developed at two communities in 2018. Before establishing the mechanism, the community people were not much more aware about what to do before flood and take necessary measurements to reduce the impacts of flood. Because they could not identify the intensity of floods and they had no judgment or ideas in this regard. The study found that the community people discussed and planned within

[3] Union is the smallest rural administrative and local government unit in Bangladesh.

[4] Upazila (sub-district) is the second lowest tier of regional administration in Bangladesh.

[5] Community Based Flood Early Warning System

their own households to take actions before, during and after flood, preserved dry food, prepared to take safe shelter/move safer locations, managed cash money for emergency purposes, preserved necessary medicine, fuel, dry straw etc. informed other community people that flood might occur. They also collected and preserved safe drinking water, planned to move livestock at safer places, recharged enough money in mobile etc. as the part of flood preparation. Beside this, they also contacted with Upazila and District Water Development Board.

3.3 Reduced economic loss in flood 2019 than the previous flood

It was found that the economic loss of the two communities reduced in 2019 flood comparing to the damages of flood 2017. The loss of the community people was assessed through considering the level of cost on the assets and properties, hindering the income of households, damages to the houses, effects on domestic animals, health impacts, crops and agricultural loss and post influences of flood for coming at the usual life of the community people.

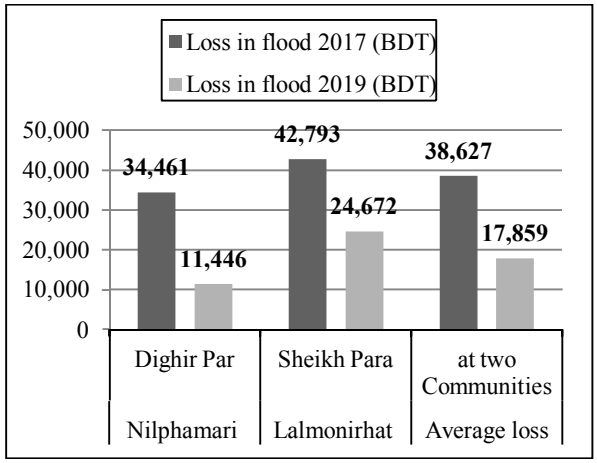

Figure 1: Reduced economic loss during flood in 2019 comparing to flood in 2017

The figure 1 demonstrates that the reduced economic loss at two communities. In 2017, the average economic loss at two communities was BDT[6] 38,627 which reduced to BDT to 17,859. At Dighir Par community in Nilphamari, the average economic loss was BDT 34,461 in 2017 flood which reduced to BDT 11,446 during flood 2019. On the other hand, the economic loss of Sheikh Para community in Lalmonirhat reduced to BDT 24,672 comparing to BDT 42,793 during the flood in 2019. This was possible as the community people were able to take preparation before flood and saved their assets during the flood. The flood early warning system greatly helped the community people to have reduced economic loss in this regard.

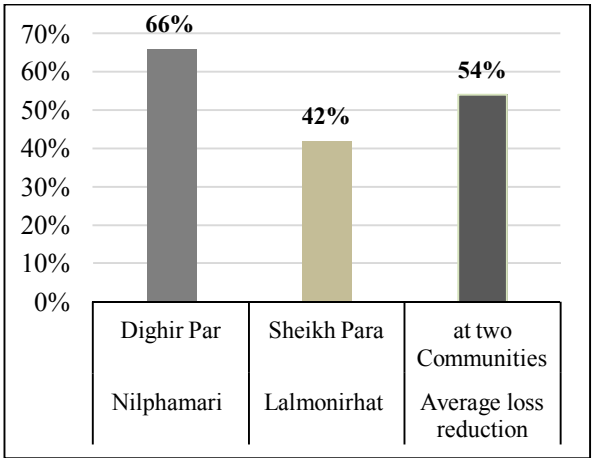

Figure 2: Average loss reduction at two communities

The figure 2 shows that about 54% of the economic loss was reduced at both communities. The economic loss reduced to about 66% at Dighir Par community in Nilphamari whereas at Sheikh Para in Lalmonirhat the loss reduced to about 42%. The developed early warning system greatly helped the community to minimize their economic loss.

3.4 Recovery after flood in 2019

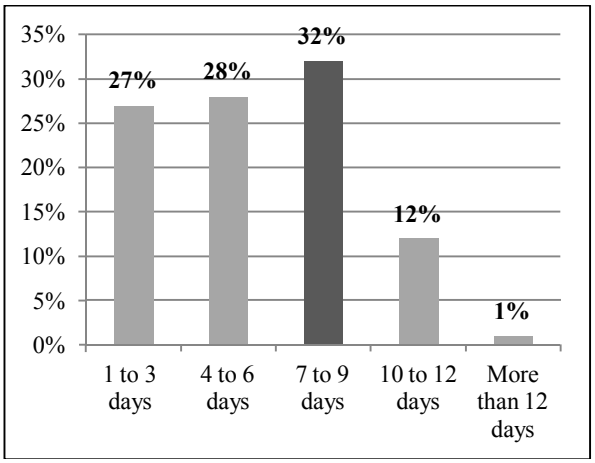

Figure 3: Two communities required times to recover from flood in 2019

The figure 03 shows that about 32% of households of the two communities required 7 to 9 days to recover from the flood in 2019. About 27% of the households of the two communities were able to come back to their normal life by 1 to 3 days. Beside this, a considerable portion of the households of two communities required 4 to 6 days and 10 to 12 days to recover from the flood situation. The community based flood early warning system helped the people to

[6] Bangladeshi Taka

come in their normal life after the flood situation in 2019. But it was seen that in the earlier flood in 2017, the community people took longer period for starting their usual works. By the establishment of flood early warning system, the community people not learnt what to do before and during flood but also they knew what measures should be taken to come back in their normal life after the flood period. For this, it was easy for the two communities to back in their normal life.

3.5 Interpretation and Conclusion

CBFEWS is very low-cost adaptation mechanism and the community people and other stakeholders can be easily engaged to make this mechanism successful. CBFEWS should be replicable and developed at flood-vulnerable communities across the HKH region as a measure of effective ecosystem-based adaptation. The CBFEWS can easily be established at the communities or areas where the adaptation project initiatives are undertaken. CBFEWS can reduce the communities' economic loss and help to shift their properties at safer places. The community people should be made aware and oriented before establishing the CBFEWS at any community or working areas. The changing biodiversity and lack of water in Teesta river basin due to climate change will be a major threat for the surroundings people to practice indigenous or ecosystem-based adaptation techniques in future. For this, more researches are necessary to explore and identify the opportunity of ecosystem-based adaptation in flood-prone areas of HKH region. The Global Survey of Early Warning system by the United Nations concluded that there are great capacities and strengths available upon which a truly effective globally comprehensive early warning capacity can be built (United Nations Report 2012). The intensity of floods is already observable and will be more visible in coming days in the HKH Region along with Bangladesh because of natural and anthropogenic climate change. Communities of Bangladesh need adequate flood early warning system at community level considering the vulnerability. The flood vulnerable communities need to apply the mechanism as ecosystem-based adaptation technique. The big benefit side of community-based flood early warning system is that the community people of the respective areas are involved in the system and they can apply their own capacity. The adaptation capacity of the communities increases to respond to flood when they are oriented with the system and apply before and during the flood period. Effective networking with Government and non-government bodies should be ensured along with the community people while developing any early warning mechanism. The early warning system should be popularized among the flood-vulnerable communities in Bangladesh to achieve for effective ecosystem-based adaptation.

Acknowledgements:

Thanks, and gratitude was given to the community people for providing necessary information. Besides, it was greatly acknowledged to the local govt. representatives and local experienced people for helping to collect data for conducting the study.

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9/19/2020