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THE IMPORTANCE OF COMMUNITY BASED APPROACH TO REDUCE SEA LEVEL RISE VULNERABILITY AND ENHANCE RESILIENCE CAPACITY IN THE COASTAL AREAS OF BANGLADESH: A REVIEW

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Abstract: The coastal zone is one of the most dynamic natural systems in the world. Bangladesh, a low-lying country, is particularly vulnerable to climate change induced sea level rise (SLR) due to its geographical location and socio-economic condition of the people. Bangladesh is the first country to develop and implement successful community based adaptation (CBA) projects in the coastal areas to reduce SLR vulnerabilities and enhance resilience capacity. In this regard, the present review examines the significance and relevance of community participation in Bangladesh to cope with SLR and to enhance community resilient capacity. The study argues that local level CBA approach is very effective in resilience building among the most vulnerable segment of the society as well as community involvement in decision-making process is also very crucial for a successful resilience building process in the coastal areas. Study identified gaps in government policies and strategies in both National Adaptation Programme of Action (NAPA) and Bangladesh Climate Change Strategy and Action Plan (BCCSAP) paid little attention to CBA priorities. Therefore, community participation needs to be integrated in the broader national strategies for developing effective adaptation as well as social-ecological resilience system. Multilevel social networks is also essential for developing social capital for supporting the legal, political, and financial frameworks that enhance community resilience.

Keywords: Sea level rise, community based adaptation, indigenous knowledge, social capital, resilience, National Adaptation Programme of Action, Bangladesh Climate Change Strategy and Action Plan.

Introduction

From the latter half of the 20th century, human-induced global warming contributed to the global mean sea level rise (SLR) and there is high confidence that the rate of SLR has increased since the early 1900's (IPCC, 2007; IPCC, 2013). Nicholls and Cazenave (2010) estimated that, for the period of 1950 to 2009 SLR is increased of 0.0017 m per year as well satellite data showing a rise of 0.0033 m per year from 1993 to 2009. The U.S. Global Change Research Program projected that by the year of 2100, the average SLR would have been between 0.3 m and 1.2 m since 2014 assessment (USGCRP, 2014). The Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC) found that, recent observations of global average SLR at a rate of 0.0032 m per year and projected that if green house gas (GHG) emissions continue to keep up with the current rate, global average sea level could rise by nearly 1 m by 2100 (IPCC, 2013).

The combined impact of thermal expansion of ocean water and the melting of ice sheets and glaciers have increased global sea level by at least 0.6 m by the end of the 21st century (for the period 2090-2099 relative to 1980-1999) (IPCC, 2007). Furthermore, ice melting from the Greenland and Antarctica ice sheets could contribute an additional 0.3 m of SLR by the end of this century (NRC, 2012). Available literatures highlighted that the consequences of SLR will likely be greater for developing

countries however, most of the quantitative SLR impact studies have focused on developed countries giving limited data on many developing countries.

The coastal zone is one of the most dynamic natural systems in the world. It supports diverse ecosystems that provide important habitats and sources of food, fisheries, and provide other ecosystem related services. From the last few decades, coastal zones are a crucial battleground in the front of climate change. Such impacts include increasing SLR, coastal erosion, tropical cyclone and storm-surge, flooding, salt-water intrusion, changes in surface water quality and groundwater characteristics, impacts on agriculture and aquaculture, coastal infrastructures which have direct impact on community in different forms like displacement of people, loss of livelihoods, and submergence of low-lying areas as well as the socio-economic costs (Nicholls & Tol, 2006; IPCC, 2007). Increasing sea level affects a significant number of Europeans for example one third of the EU population lives within 50 km of the coast and the Gross Domestic Product (GDP) generated by this population amounts over 30% of the total EU GDP.

Low-lying countries like Bangladesh, Maldives and Tuvalu are among the areas that are at the particularly vulnerable to SLR. The coastal areas of Bangladesh facing the Bay of Bengal are comprised of 19 coastal districts including 710 km long coastline that made the country one of the most disaster prone and climate vulnerable countries in the world. In addition to the geophysical characteristics of Bangladeshi coast, the poor socio-economic conditions of coastal inhabitants also contribute to increase the vulnerability to climate change impacts. Livelihoods of coastal population are highly dependent on coastal ecosystem linked to agriculture, fishery, forestry and salt farming (Alam & Rahman, 2014).

Climate Change Cell of Bangladesh (it was established in the Department of Environment in 2004 under the Comprehensive Disaster Management Programme (CDMP) at Ministry of Environment and Forests) reported that projected SLR would be about 0.88 m by the year 2100. Consequently, a majority of the low-lying non-embanked coastal areas may be or completely inundated. There will be increasing risk of coastal salinity including drinking water, so scarcity of saline free drinking water will be even more pronounced (Ahmed, 2006). To fight against imminent SLR related risks - a number of initiatives have been undertaken by the donors, government, development partners, civil society organizations (CSOs) and non-government organizations (NGOs) along the coastal zones of Bangladesh. However, due to lack of proper government initiatives and follow-up and highly centralized organizational setup, climate change adaptation and resilience projects failed to show their actual outputs. On the other hand, Bangladesh is the first country to develop some successful community based adaptation (CBA) projects to cope with and reduce climate change vulnerabilities. CBA recognizes that environmental knowledge, vulnerability and resilience to climate impacts are embedded in societies and cultures. This means the focus is on empowering communities to take action based on their own decision-making processes. A CBA approach can be very effective in resilience building process as the "climate change vulnerability takes place mainly at local level where people encounter impacts, build adaptive capacity, and response" (Ayers & Forsyth, 2009).

A very few noteworthy empirical studies in Bangladesh such as Ahmed (2004) and Alam and Murray (2005) on the relation between government strategies and significance of community participation in tackling climate change impacts in Bangladesh were conducted. Against this backdrop, this paper intends to examine the significance and relevance of community participation in reducing impact of SLR in the coastal areas of Bangladesh. Therefore, it is worth investigating how CBA strategies contribute to resilience building process. Based on secondary data and literatures, the review study analyses published government documents and other agencies'

reports as well as journal articles on community participation for climate change adaptation. The study depicts the scenario of climate change vulnerability leading to SLR in Bangladesh, evaluates the issues regarding CBA approaches to reduce vulnerability and related environment, forest, coastal and other policies in Bangladesh. Finally, it attempts to identify the weakness of government strategies to address SLR vulnerability in coastal Bangladesh.

Sea Level Rise in Bangladesh

Bangladesh is a low-lying riverine country, located in the delta of three large river systems the Ganges, the Brahmaputra and Meghna (GBM). Thus, the unique geographical setting makes Bangladesh highly vulnerable to climate change impacts particularly in SLR as 32 percent of the total land mass is coastal zone. In addition to that, more than 28 percent of the country's total population live in the coastal areas (BBS, 2011). The Bay of Bengal is a perfect ground for initiation of tropical cyclones where on an average annually 12-13 depressions are formed, and at least one or two powerful cyclone strikes Bangladesh each year, for example, cyclones *Sidr* (2007), *Aila* (2009) and *Mahasen* (2013) struck the coast of Bangladesh (Alam & Rahman, 2014). Between 1970 and 2015, over 45 devastating cyclones swept acrossthe country causing immense harm to live, property and coastal livehoods relating to fisheries, forestry and agriculture (Rahman & Alam, 2016). Furthermore, about 40 percent of the total storm surges in the world occurred in the Bangladesh (Dasgupta *et al.,* 2010), and 60 percent of the total world deaths due to cyclones occur in Bangladesh in the last 20 years (World Bank, 2013a).

The anticipated SLR, therefore, could potentially affect both the large proportion of its land and population. In a study by Khan *et al.* (2011) shows that the rate of SLR during the last 22 years in Bangladesh is many-fold higher than the global SLR over 100 years. A study measured three coastal stations (Hiron Point, Char Changa, and Cox's Bazar) in Bangladesh and found that the water level rose up to 0.4, 0.6, and 0.78 cm per year respectively. UK's Department for Environment, Food and Rural Affairs (2007) calculated that the projected SLR ranged from 0.53 to 0.97 m in 37 stations in southern coast in Bangladesh for the year of 2100, where the predicted global SLR is 0.09 to 0.88 m.

Furthermore, scientists predicted that the Sundarbans mangrove forest (largest mangrove forest in the world and a UNESCO World Heritage site covering parts of Bangladesh and India) is projected to be most vulnerable to current and future SLR. For example, a meter SLR may cause complete losses of the Sundarbans resulting loss of heritage, biodiversity, and fisheries resources. The Sundarbans is the home of iconic Royal Bengal Tigers (*Panthera tigris tigris*) and a study by Loucks *et al.* (2010) reveals that a 0.28 m SLR will cause a decline of 96% tiger habitat. In addition, the distribution and habitat of the important cetaceans (aquatic mammals including such as dolphins) in Sudarbans, the Ganges river dolphin, *Platanista gangetica gangetica* preferring lower salinity may also be affected due to SLR (Smith *et al.,* 2009). Additionally, following Figure 1 shows the SLR related risks in Bangladesh.

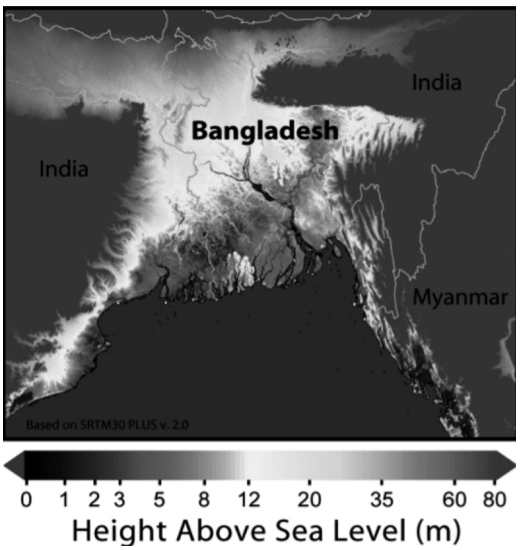

Figure 1: Risks from sea level rise in Bangladesh (adapted from: www.globalwarmingart.com)

More than 1.5 million people living in Dhaka, Chittagong and Khulna, the three mega cities in Bangladesh, could be affected by one meter SLR by 2070 (Brecht *et al.,* 2012). In line with this research findings, Hanson *et al.* (2011) estimated that only 0.5 m SLR could be exposed nearly 17 million people of Bangladesh. If the SLR scenario goes to mid range (0.4 m by 2080) the impact will be devastating for the country. It was predicted that, there will be extreme floods, more intense cyclone and storm surges, and higher intrusion of salt water, higher temperature, losses of biodiversity and increased decreasing of seasonal crops. Moreover, due to SLR and other climatic impacts, the rice production of Bangladesh would be reduced approximately to 80 million tons from 2005 to 2050 and/or loss of $2.68 billion per year which will be decline 5.14 percent of national GDP (Yu *et al.,* 2010).

Khan *et al.* (2011) reveals that already 100 km coastland as well as one-fifth of the total area has been encroached by salinity in Bangladesh and this leads to decrease agricultural productivity as well as increase in food deficiency along with increase salinity in natural drinking water (Basak & Alam, 2013). As for example, in Satkhira, a coastal district, rice production has been decreased up to 69 percent between 1985 and 2003 (Ali, 2006). A World Bank (2013b) study also identified the following potential threats due to SLR in the coastal areas of Bangladesh:

- ✓ A meter SLR may cause permanent relocation of 13 million people in the coastal areas. Additionally, between 1.5 to 1.54 million people could be affected by a one meter SLR by 2070, and increased storminess in the coastal cities in Bangladesh.
- ✓ Some 40% of agricultural land will be lost by 0.0065 m SLR. A 0.27 m SLR with storm surges by 2040 could inundate an area more than 80 percent larger than the area inundated at present by a similar event. With increasing SLR, extreme heat and more intense cyclones threatening food production, livelihoods and coastal infrastructures, as well as slow down the rate of poverty reduction.
- ✓ SLR and storm surges would lead to saltwater intrusion degrading groundwater quality where about 20 million people are already affected by salinity in their drinking water.
- ✓ Contamination of drinking water by saltwater intrusion may cause increasing diseases like diarrhoea, cholera, *vibrio cholerae*, high blood pressure, hypertension in pregnancy, and maternal and fatal health problems.
- ✓ SLR may lead to increased breeding of salinity tolerant mosquitoes such as *Anopheles* spp., *Culex* spp., etc.

Causal Effects of Sea Level Rise in Bangladesh

The result of SLR may cause loss of agriculture, livelihood, and forced migration. The loss of agriculture and fresh water resources due to salinity intrusion and water inundation will have a negative effect upon the food and fresh water. This may lead to conflict over food and water due to resource scarcity and rising food costs as well as lead to less arable land and a loss of livelihoods. Thus, people will be forced to migrate northwards into Dhaka and potentially into the neighboring country like Myanmar, India, Malaysia. The Figure 2 shows the causal effects if SLR in Bangladesh. Within this causal diagram, there are different forces that the effects of climate change will have an effect upon the people of Bangladesh, which will continue to grow exponentially (Litchfield, 2010).

A large portion of the population of Bangladesh lives within a zone of five meters above sea level or less. If the sea level were to rise, this would cause this land to be lost to the sea, and further affect the levels of soil salinity. The loss of land as a living space as well as the loss of economic support through agriculture will lead to people forced to migrate out of survival needs. Both land depletion and increase in soil salinity would have a very detrimental effect upon the agricultural output of the state as

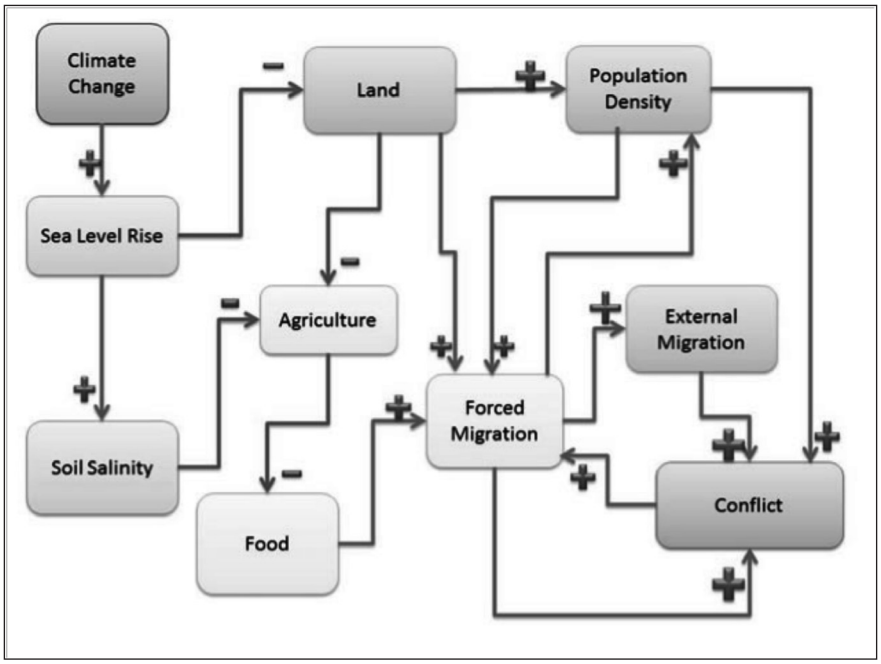

Figure 2: Causal effects of sea level rise in Bangladesh (adapted from Litchfield, 2010)

a whole. This would lead to food scarcity when agriculture output drops, and it is also a possible contributor to conflict. Furthermore, the forced migration will lead to increased population density and conflict during the migration. Eventually, people will be forced to migrate outside of the country in search of new land. This will also increase the possibility of conflict, and there are real possibilities of violence if there were to be such migration (Figure 2) (Litchfield, 2010).

Community Based Adaptation (CBA) to Climate Change

One should note that the climate change risk is not a physical event only, it is often related to the social, regional, political, institutional or ecological factors. From this concern, community based approach emerges as a new dimension of climate change adaptation. The term "Community-based Adaptation (CBA)" came to forefront recently by Huq and Reid (2007), and has been defined as "a community-led process, based on communities' priorities, needs, knowledge and capacities, which should empower people to plan for and cope with the impacts of climate change" (Reid *et al.,* 2009). The characteristics of CBA approach prioritized and implemented by local communities are livelihoods resilience, minimize the impact of climate change risk, capacity strengthening of local civil society and government institutions, and advocacy and social mobilization to address the underlying causes of vulnerability (Huq & Reid, 2007).

CBA aims to reduce climate change risks mainly in the case of poorer and vulnerable communities who depend on natural resources and occupy areas already affected by climate change. It argues that local people have 'the skills, experience, local knowledge and networks' to take effective resilience strategy to fight against adverse situation including climate change risks (Forsyth, 2013). CBA, therefore, could be very effective for Bangladesh, since almost one-third (31.5%) of its population is living below extreme poverty line (World Bank, 2010).

CBA emphasizes that climate change adaptive process should be area-specific and addressing local vulnerability rather than assessing climate risk only in terms of physical events. For instance, to cope with the climate change, they might need to use different crop varieties and different livestock opportunities. Despite the government and institutional initiatives, CBA can be very effective in resilience building process.

This approach suggests that outsiders who will come to implement projects or programs must gain the trust of the communities. The trust could be gained spending time with them, provide project work or involve them in the planning process. Coping capacity, indigenous knowledge about the problem, and responses and remedial practices of the community are important to successful resilience building process and program implementation. However, not all indigenous knowledge and practices or successful coping methods could be scaled up and implemented to other regions. Nevertheless, sharing knowledge and experience from pilot community based projects or indigenous community initiatives could transcendent to the national level programs which have been identified as an appropriate adaptation option worldwide, for example, in the Arctic, in South Africa, in Nepal or in Bangladesh (Tiempo, 2008).

Community participation can be physical or financial or both, or individual or group based. In this article, community participation denotes _ any group based physical activities to adaptation to climate change with the characteristics of collective action, indigenous knowledge, prioritize community needs, and livelihood benefits. Other characteristics and types of community participations are also visible in the adaptation scenario, however, that are beyond the scope of this article.

Scholars have analyzed SLR related risks in Bangladesh from different social science perspective such as human security risk (Shamim, 2008; Hossain, 2008), adaptation and mitigation (Alam & Rabbani, 2007) and from NGOs and civil society's involvement (Ahsan *et al.,* 2009). However, only a very few discussed the issues of government strategies and community participation. Among them, Rawlani and Sovacool (2011) examine the drivers, benefits, and challenges to climate change adaptation in Bangladesh. They explore how the 'Community Based Adaptation to Climate Change through Coastal Afforestation (CBACC-CF) in Bangladesh' by UNDP's project builds various types of adaptive capacity in Bangladesh and its implementation and what lessons offer it for other adaptation programs around the world. Study summarize that the technology by itself is only a partial element of successful adaptation efforts where cross-sectoral, institutional, and infrastructural dimensions are needed, to build effective resilience process.

Similarly, Ayers and Forsyth (2009) describe that as a new approach to climate change adaptation, community participation addresses the needs of poor and vulnerable people to promote resilience. They argue that though CBA projects are now in operation involving vulnerable communities, fundamental challenges and uncertainties remain there in adaptation policy, which in turn, affects the implementation of CBA. Finally, they conclude that examples in vulnerable communities in Bangladesh help illuminate the role and value of CBA and facilitate its integration into wider climate change policy.

Alam (2011) evaluates how indigenous knowledge and preparatory activities reduce the impact of climate change hazards and natural disaster of costal dwellers of Bangladesh. The study explores that people's approach is more viable than migration of the disaster-impacted people. Therefore, the study emphasizes more on government and non-governmental support to communities for better adaptation options. Likewise, Masum (2010) has done one of the notable works, regarding climate change vulnerability and governance, where his study systematically explores adaptation to climate change, community based approach to adaptation and sustainable people's development (SPD) in the context of Bangladesh.

Climate Change Adaptive Policy, Strategy and Institutional Response in Bangladesh

The Government of Bangladesh yet to have no separate policy to tackle climate change issues in Bangladesh. Climate change issues are managed by existing policy frameworks such as Environment Policy (1992), Forest Policy (1994), Environmental Management Policy (1995), Energy Policy (1996), National Policy for Water Supply and Sanitation (1998), Fisheries Policy (1998), Wetland Management Policy (1998), Industrial Policy (1999), Water Policy (1999), Agricultural Policy (1999), Land Use Policy (2001), National Water Management Plan (2001) and Coastal Zone Policy (2005). Indeed, after the Bali Cooperation in 2007, Bangladesh took initiated to formulate climate change related policy. At that time, five technical working groups were also constituted on adaptation, mitigation, technology transfer, financing and public awareness. Line ministries and agencies such as Ministry of Environment and Forests, Ministry of Disaster Management and Relief, Ministry of Agriculture, Ministry of Fisheries and Livestock, Ministry of Planning, Ministry of Water Resources, etc. has yet to undertake any separate policy or strategy to address the climate change vulnerabilities in Bangladesh. Departments and directorates working under these ministries have taken several innovation approaches to fight against imminent risk of climate change vulnerabilities (Masum, 2010).

Bangladesh is the first country to formulate National Adaptation Programme of Action (NAPA) in 2005 which is the national focal point of the United Nations Framework Convention on Climate Change (UNFCCC). Under the UNFCCC obligation, all Least Developed Countries (LDC) are required to prepare its NAPA to meet the adaptation need for fighting against climate change risk. One of the important aspects of Bangladesh NAPA is that it identifies the coastal communities as the most vulnerable to climate change risk, especially to SLR as well as other climatic hazards. Importantly, according to the guideline of UNFCCC, NAPA should give priority to participatory approach and community level inputs (LEG, 2002). NAPA identified 15 priority activities to be performed using Least Development Countries Fund (LDCF). According to UNFCCC database, the first and most prioritized project of NAPA is 'Community Based Coastal Afforestation Programme' currently being implemented in five coastal districts (Barguna, Patuakhali, Bhola, Noakhali, and Chittagong) of Bangladesh.

Bangladesh has formulated a country framework for 'Climate Resilient Development' in 2008, where in 2009 the country has developed "Bangladesh Climate Change Strategy and Action Plan (BCCSAP)" for a period of 2009-2018 to meet the challenges of adverse impacts of climate change. The BCCSAP is the main climate change strategy and action plan of Bangladesh which is a part of overall development strategy of the country. The BCCSAP emphasizing the principle of *'common but differentiated responsibility'*. BCCSAP has set 44 programs under the six themes (pillars) for first five year period (2009- 2013) with total cost of programs commencing in the first five years could be of $5 billion. The themes are:

T1: Food Security, Social Protection and Health;

T2: Comprehensive Disaster Management;

T3: Infrastructure;

T4: Research and Knowledge Management;

T5: Mitigation and Low Carbon Development;

T6: Capacity Building and Institutional Strengthening (MoEF, 2009).

Following Figure 3 shows the institutional arrangements for managing climate change risk in Bangladesh. The figure shows that, the Ministry of Environment and Forests is the focal ministry and its department, Department of Environment, is the focal department for all climate change related activities including international negotiations where it has established the Climate Change Unit for international negotiation, local level coordination with other ministries, stakeholders and NGOs.

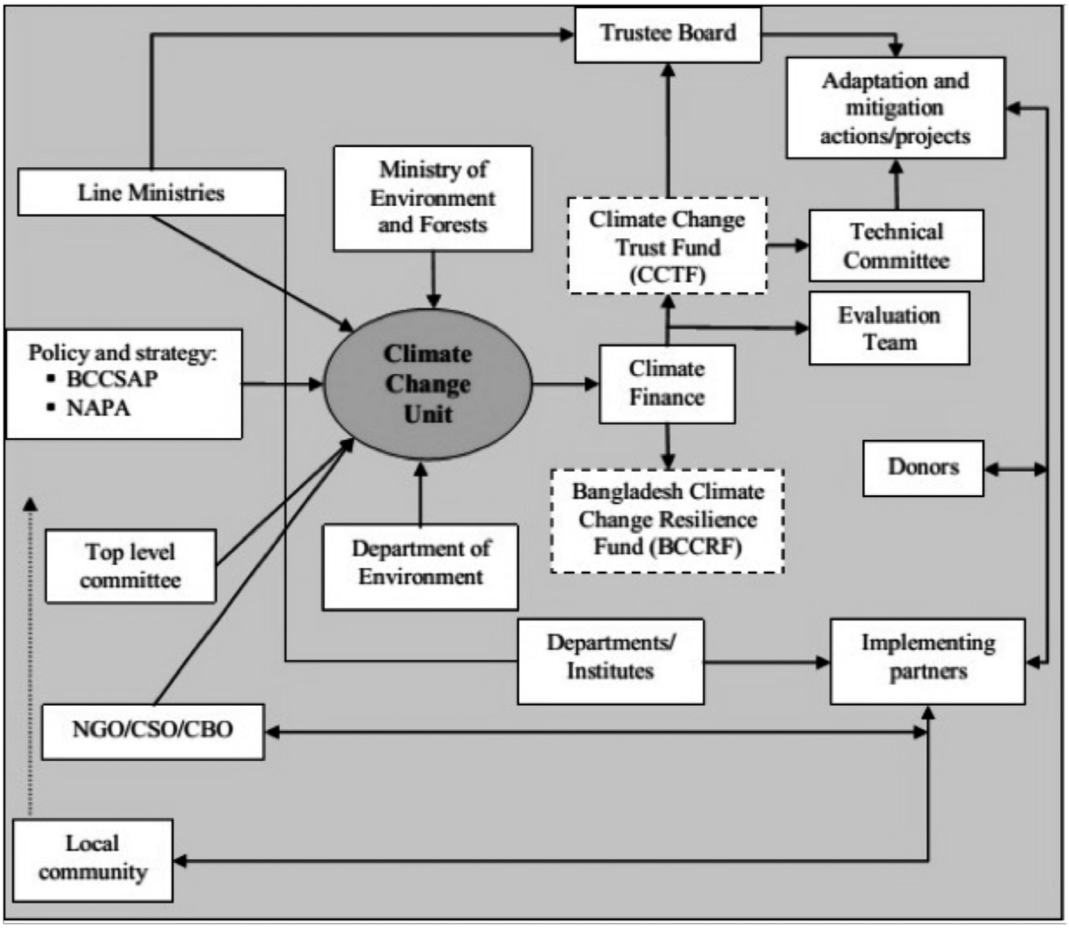

Figure 3: Institutional arrangements in Bangladesh to face the climate change (adapted from Huq & Rabbani, 2011)

National Environment Committee and National Steering Committee on Climate Change are the highest authority of environmental issues which ensures the coordination and strategic overview. The National Disaster Management Council is the top-level forum for the formulation and review of disaster management policies. The Inter-Ministerial Disaster Management Coordination Committee is in charge of implementing disaster management policies and the decisions. Disaster Management Bureau is the apex organization responsible for coordinating national disaster management interventions across all agencies. The Climate Change Cell supports the mainstreaming of climate change into national development planning. The Meteorological Department and Space Research and Remote Sensing Organization (SPARRSO) are two of the key institutions in this field. Other 35 related line ministries including food and disaster management, water resources, health, agriculture, livestock and fisheries, energy, local government, urban planning, road and transport are there to take care of vulnerabilities caused by climate change. The policy frameworks are guided through NAPA and BCCSAP and the donors are addressing the climate change issues in Bangladesh through the Department of Environment (Figure 3).

Coastal Zone Adaptation Strategies from Sea Level Rise in Bangladesh

Government of Bangladesh formulated a national Coastal Zone Policy (CZP) in 2005 to ensure sustainable development of coastal communities and to cope with the changing climate. The intention of this policy was to harmonize coastal zone policies across sectors, ministries, departments and agencies to coordinate their activities. CZP proposes an institutional framework for monitoring SLR and formulating programs to augment adaptation to SLR related impacts. CZP suggested for protecting the coastline, soil erosion, floods and storm surge at the coastlines by sea facing embankment which is later adopted in the NAPA of Bangladesh.

In relation to coastal zone management to SLR, the NAPA of Bangladesh identifies some immediate adaptation needs and prioritized actions which include:

- ✓ promoting adaptation to coastal crop agriculture to combat increased salinity;
- ✓ promoting adaptation to coastal fisheries through culture of salt tolerant fish species in coastal areas of Bangladesh;
- ✓ reduction of climate change hazards through coastal afforestation with community participation;
- ✓ providing drinking water to coastal communities to reduce increased salinity impact caused by SLR;
- ✓ promoting research on saline-tolerant crop varieties to facilitate further adaptation in the future;
- ✓ enhancing resilience of urban infrastructure and industries adversely impacted by climate change including floods and cyclone (MOEF, 2005).

BCCSAP coastal zone related prioritized activities related to SLR include:

- ✓ development of climate resilient cropping system and production technologies;
- ✓ adaptation against salinity;
- ✓ improvement of cyclone and storm surge warning;
- ✓ repair and maintenance of cyclone shelters;
- ✓ repair and maintenance of existing coastal polders, adaptation against tropical cyclones and storm surges;
- ✓ preparatory studies for adaptation against SLR and its impact;
- ✓ afforestation and reforestation programme (MOEF, 2009).

Community Participation to Reduce Sea Level Rise Vulnerability and Enhance Resilience Capacity in Bangladesh

The UNDP emphasizes that Bangladesh needs to focus on CBA approach for water and agriculture sectors to reduce climate change induce risks and vulnerabilities as well as to protect biodiversity and ecosystems. In regard to this, many national and international NGOs and civil society organizations are working in coastal districts of Bangladesh to make the local people accustomed to newer adaptive options and the technologies compatible to geographical, ecological and unique lifestyle (Ayers & Forsyth, 2009).

The Food and Agricultural Organization (FAO) in Bangladesh announced to provide funds for small scale CBA projects at the 'Third International Community-Based Adaptation Workshop' in Dhaka in 2009 where other development partners such as World Bank, United Nations Development Program (UNDP), Department for International Development (DFID), Canadian International Development Agency (CIDA), Swiss Development Cooperation (SDC), and Swedish International Development Cooperation Agency (SIDA) supported the CBA approach to face the climate change and SLR risks. Different international agencies supported from development partners like IUCN, CARE, Practical Action, ActionAid, WaterAid, Islamic Relief Worldwide, Save the Children, Plan, Oxfam, Concern Worldwide, Caritas, Christian Aid, WorldFish, Bangladesh Center for Advanced Studies (BCAS), and

Action Research for Community Adaptation in Bangladesh (ARCAB) providing technical and financial supports to local level NGOs for implementing CBA projects ranging from fisheries to livelihood with the involvement of local communities to address the imminent threat of SLR. Many CBA programs are there in response to the problems of SLR to address water-logging, salinity intrusion, and increasing storm and cyclone severity.

Practical Action in Gaibandha, a flood prone district of Bangladesh, developed an innovative CBA project called "floating garden (a floating garden is built using aquatic weeds mostly by water hyacinth with soil and compost as a base on which vegetables can be grown) technology" or locally known as *baira* during flood. The floating garden is used for planting mainly leafy vegetables and spices including green chilli, onion, garlic, turmeric and mustard crops can produced, and can move from one place to another (Practical Action, 2005). Similarly, in the flood prone *haor* (wetland) areas of Bangladesh, vulnerable people are now using floating garden during flooding and water logging, and found useful for improving nutritional security, income, employment, and land use capacity (Irfanullah *et al.,* 2011) (Figure 4).

Raising and reinforcing household to cope with the flooding and cyclonic activities is an example of successful CBA project in Noakhali district which was implemented by the IUCN. The project involved a team of local house-building specialists, engineers, planners, carpenters and other local stakeholders – to build a local knowledge-based building design which include raising foundations of house structure and raising platforms within homes where people can take shelter during flood or cyclone and reducing need to flee from their homes (Rawlani & Sovacool, 2011).

Cage aquaculture, another promising CBA strategy in Bangladesh to assist poor villagers

Figure 4: Floating agriculture in flood prone and wetland areas of Bangladesh (source web)

to develop small-scale cage culture practices to produce a range of freshwater species which could provide food for home consumption and earn income. The choice of species included Tilapia, Chinese carps, catfish (*Pangassius* sps.), silver carp (*Barbodes gonionotus*), and the freshwater prawn (Figure 5). Cage culture has advantages over other aquaculture systems that are potentially important in terms of uptake by rural poor and landless people. Traditional aquaculture in Bangladesh has focused on pond systems that necessitate the ownership of a water body. However, a large number of landless poor do not have access to ponds. The integrity of the cage unit means that large, communal water bodies including rivers can be used (Ahmed, 2010).

'Community Based Disaster Preparedness Program (CBDPP)' in Cox's Bazar district was another good example of CBA project in Bangladesh which was implemented by German Red Cross in 1996. The objective of the program was to improve communities' self-help capacities aftermath of devastating cyclone in 1991. Bangladesh Red Crescent Society and other organizations revealed that despite the cyclone shelter many people were not aware of the need to take shelter there during cyclone and about 90 percent of them were women and children. In response to that finding, German Red Cross initiated unique coping strategy with the involvement of local communities to built 30 cyclone shelters along the most vulnerable point of Bangladesh coastline. Gender specific micro group were formed for each cyclone shelter which constituted 15 to 25 members – to ensure active participation of the community. The group was given responsibility to build, maintain and manage the cyclone shelters and carry out disaster preparedness activities with all the members of the community and to raise awareness about imminent climate change risk. After successful implementation of the same the German Red Cross officially handed over management responsibility of those shelters to the Bangladesh Red Crescent Society and the local communities (BDRCS, 2009).

Involving local communities and organizations, CIDA initiated a project named 'Reducing Vulnerability to Climate Change (RVCC)' for six districts in southwestern coastal Bangladesh which was implemented by CARE Bangladesh from 2002 to 2005. The aim of the project was to increase adaptive capacity and awareness of local communities to address adverse impact of SLR. The output of the project was vulnerable communities understand and are better able to respond to adverse climatic effect, local organizations are better able to understand and explain climate change and have the skills and knowledge to advocate on climate change; agencies of local and national government are sensitized to the need for strategic interventions to enhance adaptation to climate change for vulnerable communities (CARE Bangladesh, 2005).

Figure 5: Cage aquaculture in the wetland areas of Bangladesh © MHR

Along the coastal zone of Bangladesh, historically, salinity is a big problem for rice cultivation which has been added by SLR. To address this, villagers of Mongla Upazila (sub-district) near Sundarbans forest, building their houses on raises platform and reserve rain water in sealed containers, called *Motki* made by potter and buried into clay soil near houses. Similarly, they started shrimp farming alternative to rice cultivation (Ayers, 2011).

Direct involvement of local communities in project implementation is very important for a successful adaptation. Many CBA projects in Bangladesh like Livelihood Adaptation to Climate Change (LACC) (Bass & Ramasamy, 2008), Integrated Planning for Sustainable Water Management (IPSWAM) (IPSWAM, 2011), and RVCC (Ahmed, 2004) shows that the rate of adaptation was very high where local communities were directly involved in project implementation. For instance, IPSWAM was a good example for successful CBA project implementation where local communities were directly involved in the project planning to implementation. The project was initiated in the southwestern coast of Bangladesh by Bangladesh Water Development Board (BWDB) with the assistance of Dutch Government to manage water resources and related issues with meaningful local people's participation in the period of November 2003 to June 2011. The project ensured water organization of local communities with effective participating in planning and supervision of construction which created a kind of sense of ownership of the scheme among them (IPSWAM, 2011).

Indigenous Knowledge Based Adaptation to Climate Change in Bangladesh

Indigenous knowledge based adaptation plays an important role to reduce climate change vulnerabilities as identified by scholars. For example, Alam (2011) showed adaptation strategies of local people to storm surge of eight coastal districts of Bangladesh where the study finding shows that some people could anticipated storm surge from a *'sense of cold'* without noticing weather signal. People also claimed that they anticipated storm surge from their traditional knowledge, such as if cyclone occurs during the ebb tide they anticipated a storm surge, if the cyclone comes from the south-east angle they anticipated a storm surge and sometimes they anticipate storm surge especially when the wind force is very severe. These anticipations prompt them to take shelter in safer places before a storm surge occurs and reduces casualty likely to emanate from the devastating storm surges (IWM, 2009).

Indigenous knowledge and practice facilitate to reduce project cost and increase production cost. For example, Bass and Ramasamy (2008) referring one important CBA project named LACC initiated by FAO to promoted livelihood adaptation and reduced vulnerability to climate change in drought prone areas of Bangladesh. Where the study explored that:

"The adoption of rain water harvesting and supplemental irrigation during drought in Kharif 2006 improved the rice yield by 23% and net profit by 75%. Water saving irrigation practice increases the water use efficiency of rice by 20%, but yield and economic advantage is marginal due to low cost of water. Adoption of improved stove at household level requires an investment of US$10/household, while it saves 30% fuel use and reduces 35% time for cooking."

Tidal River Management (TRM) is an innovative indigenous knowledge based river management project in the southwestern coast of Bangladesh. Under the project, local communities given collective efforts to manage a huge land area being raised to solve the severe drainage congestion and water logging problem caused by deposition of sediments in the main rivers. Further, the construction of coastal polders to reduce the risk of cyclone and storm surges has worsen the situation as the polders "de-linked the flood plains from the rivers, and diminished upstream flow during the dry season deteriorating the sedimentation problem in the region" (Shampa, 2012). The rivers of coastal regions witness two cycle of tides everyday in 6

hours intervals and high tides bring muddy thing – concentration of sediments. From a generation old practice, local communities invented a technique to reserve these sediments in *beel* – a low lying land between two rivers – to raise it and make cultivable for farmers and also to maintain proper drainage capacity of the rivers. The TRM technique is very simple, the local communities cut the embankment to enter high tides in the *beel* and it leaves behind a significant amount of sediments and goes back to the sea. In this process, the deposition of sediments raises *beel* land over time, usually three years and also do not deposit sediments on the river bed and makes the rivers flow congestion free. A case study shows that 31.32 sq. km land had been raised using TRM method by local communities in Beel Bhayana and Beel Dakatiya in Khulna district of Bangladesh (Kibria and Mahmud, 2010). Scholars have recognized TRM as a valid approach for raising low lying lands and ensure proper drainage capacity of the rivers in the southwest coastal regions of Bangladesh like for example Shampa (2012), Amir *et al.* (2013), Rahman and Salehin (2013). Inspired by the success of TRM, the technique has been implemented in some other parts of that region with the help of government and the NGOs. TRM technique, therefore, deserves much attention from the policy-makers and needs to scale up to other river basins of southwest coastal regions of Bangladesh.

Social Capital to Reduce Climate Change Vulnerabilities

Social capital defined as *"the trust, social norms, and networks which affect social and economic activities"* which plays an important role to reduce climate change vulnerability (Nakagawa, 2004). Vulnerable people mostly depend on their social network (i.e., bonding networks with family and relatives, and bridging networks with neighbors and friends) and knowledge sharing, reciprocity in disaster risk reduction practices, using crop verities, etc. These sharing practices have an important role to accept adaptation strategies and enhance community participation (Heijmans & Lorna, 2001; Nakagawa, 2004; Islam &Walkerden, 2015).

Social capital is especially applicable to coastal dwellers of Bangladesh as for their poor socioeconomic condition (Alam & Rahman, 2014) and literatures also showed that social capital is vital for disaster recovery. A community with social capital can pro-actively participate in reconstruction activities, which leads to a successful and timely recovery from earthquake damage in Japan (Nakagawa & Shaw, 2004). In Bangladesh, four types of social capital-based support like informal and formal monetary, and informal and formal nonmonetary were identified after cyclone *Sidr* for enhancing community resilience (Jordan, 2015). Social capital also plays an important role in residents' accessing to aid given by government or aid organizations (Beggs *et al.,* 1996). Kilby (2008) studied the role of social networks after *tsunami* in India and concluded that the trust and social capacity developed through previous community network activities enabled local NGOs to launch an effective response.

Lack of awareness about SLR risk and choosing associated adaptive options make coastal dwellers dependent on their social networks about what to do for coping with climate change vulnerabilities, for example, shifting to saline tolerant crops, taking shelter during storm surge and choosing livelihood options (Islam & Walkerden, 2014). In this respect, adaptation policy could play a key role in empowering local communities by securing and enhancing their access to resources including land, water, information, education as well as health care, in order to reduce their climate change vulnerabilities.

Studies found that women act as main agent in developing and maintaining their social network. In Bangladesh, after cyclones *Sidr* and *Aila*, at first women drew heavily on their relationships and share their water, food, medicine as well as mutually do their recovery and reconstruction works (Alam & Rahman, 2014). Moreover, lack of social network and capital tend to have less capacity to cope with

disasters, increased traumatic stress disorder like depression and other psychosocial symptoms of the affected people (Wind & Komproe, 2012; Adeola & Picou, 2014).

Community Participation to Reduce Sea Level Rise Vulnerability and Enhance Resilience Capacity: Weaknesses in Government Strategies

There are two points to discuss here in relation to community participation to reduce SLR vulnerability and enhance resilience capacity at community level and weaknesses of government strategies. First, community participation does not get adequate attention or proper integration in the government policies as well as strategies. Secondly, program implementation does not reflect proper community participation in terms of decision-making, monitoring, identifying risk and involvement.

Literatures criticized the community participation for the problem of *'effectiveness and legitimacy'* or *'too generally identified'* the vulnerability and limited scope for local institutions to implement the adaptation program (Agrawal, 2008). Ayers (2011) identifies that 'there remains a significant tension between local and global definitions of climate change risk, which impact the effectiveness and legitimacy of the participatory processes undertaken during NAPA development'. Similarly, some criticized government's strategies towards coastal zone management as poor linkages between government institutions and local communities, weak coordination among government agencies and insufficient presence of government institutions at local level. Rabbani *et al.* (2010) points out that: the coast remains an area of institutional weakness. Though several government agencies and NGOs are working in the coastal region, there are limited linkages between them and institutional fragmentation is common. Further, many of the government agencies responsible for coastal policies have hardly any presence at the local level. Insufficient coordination compounded by a lack of institutional, financial, and human capacities for implementation and monitoring impedes effective policy action.

Poverty Reduction Strategy Paper (PRSP) of Bangladesh recognizes and emphasizes the community involvement and integration into sustainable risk management in all government development programs, but there remains knowledge gap and feasible policy implication. Such as, among the 44 programs of six themes of BCCSAP 2009, there is only a project 'Awareness raising and public education towards climate resilience (T2P3)' in the theme of 'Comprehensive Disaster Management' where local communities are directly involved. T2P3 program is designed to raise awareness among local communities about impact of climate change. Though some programs have community awareness building action activities, for example T3P2, T4P4, however, local communities are not directly involved in any of those programs in terms of decision-makers or feedback providers. Thus, there is no scope for incorporating the views of local communities in those programs which can be identified as the major drawback of BCCSAP 2009 programs. For instance, a study by Masum (2010) suggests that it is a long way to translate the national policy into the ground realities through running a community support program in south-west Bangladesh.

Scholars also criticized the BCCSAP (2009) such as insufficient fund to promote indigenous knowledge based adaptation and local capacity building, absence of legal obligation of consultation with local affected communities and inadequate support for climate resilient crops varieties and local varieties. Moreover, among the allotted fund from Bangladesh Climate Change Trust Fund (BCCTF), Bangladesh Climate Change Resilience Fund (BCCRF) and Pilot Programme for Climate Resilience (PPCR) for climate change adaptation and mitigation in Bangladesh almost 1/3 of funds have been spent for mitigation programs rather than adaptation; and 1/4 BCCSAP funds have been spent for construction, repair and maintenance of embankments rather than fund allocation for R&D and capacity development. On the other

hand, from BCCTF funds 36% have been allotted for Bangladesh Water Development Board, 28% for others ministries and departments, 25% for Forest Department and 11% for Relief and Rehabilitation activities (Khan, 2012).

Likewise, Nandy *et al.* (2013) stated that coastal land zoning is prepared until now without institutional integration to share climatic risks as *"shared roles"* and developing participatory livelihood. BCCSAP, NAPA, PRSP, Millennium Development Goals (MDGs) and other relevant development program focused on integrated and sustainable coastal development strategy. The policies yet lack in comprehensive and practical guideline for institutional integration mechanism in development projects.

Local community often relies on proven local practice and indigenous knowledge. It is, therefore, necessary to assess the real value of these practices in the context of future climate change risk. If local communities are not involved in the Climate Change Adaption (CCA) programs, they usually depend on their proven local practices irrespective of the CCA program's goal or suggest action for adaptation to climate change risk. In addition, Bass and Ramasamy (2008) argue: "adaptation practices related to crop diversification and income generation are preferred at community level." This study shows that water-saving rice cultivation in some drought prone areas of north-west of Bangladesh is less preferred by local farmers where deep tube wells are available and they do not usually take into account the future risk of using excessive ground water as there will be scarcity of water. This indicates the necessity of local community awareness and their involvement in the CCA programs.

Dumaru (2010) shows local communities' involvement in CCA projects in Fiji Island which is the key component for resilience in the case of climate change vulnerabilities. Involvement of local communities in CCA projects, indeed, does not require a lot of money as he suggests that CBA should (i) aware local communities to climate change risks (ii) empower them to take decision, (iii) connect to network of information and resources and (iv) enable to take part in decision-making process. In the same vein, the decentralization model of IPSWAM project created scope for the community to assert 'local authority' in water management. The project has initiated a long prevailing centralized and top-down mode of water management towards a bottom-up and inclusive model of successful adaptation option (IPSWAM, 2011).

Bass and Ramasamy (2008) in evaluating LACC project's success stated that for reducing vulnerability and ensuring resilience to climate change an effective community participation is crucial and thereby it is imperative to integrate it in the institutions where top-down approach and policy process are used. Bangladesh's NAPA frames 'risk' due to climate change impacts in terms of physical implications, such as land labor loses their work in agricultural sector for climate change, where community people frame 'risk' in terms of the factors that led them to 'vulnerabilities' (Ayers, 2011). In addition, though NAPA affirms to promote community participation but the participation is limited to influential local stakeholders such as local elites, political activists, or people who have institutional affiliation, rather than the real vulnerable and the poorest segment of the society who are being excluded.

There is lack of proper implementation and participation of local communities in the project implementation; even some suggest that the project is not the most prioritized need for them to reduce vulnerability. According to local communities, in some unions (sub-sub-district) of coastal district of Noakhali, the greatest vulnerability for them is 'water logging and salinity intrusion' rather than storms, cyclone and tidal bores. Indeed, water logging and salinity intrusion induced because of government facilitated polder development projects instead of climate change that reduce water flow (Ayers, 2011).

Dumaru (2010) suggests that involvement of local communities in decision-making process is very crucial for a successful resilience building process in the coastal areas. Additionally,

community participation in decision-making is problematic in Bangladesh in terms of access and approach. Local stakeholders have limited access to BCCSAP 2009 programs as mentioned earlier. In the process of NAPA preparation, government stated that local stakeholders such as people from local government, local NGOs, farmers and women are included in the process through 'regional consultation workshop'. However, only a very few were invited in the workshops and most of them were local government officials. A study shows that in the workshops, government experts explained to local participants about future climate change risk and probable adaptation alternatives and participants were obliged to choose adaptive alternatives from pre-determined adaptive options (Ayers, 2011). This top-down process of decision-making limits the participation of local communities in climate change adaptation.

Conclusion

The study pointed out that climate change impacts are experienced mainly at local level thus community participation, use of local knowledge and adaptive practice is important for proper resilience and thereby most resilience program should be manage and implement locally. There is a gap in government policies and strategies as very limited scope exist there for local communities to get involved in state-term programs. Both NAPA and BCCSAP paid little attention to CBA priorities. Institutionalization of local adaptation strategy into national level framework will, in turn, serve as important impetus for implementing climate change adaptive programs. Multilevel social networks need to be established for developing social capital and for supporting the legal, political, and financial frameworks that enhance community resilience. Government must take initiative to protect the infrastructures, embankments and settlements in the coast from SLR. Communities should be involved in routine maintenance of their embankments. In addition, support should be given to farmers to cultivate saline and flood tolerant rice as well as use of alternative technologies that are resilient to climate change. Health measures must be improved by involving NGOs to create awareness in the communities. Finally, to ensure pro-poor climate governance, indigenous knowledge and learning from local communities should take into account as a climate change resilience strategy and integrate into the wider national policies.

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