Empowering citizen and community adaptation to systemic risks from climate change

Natural Environment Research Council

# EMPOWER India

## Case Study Report

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# EMPOWER – India Case Study report

EMPOWER: Empowering citizen and community adaptation to systemic risks from climate change

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# Contents

# Executive Summary

There exist limited initiatives focusing on the adaptation to climate change through actions at the individual level considering systemic risks. Empowering citizens to develop individual adaptation strategies bestow personal agency to the individuals to protect themselves and their community members to reduce the impact of climate change on their life including health and well-being. With such an understanding, the EMPOWER India Project, a part of the EMPOWER project[1], studied the case of the river island of Majuli in Assam India, and conducted participatory workshops to explore the impact of climate change on the communities of Majuli and identify the plausible individual action plans to climate change. The workshops had two main components: first, a participatory systems mapping was used to recognize the various climate change threat factors and their impacts on community members, and second was to identify effective personal interventions for the individuals to protect themselves, their families and community members from the impact of climate change. A systems analysis approach adopting participatory systems mapping of social, economic, legal, political, and technological factors were combined with the domain of environmental science to examine the direct and indirect impacts of climate change. To protect the livelihood, health, and well-being of the local community members, different adaptation measures were examined from diverse perspectives considering the multifunctionality, effectiveness, and complementarity across the identified interventions.

The project piloted a novel participatory approach to co-develop adaptation strategies with citizens and local communities in three villages of Majuli, namely Salmora, Banoria Chapori, and Kulamua. While flood and soil erosion are identified as the major climate change threats common to the three villages, the nature of their impact and its related consequences on the community members of the villages varied due to context-dependency on socio-economic, and environmental factors. Hence, the possible individual action plans to adapt to climate change also varied across the three villages, although they are a part of the same river island ecosystem. Overall, the workshops piloted a new protocol to develop personalized adaptation action plans for the community members that is likely to assist the members to various context-dependent climate change threat factors in compliance with equity, multifunctionality, and effectiveness of the adaptation plans to reduce the impact of climate change. The project identified context-dependency in the options for climate change

[1] https://www.empower-project.org/about/

adaptation in the three villages, which can be enabled through better governance, and by empowering community members to advocate for and enable institutional change. The outcomes of the project will help to improve the protection of communities and develop new protocols for immediately required bottom-up approach to climate change adaptation. This report has documented critical learnings from the implementation of pilot-scale novel participatory approach. This report has summarized the participatory systems mapping in PRSM[2] software and further studying the interventions needed at the individual and three communities of Majuli.

[2] PRSM – Participatory Systems Mapper - https://prsm.uk/

# 1. Introduction

The EMPOWER project funded by NERC-UK is aimed at understanding individual and community level adaptation and resilience to climate change through a participatory approach[3]. The project aimed at piloting a protocol for coming up with locally relevant adaptation strategies for individuals and communities through a participatory approach. This report summarizes conducting participatory workshops (henceforth EMPOWER workshop) in the case study region of Assam, India.

# 2. Case study region:

## 2.1 Brief background to Assam and Majuli Island

The North-eastern part of India, which comprises eight states, is one of the most biodiverse regions in the world and known for its varied flora and fauna (Chatterjee, 2008). Assam is the largest state in Northeast India, which is in the foothills of the Eastern Himalayas. It accounts for nearly 2.4% of India's total geographical area and has uneven topography, including hills, plains, and rivers (Govt. of Assam, 2022a). However, Assam is also one of the top three climate-vulnerable states in India, along with the states of Andhra Pradesh and Maharashtra. Assam is situated in a high rainfall zone and also referred to as the flood capital of India due to extreme floods. It has become ever more alarming due to the increased frequency and intensity of flood events in recent decades (Mohanty and Wadhawan, 2021). The river Brahmaputra originating from glaciers in the Himalayas, flows along the length of the state, causing annual floods that adversely impact the socio-economic status of the region. The situation is further worsened due to the impact of climate change and its related influence (Chaliha et al., 2011). Notably, one of the main causes of impoverishment of the rural areas of Assam has been the recurrent floods and riverbank erosion (Chetia, 2013). The north-eastern zone of India, of which Assam is severely affected by the southwest monsoons, which are responsible for the heavy precipitation that drives recurrent floods in the region (Mohanty and Wadhawan, 2021). Discussing the context of the impact of climate change on water resources in India, Goyal (2018) highlighted that climate change-induced changes will have an adverse impact on the water resources, human systems, regional agriculture, and food security including in Northeast India.

Located in the state of Assam, Majuli is the oldest and the largest inhabited riverine island in the world. It is set amidst the mighty river Brahmaputra and a part of the vast dynamic river

[3] https://www.empower-project.org/

system of Brahmaputra basin with a catchment area of 580,000 sq. km (Govt. of Assam, 2022a). The island extends for a length of about 80 km, and 10-15 km in the north-south direction covering an area of about 875 sq. km. It is elevated at an altitude of 85-90 m above the mean sea level. The island is formed in a stretch of the river Brahmaputra where the highest number of tributaries flows away to form the delta on the northern and the southern banks (Govt. of Assam, 2022b). The landscape of the island is a combination of agricultural land, grassland, water bodies, and sandbars (Saharia et al., 2013). It is formed by the headward erosion and migration of the river Brahmaputra (Kumar and Parida, 2021). With its fertile floodplains and highly productive wetlands, Majuli forms a conducive habitat for a variety of birds including rare migratory and uncommon birds. Besides, it is home to different fauna including Asian Elephant, Wild Buffalo, Barking Deer, Pangolin, etc. Numerous beels (a lake-like wetland), streams and rivers provide ideal habitats for fishes, turtles and amphibians (Govt. of Assam, 2022c). The govt. of Assam declared Majuli Island as the "Majuli Biodiverse Heritage Site" in 2017 (Govt. of Assam, 2022c).

Majuli is known worldwide for its unique geography and rich culture (Sahariah et al., 2013). As already mentioned, the island possesses distinctive hydrogeological heritage, consisting of surrounded fresh surface water bodies, beels, wetlands, and various sub-surface aquifer systems. The existence of the hydrogeo-cultural heritage, however, is threatened by the frequent floods and land erosion due to the Brahmaputra and its tributaries, and due to the deteriorating quality of surface water and groundwater (Bharasa and Gayen, 2020). The island is largely inhabited by the Indigenous Mishing communities, who are often portrayed as the first victims of global climate change (Felding and Gustafsson, 2013). Majuli has been the cultural capital and the base of Assamese civilization for the past 500 years. It is home to the ancient cultural heritage of Assam and the Vaishnavite Shrines known as *Satras,* and home to several traditional art-crafts and dances (Saharia et al., 2013). However, the island has been continuously threatened by extreme floods and river bank erosion and has been shrinking in size over the years (Chetia, 2013; Felding and Gustafsson, 2013; Saikia et al., 2020).

### 2.1.1 Socio-Demographic profile of Majuli

The district of Majuli is divided into two administrative regions – Majuli Development Block and Ujani (Upper) Majuli Development Block. It has a population of about 170,000 with a female to male ratio of 957 per 1,000. The literacy rate of Majuli stands at 74 percent (Govt. of Assam, 2022d). Agriculture and its allied activities constitute the major occupation of the

people of Majuli and the mainstay of the economy. As per records of 2011 census, 80.6 percent of the total working population of the district are cultivators and agriculture workers. The island houses a total of 243 small and large villages, out of which 210 are cadastral and 33 non-cadastral). Non-cadastral villages are resettled or rehabilitated due to flood and erosion in Majuli. (Govt. of Assam, 2022d). Besides agriculture, other economic activities include fishing, handloom and handicraft, pottery, boat-making, etc. (Govt. of Assam, 2022e). The main ethnic communities of Majuli are Mishing, Deories, and Sonowal Kacharies. The other communities include Ahoms, Kayasthas, Kalitas, Kumars, and others. Rice is the staple food of the communities of Majuli, which is consumed with vegetables, and the meat of fowls, fish and pork, which are the delicacies of most of the ethnic communities (AIRT, 2012). However, due to the problem of prolonged flooding, erosion, and poor connectivity, several communities living in the island are lagging in economic development as compared to the communities in mainland Assam (AIRT, 2012).

### 2.1.2 Climate Change vulnerability profile: Assam and Majuli

Glaciers in Asia are the water resources of millions of people living in the downstream regions. The meltwater from the glaciers in the southern Tibetan Plateau has increased during the period 1998-2007, and it is likely to increase further till 2050 as per the ongoing work of IPCC (IPCC AR6 WG2, 2022). Glacier lake outburst flood (GLOF) along with the risk glacier collapse make downstream regions (including Assam, India) vulnerable to climate change impact (IPCC AR6 WG2, 2022). As per the ongoing research of IPCC AR6, the glaciers in Asia are likely to reduce by nearly half of its size and the glaciers in the Central and Western Asia by about 70 percent by the end of this century under scenario RCP 4.5, and under scenario RCP8.5(IPCC AR6 WG2, 2022). The Brahmaputra River is one such vulnerable river, originating in the glaciers of Tibetan Plateau in the Himalayas and flows through China, North East India, and Bangladesh before discharging into the Bay of Bengal (Pervez and Henebry, 2015).

The Brahmaputra River basin is one of the world's major river basins for human and ecological needs, supporting the livelihoods of over 66 million people through agriculture (Pervez and Henebry, 2015). However, it has been vulnerable to the impacts of climate change including melting of Himalayan Glaciers. Due to the unique topography of the basin, the yearly onset of the South Asian summer monsoon, which is characterized by heavy rains, often lead to recurrent and destructive floods. The contribution of the river Brahmaputra to the mean annual discharge of the Ganga- Brahmaputra-Meghna River system is significantly

large (nearly 50 percent of the ~40,000 $m^3/s$). Such a high volume of discharge makes the river system the third largest in the world (along with the Rio-Orinoco-Venezuela River system) (Rao et al., 2020). The high discharge rates of the river Brahmaputra can be partly due to the annual precipitation (rain and seasonal snow) of more than 3000 mm/year and partly to the snowmelt from its highly glaciated upper basin surrounding the Eastern Himalayas and parts of the Southern Tibetan Plateau (Rao, et al., 2020). In the past six decades, the extent and frequency of flooding have increased across the Himalayan region in the Indus, Ganges, and Brahmaputra Basin (Elalem and Pal, 2015).

Assam constitutes a significant part of the Brahmaputra River Basin and is highly vulnerable to the changing course of Brahmaputra and widespread flooding (Rampini, 2017; Wasson et al. 2020). The state is vulnerable to several other climate change threats such as increase in mean temperature (+1.7-2.2$^o$C by mid-century with respect to 1971-2000), increase in rainfall (+5 to 38%), frequent and heavy precipitation (in the form of cloudburst), and extreme rain events (ASAPCC, 2015). Continuous warming of the atmosphere and the related changes in precipitation patterns are impacting the water resources, agriculture, forests, and the unique biodiversity of Assam. Moreover, the increase in the intensity of rainfall and longer drought periods are aggravating the impacts further (ASAPCC, 2015). One of the worst affected regions in Assam to the impact of climate change is the Island of Majuli (Chetia, 2013; Felding and Gustafsson, 2013; Das, 2015; Saikia, 2020). Land degradation has been one of the major problems in Majuli due to the change in course of the river Brahmaputra. Recurrent floods and riverbank erosion have continuously threatened the existence of the island (Chetia, 2013; Felding and Gustafsson, 2013). It led to the loss of livelihoods and wide-reaching socio-economic and cultural effects (Chetia, 2013). Further, changes in rainfall pattern as well as an increase in temperatures on the island impacts the communities of Majuli (Saikia, 2018). With increased risk of flood and erosion in Majuli, people were compelled to migrate in search of livelihood to neighbouring cities like Jorhat (Das, 2015).

### Flood and Erosion situation in Majuli

Flood and Erosion are recurrent natural calamities in Majuli. Flood is a perennial problem impacting the inhabitants of Majuli. The island gets inundated not only during severe flood disasters but also in usual floods. At least three waves of floods affect Majuli every year with different strengths. As mentioned earlier, Majuli has been experiencing floods for a long time, as it is an integral part of the active floodplain of River Brahmaputra. Floods lead to huge loss of life and property such as damage to houses, crops, etc., non-availability of

essential commodities, spread of water borne diseases, artificial rise in commodity prices, non-availability of enough medicines, disruption to potable water supply etc. Further, access to education and healthcare get completely disrupted. The recent flood scenarios, as detailed by Jauhari (2015), reveal that the nature of flooding, its frequency, and the extent of damage has been increasing over the years. Erosion is another critical problem that affects Majuli. As it is not considered as a natural disaster, no relief is prescribed under the State Disaster Response Fund /National Disaster Response Fund guidelines except a compensation clause for the loss of substantial portions of land caused by change of course of the river (Dist. Admin. 2019). Unfortunately, families affected by erosion have a difficult time coping with the loss. They suddenly lose entire areas of agricultural land and homestead land. Extensive erosion due to flooding occurs in various parts of the island. Several villages have lost school buildings and panchayat office buildings owing to severe erosion of Brahmaputra banks. Families have moved to embankments with makeshift structures. Every year some of these families are rehabilitated by giving alternate land by the government (Dist. Admin. 2019; Chetry, 2020). The affected families within Majuli have settled on either side of embankment in several places without basic amenities (Dist. Admin. 2019).

### 2.1.3 Assam State Climate Change Adaptation Planning

Realising the need for adaptation to climate change impacts based on the assessment of vulnerabilities, the state of Assam identified adaptation strategies , which will make the state resilient to the ongoing climate changes and its related consequences (ASAPCC, 2015; NLUJA, 2016). The Assam State Action Plan for Climate Change is in accordance with the guidance provided by the missions of the National Action Plan on Climate Change and the principles of adaptation (ASAPCC, 2015), which are as follows

1. Ensuring sustainability of water resources
2. Ensuring sustainability of agricultural systems
3. Protection and conservation of forests and bio resources within
4. Making habitats climate resilient
5. Ensuring energy sufficiency and efficiency
6. Addressing enhanced impacts of anticipated extreme events

The state action plan factors in the physical and economic vulnerability of the state to climate change and the development process in its adaptation action plan to reduce the economic burden of adaptation in the long-run and to gain from new opportunities that will come along.

Accordingly, the plan identified sectors and classified them into sub-sectors/ priority areas to develop the adaptation strategies to climate change, which are as follows: (1) water resources (water availability and managing floods), (2) Agriculture (horticulture, tea, fisheries, etc.), (3) Forest and Biodiversity, (4) Habitats (drinking water, health, transportations, etc), and (5) Energy (access to energy and energy efficiency). A detailed account of climate change adaptation strategies for the identified sectors and sub-sectors/ priority areas are represented in the Assam State Action Plan on Climate Change 2015-2020 (ASAPCC, 2015). The state action plan also emphasises the need for integrating climate change finance in planning.

### Climate Change district action plan for Majuli

As discussed previously, flood and erosion are the most critical threats to the people of Majuli. However, there are other disasters such as storms and earthquakes, which are less frequent yet have caused considerable damage to people and property in the past (Dist. Admin. 2019). The district administration takes several measures to adjust with the flood situation and reduce the impact to the people of Majuli. A few examples to provide flood relief to the people of Majuli is illustrated in Table 1.

Table 1. A few examples of the district action plan for flood relief

| | | |
|---|---|---|
| Flood | Pre-flood measures | • Set up relief camps and relief shelters<br>• Provide important safety tips to public<br>• Guide the way individuals and voluntary organizations are to be associated with relief teams<br>• Guide the way village Panchayats will be associated with relief operations<br>• Prepare contingency plans |
| | Post-relief measures | • Collect agricultural statistics about acreage of crops affected by flood, damage to crops and farm families affected<br>• Report on losses and damages in each sub-division<br>• Conduct assessment of losses to houses<br>• Conduct assessment of losses to fisheries, handloom sector, and animal husbandry |

The Govt. of Assam and the Majuli District Administration has laid down action plans as adaptation strategies to climate change (ASAPCC, 2015; Dist. Admin. 2019). The people of

Majuli have also shown significant ingenuity through their livelihood strategies and adaptation practices in agriculture and other tertiary sources in response to the recurrent floods and erosion. They have been using traditional knowledge systems or indigenous knowledge to protect themselves and conserve their natural resources, restoring their livelihoods and lives from disasters (Dey, 2012; Chetry, 2020). Some of the indigenous knowledge/adaptation strategies and practices includes housing patterns (stilt houses built on a raised bamboo platform), relocating or evacuating their homes temporarily, changing cropping patterns (like growing crops like Sali and Bau), etc. (Dey, 2012; Chetry, 2020). Such individual or community level adaptation strategies to climate change are critical to build resilience of the local communities. Climate change adaptation strategies are unlikely to be effective unless the local context is understood and the perception of individuals and community members concerning how climate change impacts their livelihood and resources is considered (Urwin and Jodan, 2008; Alam et al., 2017; Conway, et al., 2019).

Climate change adaptation strategies would not only require effective implementation of the adaptation strategies at the international and national level through climate change policies, i.e., top-down approach, but also more locally focussed adaptation strategies, i.e., the bottom-up approach (Urwin and Jodan, 2008; Conway, et al., 2019). For climate change adaptation to be effective in a given area, location specific features, adaptation needs, and the degree of change needed may limit the practicality of general adaptation choices (Smit and Pilifosova, 2001). Suitability of the strategies may also differ with the selected boundary for analysis, extent of exposure to climate change threats, and selected time frame of adaptation response. Hence, it is vital to determine locally appropriate options for adaptation that are acceptable to local stakeholders, and which sufficiently address adaptation needs (Bhave et al., 2013). Due to the experiential understanding of the community members of a location about their local biophysical as well as the socio-economic systems, local stakeholders are often considered as valuable knowledge bearers of possible adaptation choices (Bhave et al., 2013). Hence, their preferences would play an important role in planning and implementation at the regional level to cope and reduce the impact of climate change (Bormann et al., 2012).

While creating disruption in natural ecosystems, climate change and disasters often destroy basic infrastructures (e.g. roads, schools) and hence these need to be considered while designing adaptation solutions. There is interconnectedness between infrastructures and society, particularly in the context of climate change related aspects (Chappin and Lei, 2014). Efforts to promote the development of adaptation technologies, which would enhance

society's ability to adapt to climate change, should be initiated (Govt. of Japan, 2010). Mitigation measures are often more capital intensive in comparison to adaptation measures which often could be done by individuals and in small-scale. Hence, such measures should be more flexible and adaptable to the local settings, which implies that apart from being socially and legally adequate they can be made cost-effective (UNFCC, 2006). Hence, a socio-technical systems perspective to gain insight into the effects of climate change on infrastructure systems, and possible adaptation strategies for the coming decades is necessary (Chappin and Lei, 2014).

# 3 Literature Review

## 3.1 Riverine Ecosystems

River ecosystems are composed of catchment basins embedded within regional landscapes across the landmasses. The basic features of river ecosystems are (1) the river, (2) its floodplains and other spatially heterogeneous and interconnected structures or habitats, and (3) the exchange of water, chemicals, and biota among those habitats (Stanford et al., 2017). Riverine ecosystems often exhibit complex features displaying structural and process related characteristics, which reflect the influence of several factors. Therefore, the physical, chemical, and ecological features often differ between the riverine ecosystems and often vary at different rates and ways (Thoms, 2006). River flow determines processes, which shape and organize the physical habitat and associated biotic communities. The natural flow of a river varies on time scales of hours, days, seasons, years, and longer. Further, river flow regimes, which are mostly determined by the size of the river and by geographic variations in climate, geology, topography, and vegetative cover, often show regional patterns (Zeiringer et al., 2018).

Rivers are process-response systems in which changes to discharge and sediment load leads to a range of ecosystem responses. Further, the structure and function of a riverine ecosystem differs downstream (Thoms, 2006). For instance, side channels, sand and gravel bars, and islands, which are formed and reformed on a regular basis, are often a part of larger alluvial rivers in their natural state. Unconstrained rivers form meanders that shift and move as bed materials are often eroded and redeposited in low gradient flood plains. Dramatic changes can occur rapidly during flood events (McCabe, 2011). Shifting of multiple channels and a considerable degree of environmental heterogeneity, often engendered by complex interactions and transitions between surface waters, subsurface waters, and riparian systems as integral components, characterizes natural alluvial rivers (Ward et al., 1998).

## 3.2 Climate Change impact on River meandering and its direct effects

Riverine ecosystems are extremely sensitive to climate change, as such ecosystems are directly associated to the hydrological cycle, closely reliant on atmospheric thermal regimes, and at risk from interactions between climate change and prevailing numerous humans caused factors (Ormerod, 2009). The ecological consequences of climate change in freshwater ecosystems in the future will mainly depend on the rate and extent of change related to climate forces, i.e., variations in temperature and streamflow. Such changes not only hint at absolute changes (increase or decrease) but also the increasing variations between the extremes. Different ecological processes are directly or indirectly activated by the thermal regimes and hydrological changes of the rivers (Pletterbauer et al., 2018). Alteration in temperature and precipitation are the most critical physical effects of change in climate on river ecosystems (Siddha and Sahu, 2022). The growing extent of human activities and climate change may have notable effects on river systems, and considerable morphological changes may occur due to altered water regime caused by precipitation change and engineering works (Kiss and Blanka. 2012).

River characteristics such as changing of regime, runoff, magnitude and frequency of flood, which often lead to altered channel patterns or meander development, are likely to be influenced by climate change (Kiss and Blanka, 2012). Due to changes in the course of rivers, some river islands may disappear completely whereas new islands appear in other places. The lateral erosion on the river banks may also lead to a decrease in agricultural lands adjoining the river banks and decrease in the areas of the river islands, which in turn might result in reduced agricultural production (Ahmed and Fawzi, 2009). Rivers in temperate climate regions will be disturbed mainly by fluctuations in temperature, whereas rivers of tropics could be intensely influenced by variations in the season and amount of precipitation. The flow rate of a river can increase or decrease based on variations in the mean precipitation. Moreover, increase in precipitation would lead to frequent floods (Siddha and Sahu, 2022).

## 3.3 Climate change adaptation challenges in Majuli

The shrinking of the Island and increasing population put tremendous pressure on its resources that have far reaching socio-economic impacts (Sahay and Roy, 2017). Climate change related incidents have further exacerbated the impact in Majuli. Annual floods and riverbank erosion have displaced thousands of inhabitants, leaving them destitute and landless. The great earthquake of 1950 has intensified the problem of erosion around the island severely as the river Brahmaputra meandering has traversed nearly 90kms along the

southern side (Chetry, 2020). A changing climate, declining crop yield, and physical challenges due to riverbank erosion and floods have exacerbated the condition of people of Majuli (Saikia et al., 2020). Further, the study by Saikia et al. (2020) that explored the vulnerability of Majuli inhabitants to climate change found that inhabitants in the high-flood zones are more vulnerable than the low-flood zones. The study further suggests that the exposure level of the high-flood zone is higher due to the disproportionate impact of the flood and bank erosion, coupled with the inadequate adaptive capacity to withstand or cope with climatic and physical exposures.

Due to the intertwined nature of the river Brahmaputra (in the south) and Subansiri (in the north), and high rate of erosion of the sand-silt deposits of the island, Majuli is facing bank erosion severely (Dutta et al., 2021). As per a study by Lahiri and Sinha (2014), the rate of bank erosion has doubled from 16.3 to 32.3% between 1975 and 2005, and it was projected to continue with the same rate or higher. Remarkably, substantial bank erosion occurs during monsoon when the discharge in the river is high, and the velocity of flow is also high, endangering the banks due to the narrowed area (Goswami et al. 2018). Discussing in the context of flood mitigation and climate change adaptation in the Brahmaputra Valley, Wasson et al. (2020) highlighted that the damage is likely to increase where embankment breaches are common, as climate change brings bigger floods, and the lock-in and path dependence increase such risk[4]. Hence, non-structural measures that would complement embankments are required for the mitigation of floods on an urgent basis.

While flooding and erosion have always been part of the natural landscape of the Brahmaputra valley, they have become more severe in recent years leading to agro-ecological instability in the region and large-scale displacement of the local population (Chaliha et al., 2011; Baruah, 2016; Chetry, 2020). In the context of Majuli, riverbank erosion has impacted the island in three noticeable ways. Erosion has resulted in the loss of nearly two-third of the original land area of the Island, which has changed the geography of Majuli. Second, the loss of land has significantly disrupted agriculture, which is a major economic activity in the Island. Thirdly, the closing down and relocation of the satras (Vaishnavite Monasteries) outside of Majuli threatens to destroy the centuries old neo-Vaishnavite culture of Majuli

[4] Embankments for flood often dominates in decision-making for obtaining solutions to flood, which is an example of technological lock-in. Such lock-ins leads to constraints in decision-making, which might decrease the region's adaptive capacity considering the current situation as well as future climatic conditions that may produce greater floods (Wasson et al., 2020).

(Sahay and Roy, 2017). At the greatest risk and vulnerability due to the adverse impacts are the farmers of the island. For instance, a study by Chaliha et al. (2011) that quantified the vulnerability of the farmers in Majuli to floods in the scenario of climate changeability found that the biophysical factors have the highest impact on the overall vulnerability, at the district as well as village levels. The biophysical factors included extreme climate events, flood duration, flood water depth, proximity to river, area under floods, and drinking water availability during floods. The study by Chaliha et al. (2011) also found that different villages within the same district had variable vulnerability to floods and suggested a need for strengthened adaptive capacity. The study also suggested for appropriate scientific planning and management to protect the Majuli Island from the unfavourable effects of the repeated floods.

While the impact of changing climate, frequent flood and erosion risk to farmlands has led to outmigration to cities and nearby urban centres for stable livelihood, a possible pathway to enhance resilience to the climatic change and the unpredictability of monsoon would be to promote alternative occupation such as eco-tourism and investment in adaptation strategies to mitigate flood by incorporating local knowledge of the Mishing community (Das, 2015). Further, facilitating community member's involvement to reduce property damages through indigenous knowledge would also help develop resilience (Das, 2015). Recent studies also recommend developing tailored policies to resolve physical challenges due to shifting river courses by reinforcing banks along with community-based and nature-based adaptation options (e.g., growing plantations, encouraging riverbank stabilization, and promoting improved farming and quality fishing), that will effectively upgrade the current level of environmental services and minimize climate change-induced hazards (Saikia et al., 2020).

## 3.4 Inter-relationships between livelihood, nature-dependence and climate change

Climate change is a critical threat to people across the world, particularly those whose livelihood are dependent on natural resources such as agriculture, fishing, forestry, and others (Dasgupta et al. 2014). Considering that livelihood is essential for fulfilling basic requirements for living (e.g., food, water, income, housing), it can be deduced that those who are more dependent on natural resources for livelihood will confront greater climate change related livelihood susceptibilities (Reed et al. 2013). Changing rainfall patterns, erratic or frequent floods, changing temperature, increased cyclones, droughts, salinity intrusion, and several other climate change threats impact the communities dependent on the nature-based

livelihood options (Selvaraju et al., 2006; Dasgupta et al. 2014). However, the impacts of climate change on livelihoods will vary across regions and geographical spaces. For instance, it can be argued that the impacts of climate change may have different influences on livelihood for people living in rural areas than to those in urban areas (Nawrotzki et al. 2015).

As the rural communities possess a greater proximity to the natural resources and are reliant on ecosystem services for their basic livelihood related activities, they are significantly influenced by climate change (Dasgupta et al. 2014). Hence climate change related impacts may lead to increase in local unemployment in rural areas and cause unmanageable financial burden for the households. Such a situation can force a large number of community members in rural areas to migrate to urban centres in search of alternative livelihood options (Dasgupta et al. 2014; Kabir and Serrao-Neumann, 2019). Climate-change induced migration, which also includes those displaced due to climate change related disasters, could represent a large portion of total human mobility in the next few decades (Kaczan and Orgill-Meye, 2020; UNHCR 2018) Besides, the impact of climate change on men and women would vary due to the differences in biological, socio-economic, and cultural factors (Soransen et al., 2018; Tanyanyiwa and Mufunda, 2020). Hence, the process of climate change-induced migration is also likely to be gendered (Chindarkar, 2012).

In summary, literature review highlighted the profile of Majuli and its vulnerability to various climate change threats. As climate change vulnerability is dependent on local context, including at the individual and community level, bottom-up approach in particular to study climate change adaptation must take a suitable approach to understand adaptation, interventions and resilience. Unlike a quantitative survey or interview approaches, participatory approach provides methodological framework to support bottom-up climate change adaptation studies. EMPOWER project developed and piloted participatory systems mapping approach to study systemic risks. The next section will explain the detailed planning done before the participatory workshop.

# 4 Pre-Workshop planning

The pre-workshop planning included understanding in detail the process of Participatory Systems Mapping (PSM). This included knowing the step-by-step approach to PSM, the challenges in conducting PSM, and how those challenges could be overcome to deliver the end results. Moreover, understanding the PSM process also included knowing the role of

various actors (e.g., facilitators and notetakers), which is critical in accomplishing the objectives of a PSM exercise. There were two workshops conducted in stages.

Understanding of the PSM process was critical to make detailed plans for conducting workshop 1, which aimed to (1) map the key climate threats to participants and their communities, and (2) identify provisional interventions options for climate change adaptation.

The planning for workshop 1 included three critical components: (1) designing the workshop, (2) timeline of the workshop (3) training for notetakers and facilitators. The designing of the workshop was centred around the PSM process and the EMPOWER workshop protocol and guidelines. Designing the workshop considered every possible element that would be necessary to conduct the actual workshop such as the requirements for the venue preparation (in the study area), pre-workshop activities, the actual workshop, and post workshop activities. While doing so, all the requirements in terms of tangible goods (equipment, internet connectivity to make the session live, stationeries, etc.) and practicalities such as - how the participants will be received, and introduced to the workshop and its process, etc., were carefully considered. A Gantt Chart was prepared to have a systematic approach to plan and conduct the event. The second component, timeline, included defining the time for different activities to be conducted on the day of the workshop. For example, how much time would be allotted for pre-workshop activities including break-up for each sub-activity, how much time for the actual workshop including time break-up for conducting the PSM exercise based on PSM steps (broadly) and the workshop protocol. This was critical, as the objectives of the workshop had to be met within the specified timeframe and within the limited resources. The third component was training the facilitators and notetakers. This included providing a detailed overview of the PSM process, the workshop's objectives and timelines, and communicating the specific roles of facilitators and notetakers in the workshop. A PowerPoint presentation was prepared to train the notetakers and the facilitators and a specific guideline was prepared separately for them.

A critical part of the workshop was identification of the villages where the workshop would be conducted and for that purpose, a preliminary field visit was made to Majuli Island. Based on understanding about Majuli through primary and secondary sources (such as journal articles, books, government reports, news articles, etc.), and observations from the field visit, three villages namely Salmora, Banoria Chapori, and Kulamua were selected as study sites.

The selection was based on several parameters such as vulnerability of the community members to climate change threats, the socio-economic dimensions, demography, and other related aspects. Apart from the aforementioned components for planning to conduct the workshop, there was continuous coordination with the selected NGO (Ayang Trust) to conduct the workshop in Majuli. This included planning for the venue in the selected three villages, the logistics, selection of participants, and several other aspects. The selection of participants for the workshop was a critical part, as the workshop aimed to consider common stakeholders' perspective. Hence, the selection process aimed at including participants who were common people with diverse socio-economic backgrounds including age, gender, and occupation rather than influential individuals or individuals coming from well-to-do families who may be less vulnerable to the impact of climate change. The pre-workshop planning also included the preparation of a PowerPoint presentation to be presented to the participants by the facilitator to make them familiar with the project, the workshop objectives, its process, and the expected outcomes.

# 5 Summary of findings

## 5.1 Workshop 1

The EMPOWER Indian workshop 1 aimed to identify the climate change threats for Majuli Island and their impact on the community members, their livelihoods, health, and well-being Subsequently, it aimed to identify the provisional interventions (individual level) to reduce the impact of the climate change threats on the community members, their health, and well-being. The workshop adopted a participatory research approach to collect primary data (Participatory Systems Mapping or PSM) in which the local community members from three selected villages were participants. The EMPOWER team members and the workshop participants worked collectively to explore, understand, and analyse how climate change threats (such as flood, erosion, erratic rainfall, etc.) impact supporting factors (such as food security, household income, etc.) and thereby the primary factor (i.e., livelihood, health, and wellbeing of the members, their family, and community members). A basic overview to the approach is illustrated in Figure 1. After identifying the climate change threats in the workshop (along with the threats identified before the workshop), participants (with the help of facilitators) mapped their relationship to the supporting factors, and subsequently to the primary factors, were understood. Participants were then encouraged to come up with interventions or individual action plans to cope with and reduce the impact of the climate change threats considering their individual and local contexts. Discussion among participants

on climate change threats and interventions was encouraged with the help of a briefing pack as a reference (summary of climate threats for Majuli region and historic disasters). Based on the discussion in the workshop, participatory systems maps including the factors, connections showing the links between factors, and plausible interventions were developed simultaneously as the discussion progressed. Participants could see the map develop through stages during the workshop. The map was developed in the physical form initially (on a white chart with the help of post-it notes of different colours), which was later digitized using the Participatory System Mapper[5] (PRSM) software after the workshop.

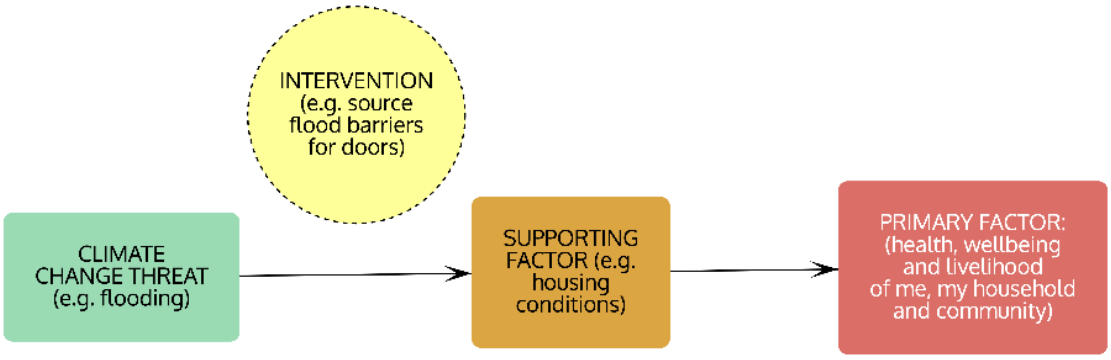



Figure 1. A basic framework of the proposed key elements for PRSM mapping for EMPOWER Workshop 1

Workshop 1 was conducted in three villages in Majuli Island - Salmora, Banoria Chapori, and Kulamua. Due to the COVID19 restrictions, the workshops were conducted separately in each village in three different sessions. The workshop in each village began with a general introduction to participants about the EMPOWER project, objectives of the project, the expected outcomes, and other details including the workshops in the UK and Ghana. Thereafter, participants were informed about the workshop procedure including how the PSM would be conducted. The participants were also shown the base Participatory Systems Map written in local language (Assamese), as illustrated in Figure 2, and explained how the end Participatory Systems Map will be a result of the workshop beginning from the base map. The workshop proceeded as per the workshop protocol to conduct a PSM exercise. The workshop successfully identified the climate change threat factors, how the factors impact their livelihood, health and well-being, and connections between the factors. Facilitator made conscious efforts to seek inputs from all the participants. The workshop also identified

[5] https://www.prsm.uk/

potential interventions that could be taken at the individual level to reduce the impact of climate change. The participants in all three villages actively took part in the mapping exercise, providing interesting insights on the nature of the impact of some of the climate change threats, their interrelations, and potential interventions. The resultant maps from the EMPOWER India workshop conducted in the three villages are provided in the below mentioned links (Link 2-4). The analysis and discussion for each of the villages are provided in the upcoming sections (5.1.1 to 5.1.3).

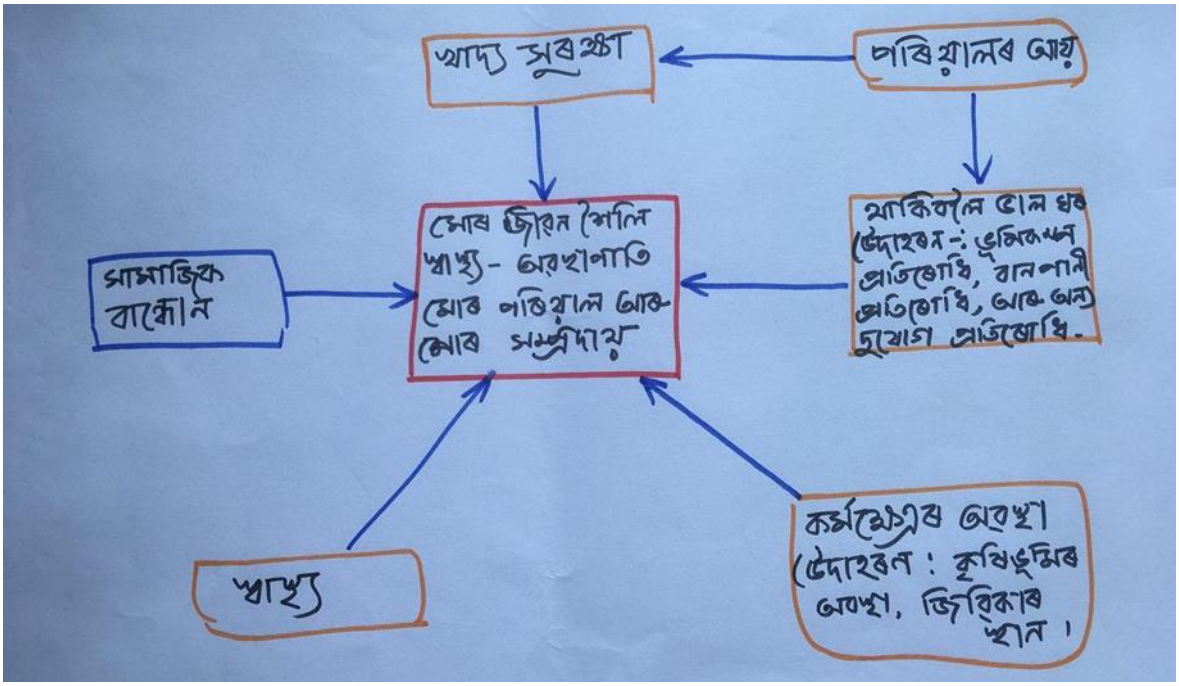



Figure 2. Base Participatory Systems Map shown to the participants before the PSM exercise

Link 1. Participatory Systems Map for Salmora village produced using PRSM platform and accessible using this link[6]

Link 2. Participatory Systems Map for Banoria Chapori village produced using PRSM platform and accessible using this link[7]

Link 3. Participatory Systems Map for Kulamua village produced using PRSM platform and accessible using this link[8]

[6] https://prsm.uk/prsm.html?room=VHZ-WXN-ONQ-QLC
[7] https://prsm.uk/prsm.html?room=HAL-ZPX-UMW-QLE
[8] https://prsm.uk/prsm.html?room=VWP-JTC-ACD-NUJ

### 5.1.1 Findings and discussion for Salmora

- A village in the bank of River Brahmaputra.
- Key climate change vulnerabilities include Flood, Soil erosion, River meandering, inundation due to flood and rain, change in rainfall pattern.
- Major occupation of the community members are pottery-making, boat-making, and carpentry.
- Community re-displaced and resettled multiple times recently. Currently in Flood prone zone. Not far from river embankment.

The PSM exercise during EMPOWER Workshop 1 in Salmora village included 10 participants from diverse backgrounds in terms of age, education, occupation, and gender. 34 climate change threats and related factors (represented in the green boxes in the PSM) emerged during the exercise in Salmora village. These factors directly or indirectly impact the livelihood, health, and well-being of the community members of the village. Moreover, several interesting interconnections were discovered during the PSM exercise, as the participants engaged in the discussion. For instance, many households had pottery-making as primary sources of income in Salmora. However, the continuous erosion of the river bank caused by river meandering of Brahmaputra has led to the reduced availability of soil for the pottery. This in turn has led to a decrease in income of the pottery-makers from pottery. Besides, the pottery-makers also found difficult to sell their products due to a lack of marketing skills. Such factors, combined, negatively influences their livelihood prospects and ability to meet other necessities required for their health and well-being. Yet another example of the impact of climate change related factor on the community members is the reduced availability of *Azhar* trees, whose timber is specifically required for boat-making. Many households in the village make their living out of boat-making. However, the government has put a ban on deforestation as a measure to conserve forests. Such a ban has negatively impacted the income prospects of the boat-makers of Salmora. As the PSM exercise progressed, several such interconnections between different factors emerged and resulted in a web of connections, as observed the PSM map of Salmora (Link 1)

After exploring the climate change related factors, their impact on the members of Salmora, and the connections between various factors, the participants were asked for possible interventions or action plans to reduce the impact of the emerged factors. Overall, 30 possible interventions were identified, which the participants suggest might help them in reducing the impact of the climate change threats. The interventions consisted of measures or actions that

could be taken at the individual level as well as measures that need to be initiated at the community level or by the government. Although the prime focus of the workshop was to identify individual interventions, few community-level or government interventions were outcomes of the analyses from workshop 1 findings. An example of possible individual action plans include, the pottery-makers were looking for alternative sources of income such as farming, fishing, or livestock rearing. Yet another example of possible individual interventions, as the participants suggested, could be to adopt flood resistant farming practices. Similarly, the female members of the village have started looking at weaving and producing handicraft items as an additional source of income to pottery-making. However, their limited technical know-how, marketing skills, and non-availability of markets emerged as some of the barriers for them to explore more about weaving and crafting for commercial purposes.

### 5.1.2 Findings from Banoria Chapori

- A village in the bank of River Brahmaputra.
- Key climate change vulnerabilities include flood, inundation due to flood and rain, Soil erosion, River meandering.
- Agriculture and livestock rearing are major occupations of the community members
- The village is relatively far away from the river bank in comparison to Salmora. However, during major floods, soil quality has substantially declined due to sand deposits.

The PSM exercise during the EMPOWER Workshop 1 in Banoria Chapori village included 10 participants from diverse background in terms of age, occupation, and education. The PSM exercise led to the identification of 34 climate change threats and related factors (represented in the green boxes in the PSM map). These factors directly or indirectly impact the livelihood, health, and well-being of the community members of the village. The PSM exercise in Banoria Chapori too led to the discovery of several interesting connections between the factors. For example, it was found that agricultural land soil quality declined due to de-siltation due to flood water (possessing high flow rate), which lead to reduced agricultural productivity. The participants revealed that deforestation has exacerbated such an impact of floods, as trees act as natural barriers to reduce the flow rate of flood water. Such an impact is a combination of both climate change induced changes as well as anthropogenic activities, which is affecting the income potential of the community members of the village

who are primarily dependent on agriculture. Another such example is the loss of land resources due to soil erosion (caused due to meandering of Brahmaputra) and frequent floods, which is further worsened by deforestation. Such changes not only impact the livelihood options but also food and nutrition security of the community members. Several such interconnections of factors can be observed in the PSM that emerged in Banoria Chapori (Link 2).

After the identification of the climate change threat factors and understanding the nature of the connections between them and how they impact the community members of Banoria Chapori, the PSM exercise focused on discovering the possible measures or action plans to reduce the impact of climate change. Overall, 23 such interventions were suggested by the participants that would help them to reduce the impacts of climate change and the related factors. Some of the suggested interventions include, for example, elevating the already stilted food storage further to keep the food grains safer during floods, keeping medicines ready before floods, shifting livestock to high-lying or safer areas during floods, etc. The community members also suggested using community-owned boats for rescue operations during floods, as there are very limited numbers of boats in the village, mostly owned by individual households. Further, the participants also believed that having a community-owned library that can be accessed by the members will help them to gain greater awareness and knowledge on diverse aspects including knowledge on modern ways to deal with flood situations.

### 5.1.3 Findings from Kulamua

- A village along the bank of River Kherkutia.
- Key climate change vulnerabilities include flood, change in rainfall pattern, soil erosion, inundation due to flood and rain.
- Major occupation of the community members includes agriculture, handloom and craft-making (by women).
- Community re-displaced and Resettled from the opposite side of River Bank. Have issues due to river flooding and also due to Dam operations.

The PSM exercise during the EMPOWER Workshop 1 in Kulamua village included 9 participants from diverse backgrounds in terms of age, occupation, education, and gender. The exercise led to the identification of 28 climate change threats and related factors (represented in the green boxes in the PSM). These factors directly or indirectly impact the livelihood, health, and well-being of the community members of the village. After

identification of the factors, the connections between the factors and how it impacts the members was discussed. The exercise led to the discovery of the interplay of factors on the livelihood and well-being of the members. For instance, the people of Kulamua are primarily dependent on agriculture for their livelihood. However, due to climate change related factors such as erratic flood and irregular rainfall pattern, their potential to make a living from agriculture is under direct threat. Besides, the farmers also started using chemical fertilizers and urea to meet the increasing demand for food for family as well as earn more to fulfill their needs. However, such use of the chemical fertilizers is gradually deteriorating the quality of soil, which has a negative impact on agricultural productivity. Flood and inundation are also damaging their crops, which impact their income from farming. Several such interaction of factors that impact the community members of Kulamua can be observed in the PSM of Kulamua (Link 3).

Similar to the community members of Salmora and Banoria Chapori, the members of Kulamua village also suggested several interventions to reduce the impact of climate change and related factors on their well-being. There were 23 such measures that emerged during the discussion. A few example interventions included reducing the use of chemical fertilizers, adoption of organic farming, plantation of trees, etc. The community members of Kulamua also suggested that reviving livestock rearing could be one of ways to improve their source of income, especially when their income from agriculture is impacted due to climate change induced changes. Remarkably, livestock rearing has been a common practice among the indigenous Mishing community of Kulamua. However, due to the livestock diseases like Swine Flu and the challenges of sustaining livestock during floods, the practice of livestock rearing is negligible in the village. Nevertheless, the villagers believe that if they are provided with adequate training and awareness on scientific or modern ways to livestock rearing, reviving it as a diversified income option could be a possible measure to reduce the impact of climate change related factors in their livelihood options. A complete list of interventions in a diverse yet interconnected context can be observed in the PSM of Kulamua (Link 3).

## 5.2 Workshop 2

Based on the data collected from Workshop 1, interventions were identified both from what was shared by the participants and based on literature. We subsequently focused on the most critical interventions from the list, analysed their co-benefits and trade-offs, and then grouped them into the categories below for Workshop 2. These interventions were grouped into

different categories as listed in Table 2 to 4. Further, different colour coding was provided to distinguish categories, for example, Dark yellow for House/ Living condition, Green for food security and agriculture, and so on.

Table 2. List of personal interventions for Salmora village with specific codes for each broad category of interventions

| Categories | Intervention Code | Personal Interventions |
|---|---|---|
| House/ living condition | HL1 | Use concrete columns for stilt houses |
| | HL2 | Identify a safe place for temporary shelter during flood |
| Food security and agriculture | FA3 | Store food and other items of basic need in a safer place |
| | FA4 | Adopt flood resistant/ climate-resilient agricultural practices |
| Income/ livelihood | IL5 | Explore income diversification options for women (e.g., Sewing, Weaving, etc.) |
| | IL6 | Educate young generation with training for self-subsistence |
| | IL7 | Explore alternative income options (e.g., agriculture, Fishing, livestock rearing and Good quality Banana production, etc.) |
| | IL8 | Adopt farming practice which is flood resistant/ climate resilient agriculture |
| | IL9 | Develop entrepreneurial skills to market products |
| | IL10 | Identify alternative options to source soil for pottery |
| General | GN11 | Afforestation: Plant trees in and around the village |

Table 3. List of personal interventions for Banoria Chapori village

| Categories | Intervention Code | Personal Interventions |
|---|---|---|
| Housing/ living condition | HL1 | Pre-flood: keep ropes to make boats from banana tree |
| | HL2 | Elevate the stilted house further or make another floor |
| | HL3 | Learn Swimming for survival |
| Food security, agriculture, water | FA4 | Pre-flood: keep all basic items safely (e.g., food) |
| | FA5 | During flood: source drinking water from high-lying areas and boil it before drinking |
| | FA6 | Increase the height of stilted food storage further |
| | FA7 | Adopt climate resilient agriculture/ learn scientific approach to farming |
| Health related | H8 | Pre-flood: keep all basic medicines ready |
| Livestock rearing | L9 | Pre flood: store feed for livestock |
| | L10 | Shift livestock to high-lying areas |

| | | |
|---|---|---|
| | L11 | Post flood: prepare medicines for livestock |
| | L12 | Learn scientific/ modern ways to livestock rearing |
| General | GN13 | Gain greater knowledge on nature-dependent resources |
| | GN14 | Gain awareness on various government schemes |
| | GN15 | Gain greater knowledge on how to deal with flood situation |
| | GN16 | Afforestation/ Plantation of trees in and around the village |

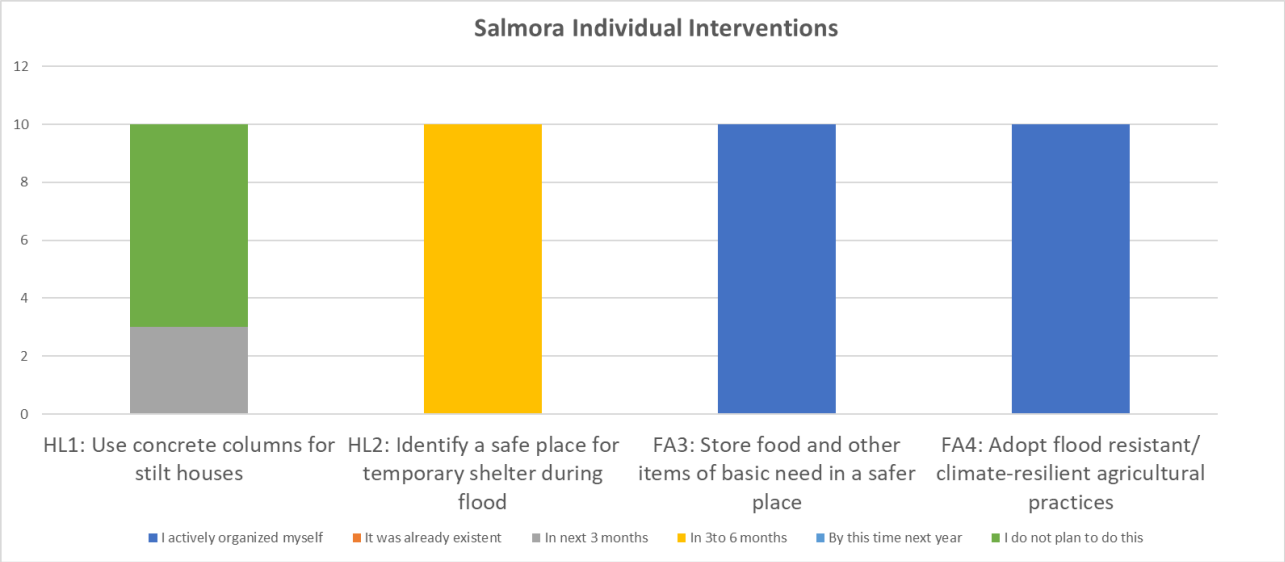
Table 4. List of personal interventions for Kulamua village

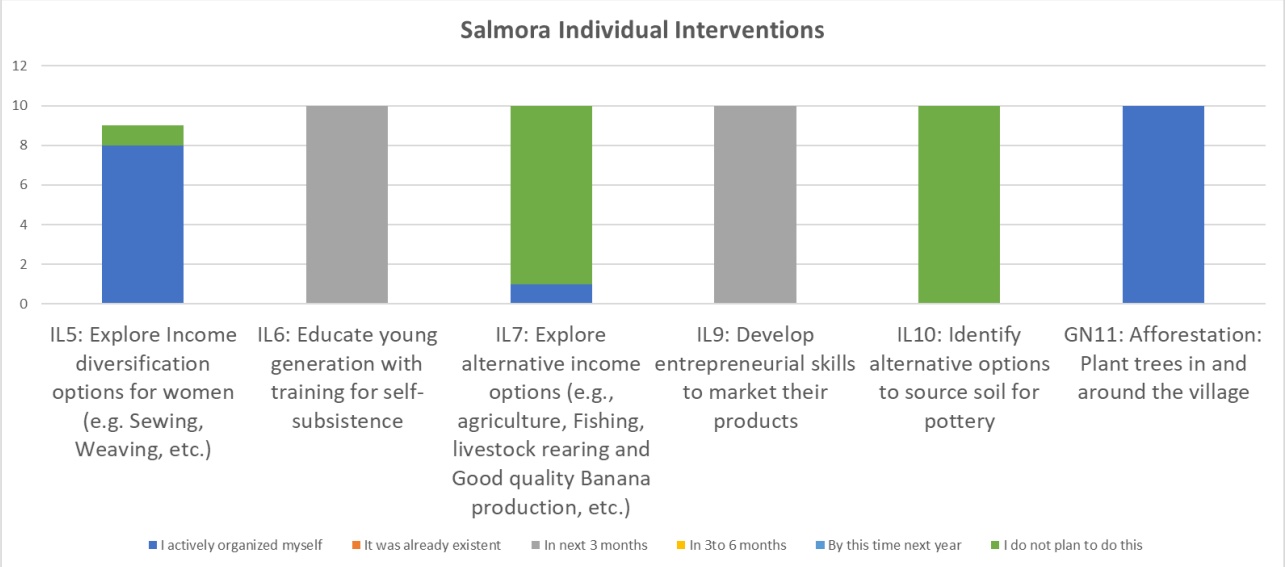
| **Categories** | **Intervention Code** | **Personal Interventions** |
|---|---|---|
| Food security, agriculture | FA1 | Adopt climate resilient Farming/ alternative cops based on seasonal changes |
| | FA2 | Reduce the use of chemical fertilizers and urea |
| | FA3 | Adopt organic farming |
| | FA4 | Gain awareness on Government schemes related to agriculture and farming practices |
| Livestock rearing | L5 | Revive livestock rearing |
| | L6 | Gain awareness on livestock diseases and prevention |
| Income/ livelihood | IL7 | Gain knowledge about alternative livelihood options |
| | IL8 | Look for alternative source of income (e.g., Fishing, Weaving by females) |
| General | GN9 | Afforestation/ plantation of trees in and around the village |

Workshop 2 was conducted in the same three communities, inviting the participants from Workshop 1. Workshop 2 begun with an overview of findings from Workshop 1, a brief overview of PRSM output, the basics of co-benefits and trade-offs were explained to the community members. After that, the list of interventions (which was translated to Assamese Language) was shown to them and explained its importance one-by-one. Each of the participants were provided with a data collection template to capture their actions taken/intended time-frame as responses, which is illustrated in Appendix I. Further, they were given coloured stickers (corresponding to the category of interventions) separately for each intervention, as illustrated in Appendix II. The data collection process began by explaining an intervention and asking the participants to paste the sticker in the appropriate box that corresponds to their own choice of taking an action for the suggested intervention (e.g., actively organized, plan to do in 3 months, plan to do in 6 months, etc.). This exercise was done for all the listed interventions one-by-one. Co-benefits, trade-offs, and barriers to take

action were discussed based on suitability of the context. Later, the response sheets were used for data entry and further analysis. The summary of the results obtained are represented separately for each of the villages from Figure 3 to Figure 5.

Figure 3. Summary of Individual Interventions and action plan from Salmora Village

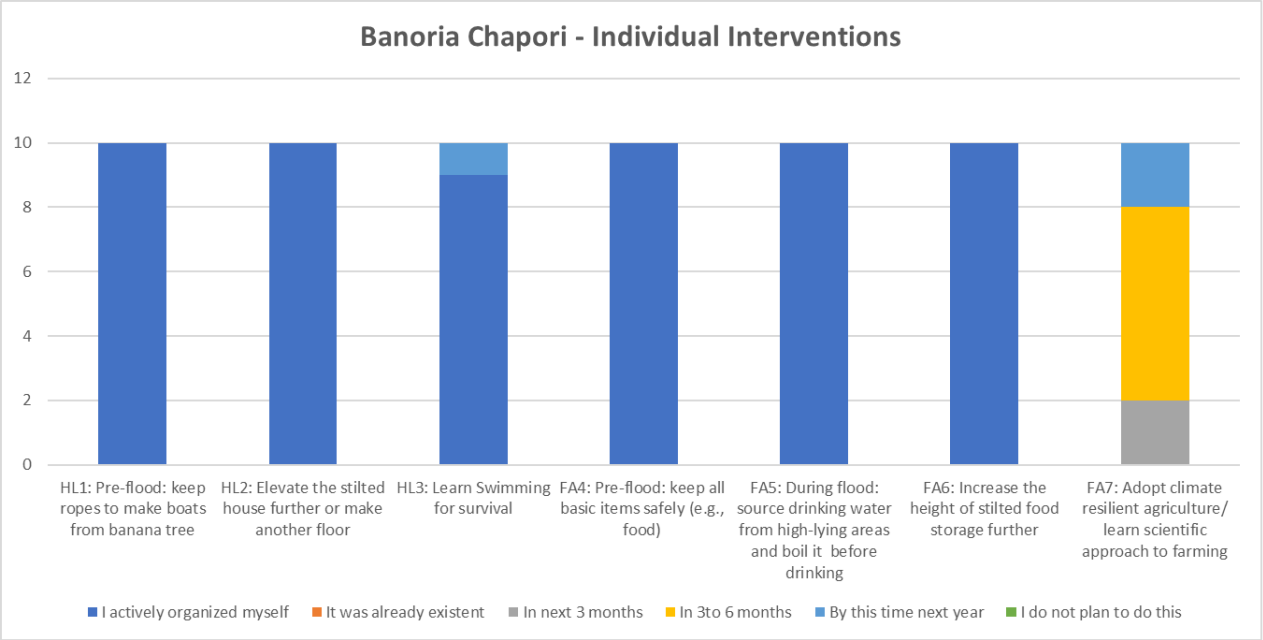


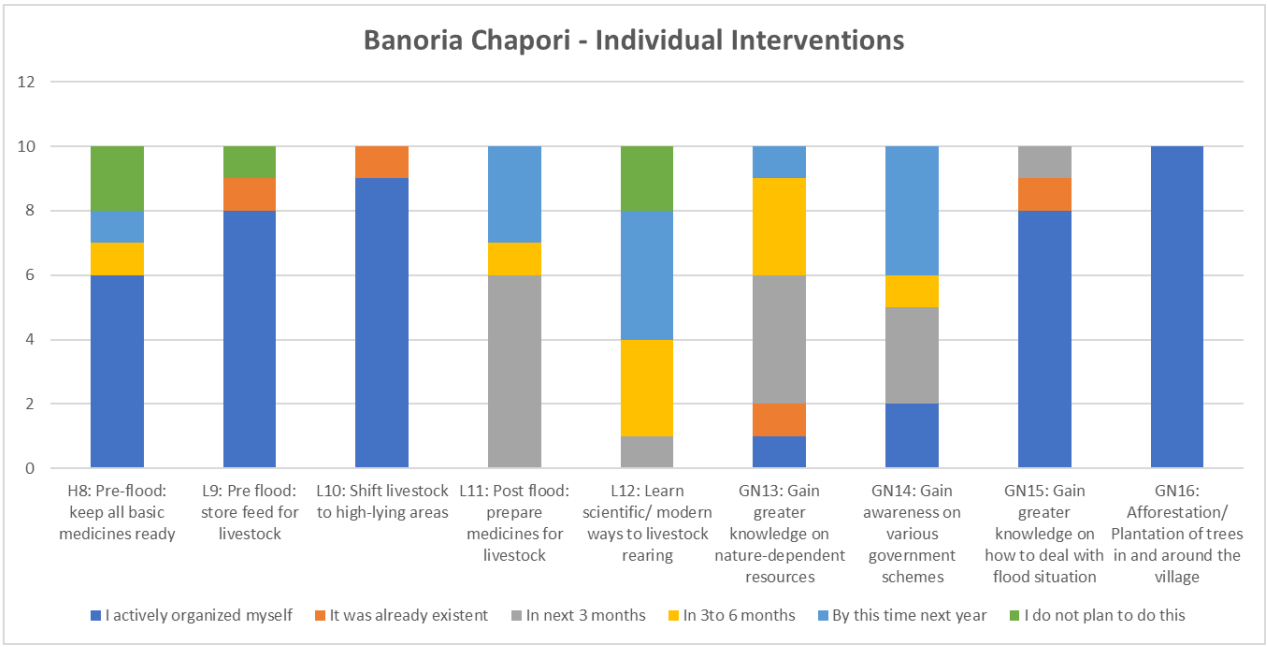




As it can be understood from Figure 3, the community members have traditionally been taking actions such as store food and basic items in safe area, practicing flood resistant farming, income diversification (by women), and plantation of trees in and around the village. However, many (7 out of 10) are not willing to construct concrete columns for stilt houses due to limited financial resources. Most (9 out of 10) are also not planning to explore alternative income options (e.g., agriculture, fishing, livestock-rearing), as they feel they are

not equipped enough to do so in terms of financial requirement as well as skills. The pottery makers are not willing to identify alternative options to source soil for pottery, as they feel it would not be worthwhile to look for alternative options unless and until there is government support allowing them to source soil from such sources.

Figure 4. Summary of Individual Interventions and action plan from Banoria Chapori Village

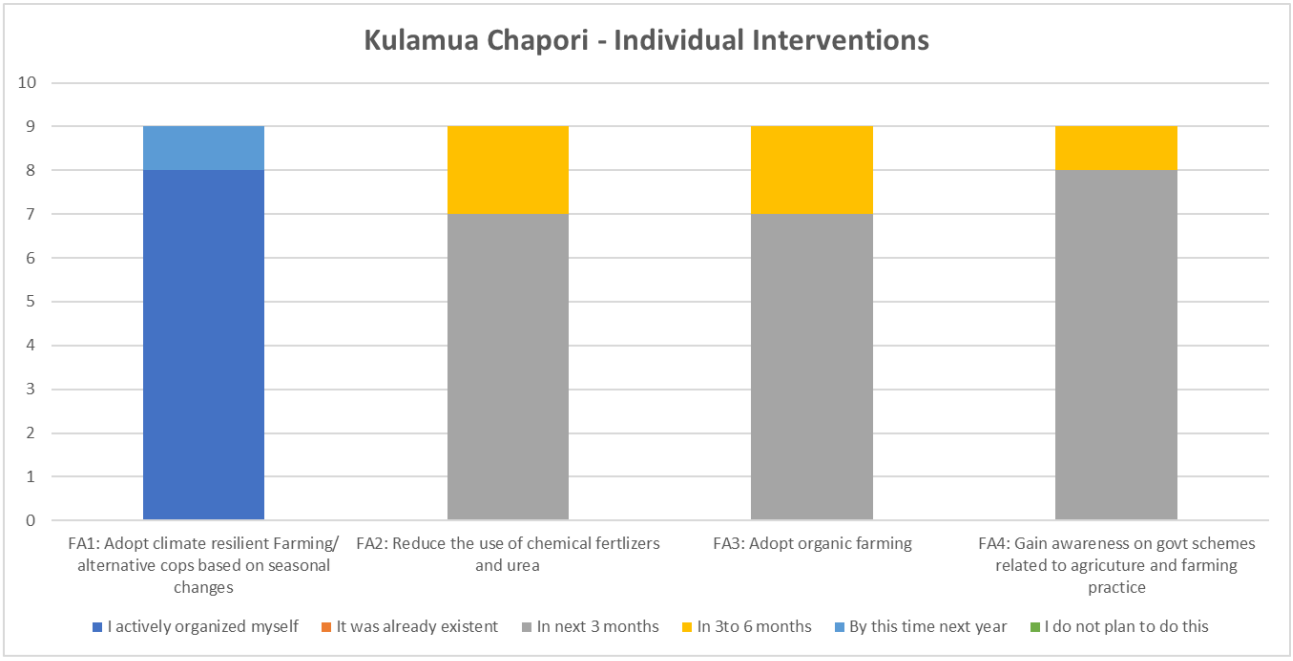


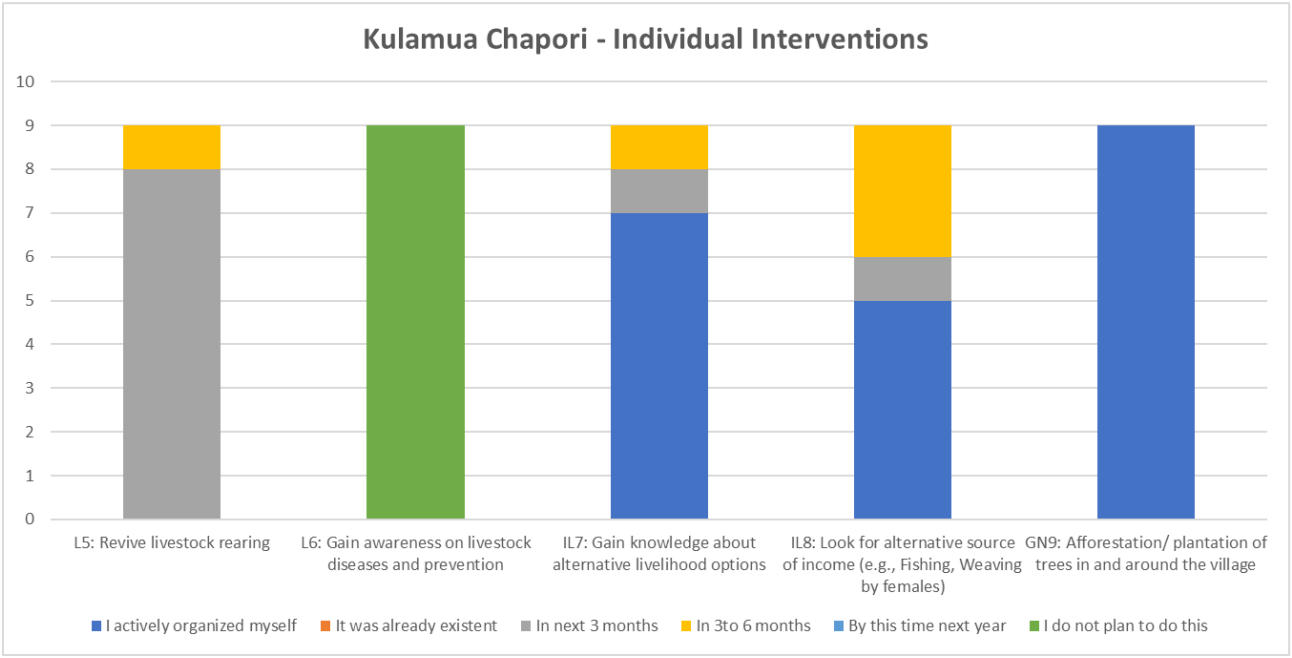




The community members of Banoria Chapori too have traditionally been taking adaptation actions such as keeping ropes to make boats from banana tree, elevating the stilted house further, learn swimming, keeping essential items safely, obtain drinking water from safe area and boil before drinking, increase the height of food storage, shift livestock to high-lying areas, plantation of trees, etc. Most (8 out of 10) of the participants are willing to adopt climate-resilient agriculture/ learn scientific ways to farming in the immediate future. Many

(7 out of 10) of the participants realizes the importance of medicines for livestock and are willing to prepare medicines for livestock in the near future. Most (8 out of 10) of the participants are also willing to learn about scientific ways to livestock rearing in near future. Several (7 out of 10) of the participants agree that it is important to know more about nature-dependent resources to adapt to climate change, and willing to take action in this regard in the near future.

Figure 5. Summary of Individual Interventions and action plan from Kulamua Village



As it can observed Figure 5, most (8 out of 9) of the members of Kulamua have already been practicing climate resilient farming, and a few who have not yet done so are willing to take action in the near future. They have already been doing plantation of trees in and around their village. The members revealed that they cannot take actions with regard to gaining awareness on livestock diseases and prevention, as they will not be able to do so without any external support (e.g., training and awareness programs). Many participants said that they will take actions such as revive livestock rearing, gaining knowledge about alternative livelihood options, look for alternative source of income, reduce the use of fertilizers, adopt organic farming, and gain knowledge about various government schemes for agriculture.

## 5.3 Evaluation

The EMPOWER project included an evaluation survey component that constituted of two surveys, Evaluation Survey 1 - conducted before workshop 1, and Evaluation Survey 2 - conducted after workshop 2. The aim of the survey was to assess if the project increased the participant's awareness about climate change risks, and whether the participants took action on any of the adaptation measures in their personal adaptation plan. The Evaluation Survey 1 had two questions for the participants, which were intended to capture the individual perception concerning their awareness of and preparedness to climate change risks. The survey used a Likert scale with five possible responses to a statement or question: 'strongly disagree', 'disagree', 'neutral', 'agree', and 'strongly agree'. The participants had to respond to two statements: 1) *I'm aware of the ways in which climate change will impact me and my household;* and 2) *I'm prepared for climate change impacts in terms of an action plan to reduce risks.* All responses to the evaluation form were collated online.

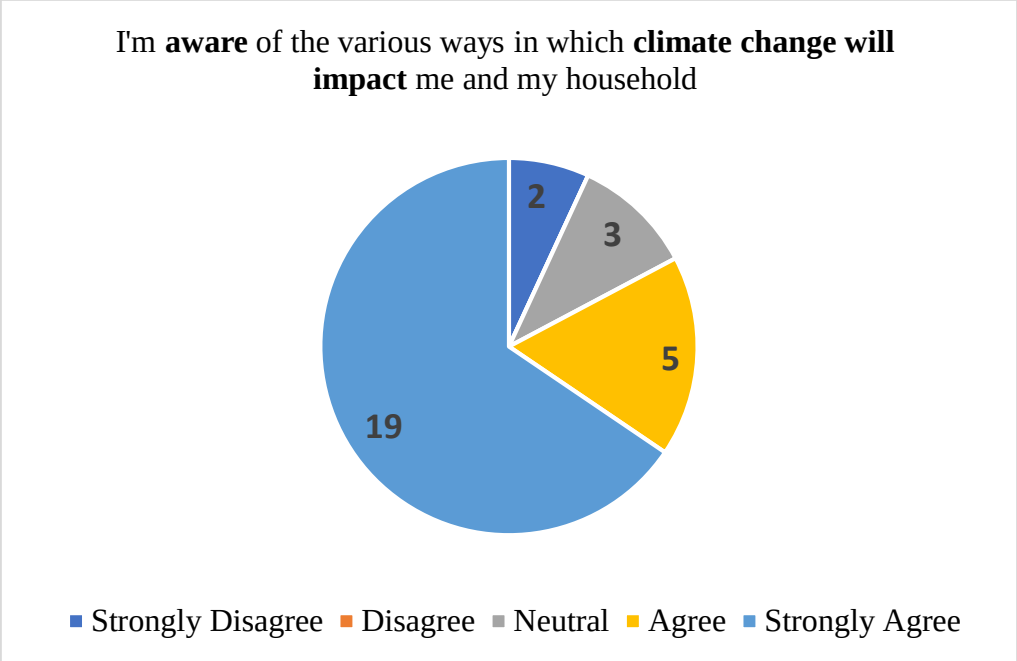
The Evaluation Survey 2 aimed to assess the influence of the EMPOWER workshop, if any, in the participants' awareness of and preparedness to climate change risks in comparison to the baseline survey (Evaluation Survey 1). The same Likert scale with five possible responses, as the one in Survey 1, was maintained for the statements initially asked to participants before the events: 1) *I'm aware of the ways in which climate change will impact me and my household*; and 2) *I'm prepared for climate change impacts in terms of an action plan to reduce risks*. In addition to those statement, the participants were also asked to respond to the following statements (about the impact of the EMPOWER project on them) based on their involvement in the workshops: 3) *The EMPOWER workshops improved my understanding of the way climate change will impact me and my household*; and 4) *The*

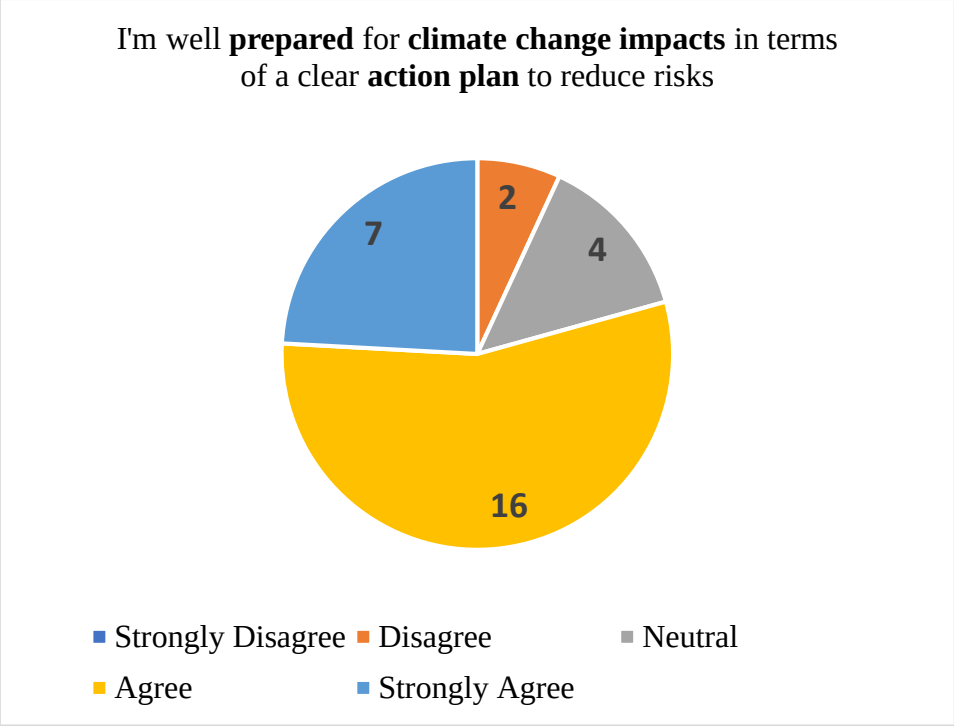
*EMPOWER workshops helped me to make clearer plans for improving my adaptation to climate change impacts*. Finally, the participants were asked to share their experience including any feedback to the EMPOWER project team.

Survey responses were collected individually. To make it easier for the participants to respond, the survey template also included a translated version of the text in Assamese language. A summary of the survey results are as mentioned below in the Figures.

## Brief summary of the findings from the Evaluation Survey 1

Figure 6**.** Results from Evaluation Survey 2



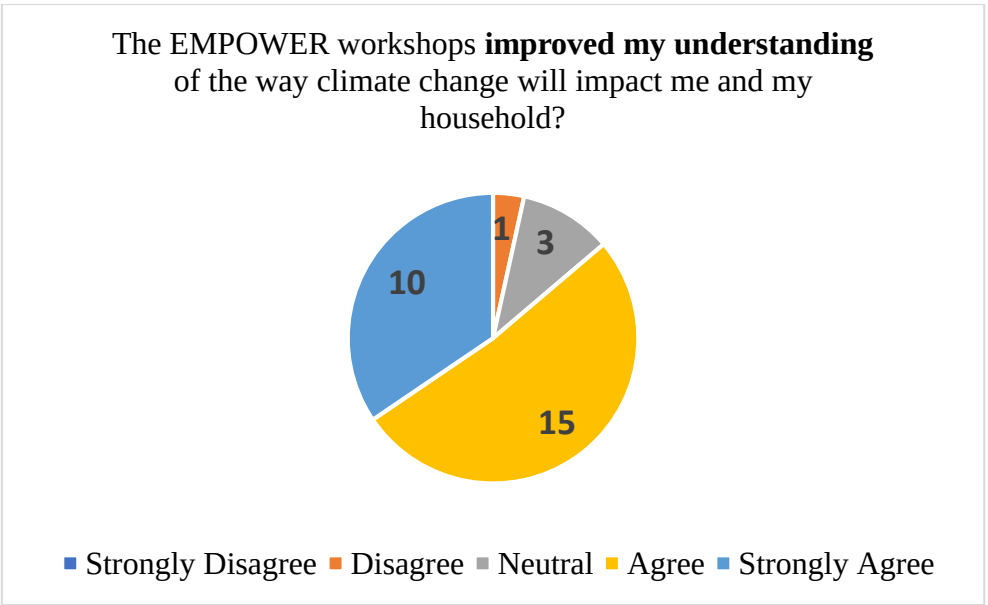


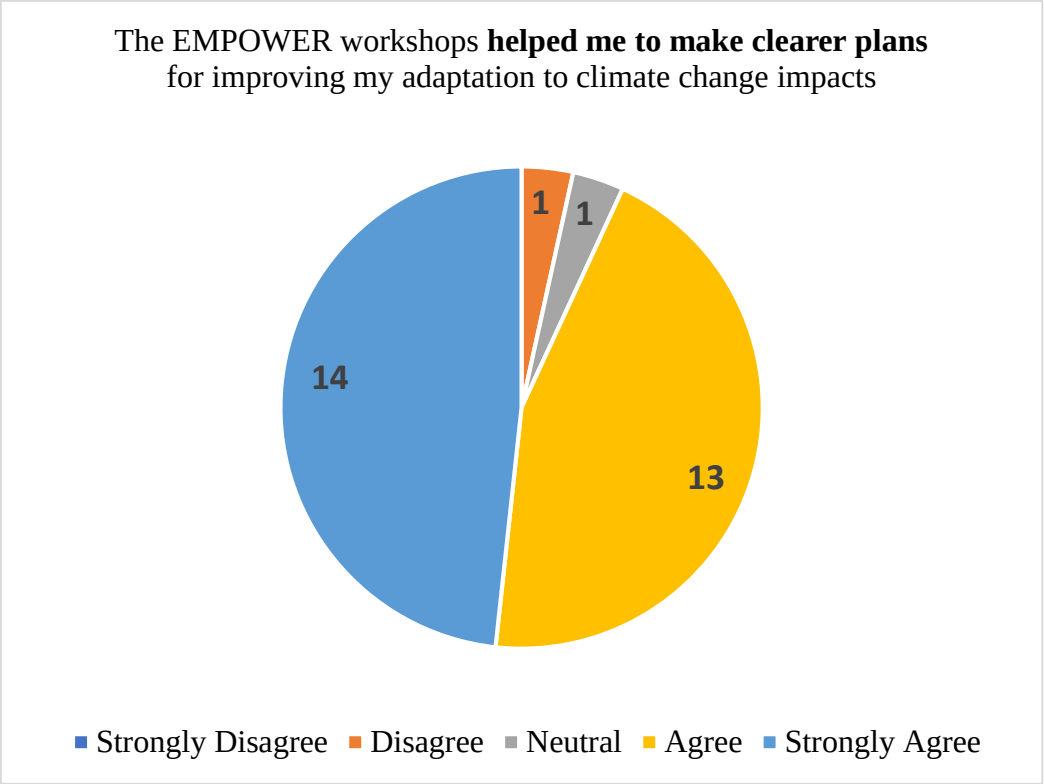

Key highlights

- Just above 80 percent of the respondents agree or strongly agree that they are aware of the various ways in which climate change will impact them and their household
- More than 80 percent of the respondents agree that they are well prepared for climate change impacts in terms of a clear action plan to reduce risks

Brief summary of the findings from the Evaluation Survey 2

Figure 7. Results from Evaluation Survey 2






Key highlights

- Around 85 percent of the respondents either agree or strongly agree that the EMPOWER workshops improved their understanding of the way climate change will impact them and their household
- A vast majority of the respondents (more than 90 percent) agree that the EMPOWER workshops helped them to make clearer plans for improving their adaptation to climate change impacts

# 6 Critical Reflection and challenges

## 6.1 Challenges of Planning data collection during COVID

The EMPOWER India workshop was initially planned to be conducted in Sundarbans in West Bengal India. However, due to the COVID19 situation, which worsened in the month of January (when the first workshop was scheduled), the workshop had to be cancelled due the restrictions of travel to Sundarbans as per the local government notification and restrictions imposed on gathering of groups in a location. As the COVID19 related restrictions continued in the state of West Bengal, the idea of conducting the workshop in Sundarbans had to be

eventually cancelled and shifted to Majuli Island in Assam. The reason for choosing Majuli for the project is the high vulnerability of the Island to impact of climate change and how the communities of the world's largest river island have been continuously threatened by climate change induced changes such as frequent floods and soil erosion. Given that the COVID19 situation and restrictions were not as severe in the state of Assam as compared to West Bengal, there were fewer restrictions in Assam. Hence, it was possible to plan for conducting the workshop in Majuli. However, to avoid gathering in large numbers risking COVID19 spread, we decided to conduct the workshops in the selected villages separately as three different sessions.

## 6.2 Challenges of data collection in remote and rural locations

The island of Majuli is a remote region and it is difficult to access it from the mainland of Assam. The entire island is considered as rural and with limited basic infrastructure (transport, telecom). The three villages selected for the workshop are relatively remote and far from the administrative centre of Majuli named Garamur, which is an upcoming semi-urban centre. While the villages have their unique challenges concerning the impact of climate change, which made them suitable to be considered for the study, they are geographically far apart. This posed some challenges in planning and coordinating to conduct the workshop within the limited resources. The following sections present the team's critical reflection, lessons learned and challenges.

## 6.3 Challenges and Lessons learned in Implementing PSM process and conducting the workshops

PSM Process

- Bottom-up process of understanding Climate change adaptation is critical to influence regional/local action plans.
- PSM process (workshop 1) was systematically designed in the protocol to organise the PSM facilitation session into distinct parts/phases (e.g. threat vectors, consolidation, connection and interventions). This helped in effectively conducting the PSM exercise in three villages and ensuring consistency.
- Base Simple PSM in Assamese provided good orientation for the participants about factors, connections, etc.
- Even though they were not familiar with the PSM and lacked formal education in some cases, they showed excellent engagement in workshop 1 while discussing connections.

- Doing the workshops within the community, helped them greater engagement in the PSM process and in both EMPOWER workshops.
- Engaging participants for PSM exercise needs thorough preparation in terms of the PSM methods as well as the timelines for various PSM steps.

Organizing the workshop

- Participation of members (commoners) from diverse backgrounds (e.g. age, occupation, gender, etc.) enhanced the nature of the outcome.
- There were few absentees in the Workshop 2 in one village and few additional turnouts in other villages.
- There were challenges of late arrivals of the participants.
- During Covid19, it was difficult to gather all the participants from different villages in one common hall or area. Unlike normal times, there was risk in transporting them while local restrictions were enforced on the number of people who could gather.
- It was difficult to host an online workshop directly in PRSM or live in Zoom due to internet issues.
- Conducting participatory research such as PSM in remote-rural context would require detailed planning and efforts in terms of logistics and execution of the workshop.
- Even though Assamese is the native language of the state, the two communities spoke Mishing tribal language and in some cases, there was a need to translate from Assamese to tribal language for better communication.

Participant Engagement

- Few of the common threats/factors/direct effects were displayed using icons during PSM exercise. This increased participant engagement.
- For workshop 2, data collection template and evaluation Survey ( the Google form) was translated to Assamese and further implemented in the workshop mode where participants exercise their own choice/response using stickers. The alternative to this was an enumerated survey. However, based on the post-workshop feedback and active engagement shown by the participants, Workshop 2 design using stickers was very effective and enabled individual involvement in the exercise.
- As the participants could see the PSM evolve during the workshop, this increased transparency in how the data was analysed, further increasing their engagement.

- Participants were willing to share more if they feel that their opinion/ concerns are taken seriously or attentively.
- Communities of the selected three villages have already been taking several measures for climate change adaptation. Hence, the preparation for the workshop had to be done by keeping the current adaptation in mind and how the impact of climate change in Majuli might worsen in future.

General Reflections and Challenges

- Knowing the local context (socio-cultural, economic, geographical, aspects) in detail is necessary to accomplish a stakeholder-based approach to Climate change adaptation.
- The role of NGO with grassroot presence was essential to recruit participants.
- Sometimes participants were emotional in sharing their views & personal circumstance and often it was difficult to intervene to shorten their sharing of emotions.
- While the workshop focused on individual adaptation plans, discussing Government or any external support was inevitable. Several individual actions plans would rely on availability of external support.
- Engagement of women in participatory research approaches such as PSM would vary based on the social norms in a community. It was planned to have a female notetaker from the local region and was cancelled as she was affected by Covid. A women team member might have increased their participation in discussions. Familiarity of the women participants with the project team could improve their active participation.
- It was realized that participants did have expectations in terms of tangible/ intangible benefits from the project. It was challenging to set right expectations about the outcomes of the project and the workshop.
- Although the selected three villages are in Majuli, they have different concerns and challenges with regard to Climate change adaptation, which indicates the need for locally tailored interventions/ measures for Climate change adaptation.
- On a few occasions personal life challenges (beyond the scope of the project and limits as academic researchers could do) were brought into workshops discussion, as it affected their personal circumstances and also their ability to take Climate change adaptations. However, these issues were beyond the project team's ability to address.

- Often major barriers (e.g. lack of financial resources) in their routine life became an impediment while discussing personal adaptation actions (what they could do further). It was challenging further to discuss what they could do further as individuals and communities.
- Based on the post-evaluation survey, the workshop certainly helped most participants to gain a greater awareness about the impact of climate change, inter-relations between various actions and also develop perspectives concerning individual actions they can take to reduce the impact of Climate change.
- While doing sequential PSM workshops, it is important to have a realistic idea of workshop duration considering time taken for post-workshop conversations and travel time between venues.

### 6.4 Limitation and further scope of research

The impact of climate change on the socio-cultural heritage of Majuli in particular *Satras* (Vaishnavite Monastries) was excluded from the EMPOWER project's scope. There has been a considerable impact on the *Satras* and their existence, and this requires further investigation. *Satras* are the socio-cultural centres of Assam and define the spiritual aspects of the communities of Assam. Future studies focusing on how climate change can be associated to such ideas would significantly add to the literature on climate change and its impact on the socio-cultural heritage of a region.

Further, as the project was conducted on a pilot-scale basis, the workshops were restricted to a few villages and communities in Majuli. However, there are several communities co-existing in Majuli. Future studies may also focus on considering the other communities and more villages that would be representative of the Island to understand the impact of climate change on the Island as a whole.

## 7 Key findings and implications for policymakers

There are several implications from the EMPOWER India project for understanding the impact of climate change and adaptation to climate change at the local level. The main objective of the project was to pilot a participatory system mapping protocol and document learnings from the exercise. The findings from the study are expected to considerably add to the discourse on climate change adaptation, especially at the individual and community level. The following are some of the key implications from the study:

- There is an urgent need to study the impact of climate change at the local level and identify individual and community level adaptation measures, particularly in the communities living in climate sensitive ecosystems such as the riverine ecosystems.
- Identifying individual or community level climate change adaptation measures would require an extensive understanding of the local socio-economic and ecological context, and of the adaptation measures already undertaken by the community members.
- Individual or community level adaptation measures to reduce the impact of climate change may considerably vary from one locality/ village to another within the same geographical area depending on the climate change threat vectors the locality is exposed to. Further, the ability to undertake such measures would also vary considerably depending upon diverse set of local factors and their interaction.
- Local government and non-government organizations have a significant role to play when it comes to enabling the members of a community to undertake the individual and community level climate change adaptation measures.

The impact of climate change is multifaceted, and have a systemic consequence, even at a very local level. Climate change related threats can directly or indirectly impact the livelihood, health, and general well-being of communities. Hence, the problem needs to be addressed through multiple perspectives and would require a systematic and interdisciplinary approach.

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# 9 Appendix

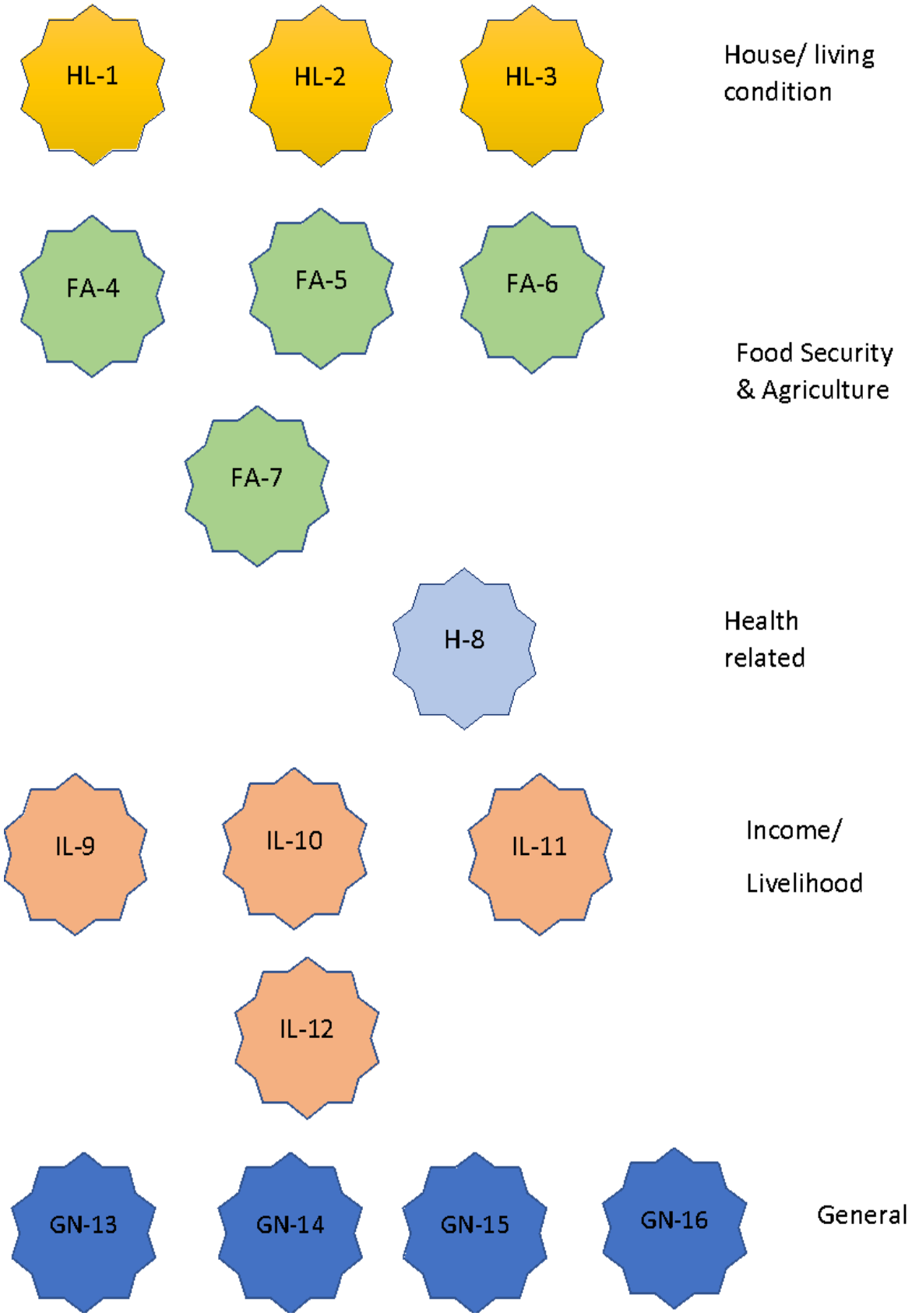
**Appendix I:** Empower Workshop 2 Data Collection Template

**Name of Participant: _____ Gender _____ Village:_____**

## Template 1: Individual Interventions (ব্যক্তিগত হস্তক্ষেপ)

| **Action preference** | **কার্য্য পছন্দ** | | |
|---|---|---|---|
| **I already have the intervention in place**<br>**মই ইতিমধ্যে হস্তক্ষেপ হাতত লৈছো** | I actively organized it myself<br>**মই নিজেই ইয়াক সক্রিয়ভাৱে সংগঠিত কৰিছিলো** | | It was already existent<br>**এইটো ইতিমধ্যে অস্তিত্ববান আছিল** |
| **I plan to do in future**<br>**মই ভৱিষ্যতে কৰাৰ পৰিকল্পনা কৰিছো** | In next 3 months<br>**পৰৱর্তী 3 মাহত** | In 3 to 6 months<br>**3 ৰ পৰা 6 মাহত** | By this time next year<br>**অহা বছৰৰ এই সময়লৈকে** |
| **I do not plan to do this**<br>(collect reasons from participants)<br>**মই এইটো কৰাৰ পৰিকল্পনা কৰা নাই** | | | |

**Appendix II:** An example sticker with Intervention codes and categories



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