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Aaranyak

COMMUNITY RESILIENCE TO WATER INDUCED DISASTERS AND CLIMATE CHANGE: A STUDY AND DOCUMENTATION OF GOOD PRACTICES IN SELECTED RIVER ISLANDS OF THE BRAHMAPUTRA RIVER BASIN, ASSAM

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Contents

REPORT

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COMMUNITY RESILIENCE TO WATER INDUCED DISASTERS AND CLIMATE CHANGE: A STUDY AND DOCUMENTATION OF GOOD PRACTICES IN SELECTED RIVER ISLANDS OF THE BRAHMAPUTRA RIVER BASIN, ASSAM

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Abbreviations and Acronyms

ASDMA	:	Assam State Disaster Management Authority
ASHA	:	Accredited Social Health Activist
ASTEC	:	Assam Science Technology and Environment Council
AWC	:	Anganwadi Centre
CC	:	Climate Change
CCA	:	Climate Change Adaptation
CFMS	:	Centre for Flood Management Studies-Guwahati
CSDG	:	Centre for Sustainable Development Goal
CSO	:	Civil Society Organisation
DDMA	:	District Disaster Management Authority
DRR	:	Disaster Risk Reduction
FREMMA	:	Flood and River Erosion Management Agency, Assam
GoA	:	Government of Assam
GoI	:	Government of India
HRP	:	High-Rise Platform
ICDS	:	Integrated Child Development Scheme
IWP	:	India Water Partnership
IWT	:	Inland Water Transport
NHM	:	National Health Mission
NIH	:	National Institute of Hydrology
PI	:	Principal Investigator
SDG	:	Sustainable Development Goal
SAPCC	:	State Action Plan on Climate Change
WIH	:	Water Induced Hazard
WRD	:	Water Resources Department

EXECUTIVE SUMMARY

The project led to better preunderstanding of the vulnerabilities of the people living in the three study sites ((i) Kobu Chapori, Dhemaji District, (ii) Majuli, Majuli District and (iii) Chalakura Char, Dhubri District) to impact of water induced hazards and climate change manifest mainly in the form of annual flooding, Riverbank erosion, land degradation due to sand deposition and storms. Vulnerability was examined in the context of physical impact of hazards, environmental situation, socioeconomic conditions, livelihood, WASH scenario, gender and marginalized population. The project has led to documentation of practices and strategies of communities in response to the impact of hazards. The communities were sensitized about pros and cons of disaster risk reduction and climate change adaptation during the interactions (group meetings) undertaken as per methodological approach for collecting information and views. Salient results of the study were shared with important stakeholders both from project sites and state level agencies in a workshop. Their suggestions were incorporated in the final report of the study. The report summarizes major recommendations and observations on the policy discourse.

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We are also thankful to the communities who participated during course of this study and provided their valuable views and suggestions.

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I. Introduction

Formation of islands in the channels is a common geomorphological feature of fluvial Rivers that carry significant amount of sediments. River islands formed due to deposition of sediment in the Rivers of Assam, West Bengal, Bihar and Bangladesh have many local names, but *Char* is a generic name of such islands. Such islands or sand bars are also known as chapori in Upper Assam.

Since chars and chaporis are created from River sediment, they are in a constant state of formation and erosion. Characteristically, chars are annually affected by flooding, shifting of river channels and bank erosion. Chars, when they become stable and the soil becomes fit for agriculture provide additional land for settlement and hence considered important natural resources.

In the Brahmaputra River and its tributaries, chars and chaporis are created by accumulation of River borne sediment as well as due to deposition of soil that is eroded from nearby land areas by the River. The nature and quality of soil formed in these islands is not uniform. In general, due to deposition of alluvium freshly laid by the River with humus, soil becomes fertile and therefore fit for growth of various flora and agricultural crops. Thus, the chars have ecology, ecosystems and biodiversity of their own which is not entirely same as that of the mainland on River banks **(Chakraborty, 2009).**

The entire length of about 800 km of the Brahmaputra River and some of its tributaries in Assam are dotted with numerous islands of different sizes and shapes. Many of these islands are permanently inhabited, some temporarily and some are barren. Most of the islands exhibit similar characteristics in terms of formation, geomorphology, natural ecosystems, community, societies and their ways of lives and livelihoods. Almost all the islands in western and central Assam are inhabited mainly by the Bengali speaking Muslim community, the forefathers of them migrated from the erstwhile East Bengal from the late eighteenth century, a trend which prevailed throughout the nineteenth century **(Sultan, 2015).** The agricultural practices and other socio-cultural traits of different char areas peopled by this community bear considerable similarity within Assam and also to those seen in the chars of Bangladesh.

In the islands of central and eastern Assam, many other communities like Nepalis, Misings, Deuris and Biharis also live. Majuli, the largest inhabited River island, located in the eastern stretch of the Brahmaputra is an exceptional case where a large population of indigenous ethnic groups live permanently, which has become possible because of its geomorphic stability providing fertile soil and a congenial environment with many natural resources that support livelihoods and progress of societies. Development of the island as a centre of spiritual and cultural heritage of the Neo-Vaishnavite religion also helped in perpetuating an educated society in Majuli.

As per the socio-economic survey results published by the Directorate of Char Areas Development, Government of Assam in the year 2004, the state has about 360,000 hectares (3600 square kms) of char land, which is about 4.5% of the geographical area of the state, where about 2.5 million people live **(DCAD, 2004)**. Out of this 1.27 million are male and 1.23 million are female. The Char areas are distributed in 23 Sub-Divisions falling under 14 Districts, with 2251 villages in 299 Gaon Panchayats and 59 Development

blocks. The total number of families is 0.44 million (about 4.4 lakhs) of which about 68% lives below the poverty line. Density of population in Char areas is much higher than average density in the State e.g. 690/sq. km. against State average of 340/sq. km **(GoA, 2005)**. About 81% of the males and 92% of females in chars of the state are illiterate **(DCAD, 2004)**.

The chars and char dwellers play a very important role in the agricultural and economic development of the state. The chars have become the granaries of the entire state since a sizeable amount of kharif and rabi crops (paddy and seasonal vegetables for example) are produced in the chars. The char community living has earned a good name as hard workers and innovative farmers as far as agricultural production are concerned. They make it possible to grow many types of crops and vegetables in environmentally hostile conditions even on heavily silted and sandy soil. Soils of similar nature are considered as wastelands and therefore unproductive, in the mainland by many indigenous communities. This has become possible because farmers in the islands are also more adaptive to the drastic and seasonally changing aquatic environment, Rivers and water than many of the mainland communities **(Das and Lahkar, 2012).**

The inhabitants of these chars are highly vulnerable to a number of water-induced hazards like flooding, River erosion and land degradation due to excessive siltation. Low rate of literacy, poor socio-economic condition resulting in poverty, lack of development infrastructure such as drinking water, health, sanitation, hygiene and nutrition and over all marginalization due to remoteness from the mainland are the factors that make them more vulnerable to the hazards. Climate change, with its overwhelming and penetrative impact on the water and River regimes of the northeastern region of India and especially on the Brahmaputra River basin, has rendered these hazards erratic and at times they are more frequent and intense thus increasing their vulnerability.

Lives of the island dwellers are overridingly dependent on ecosystem services of Rivers and Riverine ecosystems **(Karim et. al., 2015).** Their life cycle and livelihoods are tuned to the seasonal rhythm of Rivers and the monsoons. They are threatened annually by devastating floods, erosion and land degradation due to siltation. Yet many of these chars are known as centers of agricultural revolution. The people exhibit remarkable examples of resilience made possible through traditional knowledge, skills and locally innovated adaptation practices which are worth examining and analyzing so that other communities can learn from them to make survival possible and sustainable in vulnerable locations.

II. Purpose

Main purpose of the study was to understand impact of the water induced disaster and climate change on a section of vulnerable population and document the practices they have adopted to reduce vulnerability and enhance resilience to disaster and climate risks in three Rivers islands located in the Brahmaputra River, Assam viz. (i) Kobu Chapori, Dhemaji District, (ii) Majuli, Majuli District and (iii) Chalakura Char, Dhubri District.

III. Specific Objectives

The specific objectives of the study were:

(i) Study on socioeconomic and environmental conditions in the selected villages of the three project sites mentioned above.

(ii) Examine community's perception about impact of water and climate induced hazards and climate change on their lives, livelihoods and society in the three study sites and understand vulnerability and risk

(iii) Study and document the resilience practices of the communities living in the three River islands

(iv) Study and document policies and programs of Government and non-Government agencies, if any, and their impact on people's vulnerability and resilience.

(v) Recommend strategies for reduction of disaster risk and improvement in adaptation to climate change effects in the study sites as well as for all River island and flood plain dwellers of Assam.

(vi) Organize a dissemination workshop with important stakeholders (Communities, CSOs, Government) for sharing project results and finalizing project report

IV. Results

The basic information about the study sites and their demographic features along with maps are presented in Tables 1, 2, 3 and 4 and Figures 1, 2, 3, and 4 in Annexure-1.

Annexure-I

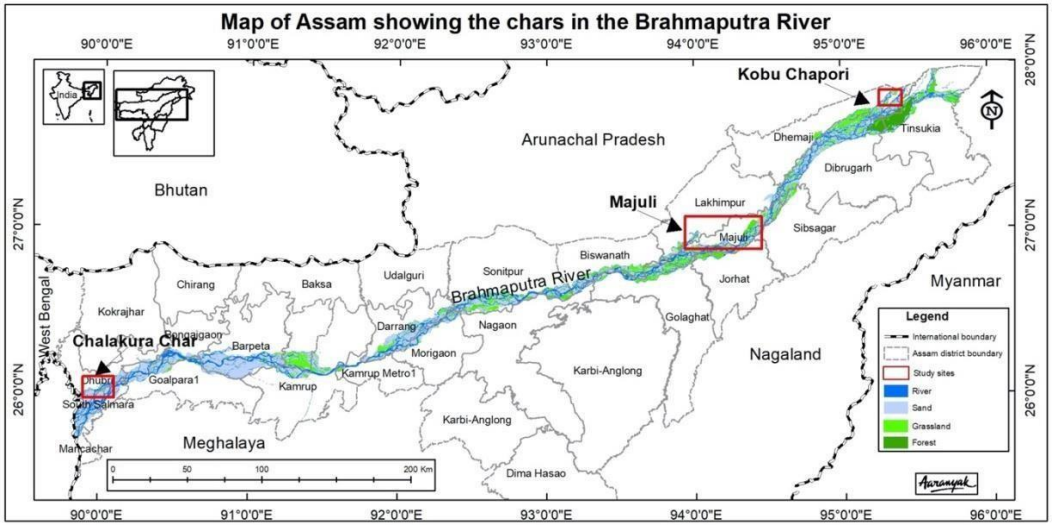

Figure 1: Location of the three study sites (river islands) in the Brahmaputra River, Assam

Table 1: Information at a glance of the three study sites (at village level)

Site Name	Villages	Panchayat	Development Block	Revenue Circle	District
(i) Chalakura Char	(1) Chalakura Part I	Chalakura	Birshingjarua	Dhubri	Dhubri
	(2) Chalakura Part II				
	(3) Chalakura Part III				
	(4) Chalakura Part IV				
	(5) Chalakura Part V				
	(6) Chalakura Poyesti Char				
	(7) Sialmari				
	(8) Birshing Sialmari				
(ii) Salmora, Majuli	(1) Kamjan Alengi	Bongaon	Kamalabari	Majuli	Majuli
	(2) Borboka Pathar				
(iii) Kobu Chapori	(1). No 1 Kobu Chapori	Silley	Murkongselek	Jonai	Dhemaji
	(2). No 2 Kobu Chapori				
	(3). No 3 Kobu Chapori				
	(4). No 4 Kobu Chapori				

Information about Individual study sites

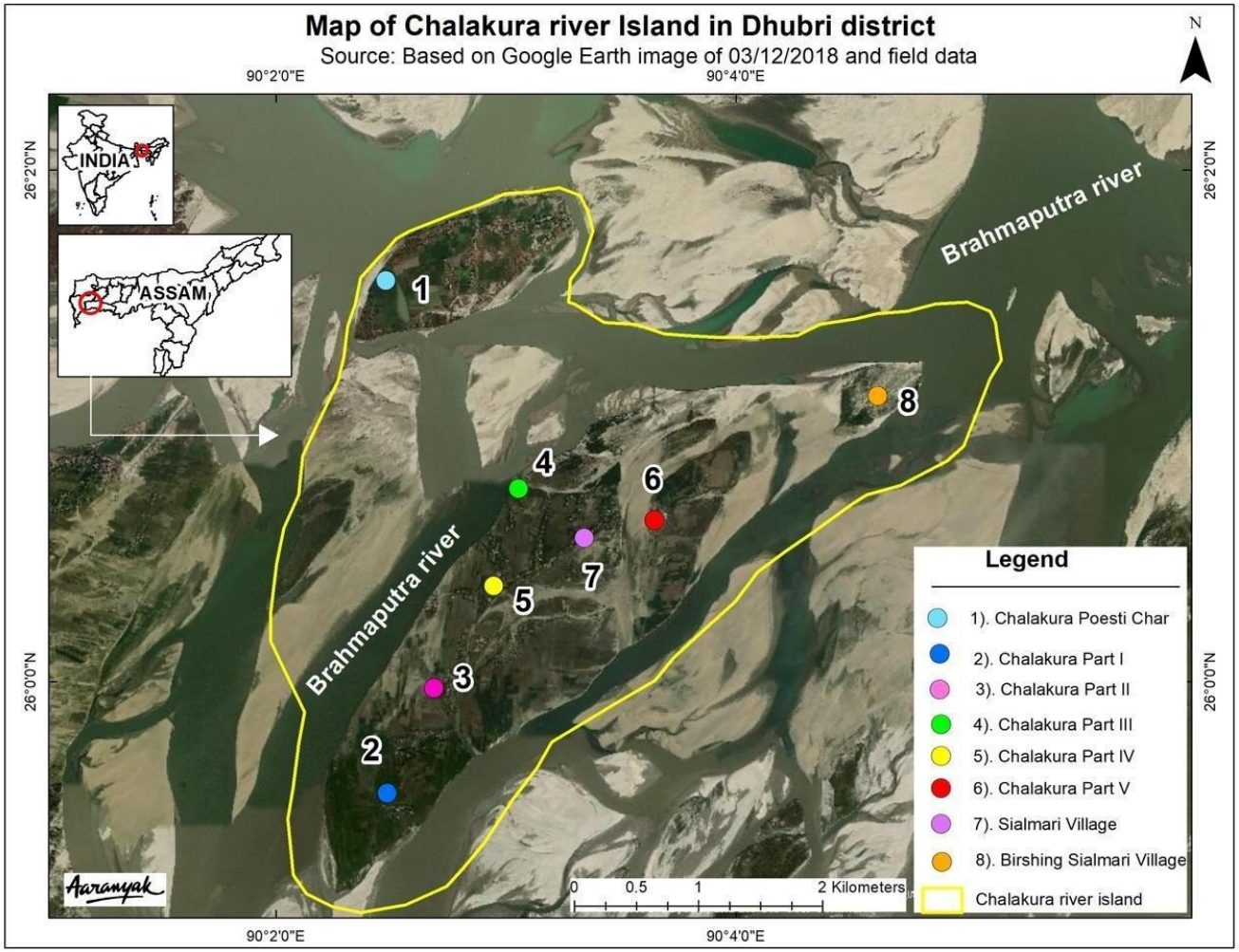

Figure 2: Location of the Chalakura Char in the Brahmaputra River, Assam

Table 2: Demographic information of the Chalakura Village Panchayat, Dhubri District

S.No.	Name of village	Area (Ha)	Number of Households	Population (Male)	Population (Female)	Population (Total)	Literate Population	% of Literacy
1	Chalakura Part I	173.1	120	390	350	740	7	0.95
2	Chalakura Part II	250.4	313	1050	955	2005	265	13.22
3	Chalakura Part III	345.7	113	330	300	630	131	20.79
4	Chalakura Part IV	217	288	945	751	1696	433	25.53
5	Chalakura Part V	178.1	381	950	760	1710	288	16.84
6	Chalakura Poyesti Char	391.7	420	356	372	728	537	73.76
7	Sialmari	280.4	102	400	415	815	191	23.44
8	Birshing Sialmari	190.8	0	0	0	0	0	0
	Total	**2027.2**	**1737**	**4421**	**3903**	**8324**	**1852**	**22.25**

Table 3: Demographic information of the study site in Salmora Mouza[10], Majuli District

S.No.	Name of village	Area (Ha)	Number of Households	Population (Male)	Population (Female)	Population (Total)	Literate Population	% of Literacy
1	Kamjan Alengi	**650**	215	505	471	976	1192	81.83%
2	Borboka	267	333	901	649	1550	1238	79.89%,
	Total	**917**	**548**	**1406**	**1120**	**2526**	**1132**	-

***Source**: Government records available with the Village Head Man of the two villages*

[10] In Assam, Mouza is a geographical revenue collection unit in an administrative district, corresponding to a specific land area within which there may be one or more settlements. This term should not be confused with the term Gaon (meaning village in Assamese). In Assam, several villages typically form a single mouza. The head of the mouza is known as a mouzadar (Source: **https://www.definitions.net/definition/Mouza).**

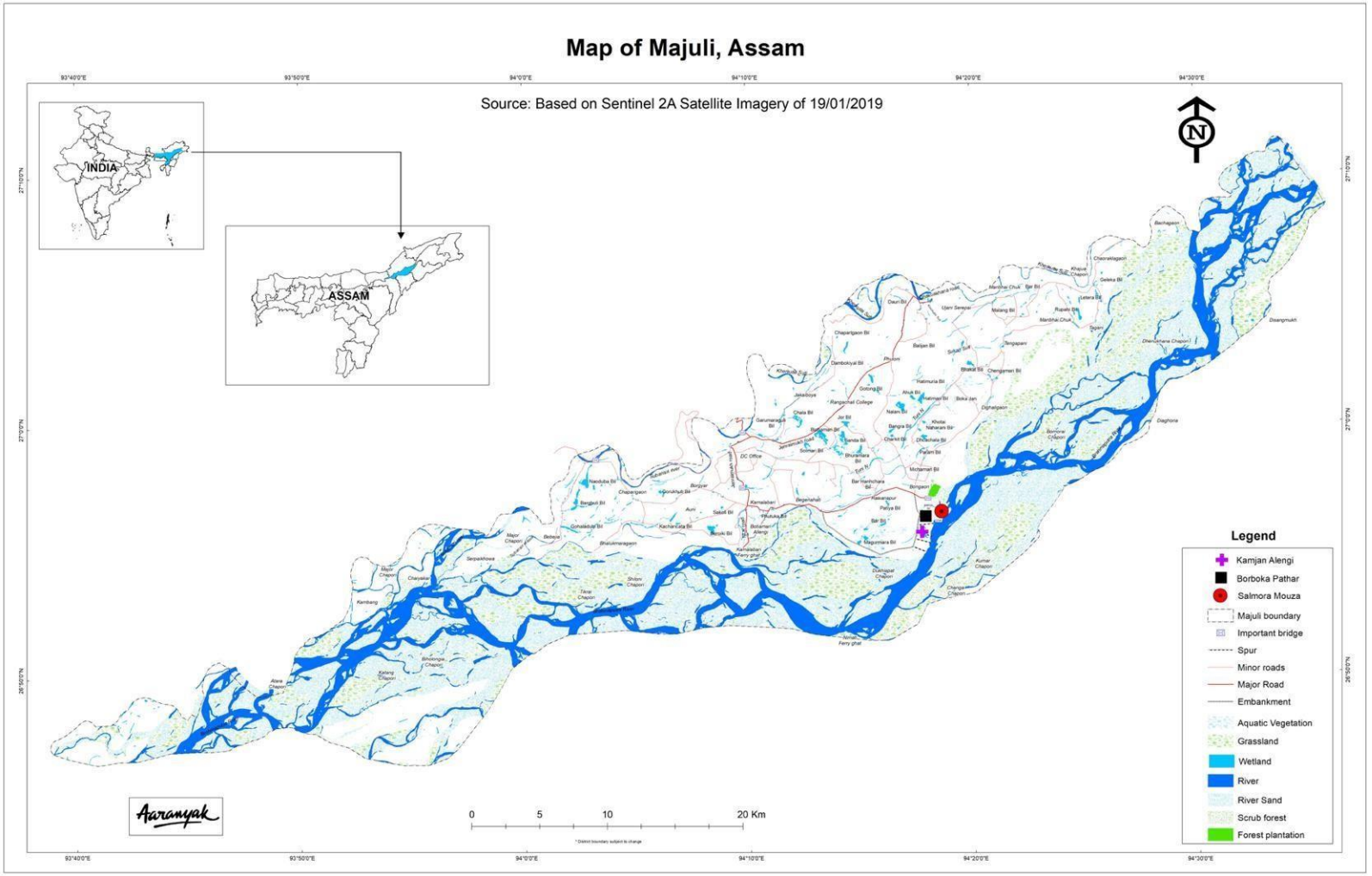

Figure 3: Location of the two project villages viz. Kamjan Alengi and Borboka Pathar in the Salmora Mouza of Majuli District

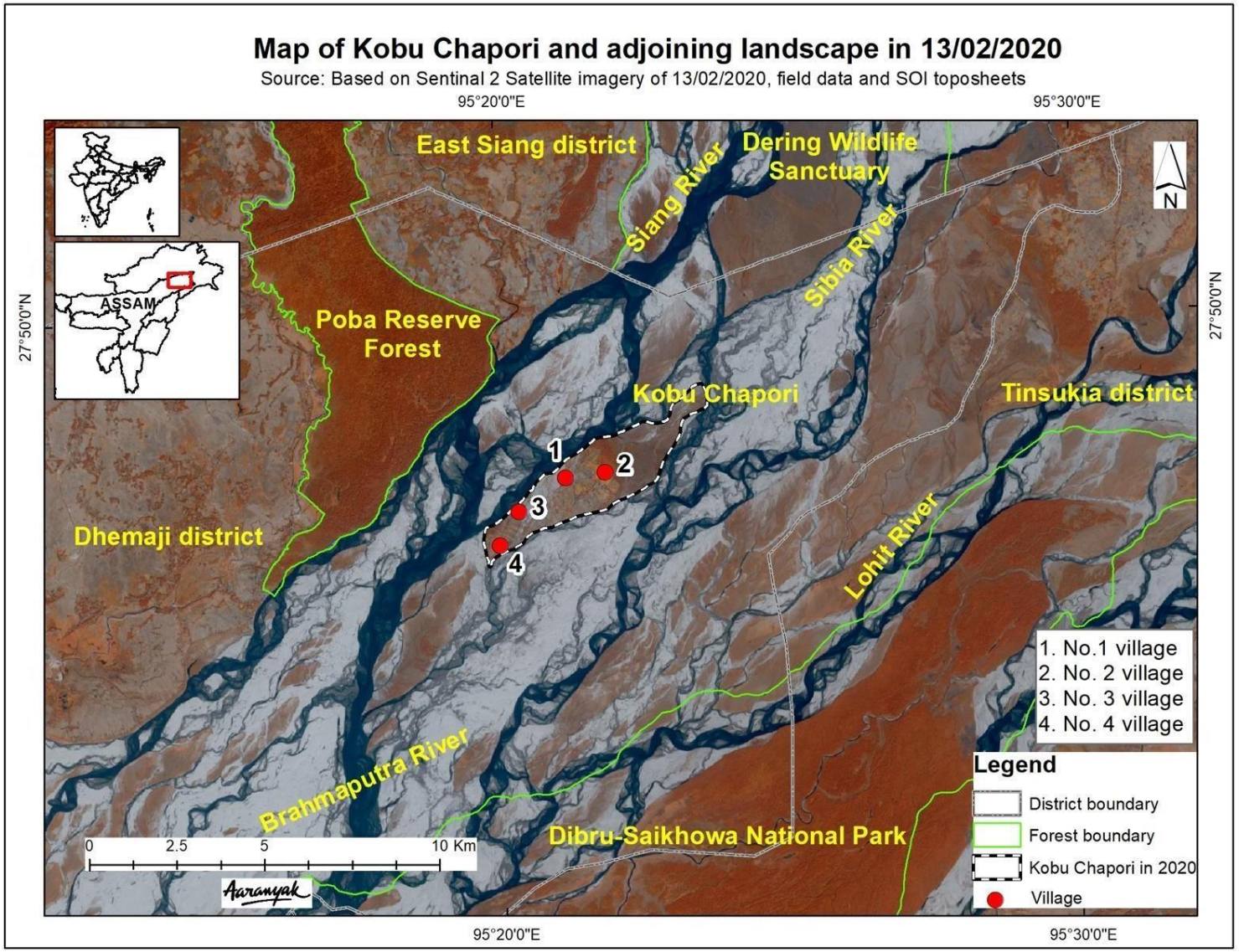

Figure 4: Location of Kobu Chapori in the River Siang (Mainstream of het Brahmaputra River) in Dhemaji District.

Table 4: Demographic information of Kobu Chapori, Dhemaji District

S.No.	Name of village	Area (Ha)	Number of Households	Population (Male)	Population (Female)	Population (Total)	Literate Population	% of Literacy	Number of BPL families	Number of landless families
1	No 1 Kobu Chapori	1675	86	255	200	455	132	34.469697	86	55
2	No 2 Kobu Chapori	1860	123	311	216	527	178	29.6067416	123	46
3	No 3 Kobu Chapori	1765	167	398	402	800	258	31.0077519	167	39
4	No 4 Kobu Chapori	2000	278	844	752	1596	467	34.1755889	278	178
	Total	**7300**	**654**	**1808**	**1570**	**3378**	**1035**	**32.6376812**	**654**	**318**

***Source**: Government records available with the Village Head Men of Kobu Chapori Revenue Village*

***General Sources**: (i) District Census Handbook-Dhubri, Series-19, Part-Xii A, Directorate of Census Operations, Assam (Page 390 and 414)*
(ii) http://censusindia.gov.in/pca/cdb_pca_census/Houselisting-housing-Assam.html

V. Case Studies

A. Case study 1: Chalakura Char, Dhubri District

A1. Vulnerability scenario

Common Impact of Water and Climate Induced (WACI) disasters are: (i) River bank erosion which takes place round the year; (ii) Flooding that occurs generally during the months of June to August; (iii) Storm which is common during April-July and (iv) Dust storm which occurs in the months of February and March; and, (v) Sand deposition on farm land and human habitat.

Impact of Erosion: Riverbank erosion started from the year 1962, a year in which there was large flood devastation in the whole of Brahmaputra Valley in Assam. Till 1960s the area had thick forests and hard soil just like other land areas on Riverbanks which the char dwellers refer to as *Qayemi*[1] land. Because of contiguity of land to Riverbanks, land-based communication was possible on the all sides. Since the Great Assam Earthquake of 1950, the depth of the River in this area started reducing and flood and erosion assumed dangerous proportion. The entire island fragmented into pieces. Since then erosion has remained a permanent feature of this Riverine landscape.

Shrinkage of island area and consequent change in landscape: An analysis of the Land use and land cover of the char carried out using remote sensing and GIS techniques in the project area from 2010 to 2018 shows that during the last nine years the char has gone through drastic change in its area and land use categories (Annexure-II; Figures 1, 2, 3 and Table 1). In the year 2010 the Chalakura Panchayat had an area of 5.60 km^2, which increased to 13.17 km^2 in 2014 due to accretion with most of the increased land being sand. But in the year 2018, the area reduced significantly to 5.67 km^2.

During the last one decade, the settlement (rural built-up) area has drastically decreased from 6.25% in 2010 to 1.14% in 2014 and slightly increased to 3.00% in 2018. The sandy area has increased from 30.54% to 58.77% to40.74% in the same period. Water bodies are constantly vanishing with figures showing 2.68% in 2010 becoming 1.06% in 2014 and then 0.53% in 2018. The population who lost habitats in this period have mostly migrated to nearby char areas as well as other land areas of Dhubri District.

The char has lost an area of about 8.03 km^2 due to erosion of the Brahmaputra River during the last 5 years. This is an example of how dynamic the char lands are and how the River acted on by the hydro-meteorological and geomorphological drivers can change the landscape structure and area, cause forced displacement and thus affect people's settlement and livelihoods very significantly almost every year.

Every household in all parts of the island suffer from flooding and River erosion. Some households, displaced by erosion, have to shift to new places of residence usually more than twice. So intense is the force of erosion that many chars do not exist beyond 5 to 7 years on an average in Western Assam.

The char land is composed mainly of soft sandy soil. Only in certain locations one can see an outer layer of dark hard soil of thickness about 8 to 10 inches above the sand cover. This is why even strong winds also can induce soil erosion besides River water. This makes this area extremely vulnerable to erosion.

[1] Qayemi land means land of permanent nature, found mainly in the mainland (of non-char origin)

Impact of flooding: The char is subjected to flooding at least 2 to 3 times on an average every year. The most catastrophic floods in recent history took place in the year 1988, 1996, 1998, 2004, 2012 and 2019. Majority of the people believe that floods have become more powerful and devastating due to loss of depth of the River. Others think that it is impossible to stop this River from flowing in any direction that it wants to. There was a time about 50 to 60 years ago when the River behaved differently. The River was deeper, and it used to flow in a certain direction. Now the River is totally different. It may flow in any direction refusing to be controlled by any obstacle.

People suffer the most when erosion and flooding happen simultaneously because they cannot cope with both the disasters at the same time and become helpless. Because of erosion they have to shift and rehabilitate themselves in different locations while they also have to face the floods which make them succumb to both the disasters at the same time.

People and livestock suffer in many ways during and after the floods. Most people get their houses damaged during floods which they have to repair and rebuild after the flood water recedes. Many cows, goats and buffaloes die or swept away by flood waters. Poultries suffer from various diseases. Human health is also affected by various maladies like viral fever, skin diseases. Children become more vulnerable to health hazards.

There are only two highlands[2] in the entire char which are located in the Chalakura Part V village. Only one of these highlands was functional during the floods of 2019. The other was destroyed during the floods of 2017 and 2018 part by part. Since one highland is far too insufficient to cater for the whole char population comprising seven villages, therefore lack of adequate number of highlands is a source of vulnerability for the villagers.

The villagers direly feel the need of some facility to store and preserve food, seed and vegetables as well as the jute items during floods. In absence of such facility, vegetables, other food items and the jute products are regularly damaged by floods.

Impact of dust storms: The char areas experience severe dust-storms in the months of February and March. During such dust-storms, a heavy amount of sand is blown off into the air which cause suffocation and choke respirational processes of human beings. Therefore, when people are forced to remain interned in their houses because exposure to the dust and sand is very harmful to human health. Due to inconvenient windy condition, it becomes difficult to ignite fire using firewood and other fuel and therefore cooking becomes irregular. People survive by eating food like muri (fried dry rice) and *chira* (flattened rice) etc. Using fire is also dangerous since the walls of the houses are usually made of bamboo and stems of jute (locally called Chennai) which are highly combustible and therefore may create fire hazard.

WASH situation: The main source of drinking water in this area is tube well which is usually not installed scientifically and therefore most of the tube wells become either defunct or get inundated during floods. Due to this people suffer from crisis of drinking water during the months June-September. Sometimes during floods, they also collect water from the River itself which they boil before consuming.

[2] A highland is actually a plot of land with higher ground compared to its surrounding which has a natural height or is raised from the ground to a certain height by dumping soil. Also called high rise platforms, these structures are constructed by District Administration or NGOs or sometimes by people themselves for the purpose of providing shelter. In general, the villagers along with the livestock like cow, buffaloes and goat take shelter on such highlands during high floods.

In the months of February-April which is a dry season, ground water level goes down and therefore getting water from tube well becomes difficult than in normal days.

The sanitation situation in the char is very poor. Although Swachh Bharat Abhiyan (Clean India Mission) is being implemented, it is mainly on paper; one rarely sees any sanitary latrine in these villages. Most households are habituated in open defecation.

Communication and transport: Communication in this char is a problem for the villagers as passenger boats are not running regularly between Dhubri and this area. Thus, it is very difficult to take ailing people for medical treatment to the Dhubri town especially during flood times, which is a cause of sometimes patients dye due to not getting required medical attention timely. There are many examples where pregnant women suffered a lot for not getting medical treatment in due time.

The most common mode of communication in this area is the boat, (country boats or passenger boat of various sizes). Communication becomes difficult in the lean season when the River channels dry up and recede from near the char because boats cannot be used in this season and therefore people have to travel long distances on foot before they get a boat to go to other places. Whereas in the flood season communication become relatively easy and convenient as one can access boats easily from the designated Ghats and many other places, sometimes from one's own residence due to an inundated situation.

Lack of energy security: There is no provision of grid-connected electricity to the char. Infrastructure for provisioning electricity has not been installed by the State Government mainly because of the instability of the char land and the threat of erosion. People use solar panels, kerosene and torch light for lighting purposes. About 90% of the inhabitants of the Chalakura Part 3 and Chalakura Part 5 villages were selected to be covered for solar lighting under the Dindayal Upadhyay Gram Jyoti Yojana. But about 70% of these households never received any solar equipment.

Most of the households use fuelwood and conventional home-made ovens for cooking. The fuelwood is usually collected from nearby woodlands, Riverine forests and their own home-gardens. Only about 7% of the BPL families have received cooking gas cylinders (LPG) at subsidized rates under the Prime Minister's Ujjwala Yojana.

A2. Community response: Good practices of DRR and CCA

Usually people remain prepared to face the floods because they are aware that flood will inevitably come during July to August. They store food and medicines for emergency. Boats are repaired and new boats are prepared before the advent of floods.

Housing: People of this char live in houses made with high foundation and plinth. If needed, the houses can be easily dismantled. They choose safe shelter on higher ground within the village areas and keep livestock like cows, buffaloes, goats and sheep in such places during floods.

Agriculture based livelihoods: They have adopted cultivation of crops like Chinese Boro which grow mainly during the flood free period. Mustard is a popular Rabi crop which earns them good amount of money. A variety of cereal crops such as Masur*, Kulti kalai and Mati kalai*, etc. are also produced by the farmers. The soil where is no sand deposition is suitable for such cereals which provides about 4 to 5 Mon per Bigha. The char is self-sufficient in production of vegetables. They have to buy vegetable from outside

market only during high floods, when the vegetable on agricultural land is destroyed. Farmers usually produce vegetables like water melon (*Tormuj* in Assamese), cucumber (*Tiyonh* in Assamese), pumpkin (*Rangalao* in Assamese), peanut (*Badam* in Assamese), Teasle Gourd (*Bhat Kerala* in Assamese; Scientific name: Momordica dioica); Mouse melon (*Siral* in Assamese, scientific name: Melothria scabra) and Santa clause melon (*Bangi* in Assamese) in the black sandy soil. These are typical vegetables and fruits that grow well in the sand deposited soil which is not fit for mainstream crops like paddy. This shows that the farmers have learned to adapt to the changing soil conditions.

Jute is the second most important crop after paddy. The climatic conditions of Assam are very conducive for jute production. The hot and humid climate of the char land areas with plenty of rainfall and alluvial soil enriched with annual supply of silt from floods is the most suitable for jute cultivation. Jute is less vulnerable to inundation in normal floods. The waterlogged areas and the wetlands in the chars are rather useful for retting, washing and cleaning the jute fibres. Jute is cultivated during May and July and the yield per Bigha[3] is about 12-15 Mon[4].

The villagers, especially the women make a variety of products from jute viz. bag, hanger, swinging bed for children, rope and sack. Such products enjoy a good market both in Dhubri district and many other parts of Assam and even outside Assam. Production of jute items is almost like a women-led cottage industry which is in need of support from Government and NGOs for expansion and diversification. It has great potential to become a viable resilient livelihood.

There are about 150-200 individuals who are recognized as skilled jute craftsman by the Office of the Development Commissioner, Handicrafts of the Ministry of Textiles. But they have never received any financial or technical support from any Government agency or bank. A large number of people in this char are now earning money out of making of such jute products.

Non-farm livelihoods: On the other hand, they have also resorted to a number of non-farm-based livelihood options such as dairy and fishing. However, both these livelihoods are not entirely free from effect of floods. Daily wage earning is the most common source of income that helps them survive in the time of disaster. They get engaged in various activities like pulling handcart and menial rickshaw, Auto rickshaw and E-Rickshaw; small business-like fruit stall, tea stall, selling vegetables, areca nut and beetle leaf etc.

Local knowledge: Local people are aware of the properties of plants like banana, bamboo and *Paharia kalmy* (Ipomoea carnea), which, when planted on Riverbanks, can help in resisting erosion, but only as a temporary measure. It is not possible to stop erosion permanently by local means.

People have an uncanny ear of guessing and anticipating the location and time of erosion that happens mainly during the rainy season. Whenever they hear a peculiar sound of the water current and see froth of white and brown colour and small whirlpools being formed on the water surface, they know that the nearest location on the bank may be eroded by the River soon. Actually, the appearance of these features in the River is an indication that the water current is penetrating the soil of the bank underneath as a result of which large masses of the bank land may collapse within a short time. Sometimes a large part of the char land can disappear in the matter of a few hours. The erosive forces become unstoppable in such circumstances.

[3] In Assam, a bigha is a unit of land equivalent to14, 400 square feet (1,340 m^2).

[4] Mon is a local unit of weight used in Assam equivalent to 37.3242 kilograms

Social cohesion: However, they fight against all odds and build back and repair their houses and restore their livelihoods with help and support from each other whichindicates that they have good social networking and support system in place. Their social cohesiveness is also reflected in the fact that they share information related to disaster, livelihood and development with all others.

Role of women: The women folk play an important role in rehabilitation work. Just after the floods recede, the men of the villages go out to earn money by doing sundry jobs. In such times, women take all responsibilities of keeping and maintaining the home front as well as in reviving some sources of income generating activities.

Mobile healthcare facility: Boat clinics commissioned under the National Health Mission (NHM) of the GoA visit the Chalakura Panchayat from time to time during and after floods and provide medical treatment to the ailing people. This service is extremely useful for them and helps them in reducing possibilities of loss of lives.

Labour outmigration: The area has a long history of labour outmigration. In recent years many young boys have migrated out of the char and gone to outside states to earn money by different means. Almost every household of the Panchayat has one or two migrant workers working in in the states of western, central and southern regions of India (e.g. New Delhi, Punjab, Haryana, Kerala and Andhra Pradesh) in search of jobs. Some people have been working in outside states for last 30 to 40 years.

They usually find petty jobs in rubber and leather manufacturing units, or other jobs in companies involving manual labour or work as agricultural labourers. Some of them sell the jute products that they make back in the char. Some others sell Chinese goods. They remit a part of the money, about Rs. 7000-8000/ per month on an average, they earn to their parents and relatives back home. The parent households use this money for fulfilling their various needs which include repairing of households damaged in floods, buying livestock, or investment in various other livelihood activities. Thus, the remittance of money plays an important role in enhancing the economic condition of the people which makes them cope better with the impact of disasters and climate change.

Photographs of Case Study-1: Chalakura Char

Photo 1-Typical settlement area in a riverine island, Poesti Char (village), Chalakura Char (Panchayat), Dhubri District: People build raised houses on ground that lies higher relative to the flood plain.

Photo 2: Movement of the river's channels towards the char induces land erosion for which people lose valuable land of resettlement and agriculture. Erosion is the main threat to the char people.

Photo 3: Deposition of sand by flood waters every year is a cause of degradation of land and diminishing agricultural productivity sand cast soil become unfit for cultivation.

Photo 4: Housing types: The houses are constructed on higher ground or with higher foundation to keep them safe from flooding. The materials used are derived mostly from natural resources available locally. The houses can be dismantled quickly if necessary when threatened with erosion.

Photo 5: Boat centric life in the char. Boats are the only mode of connectivity and communication with the mainland in Dhubri and with nearby chars.

Photo 6: Animal husbandry and dairy are important livelihoods for the villagers for whom agriculture holds little promise in the sandy erosive landscape of the char.

Photo 7: A focus Group Discussion with a section of villagers in Sialmari village, Chalakura Char

Photo 8: The tall *Jhao ban*(Grasses) that grow naturally in sandy soil on river banks provide a natural resistance to the erosive forces of the river. Villagers understand its value and do not cut them. At the same time they use small branches as firewood for cooking.

B. Case study 2: Salmora Mouza[5], Majuli District

B1. Introduction to the study site:

The Majuli Island experiences the ravage of flood and River erosion every year. As per Survey of India map, the area of Majuli Island was 733.79 sq.km. in the year 1914, which got reduced to about 708.91 sq. km. in 1949 and progressively to 510.79 sq. km in 1998; 502.21 sq. km. in 2004 and 522.73 sq. km. in 2013**(BB, 2012; Sarma, 2014).**

The Salmora area, situated in the south-eastern part of the River island Majuli. Salmora is a *Mouza* (Tehsil) of Majuli District consisting of mainly three revenue villages called Kamjan Alengi, Borboka Pathar and Besamora and having about 600 families.

This study was done in two villages (i) *Borboka Pathar* and (ii) *Kamjan Alengi* contiguously located under the Salmora *Mouza* (Figure 4, 5, 6, 7 in Annexure-II)

B2. Vulnerability scenario

Impact of flooding: Flood is an annual phenomenon in not only the study area but all over Majuli due to several factors discussed in the report. The villages in Majuli have been experiencing the curse of flood since time immoral, but the intensity has increased after the 1950 Earthquake, after which, the River Brahmaputra has also shifted considerate amount.

Floods inevitably wash the village at least 5 to 6 times every year in the rainy season, usually May to October. In the six-month long flood season, the area remains inundated at least for 30 days. During heavy floods, the area remains inundated continuously for about 5 to 6 days. The aged people of the community remember that earlier, three decades back the River was deeper and flood was not as devastating as it is now, and flood waters did not rise as high as it is doing now.

Impact of erosion: As per the analysis (Figure 6 in Annexure-II) using geospatial technology, the mainland mass of Majuli has progressively decreased from 497 km^2 in 1987 to 478 km^2 in 1999 to 476 km^2 in 2009 to 468 km^2 in 2019. This means the island has lost 19 km^2 in 12 years during 1987-1999; 2 km^2 in 10 years during 1999-2009 and 8 km^2 in the next 10 years between 2009 and 2019. The total loss of land mass in 32 years (1987-2019) is 29 km^2. The analysis gives different results from earlier estimations probably because the previous assessments included fresh deposition of land (in the form of sand bars adjacent to the banks) as part of the main landmass.

The direct impact of the shrinkage of the fertile landmass of the island has fallen on agriculture as agricultural land has decreased from 81.83% in 1987 to 79.66% in 1999 to 72.75% in 2009 to 72.58% in 2019. In the last one decade the shrinkage in farm area is almost nil because of conversion of erstwhile sandy areas and sandbars (*chapori*) to cropland by some innovative and enterprising farmers. At the same time built up area (Settlement with home gardens) has increased from 7.49% in 1987 to 11.03% in 1999 to 15.55% in 2009 to 16.52% in 2019 indicating the pressure of a growing population on land use practices.

[5] In Assam, Mouza is a geographical revenue collection unit in an administrative district, corresponding to a specific land area within which there may be one or more settlements. This term should not be confused with the term Gaon (meaning village in Assamese). In Assam, several villages typically form a single mouza. The head of the mouza is known as a mouzadar (Source: **https://www.definitions.net/definition/Mouza).**

In last 20 years, the Brahmaputra River eroded about 3 km in the Northern side eating up almost the entire Salmora area with only one third of its original area existing now. Most of the families living in the study villages as well as in some other nearby Riverbank areas have shifted their houses at least 6 to 7 times in the last three decades. The original locations of the two study villages are already under water.

Flood Management: Conventional measures adopted by the Central and State Governments such as construction of embankments, laying of spurs and porcupines have not effectively helped the people in getting protection from the twin disasters of flood and erosion. The four numbers of spurs laid in the area and its vicinity(Figure 5 in Annexure-II) have helped other areas located on the west of the study villages in getting protected since the River has been pushed away from the bank in the immediate downstream as an effect of the spurs. However, the Salmora villages had no respite form erosion. Local people believe that the spurs were not designed and laid properly. The entire Riverbanks in the area is being fortified by laying geo-bags at present. Villagers are skeptical about their efficacy since the geo-bags were not installed with proper depth and coverage.

Proximity to the River: Both the villages are located very close to the River Brahmaputra. The settlement in Borboka village is scattered on both sides of a spur with households almost kissing the River to a distance of only 400 meter. Kamjan Alengi is a little farther but still in the immediate vicinity of the River. Thus, the area is highly susceptible to flooding and erosion by virtue of its very close location to the River.

Livelihoods prone to water and climate: Majority of the people of the Salmora area belong mainly to the potter (Kumar) community. The Salmora area is famous for its traditional craft of hand-made pottery and boat making. They use these boats to carry the earthen pots to various Riverine areas of the Brahmaputra Valley spanning a Riverine route of more than 300 kilometers from east to west of Assam. They also earn money by transporting passengers and goods in boats. Fishing in the Brahmaputra and many off-shoot channels and distributaries of the River as well as in wetlands is another source of earning for them.

For all these livelihoods they have to depend mainly on the mercy of the River Brahmaputra, because they derive the ingredients for both these crafts viz. driftwood and wet soil, from the River. There is hardly any agricultural practice in these villages because they have no land available for agriculture.

With changing nature of geomorphic and hydrologic characteristics of the River, finding and collecting driftwood and the potter's soil has become difficult now-a days. This makes their main two vocations less viable at present than before and may be unsustainable in future.

For pottery making, they use a special type of soil, called the Kumar *mati* (potters' soil), a type of glutinous (sticky) clay which they collect from the Riverside very close to the bank of the River Brahmaputra by digging to about 30 to 40 feet. Both men and women participate in collection of soil from the Riverbank, which, however, is a very strenuous activity. However, this soil is available only in few stretches of the Brahmaputra River. Availability of this soil is central to the survival of this traditional livelihood, which is a source of vulnerability for these people.

Even ten years ago getting good quality clay for pottery was not a problem. But the River has penetrated into the villages by about 1 km over the last decade. Availability of the same quality of original soil is not guaranteed all along the bank at present. Therefore, now clay of standard quality is not easily available.

In the year 2015, the then Sub Divisional Administration of Majuli prohibited digging of soil from the clay pits of the Riverbank because citing the reason that this practice could induce and intensify bank erosion. On the other hand, the ongoing fortification of Riverbanks with geo-bags also has put an end to this local mechanism of soil collection. As a result of this restriction, the villagers are now collecting soil not from very close to the bank, but at a distance from the bank and from a lower depth. They think that the soil they are now getting at these places can be used for pottery making but it is not as good as the original soil which they used to get from the Riverbed earlier which lies at deeper strata. They fear that use of inferior quality soil, would affects the pottery business since they might get less price for these products in future.

Another facet of their struggle for survival and livelihood is that they collect driftwood from the Brahmaputra River round the year but more aggressively during floods. Although they use boats for collecting floating pieces of wood from the River, sometimes they have to swim amidst torrential current of the River thus risking their lives. The driftwood is used for multiple proposes such as making boats, using a variety of decorative items, which are sold in local markets and are also bought by tourists visiting the island as souvenirs. The unique feature of this craft of Salmora is that the artisans make these materials without using any potters' wheel.

Pottery making as a women centric practice: Women play an important role in pottery making, while trading is carried out by the menfolk. The women folk of the potter community make use of only hands, mainly palm and fingers, with simple tools to make the products. Thus, pottery making has evolved as an adaptive livelihood source that has maintained traditional norms and characteristics for several hundred years now.

Traditional boat making and boat-based Riverine transport: Communities of Salmora have a reputation all over Assam for their skill in boat making. Primarily they make boats to fulfill their own needs as they need to transport the earthen products to sell them in many places along the River. They also run boats commercially to transport passenger and goods. Earlier they could get the wood required for making boats from plantations and forest that were available in and around Majuli and nearby areas. However, now

there being restriction on harvesting wood from forests and even privately-owned plantations, availability timber has become a problem. However, they have found an alternative source in the form of driftwood that is caffeic by the Brahmaputra River round the year, but more during flood time.

This is also a good example of how they have used another Riverine resource and put to application their physical skill of being good swimmers and their traditional knowledge about the mood and behaviour of the River during floods.

Adaptation in housing: For some ethnic communities in Assam, housing is a cultural trait. The type of houses they make, and their inner structure is different for different communities. For example, the Mising people of Assam, one of the most water adapted communities of India, live on Riversides in stilted houses, locally called 'chang ghar'[7] Because of this housing practice they remain safe and comparatively less affected during inundation of flooding than other communities who live in traditional grounded houses. Some of these communities are reluctant to live in stilted houses due to cultural norms and taboos.
The villagers of Salmora area used to live in normal grounded houses for ages although they were Riverbank dwellers, because that was the tradition of their community. But as flood waters gradually began soaring high into the village drowning houses to the top, the River side dwellers were compelled to change their housing style and habits. They started making and living in the chang ghar to make them more secure and comfortable during floods. At present almost all houses are stilted houses about 4 to 5 feet high in general. Almost all the materials required to build such houses are derived from locally available resources like bamboo, cane, timber, thatch and Riverine grasses.

By staying in such tall houses, they avoid the possibility of drowning of the house during normal flooding. However, during high floods, sometimes the stilted house also gets drowned to the floor. In such situations they make platform inside the house and keep their valuables there. When even the stilted houses are not safe and protective enough people temporarily leave their houses and take shelter on nearby roads, high platforms, the boulders spurs or other safe places.

[7] Chang means elevated shelf and ghar means house. It is a typical traditional housing practice of the Mising community who live mainly in flood plains including Majuli

Ecosystem based adaptation (EBA): The water centric livelihood practices viz. pottery making, boat making, water transport using boats, fishing, stilted housing etc. mentioned above are also examples of ecosystem-based adaptation since in all these activities ecosystems products and services are amply used. For pottery making, they use a special type of soil, called the Kumar *mati* (potters' soil), a type of glutinous (sticky) clay which they collect from the Riverside very close to the bank of the River Brahmaputra by digging to about 30 to 40 feet. This is a good example of using ecosystem services of the River and Riverine natural resources for eking out one's livelihood.

Congenial Social relationships and social support system: Most of the villagers have good relationship with their neighbours and the Gram Pradhan. They may not be able to help each other financially but the villagers rescue people in need and help in reconstructing houses in the post- disaster period. Good relationship with the Gram Pradhan ensures better accessibility to public infrastructure as well as any kind of monetary and non- monetary help along with policy implications by the Govt. and private organizations.

Photographs of Case study-2: Borboka Pathar and Kamjan Alengi, Salmora Area, Majuli District

Photo 1: Erosion is the most imminent threat to the existence of the Salmora area as well as the Majuli Island itself. Geobags, being laid now have not been installed properly in some places as per community opinion.

Photo 2: Structural mitigation measures taken by the State and Central Government include use of RCC porcupines to recover land by inducing siltation; Boulder Spur to push an intruding active channel of the river away from a particular stretch of the river bank and geo-bags to resist erosion of river banks. Although porcupines have worked well, the spurs didn't help Salmora area. Success of Geo bags could be limited as seen during the flood of 2019.

Photo 3: People usually live in stilted houses that protect them during the period of inundation.
Even latrines provided under the Swachh Bharat Abhiyan are constructed on high ground.

Photo 4: Traditional pottery production is a women-led activity. Women have spent long hours and work hard for making the pots. Pottery is still the main livelihood for the people in Salmora.

Photo 5: The boats made by the skilled villagers of Salmora are mainly used to ferry the pottery which they sell mainly in the ghats of the Brahmaputra covering its length and breadth from east to west.

Photo 6: Women are expert weaver, though they make clothes mostly for their own consumption and less for the market. It is a potential area for development as a major livelihood.

Photo 7: Collection of driftwood from the Brahmaputra is a hazardous task, but is a common practice for the villages of Salmora. They use it mainly as firewood for cooking and burning in the woven for baking the earthen pots. Boat making is an important source of income.

Photo 8: Boats are integral part of the landscape and people of Majuli. Villagers in Salmora keep boats prepared to face the floods. The island is connected to the outer world mainly through ferry services run by both the Inland Water Transport (IWT) and private operators.

Photo 9: Use of raft made of banana tree for local communication is common for all those who do not have boats.

Photo 10: Women have a customary gendered responsibility of collecting and managing water in households. The task become challenging during the floods when they have to travel in boats and get water from distant sources.

Photo 11-Interaction with villagers for primary data collection: Focus Group and Participatory Landscape Mapping

C. Case study-3: Kobu Chapori, Dhemaji District

C1. Vulnerability scenario

Effect of Erosion: Erosion is the real issue which has affected the life of each and every person living in this remote island. There is no measure taken by Government agencies to protect the island from erosion.

Although erosion was always a problem it has become particularly severe since 2016. The island has, on paper 4 villages; but in reality Part 1 and Part 4 of the island has completely disappeared in the last five years. Most of the villagers from these two villages have migrated to the outside world in search of safe habitat, jobs and income.

Data available from the local Panchayat Office reveals that the loss of landmass in the four villages since the year 2000 till 2017 was 0.75 km^2 in No1 Kobu Chapori; 0.15 km^2 in No 2 Kobu Chapori; 0.30 km^2 in No 3 Kobu Chapori and 2.15 km^2 in No 4 Kobu Chapori with a total of 3.35 km^2 vanishing into the River.

But our RS-GIS based analysis shows very drastic change in the landmass of the island as well as its land use and land cover during the last four decades, 1977-2019. In the year 1977 the island was much larger than now with an area of about 91.35 km^2 which has now decreased to about 10.85 km^2 indicating a loss of about 80.5 km^2 which is about 88.1 % of its landmass in 1977. Figures 8 to 14 and Table 2 in Annexure-II present the results of this analysis.

Several hundred hectares of land were eroded by Siang and Lali Rivers since China Flash Floods in the year 2000 which led to creation of an additional river channel of Lali through the Kobu Chapori River Island. This led to erosion of over 200 Ha (2 km^2) out of a total of 9400 Ha (94 km^2)[8]

Local people believe that increased rate of erosion has been triggered by deforestation and excessive mining of boulder and sand from the foothills of Assam and Arunachal Pradesh in upstream areas.

Effect of Flood: During the flood time almost the entire island is inundated by waters of the River Siang which is also locally called River Lali, and is actually the main stream of the River Brahmaputra that originates in Tibet) from where it enters India through Arunachal Pradesh and then becomes the Brahmaputra River after meeting the Rivers Dibang and Lohit just below Kobu Chapori in Assam.

Almost all houses and granaries along with stock of paddy and other food items get destroyed. The island becomes isolated and disconnected from the rest of the world due to lack of regular communication of boat. The people suffer from food crisis. The marooned people desperately search for safe places to take shelter. The livestock faces immense suffering and many animals die of hunger and disease.

[8] Making Inclusive District Disaster Management Plan of Dhemaji District of Assam, DDMA-Dhemaji, 2014 http://dhemaji.nic.in/Draft%20District%20Disaster%20Management%20Plan%20of%20Dhemaji.pdf

Effect of transboundary hazards: The Kobu Chapori has been affected by flooding from the Siang or *Lali* River many times. Several of these flood events had transboundary origins. People still remember the catastrophic flash floods of June 2000 when they the entire island was devastated by a sudden flood from the Siang River. Later it was learnt that the flood originated from the bursting of a landslide dam on a tributary of the Yarlung Zhangbo River in Tibet.

Another incident that affected the people was the pollution of the waters of the Siang River resulting in darkening of the colour of water during November-December of 2017. Many domestic animals, mainly cows, buffalos and goats died by drinking the River's dirty water during that time in the Jonai area including Kobu Chapori. Many people who used to take bath in the River or catch fish or had to cross Rivers for farming in small islands fell ill due to physical exposure to the water contaminated with chemicals. This episode of water pollution was a result of a landslide induced by an earthquake that occurred in Tibet near the China-India border in November 2017. The source of many varieties of chemicals and cement like materials found in the waters of the Brahmaputra is still not known to public.

This earthquake resulted in formation of several landslide dams in the upper course of the River Siang (Yarlung Zhangbo) in Tibet, which remained a source of threat of flash floods to the people living in downstream areas in Arunachal Pradesh and Assam. About a year after in October 2018, there were two episodes of flash floods, which were ascribed to landslides in Tibet near the India-China border that also affected some areas in Arunachal Pradesh and Assam (Dhemaji District) including the Kobu Chapori. There was panic among people along with a lot of rumours floating around about a mega flood that would wipe out many riparian areas in Arunachal Pradesh and Assam. A number of people living in islands and banks of the River were evacuated and sheltered in safe areas by the state Governments of the two states.

Effect of climate change: Although villagers have no concrete knowledge about climate change, they have reported some observations which are indicators of climate change at local level. For example, villagers have observed weather in general and rainfall in particular to have become erratic over the years. Rainfall has increased compared to the past, rains are not occurring when they are expected, and too much of rainfall and storms are occurring frequently. The summers have become warmer. Some villagers informed that they have seen growth of some unknown vegetation.

People are familiar with the nature of water induced disasters. But they have no perception and awareness about climate change and its impact. Regular cycles of disasters and climate change is causing threat to their lives and people think that irregularity in local weather and especially rains have caused reduction in agricultural crop production. People do not know how to secure their livelihoods against impact of climate change. There is not much local collective action seen for reducing impact of disasters and climate change. People leave it to their destiny and God to help them protect from such calamities.

Livelihoods: Agriculture is the main source of livelihood. Paddy cultivation is the main source of agricultural livelihood and food security. Villagers also produce *fapar*, maize, lentil, mustard and sugar cane. Some families also rear livestock like cows and goats. All the main livelihood practices are vulnerable to climate change and disaster risk.

Loss of land due to unabated erosion and changing weather has resulted in reducing agricultural production. The major blow to agriculture has come from erosion and sand casting. Table 1 shows the area of agricultural land lost due to land cutting and affected by sand deposition on farmland. Paddy is the most affected crop while effect on sugarcane is least due to disasters and climate change.

Table. 1 Agricultural area affected by erosion and sand casting

Name of village	Land lost in erosion in km^2	Land affected by sand deposition in km^2
Kobu Chapori Part 1	0.35	0.75
Kobu Chapori Part 2	0.15	0.20
Kobu Chapori Part 3	0.30	0.18
Kobu Chapori Part 4	2.75	0.275
Total	**3.55 Km^2**	**3.88 Km^2**

They shift the livestock away from the island in time of flood to safe places; however many domestic animals die during such shifting.

Impact on women: Women of Kobu Chapori experience more stress and inconvenience due to impact of disaster and climate change. The menfolk of many families live outside the area including outside states for jobs because of which the women have to stay alone. They have to handle most of the problems during disasters all on their own and face and cope with all the hazards generated by annual flooding, erosion and other related disasters. When they become indisposed due to various diseases, there is nobody to take their care in a remote land where there is no amenity for any medical treatment.

Pregnant women face grave problem during floods as it become hard to find suitable mode of transport and communication to the outside world to get proper medical care. Some women even have died inside the villages due complicacies developed during delivery.

Their social position is also not strong as it is mainly a male dominated society that they live in. There is no awareness about women empowerment, nor any such program in place there.

Lack of awareness of improved farming practices: At present people do farming following traditional methods. They are not aware about modern and scientific methods of agriculture that could augment production and quality of crops. They have not got any opportunity to get education or training on agriculture or received any tools and materials for improving their farming skill. But they are eager to learn so that they can get more crops per unit land.

Lack of transport and communication facility: The main reason of isolation of Kobu and marginalization of the villagers is the remoteness of this island from the mainland and especially due to lack of regular boat connectivity with the mainland in Jonai Sub Division of Dhemaji District. There is no regular service of passenger boat under Government supervision or run by the Inland Water Transport Department (IWT) of Government of Assam. At present boats run by private operators communicate only two times a day and

for that too they charge exorbitant price. The small country boats that the villagers have for local transport cannot be used to cross the turbulent River in the flood season. This is a big constraint for their survival in case of any serious accident or health emergency especially during the nighttime.

Lack of energy security: People use firewood, kerosene, candle and mustard oil[9] for lighting. For heating they make use of firewood and coal. Cooking needs are fulfilled by using kerosene, fuel wood and LPG where LPG accounts for about 5% of all energy use for cooing purposes. The machine boats which are the only mode of conveyance and connectivity to the outside world from the island are driven by diesel. Personally owned motor bikes are run on petrol.

There is no conventional electricity connection to the island. About 5% of the population has got the benefit of having LPG cylinders under the Ujjwala scheme. Some households have acquired solar based lighting systems at their own expenses since none of the Government's solar schemes have been implemented with real earnest in these villages.

Lack of electricity provision causes a range of difficulties that increase vulnerability of people during and after disasters like flood and storms. Absence of lighting in the High-Rise Platforms (HRP) makes it very difficult for people to stay during the time of inundation, especially when they also have to accommodate animals in such shelters. Evacuation, rescue, relief and general communication during night time is extremely constrained due to lack of lighting sources in the villages. Inability to charge mobile phones makes communication within the island and with the outside world difficult. The smoke generated by the conventional clay made *Chouka* (*chullah* or woven) is harmful to the health of the woman. Many families do not have ration card as a result, they have to buy kerosene from the open market at excessive prices.

C2. Community response: Good practices of DRR and CCA

Physical skill: People in general, including children and women can swim and operate boats.

Mental resilience: Although some people have left the island seeking safe habitats elsewhere, most of the villagers have no other place to go. Therefore, they know very well that they have to fight against all odds to survive there. They have developed a kind of mental robustness with which they deal with the adverse situations bravely.

Preparedness: The villagers remain prepared to face the floods. They store food item, fuel wood, medicines and save some money for the days of confinement and suffering ahead further they buy and store medicine and fodder for the domestic animals as far as possible. They also keep the boats ready before the advent of the rainy season.

Housing safe shelter: Most of the people live in houses built with high foundation or on high ground. Stilted houses are also made to keep seed, food and other valuable items of the households. If flood waters enter the houses, they make high platforms within the house where they stay, keep food and other assets. The villagers collectively build High-Rise Platform (HRP) to keep the livestock safe, or they identify and choose locations with natural high ground for this purpose.

Boat-centric life during floods: Boats are lifelines for the people of this remote island. They need and depend on boats for every survival activity during flood time. Boats are used to shift the livestock to the

[9] A small cup-shaped oil lamp made of baked clay also called *Diya* in Hindi

HRPs or other safe places as well as to collect fodder for the animals. Boats are the main mode of transport and communication within the villages and to the mainland across the Rivers. Sometime some families stay on the boats for days when the houses are destroyed or fully inundated and there is no alternative shelter available for them in the island.

Active role of women: Women help the family economically by earing money by rearing poultry, goat and tailoring etc. They also produce horticultural products in their home gardens and sell the same in the market. They invest this money in education of their children and health care of the family.

Agriculture: Although traditional agricultural practices are hit hard by flood and erosion, farmers have started adopting winter farming seriously. They cultivate maize, lentil, mustard and sugarcane in the lean (flood free) season. Thus, there is an increase seen in agricultural area in the island from 7.75% in 1977 to 38.99% in 2019(Table 2, Annexure-II).

Labour outmigration: Young people, both male and female, have migrated out from many households of all the four villages of Kobu Chapori. They are earning money from various jobs in different districts of Assam and different states of India. As found during this study, the number of male and female migrant workers is 505 and 80 respectively. Most of them are working states like Kerala, Andhra Pradesh, Telengana, Chennai, Gujarat and Arunachal Pradesh. They are mostly engaged in manufacturing jobs and agriculture as labourers.

Their average monthly earning varies from Rs. 12,000.00 to Rs. 25,000.00. They send about Rs. 5000.00 to Rs. 7000.00 back to their families every month. The money remitted by them to their families is an important resource for survival in many ways. The families spend the money in general in buying food items, supporting education of children, in medical treatment and repairing and construction of houses. The migrant workers visit their families at least once a year. Some of them have established marital relation with local people in their places of jobs and settled down permanently.

Case Study-3: Kobu Chapori, Dhemaji District

Photo 1: Living on the edge: Proximity to the river increases vulnerability to extreme point.

Photo 2: Floods in 2019: More than 8 km^2 of cropland and 3 thousand people in 4 villages were affected

Photo 3: Villagers taking shelter with livestock on a high land. They make their own make shit tents for staying and cooking with plastic sheets, which the buy and sometimes also receive from NGOs. Fuelwood is kept ready instock. Lack of electricity makes life difficult in such situations.

Photo 4: Lean season agriculture is an important for the food security and income for the people. Fishing is the second most important livelihood.

Photo 5: Staying in stilted houses or grounded houses located on high ground is a common coping practice.

Photo 6: Villagers are smart enough to make temporary bamboo bridges over cesspools of water and make ad-hoc arrangements for communication: a good example of coping strategy.

Photo 7: Rafts made of banana plants is at the most common and cheapest way of communication in a flood situation. Rafts are the lifeline for people who cannot afford to make or buy a boat. Even children are efficient in operating rafts.

Photo 8: Building houses on stilts helps stay safe above the flood level

Photo 9: Boats are the only mode of communication and connectivity to the outside world. People are used to stay on boats during flood with all necessary preparations. Boats are indispensable for survival of riverine people of this island**.**

Photo 10: There is no electricity in this remote island. Some households have procured solar panels spending their o family resources. Government's solar schemes have not yet reached them.

Photo 11: Group meetings with the communities for sensitization as well as collection of information and views

VI. Conclusions

- The River islands are highly disaster prone areas of Assam not only because of direct exposure to the River's water front, but also due to increasing intensity and frequency of the water induced hazards. The effect of climate change is observed mainly in the form of intensification and erratic nature of the hazards which are significantly deviant from their long term normal behaviour pattern.

- Vulnerability depends on a complex combination of various factors like physical exposure to hazards, intensity and frequency of hazards, socioeconomic conditions with respect to awareness, literacy, education, health, hygiene, drinking water; nature of livelihoods, poverty, energy security, ethnic cultural norms, social network and support system and governance(Government's policies, programs and institutions)etc.

- Among the common water induced hazards, erosion is the biggest source of threat to habitats and lives of the communities who find flood easier to cope with, than the erosion since erosion cause permanent loss of land to the River.

- In all the study sites the history of settlement of the community has been determined by a shifting River course of the Brahmaputra River.

- Sources of water for domestic use, access to drinking water, facilities of sanitation and common practices for keeping health, hygiene and waste disposal are important factors that determine vulnerability of a community.

- Ineffective, inadequate and poorly implemented structural measures adopted so far to protect the chars from flood and erosion (such as embankments, spurs, RCC-porcupines etc.) is the prime reason of large exposure of the inhabitants of the River islands to Riverine disasters. Although they harbour a large human population, most of the chars are unprotected from flood and erosion.

- Dependence on climate and water dependent livelihoods such as agriculture, pisciculture, animal husbandry, etc. is a main source of vulnerability for the island dwellers.

- In general, there is no conventional grid-based electricity facility in the Riverine islands, mainly because of the fact that charlands are transient and lose their landmass regularly due to erosion.

- Lack of electricity causes a range of difficulties that increase vulnerability of people during and after the occurrence of water and climate induced hazards. Lack of electricity in the shelter and relief camps is a constraint for studies of children. Absence of regular power supply makes cooking difficult for inmates. Medical treatment of inmates is also adversely affected by lack of power. Such situations also increase insecurity of women from anti-social elements.

- Darkness causes immense difficulties in rescue operations and relief distribution in the nighttime in flood affected areas of the chars. Lack of electricity is the main reason that is why relief provision and rescue operations cannot be carried out during the flood in nighttime. This constraint leads to more injuries, accidents and deaths and other accidents of people in flood affected areas.

- Lack of proper implementation of Government's policies and schemes in the field of DRR, CCA, rural

development, women empowerment, agriculture, health, family welfare, education, livelihood security etc. is one of the principal factors that determine their socially and economically weak status and vulnerability. Communities generally do not have the collective voice and action that is necessary to compel the Government machinery to act and deliver benefits to the people through regular welfare schemes without bias and financial corruption.

- Influence of politics and local politicians is responsible for unequal attention and benefits of programs like relief and rehabilitation in the aftermath of the disasters.
- Community's response to overcome the shock and adverse impact of disasters and climate change comprise most autonomous coping and adaptation measures. The coping measures are immediate response to reduce the effect whereas adaptation mechanism is a long-term response to reduce stresses and negative consequences of disasters and climate change. A number of traditional coping and adaptation strategies have become relatively ineffective or less effective at present due to the changing nature of natural hazards and climate related vulnerabilities. Communities at present are in need of external support to adapt successfully to the changing environmental, climatic and socioeconomic scenarios of the vulnerable habitats.
- Resilience of communities depends on the effectiveness of their coping and adaptation practices, ability to innovate, modify and improve their adaptation skills. Good Resilience Practices (GRP) include those adaptation measures adopted by the local people, which are more effective, have a long-term positive impact, time tested and socially and culturally inclusive.

- Many activities related to livelihoods, economic and business activities as well as socio-cultural aspects of community lives are determined by the efficacy of the physical and structural security from Riverine disasters. Adaptive decision making of communities both at household and collective levels are greatly determined by how secure they feel from flood and erosion.
- Survival and sustenance activities and livelihoods of char areas in general are tuned to the seasonal rhythm of Rivers, weather and climate (especially the monsoons). For them successful adaptation is a precondition for survival. Physical skills like swimming, plying boats and banana rafts, survival with little food in hard weather conditions, capability of doing hard manual labour and being mentally robust help them in surviving and flourishing in adverse conditions.
- Housing design is an important element of adaptive living in floodplain areas. Living in stilted houses, houses with high foundation, collapsible material and design are good practices of char communities in general.

- Local knowledge comprising traditional knowledge, skill and wisdom as well as community's own innovation is the basis of all autonomous adaptation practices.

- Ability to produce crops in sandy soil, locally modified crop calendar, experimentation with different farming techniques are hallmark of agricultural practices of people living in char areas that help them adjust continuously to changing climatic situations.

- Labour outmigration, especially of young males to outside destinations both within Assam and outside the state is a common trend in all char areas which is considered as a good strategy since the remittance helps families in reducing risk and adopting adaptive measures.

VII. Recommendations

- Both Government and Non-Government Development Agencies should treat the River islands and their people as a special case and prepare specific policies and action plans to reduce their risk of disaster and climate change at a war footing basis.

- The Char Development Department of Government of Assam should hold a comprehensive population census in the chars of Assam to without any further delay. Such a population survey should also include assessment of socioeconomic, livelihood and environmental status of thechars.

- The communities of the River islands need to be sensitized about the existing Government programs, polices and schemes through extensive awareness programs and supported for getting maximum benefits from the same.

- Provision of early warning of floods with a lead time of 6 hours can be very useful in reducing loss and damage of floods. Community based flood early warning systems are highly recommended for all such Riverine islands.

- There is an urgent need to implement especially designed women empowerment programs in the project sites as well as in all important inhabited River islands of Assam focusing on health menstrual hygiene, livelihood, participation in planning and decision making in DRR, CCA and development activities.

- Due to lack of grid connected electricity infrastructure in chars, renewable sources like solar should be made available at subsidized prices to each and every household for lighting and cooking. Disaster resilience measures should go hand in hand with provision of energy security.

- Mobile boat-based healthcare units such as boat clinics operated by the National Health Mission in some Riverine areas of the Brahmaputra should be extended to all remote chars.

- Use of cost-effective technology for preservation of seed, vegetables, crops and food during the flood time will go a long way in ensuring food and livelihood security in such remote areas

- The State Action Plan of Climate Change (SAPCC) for Assam needs to be revised with incorporation of a special chapter on vulnerability of Riverine islands and their inhabitants and provision of specific measures for resilience building of such areas and other flood plain dwellers ofAssam.

- Special attention needs to be given to the safety, security, resilience and welfare of children and preservation of child rights in such chronically disaster affected areas.

- The Inland Water Transport (IWT) Department of the Government of Assam should take urgent measures to connect populated River islands (like Chalakura and Kobu Chapori) with regular boat services.

- To sustain the traditional pottery making of the *kumar* community of the Salmora area of Majuli, the District Administration must facilitate digging of the potter's soil in adequate quantity using mechanized means from alternative places.

- The Centre for Sustainable Development Goals(C-SDGs) of Government of Assam should assess all Government programs being undertaken in the River islands from the SDG perspectives and ensure that all SDGs relevant for the Riverine populations (presented in the Figure 1, section on Outcome below) are achieved in a time bound manner.

- Although labour outmigration is considered a useful adaptation strategy, which helps the parent household cope better with disaster and climate risk with the help of the remittance money sent by the migrant to family member/(s), the process of out migration is not documented and monitored. It is a self-initiated effort without any meaningful role of the State Government. Therefore, the Government of Assam should make it mandatory to register the migrants and create a data base of them. It will help in assessment of migration population and the related economic contribution. Identification of migrant households is essential to offer special support to families where old parents or young wives are left behind.

- Government of Assam must adopt a progressive Relief and Rehabilitation Policy for delivering maximum possible benefits to all those people who have lost land and assets to erosion including providing them alternative land in other safer places.

- It is high time a comprehensive study is carried out to understand the physical vulnerability and sustainability of all major Riverine islands of Assam taking into account the impact of structural interventions in Rivers like embankments, dams, bridges etc.

VIII. Outcomes

Following are the outcomes of the research study:

- The study, as expected, has unraveled a host of inter-correlated factors that have determined vulnerability of the people living in the project sites, which should attract attention of Governments, CSOs and Development Agencies and Donors to work for mitigation of disaster risk and building up of climate resilience in the River islands of Assam and other states of India experiencing similar problems
- The findings of the study highlight an important aspect of our governance mechanism viz. non-implementation or poor execution of existing policies and programs and thus deprivation caused to the poor and vulnerable people of these areas from the benefits that they are entitled to receive from the Government. Non-existence of some desired policies, policy gaps and governance deficit are brought to the fore for the consideration of policy makers at local, state and national levels.
- Documentation of the rich repertoire of traditional knowledge, innovative adaption strategies and resilience practices documented in this study will contribute to better understanding of human response to disaster and climate risk under particular physical, social and cultural contexts.
- The findings of the study were shared directly with 42 participants in stakeholders' workshop on **'Community resilience to water induced disasters and climate change: Vulnerability and Adaptation in the Brahmaputra River Basin, Assam**' organized at the Indian Institute of Bank Management, Khanapara, Guwahati on January 09, 2020. A brief report of the workshop along with media coverage of the event and photographs is provided in (Annexure-III).
- Advocacy campaign conducted during the study and later in the workshop with respective District Administrations, DDMAs, concerned Government agencies, CSOs, experts and researchers is expected

to influence policies in the coming days in favour of vulnerable communities for making them more resilient to disaster and climate risks. About 14,228 people living in 2939 households will be benefitted directly and indirectly from this research and advocacy intervention through increased awareness, better policy and improved governance.

- The issues addressed in the study mainly relate to 13 of the Sustainable Development Goals (SDGs), however, it addresses the other SDGs also as indicated below:

Figure 1. SDGs relevant to the study

f

IX. Main beneficiaries

The main beneficiaries of this project are:

(i) The communities who are living in the three River islands with extreme risk of disasters and climate change impact,
(ii) Local District administration and State and Central Governments who can get enough food for thought and direction for action from the observations, conclusions and recommendations;
(iii) Scientists and researchers can learn about the challenges of disaster and climate risk and their overwhelming effects on lives and livelihoods of people, and,
(iv) The national and global development community will get enough information from this study report to achieve motivation for future interventions in these study sites as well as other similar vulnerable areas of the state.

X. Outputs

Following are the key outputs of the study:

(i) The technical narrative report that describes the results, findings, conclusions and recommendations;

(ii) A set of maps and tables that explain how the landscapes of the three islands have changed over the time as result of mainly erosive action of the Rivers, which have led to increase in vulnerability

of the people and also determined social, economic and cultural consequences of increased risk (Annexure I and II);

(iii) The stakeholders workshop on **'Community resilience to water induced disasters and climate change: Vulnerability and Adaptation in the Brahmaputra River Basin, Assam**' organized at the Indian Institute of Bank Management, Khanapara, Guwahati on January 09, 2020 (Annexure-III) helped in direct dissemination of the project results and related discussion to 42 participants(32 men and 10 women).

XI. Type and number of beneficiaries

About 14,228 people living in 2939 households will be benefitted directly and indirectly from this research and advocacy intervention through increased awareness, better policy and improved governance. The 42 participants (32 men and 10 women) who attended the stakeholder workshop learned new information and knowledge from the workshop's deliberations and discussions. Different categories of beneficiaries of the project are: (i) Inhabitants of the three Riverine islands, (ii) Government officials of relevant departments such as State Water Resources Department, Assam State Disaster Management Authority (ASDMA), Flood and River Erosion Management Agency, Assam (FREMMA), Assam Science Technology and Environment Council (ASTEC) and the Centre for Flood Management Studies (CFMS)-Guwahati of National Institute of Hydrology (NIH), Ministry of Jal Shakti, Government of India, (iii) CSO actors engaged in similar work, (iv) Experts and researchers and (v) Development agencies and donors.

XII. Catalytic effects- Any additional funding, commitments:

Aaryanak expects that the project report, media reports of the workshop and some future attempts to highlight the project findings in local and national media will help in getting more funds for additional work in similar lines in some other River islands of Assam.

XIII. Key Partners of the project supporting your interventions:

Sanchipaat, a socio-cultural organization of Majuli and North Eastern Society, a development NGO of Jonai were our partners who helped us in conducting the field work in Majuli and Kobu Chapori respectively.

XIV. Explain, if any delays in implementation, challenges, and lessons learned & best practices:

- There was some delay in organizing the stakeholder workshop at Guwahati because of the ongoing political unrest and challenging law and order situation that prevailed in Guwahati and many other parts of Assam throughout the month of December 2019 till the first week of January 2020.

- Further delay was caused in finalizing the technical report because the project team had to revisit the filed sites for validating some results of RS-GIS analysis and some findings from field surveys during the last week of January, 2020 and first two weeks of February 2020. Re-analysis of desktop mapping process took one more week, till third week of February, 2020.

- The main challenge in implementing this project was the limited time and financial resource. Because of extremely adverse situations prevailing for more than five months (June-October) during the rainy

season due to flood and erosion, the time left for proper field work was not enough. Limited finances available hindered us for making adequate number of visits to the project sites.

- The most important lesson that we learned from this project is that when one visits such remote places of high vulnerability inhabited by marginalized communities and engages with them persistently for days as participants observe and mingles with them freely and gains some confidence and rapport with them, being part of their daily lives, one generates expectations in their minds about solving some of their prolonged existential problems such as exposure to disasters, social backwardness and abject poverty.

- We all know that their expectation from us is misplaced. Therefore, it is important to tell them honestly and frankly that it is not possible for us to solve their problems through such a brief intervention which is mainly a research study. What we can at the best do for them is to apprise policy makers in Districts and in the State Government about their real situation and promote advocacy effectively for better policies and programs of DRR, CCA and development in these areas. This will ensure some positive results for them in the long term.
- In our experience, sincere and honest approach preceded by proper rapport building with the communities is the most effective way of getting correct information for such a community-based study. Validation of some community views through methodical peer consultation is also required to get reliable data.

XV. Sensitization of community on behavioral and attitudinal changes

The project team sensitized the communities on various issues such as water induced hazards, vulnerability, climate change, coping, adaptation, resilience, livelihoods, rural development, SDGs etc. during the interactive sessions e.g. Focused Group Discussions, Key Informant Interviews, Participatory Landscape Mapping and Analysis. This has led to improved understanding of the communities about physical, social, economic cultural and other related aspects of vulnerability with links to water induced hazards and climate change. Examples of successful adaptation stories from similar geographical areas of India increased their motivation thus making them more attentive and receptive to the processes of community based participatory research methodology adopted during the study.

XVI. Monitoring Arrangements

- The draft reports prepared by the three field teams that worked in the three study sites were thoroughly examined by the PI. The teams were resent to the field to validate and correct some observations and findings. After receiving the input from the stakeholders in the workshop held at Guwahati on 9th January 2020, a fresh round of field validation and ground trothing were carried out in all the three sites for correcting the maps and the RS-GIS based analyses where doubts were prevailing. No external monitoring system was engaged.

- An assessment of the changing characteristics of land use and land cover were done for all the three study sites using RS and GIS, the results of which are mentioned in the narrative report and shown pictorially in Annexure-II. The study was done on various aspects of vulnerability and adaptation of the communities with respect to water induced hazards and climate change which have been built-in to the narrative report as well as presented in tabular format in Annexure-VII.

XVII. Reference

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Annexure-II

Landuse and Landcover change analysis in study sites
Study Site-1: Chalakura Char, Dhubri District

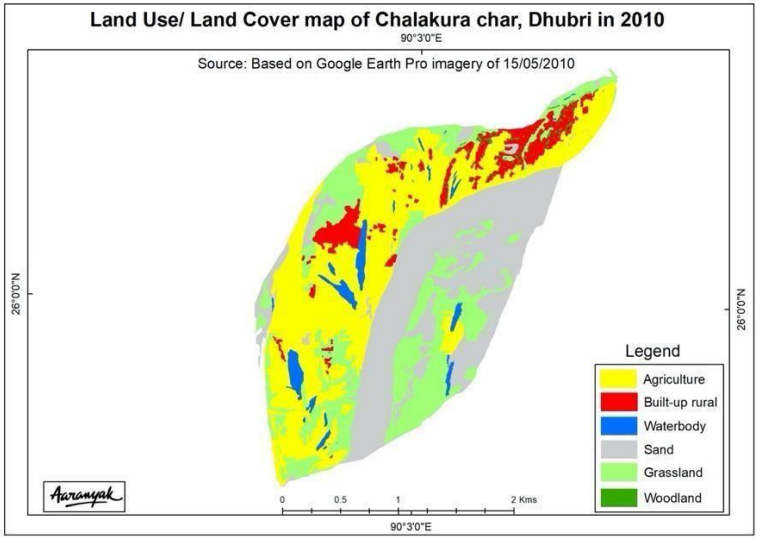

Figure-1: LU/LC status in Chalakura Char in 2010

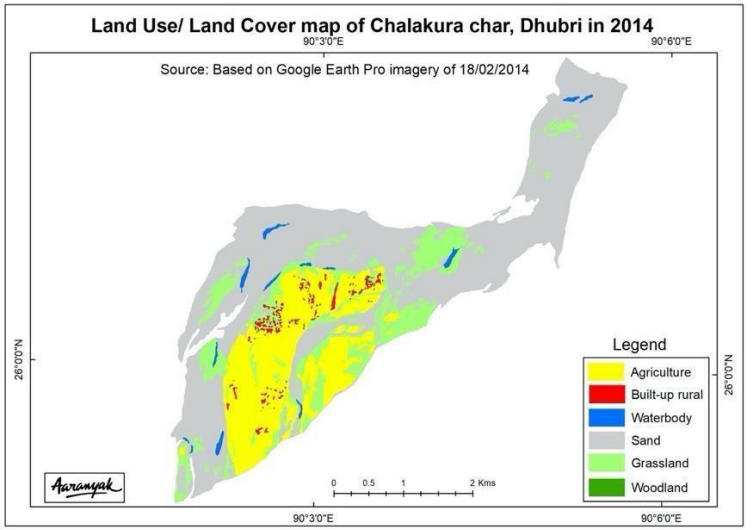

Figure-2: LU/LC status in Chalakura Char in 2014

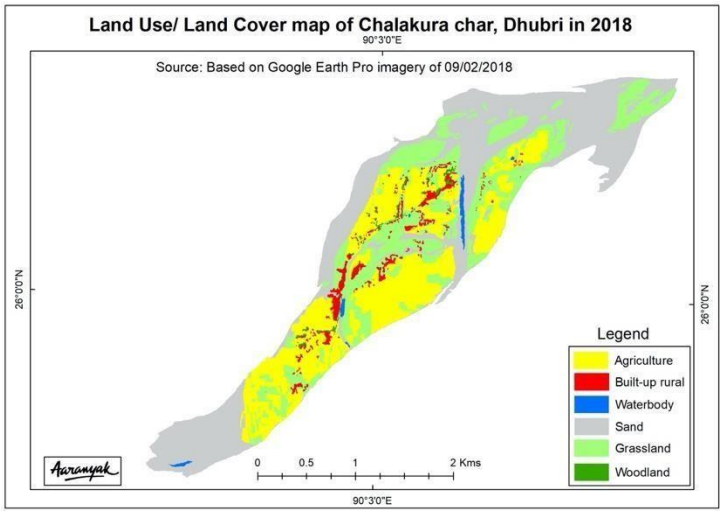

Figure-3: LU/LC status in Chalakura Char in 2018

Table 1: Land Use/ Land Cover Analysis: 2010-2018, Chalakura Char, Dhubri District

(Area in Sq.km)

Sl.no	Land Use/ Land Cover classes	Year 2010		Year 2014		Year 2018	
		Area	Percentage	Area	Percentage	Area	Percentage
1	Agriculture	2.04	36.43	2.96	22.48	1.7	29.98
2	Grassland	1.32	23.57	2.17	16.48	1.43	25.22
3	Built-up rural	0.35	6.25	0.15	1.14	0.17	3.00
4	Sand	1.71	30.54	7.74	58.77	2.31	40.74
5	Water body	0.15	2.68	0.14	1.06	0.03	0.53
6	Woodland	0.03	0.54	0.01	0.08	0.03	0.53
Total		**5.60**	**100.00**	**13.17**	**100.00**	**5.67**	**100.00**

Study Site-2: Borboka Pathar and Kamajan Alengi, Salmora Mouza, Majuli District

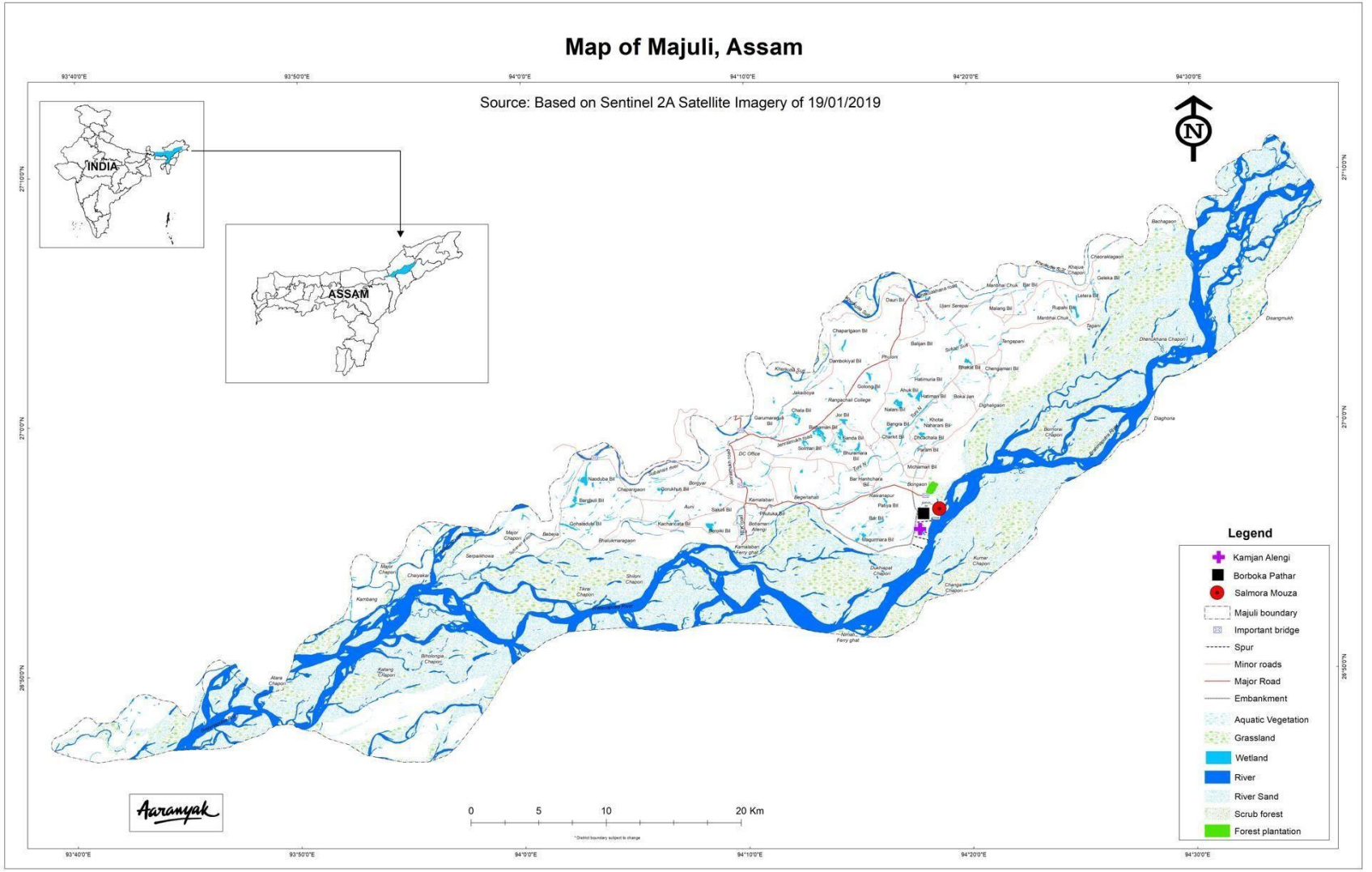

Figure 4: Map of Majuli Island showing the location of the two study villages viz. Borboka Pathar and Kamjan Alengi

Figure 5: Location of the Borboka Pathar and the Kamjan Alengi villages on the edge of the bank of River Brahmaputra. The households in Borboka are scattered on and around the Spur Number 1 and 2. Kamjan Alengi is situated to the east of Borboka. Borboka is not protected by any embankment, while Kamjan has a stretch of the remnants of an embankment which is ineffective. As a result, both villages are directly exposed to the River

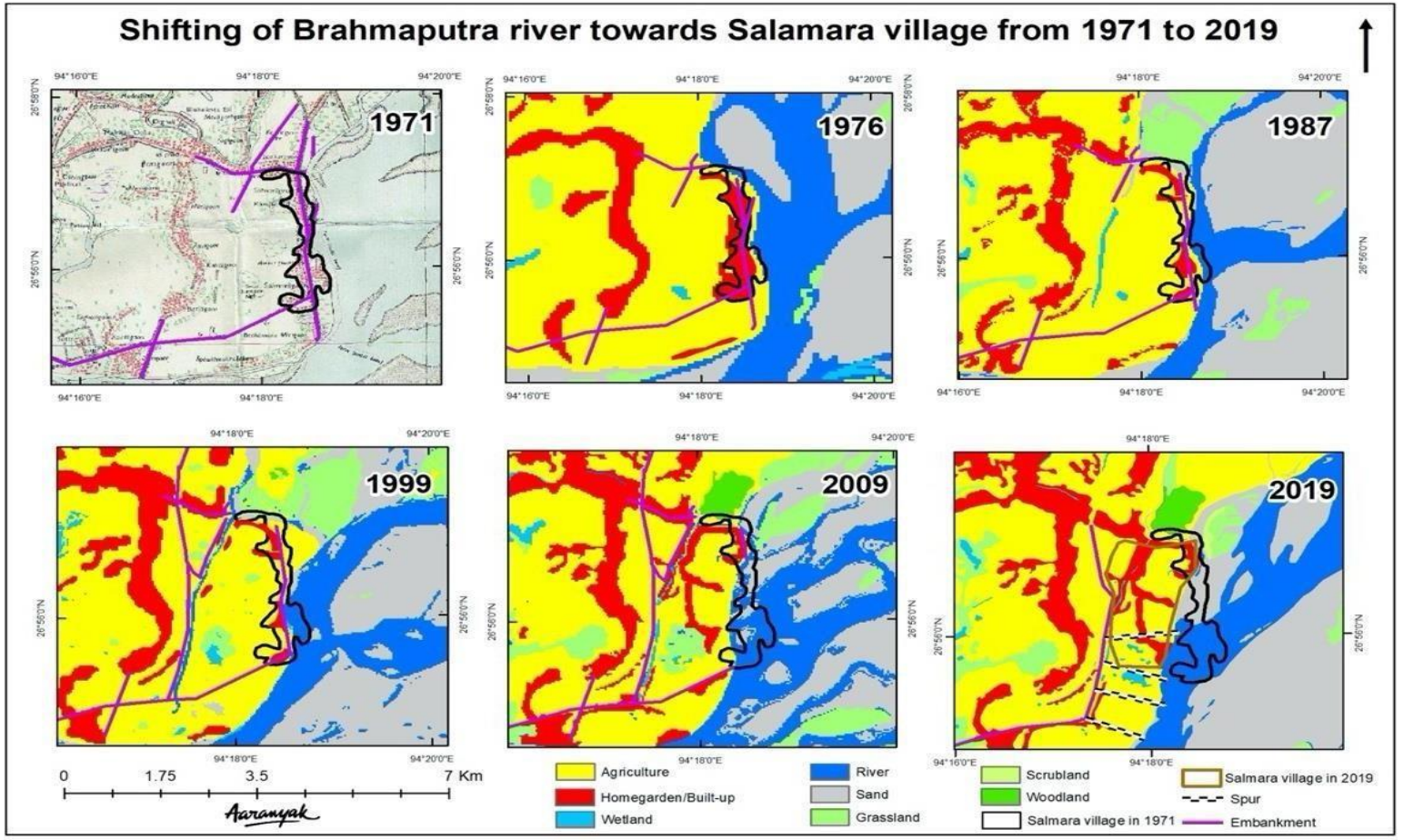

Figure 6: The progressive movement of the north (right) bank of the Brahmaputra during 1976-2019 towards the Salmora area of Majuli resulting in continuous erosion and loss of landmass. About three fourth of the area is gone by now. The erstwhile Borboka Pathar and Kamjan Alengi villages are complete under water now.

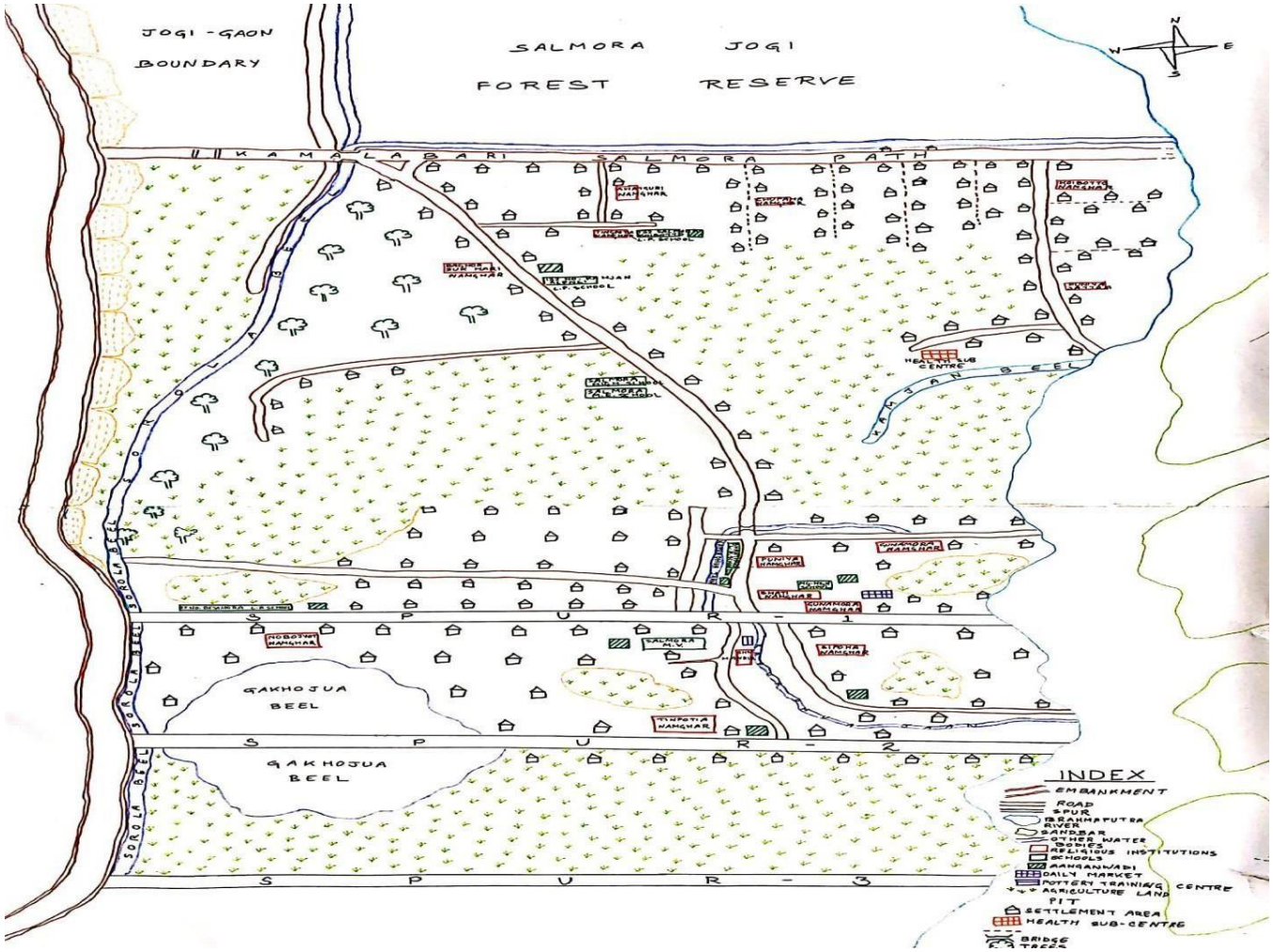

Figure 7: Social map of the study area consisting of two villages' viz. Borboka Pathar and Kamjan Alengi prepared by the community in Participatory Landscape Mapping sessions.

Study Site-3: Kobu Chapori, Dhemaji District

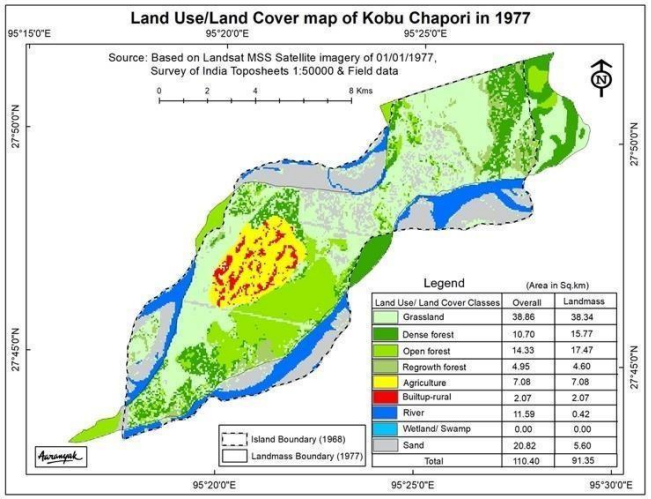

Figure-8: LU/LC status in Kobu Chapori in 1977

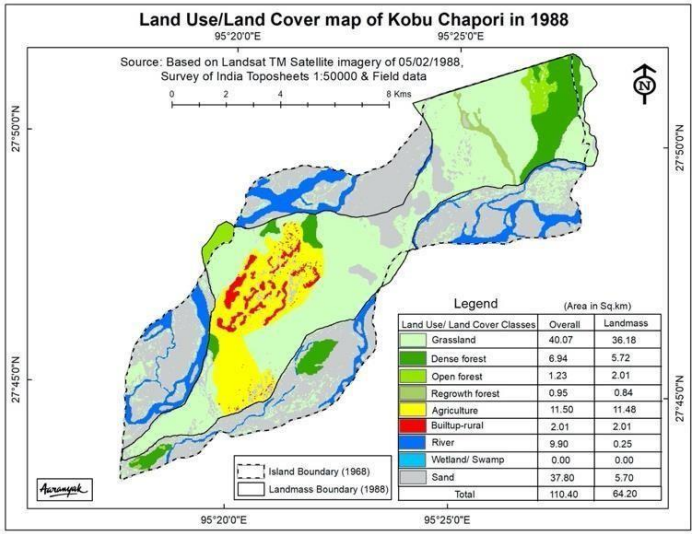

Figure-9: LU/LC status in Kobu Chapori in 1988

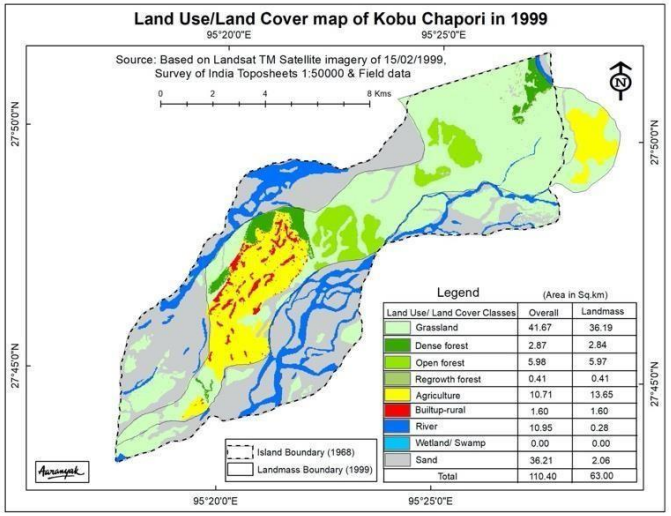

Figure-10: LU/LC status in Kobu Chapori in 1999

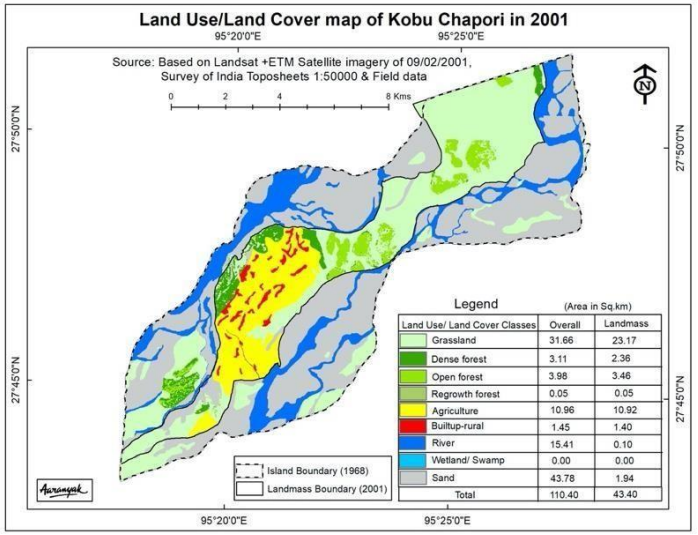

Figure 11: LU/LC status in Kobu Chapori in 2001

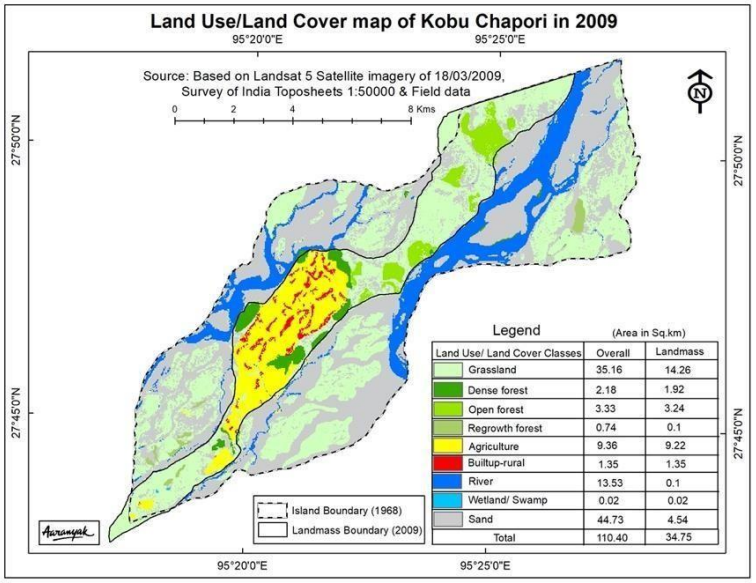

Figure 12: LU/LC status in Kobu Chapori in 2009

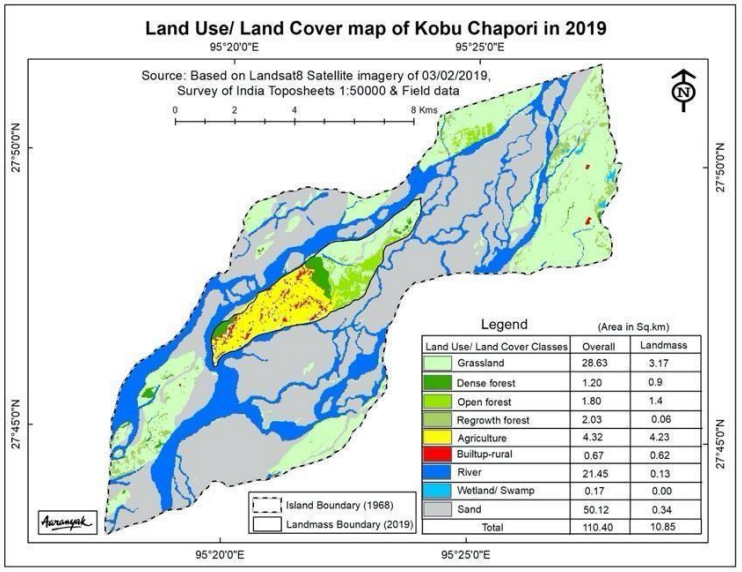

Figure 13: LU/LC status in Kobu Chapori in 2019

Table 2: Land Use/ Land Cover Analysis: 1977- 2019, Kobu Chapori, Dhemaji District

(Area in Sq.km)

		Year 1977		Year 1988		Year 1999		Year 2001		Year 2009		Year 2019	
Sl.no	**LULC Class 2019**	**Area**	**%**	**Area**	**%**	**Area**	**%**	**Area**	**%**	**Area**	**%**	**Area**	**%**
1	Grassland	38.34	41.97	36.19	56.37	36.19	57.44	23.17	53.39	14.26	41.04	3.17	29.22
2	Dense forest	15.77	17.26	5.72	8.91	2.84	4.51	2.36	5.44	1.92	5.53	0.9	8.29
3	Open forest	17.47	19.12	2.01	3.13	5.97	9.48	3.46	7.97	3.24	9.32	1.4	12.90
4	Regrowth forest	4.60	5.04	0.84	1.31	0.41	0.65	0.05	0.12	0.1	0.29	0.06	0.55
5	Agriculture	7.08	7.75	11.48	17.88	13.65	21.67	10.92	25.16	9.22	26.53	4.23	38.99
6	Built-up:rural	2.07	2.27	2.01	3.13	1.60	2.54	1.40	3.23	1.35	3.88	0.62	5.71
7	River	0.42	0.46	0.25	0.39	0.28	0.44	0.10	0.23	0.1	0.29	0.13	1.20
8	Wetland/ Swamp	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.06	0	0.00
9	Sand	5.60	6.13	5.70	8.88	2.06	3.27	1.94	4.47	4.54	13.06	0.34	3.13
Total		**91.35**	**100.00**	**64.20**	**100.00**	**63.00**	**100.00**	**43.40**	**100.00**	**34.75**	**100.00**	**10.85**	**100.00**

Social Mapping Kobu Chapori Area

Figure 14: Social map developed by communities for the Kobu Chapori

Annexure-III

Stakeholder Workshop
on
Community resilience to water induced disasters and climate change: Vulnerability and Adaptation in the Brahmaputra River Basin, Assam
Venue: Indian Institute of Bank Management, Khanapara, Guwahati
Date: January 9, 2020

Aaranyak with support of IWP completed a research study entitled '**Community resilience to water induced disasters and climate change: A study and documentation of good practices in selected River islands of the Brahmaputra River Basin, Assam' during March-December 2019.** The study was carried out in three River islands of the Brahmaputra e.g. Chalakura Char (Dhubri District), Majuli (Majuli District) and Kobu Chapori (Dhemaji District). The study was facilitated by IWP through its Regional Office, GWP-South Asia, International Water Management Institute, Colombo, Sri Lanka. On completion of the research study, a stakeholders workshop with the theme **'Community resilience to water induced disasters and climate change: Vulnerability and Adaptation in the Brahmaputra River Basin, Assam'** was organised at the Indian Institute of Bank Management, Khanapara, Guwahati on January 09, 2020. Objective of the workshop was mainly to disseminate the findings of the study to a select group of stakeholders and receive suggestions for improvement on the draft report.

The major findings of the study were disseminated to major stakeholders in this workshop, which was attended by 42 participants, out of which 32 were men and 10 were women. The audience comprised representatives of local communities of the study sites, officials of relevant departments of Government of Assam, CSO actors engaged in similar work, officials of IWP, researchers of Aaranyak and a few subject experts. Government agencies represented were: State Water Resources Department, Assam State Disaster Management Authority (ASDMA), Flood and River Erosion Management Agency, Assam (FREMMA), Assam Science Technology and Environment Council (ASTEC) and the Centre for Flood Management-Guwahati of National Institute of Hydrology, Ministry of Jal Shakti, Government of India. Dr Partha J Das, Head, WATCH Division and Principal Investigator of study, set the ball rolling by elaborating on the importance of the theme of the study as well as the subject of the workshop. He gave a presentation on the theme of the study and introduced the concept, objective, and outcome to the audience.

He explained the process of formation of the River islands and determinants of vulnerability and adaptation in the socio-economic and cultural context of the communities of the islands. He also elaborated on the hydrological geomorphological mechanism of formation of chars (Riverine island) in the Brahmaputra River.

Dr. Bibhab Kumar Talukdar, CEO and Secretary General of Aaranyak, provided a glimpse of the diversity of the activities of Aaranyak over the last three decades.

Dr. Veena Khanduri, Executive Secretary-cum-Country Coordinator, IWP, Gurugram, Haryana presented the activities undertaken by IWP in the recent past on Integrated Water Resources Management and climate change along with its vision, mission, aims & objectives and recapped the collaborative activities of IWP with Aaranyak over the last five years.

Ms. Bedika Borah, Mr. Wahid Hussain and Mr. Navajyoti Deuri presented detailed case studies on Majuli, Chalakura and Kobu Chapori respectively. Mr. Arup Das of the Geospatial Technology Application Division of Aaryanyak explained the findings from a GIS-Remote Sensing based study of the three River islands.

A panel discussion chaired by Mr. P Changkakati, Former Water Resources Secretary to the Government of Assam received views of panellists viz. Dr. Arnab Sarma (Faculty in Water Resources Engineering, Royal Global University). Mr. Moferjal Sarkar (District Project Officer, Disaster Management, Dhubri District); Dr. Veena Khanduri and Dr. Jaydeep Baruah (Head, Environment Division, ASTE Council, Government of Assam). A number of important recommendations meant for the state government and civil society were adopted from the panel discussion as well as views submitted by the participants.

The workshop concluded that the River islands are the most disaster prone areas of Assam and the inhabitants of the chars are the most vulnerable population of the state because of lack of socioeconomic empowerment, development infrastructure and ineffective disaster management and climate change adaptation programs.

The workshop urged that both Government and Non-Government Development Agencies should treat the River islands and their people as a special case and prepare specific policies and action plans to reduce the risk of disaster and climate change at a war footing basis.

The workshop served several purposes with a concrete outcome. Findings of the study were disseminated to the major stakeholders. Important suggestions were received for inclusion of additional information in project report. The workshop provided a platform for local stakeholders and Government officials to interact and exchange information and views. The consultation led to better understanding of Government officials about the various sources of vulnerabilities of the char dwellers and the extreme risk with which they live in these remote hinterlands.

Major suggestions emerged out of the workshop have been captured under “Recommendations” part of the report.

Media Coverage

The three media coverage of the workshop along with their web link is given below:

1. https://www.telegraphindia.com/states/north-east/workshop-on-brahmaputra-river-islands/cid/1735525

Workshop on Brahmaputra River islands

Policies to reduce risk of disaster and climate change on a war footing

By Our Special Correspondent in Guwahati

- Published 14.01.20, 12:43 AM
- Updated 14.01.20, 12:43 AM

Majuli (The Telegraph file picture)

Experts working with community in three River islands — Majuli (Majuli district), Chalakura Char (Dhubri district) and Kobu Chapori (Dhemaji district) — in the Brahmaputra have urged both the government and NGOs to treat the islands and their people as "special" and prepare specific policies to reduce their risk of disaster and climate change on a war footing.

A workshop on Community resilience to water induced disaster and climate change: Vulnerability and adaptation in Brahmaputra River Basin organised by Aaranyak in Guwahati recently dealt in detail with various problems faced by the community.

Dr Partha J. Das, Head, Water, Climate and Hazard (WATCH) Division of Aaranyak said on Monday River islands are the most disaster-prone areas of Assam and the inhabitants of the sars are the most vulnerable population because of lack of socio-economic empowerment, infrastructure, effective disaster management and climate change adaptation programmes.

Das gave a presentation on the theme of the workshop which was carried out recently by the WATCH division.

Bedika Borah, Wahis Hussain and Navajyoti Deuri also of Aaranyak presented detailed case study on Majuli, Chalakura Char and Kobu Chapori respectively.

Arup Das of the geospatial technology application division of Aaranyak explained the findings from a GIS remote sensing based study of the three River islands.

2. http://theshillongtimes.com/2020/01/13/river-island-communitys-resilience-to-disasters-climate-change-in-focus/

GUWAHATI: : A workshop on “Community resilience to water induced disaster and climate change: Vulnerability and adaptation in Brahmaputra River Basin” dealt in detail with various problems faced by the community in three of Brahmaputra River islands – Majuli (Majuli district), Chalakura Char (Dhubri district) and Kobu Chapori (Dhemaji district)- in Assam.

The workshop for key stakeholders was organised by Water, Climate and Hazard (WATCH) Division of Aaranyak, a top-bracket biodiversity conservation and environmental research organisation in Northeast India, at the Indian Institute of Bank Management here on January 9, 2020.

Dr Partha J Das, Head, WATCH Division and Organising Secretary of Aaranyak, set the ball rolling by elaborating on importance of the workshop. He gave a presentation on a research study entitled "Community resilience to water induced disasters and climate change: A study and documentation of good practices in selected River islands of the Brahmaputra River Basin, Assam" which was carried out recently by WATCH Division of Aaranyak. He explained the process of formation of the River islands, determinants of vulnerability and adaptation. He also provided basic information on chars (river islands) of Assam and the objective of the study.

Dr. Veena Khanduri, Executive Secretary-cum-Country Coordinator, India Water Partnership (IWP), Gurugram (Haryana), which supported the project, presented about their recent activities undertaken on Integrated Water Resources Management and climate change, IWP's vision and Mission, their aims, etc.

Ms. Bedika Borah, Mr. Wahis Hussain and Mr. Navajyoti Deuri presented detailed case studies on Majuli, Chalakura Chalakura Char and Kobu Chapori respectively. Mr. Arup Das of the Geospatial Technology Application Division of Aaranyak explained the findings from a GIS-Remote Sensing based study of the tree River islands of the Brahmaputra River.

The presentations were followed by a panel discussion that was participated by Mr. P Changkakati, Former Water Resources Secretary to the Government of Assam; Dr Arnab Sarma, Faculty in Water Resources Engineering, Royal Global University; Mr. Moferjal Sarkar, District Project Officer (Disaster Management), Dhubri District; Dr. Veena Khanduri and Dr Jaydeep Baruah, Scientific Officer, Head I/C ASTEC.

Dr. Bibhab Kumar Talukdar, CEO and Secretary General of Aaranyak, enlightened the participants in the programme about the aims, objectives and works so far done on a mission mode by Aaranyak since its inception over 30 years back.

The workshop concluded that the River islands are the most disaster prone areas of Assam and the inhabitants of the chars are the most vulnerable population of the state because of lack of socioeconomic empowerment, development infrastructure and effective disaster management and climate change adaptation programs. The workshop urged that Both Government and Non-Government Development Agencies should treat the River islands and their people as a special case and prepare specific policies and action plan to reduce their risk of disaster and climate change at a war footing.

3. https://www.facebook.com/pg/aaranyakindia/photos/?tab=album&album_id=10158009978242363&__tn__=-UC-R

Stakeholder workshop on community resilience

A stakeholder workshop on community resilience to water induced disasters and climate change: Vulnerability and Adaptation in the Brahmaputra River Basin, Assam' was organised at the Indian Institute of Bank Management (IIBM), Khanapara, Guwahati on 09 January 2020. During the programme discussion on three River islands of the Brahmaputra viz. Chalakura Char (Dhubri District), Majuli (Majuli District) and Koba Chapori (Dhemaji District) were conducted. Mr. P Changkakati, Secretary, GoA, Water Resources, Dr. Arunab Sharma, Faculty, Water Resources Engineering, Royal Global University, Dr. Jaydeep Baruah, Scientific officer, Head I/C ASTEC, Ms. Mandira Buragohain, State Project Officer, ASDMA were the esteemed hests present during the programme. Dr. Partha J Das, Organizing Secretary of Aaranyak briefed the gathering on the issue and the importance of the workshop. He also gave a presentation on "Community resilience to water induced disasters and climate change: A study and documentation of good practices in selected River islands of the Brahmaputra River Basin, Assam" based on the work conducted by WATCH division of Aaranyak. He elaborated on the formation of the River islands, determinants of vulnerability and adaptation, and also shared information of the chars of Assam and the objective of the study. Dr. Bibhab K Talukdar, CEO and Secretary General of Aaranyak, talked about Aaranyak. Dr. Veena Khanduri from India Water Partnership highlighted their aims and objectives during the prgramme. Ms. Bedika Borah elaborated their study on Solamara, Majuli and shed light on the impact of climate change in the region. Mr. Wahid Hussain, Researcher & Convener, Empower People, Assam ranch, Dhubri elaborated about the possible impact of climate change in Chalakura char of Dhubri. While, Mr. Navajyoti Deori talked about the impact of flood, out-migration, livelihood, and the current education, water & sanitation scenario in Koba Chapori. The lack of road connectivity also affects the residents. The presentations were followed by a panel discussion.

Participants of the workshop on "Community resilience to water induced disaster and climate change: Vulnerability and adaptation in Brahmaputra River Basin in Assam.

Annexure-VII

Summary tables presenting sources of vulnerability and resilience practices in selected study area

Name of study area: Chalakura char, Gram Panchayat (GP): Chalakura,
Circle: Dhubri, Development block: Birshingjarua,
District: Dhubri

(Climate change is a factored into all water induced hazards)

Table 1: Summary Table for vulnerability

Aspect of vulnerability	Description of vulnerability	Source of vulnerability: WIH(Name)/CC/ Others	Source of vulnerability: Governance deficit/ Development gap/Socio-cultural condition and norms	Affected population (Approximate)	Ranking score: From 1 to 5 With 1 being least and 5 being highest
Physical	River island (human habitat) is directly exposed to the waters of the Brahmaputra.	Flood, CC	Lack of flood protection measures	All	5
	Shrinkage of land area of island due to continuous erosion	Erosion, CC	lack of erosion protection structures	70%	5
	Insufficient vegetation and forest on Riverbank	Flood, erosion, sand casting, CC	Lack of Government as well as community initiatives for afforestation	80%	3
	Degradation of soil quality and infertility due to sand casting	Sand casting	Lack of Government program for soil reclamation	75%	4

Aspect of vulnerability	Description of vulnerability	Source of vulnerability: WIH(Name)/CC/ Others	Source of vulnerability: Governance deficit/ Development gap/Socio-cultural condition and norms	Affected population (Approximate)	Ranking score: From 1 to 5 With 1 being least and 5 being highest
Social: Education	Schools are regularly inundated and damaged by floods, erosion and sand deposition	Flood, CC	Poor structure of school building; not located on high ground; not made with flood proof design and structure	40%	4
	School classes come to a halt during floods or when damaged by erosion and sand deposition	Flood, erosion, CC	Lack of alternative site or facility for schooling; difficulty in communication and transportation during floods for students and teachers	40%	4
	Many students drop out of schools	Flood, erosion, CC	Discontinuity of education due to disasters; poverty; compulsion of earning money for the family	25% of students	3
Social: Marginalized people	Elderly and differently able people have more difficulty during disasters	Flood, erosion, CC	Lack of appropriate DRR program for capacity building of marginalized people	35%	3
Economic	Poverty	Flood, erosion, CC	lack of implementation of Government's development program, illiteracy and lack of higher education	95%	4
	Decreased purchasing power	Flood, erosion, CC	Poverty trap	All	3
	Lack of insurance coverage for crop loss	Flood, erosion, sand casting, CC	Lack of awareness, Lack of action by NGOs, lack of implementation of Government schemes	All	3

Aspect of vulnerability	Description of vulnerability	Source of vulnerability: WIH(Name)/CC/ Others	Source of vulnerability: Governance deficit/ Development gap/Socio-cultural condition and norms	Affected population (Approximate)	Ranking score: From 1 to 5 With 1 being least and 5 being highest
Livelihood	Labour out-migration	Flood, CC, erosion	Poverty	45%	1
	Damage to crops	Flooding, sand casting, erosion, CC	Lack of proper flood management and erosion	90%	4
	Food insecurity	Flood, erosion, sand deposition on farmland, CC	Lack of awareness and training on alternative livelihood, poverty, lack of awareness about alternative livelihoods	All	4
	Loss and death of livestock	Flood, CC	lack of safe flood shelter	80%	3
	Decrease in production of jute materials	Flood, CC	lack of Government support, lack of market link	60%	2
Cultural	Lack of confidence on outsiders	Remoteness and lack of familiarity with people from the outside world	Long history of marginalization, remoteness from mainland and governance deficit	90%	1
	Fairs, festivals and religious program are affected	Flood, erosion, CC	Poverty	All	1
WASH	Open defecation is rampant	In general, but more during flood	Lack of awareness, behavioural inertia, no implementation of Government missions like Swach Bharat Abhiyaan	95%	4
	Drinking water is used directly from tube wells and mostly untreated	In general, but more during flood	Lack of awareness	80%	3
	Skin diseases	Flood, exposure to muddy and dirty water, dust storm	Lack of health care facility	All	2

Aspect of vulnerability	Description of vulnerability	Source of vulnerability: WIH(Name)/CC/ Others	Source of vulnerability: Governance deficit/ Development gap/Socio-cultural condition and norms	Affected population (Approximate)	Ranking score: From 1 to 5 With 1 being least and 5 being highest
Gender	Women are highly affected by hazards	Flood, erosion, CC	Lack of implementation of Government's women empowerment program, Burden on women of household chores and managing children and contributing to livelihoods	All women	4
	Women face discrimination and inequality in society		Religious and cultural constraints in participation in community's decision-making process, raising voices of opinion and aspiration; limitation in movement	All women	4
	Women's sanitation (especially menstrual) practices are unhealthy and unhygienic	Flood	Lack of sanitation awareness for women, lack of implementation of sanitation schemes	All women	4

Aspect of vulnerability	Description of vulnerability	Source of vulnerability: WIH(Name)/CC/ Others	Source of vulnerability: Governance deficit/ Development gap/Socio-cultural condition and norms	Affected population (Approximate)	Ranking score: From 1 to 5 With 1 being least and 5 being highest
Children	Discontinuity of education	Flood, erosion, CC, dust storm, physical damage to schools, roads and houses	Schools remain closed due to hazards; repairment and maintenance is not timely; Alternative site or house usually not available for continuation of school education;	All children	4
	Health: Diseases, trauma	Flood, erosion, CC, dust storm	Lack of awareness about child healthcare; Lack of psychological counselling for children	70% of the children	4
Governance: DRR, and Development	Non-functioning of development and public infrastructure facilities like Highland shelter, roads, electricity, school, education	Flood, erosion	Lack of maintenance, Lack of collective action of community, poor governance	All	4
	No early warning about disasters	Flood, erosion, storm	DRR program not reaching people	All	4

***NB**: Governance deficit or Poor governance: Lack of proper policy, non-implementation of existing policy and programs, Lack of functioning of existing institutions, lack of attributes of good governance e.g. efficiency, coordination transparency, participation etc.*

Name of study area: Chalakura char, Gram Panchayat (GP): Chalakura,
Circle: Dhubri, Development block: Birshingjarua,
District: Dhubri

Table 2: Summary Table for Adaptation

Aspect of adaptation	Adaptation strategy	Agent of action: Individual/Household/Community	Autonomous/ Planned	Source of external support from Government/NGO/Others
Physical attributes	People's skill in swimming, piloting boat and doing hard labour	Individual, Household	Autonomous	Not Applicable
Mental attribute	Accepting their destiny and gathering determination to survive and flourish in hazardous and adverse situation	Individual, Household, Community	Autonomous	Not Applicable
Preparedness	Preparedness with food items, fuelwood and boats	Individual, Household and Community	Autonomous	Not Applicable
Housing	House with high foundation for flood proofing	Household	Both	NGO, Community's learning from other places
	Internal raised platform inside house during flood	Household	Autonomous	Not Applicable

Aspect of adaptation	Adaptation strategy	Agent of action: Individual/Household/ Community	Autonomous/ Planned	Source of external support from Government/NGO/Others
Social	Social support system: People help one another in times of disaster and during rebuilding and rehabilitation after disaster.	Community	Autonomous	Not Applicable
Livelihood and Economic	Water based Livelihood e.g. Fishing, boating for passenger transportation	Individual, Household	Autonomous	Not Applicable
	Non-farm livelihood such as daily wage earning outside char area	Individual, Household	Autonomous	Not Applicable
	Outmigration to nearby districts of Assam and other states for job and income	Individual, household and community	Autonomous, planned	Facilitation by some agents from both inside and outside the community
Cultural	Use of local knowledge for anticipating time and occurrence of erosion and flooding	Community	Autonomous	Not Applicable
Gender	Women take part in production of jute items and help in income generation	Household and community	Autonomous	Not Applicable

Name of study area: Borboka village and Kamjan Alengi village, Salmora Mouza,

Panchayat: Bongaon, Revenue Circle: Majuli,
Development Block: Majuli Kamalabari, Majuli District

(Climate change is a factored into all water induced hazards)

Table 3: Summary Table for vulnerability

Aspect of vulnerability	Description of vulnerability	Source of vulnerability: WIH(Name)/CC/ Others	Source of vulnerability: Governance deficit and Development gap	Affected population (Approximate)	Ranking score: From 1 to 5 With 1 being least and 5 being highest
Physical	Very close proximity to River	Flood, Erosion, Sand casting	Lack of proper technical measures for mitigating flood and erosion	100% of the population	5
	Reduced green cover, wetlands & biodiversity	Flood & Erosion, sand casting	Extraction of small forest patches of villages forests for firewood, expansion of habits	100% population	3
Social	Inequity in Government support to different ethnic communities	In general, but more in disaster relief programs	Poor governance, lack of pro-active action of lesser privileged communities	Ethnic minorities (Approximately 27 households)	3
	Lack of awareness about Government policies and schemes, climate change possibilities of improvement of quality of life and better livelihoods	In general,	Inadequate intervention of development agencies and NGOs in the field of awareness and education	100% population	3
	Lack of effective collective pro-active action for risk reduction	Flood, Erosion, Sand casting, CC	Lack of community cohesiveness	100% population	4

Aspect of vulnerability	Description of vulnerability	Source of vulnerability: WIH(Name)/CC/ Others	Source of vulnerability: Governance deficit and Development gap	Affected population (Approximate)	Ranking score: From 1 to 5 With 1 being least and 5 being highest
Economic	Low income & profitability of local products such as earthen pots, woven clothes, handicrafts	Flood & Erosion, remoteness, lack of proper transport and communication infrastructure	Lack of initiative of Government and NGOs to promote and provide market link	60% population	3
	Unable to save & invest money	Flood & Erosion	Lack of awareness, lack of support from Government, NGO and financial institutions such as banks		3
	Economically dependent population	In general, but more because of effect of disasters and CC	Unemployment, livelihood insecurity	Dependent population (Approximately 450 persons)	3
	No crop or life insurance	Flood, erosion,	Lack of awareness, non-implementation of Government insurance schemes	100% population	3

Aspect of vulnerability	Description of vulnerability	Source of vulnerability: WIH(Name)/CC/ Others	Source of vulnerability: Governance deficit and Development gap	Affected population (Approximate)	Ranking score: From 1 to 5 With 1 being least and 5 being highest
Livelihood	High dependence of major livelihoods on River, highly climate vulnerable livelihoods	CC, flood, erosion, CC, sand casting	No support from Government for facilitating and strengthening traditional livelihoods	80% of population	4
	Lack of proper market linkages for products like pottery, weaved products	In general,	Inadequate government support	100% population	3
	Unavailability of raw materials like potter's soil, timbre etc.	Flood, erosion,	lack of Government support	85% population	4
	Lack of capital and funds at household or community levels for sustenance of livelihoods	In general, but more in the context of disasters and CC	Lack of support of Government and banks	100% population	3
Cultural	Damage to religious institutions like Namghars and Satras[11].	Flood, erosion, storm	Lack of proper technical measures for mitigating flood and erosion	100% population	1
WASH	Open defecation during flood	Flood	Lack of sanitation and hygienic awareness	100% population	4
	Unhygienic source of drinking water during flood	Flood	Lack of alternative and safe source of drinking water	100% population	4

[11] Namghar: Literally Namghar means Prayer House which are places for congregational worship associated with the entire Assamese community and the *Ekasarana* sect of Hinduism, in particular, that is native to Assam. In the Assamese language, 'Naam' means prayer and 'Ghar' means house. Hence, it is called Naamghar. Besides forming the primary structure used for worship, they also function as meeting houses for congregations, as well as theaters for dramatic performances (*bhaona*). Source: https://en.wikipedia.org/wiki/Namghar
Satra: (monasteries) are institutional centers associated with the Ekasarana tradition of Vaishnavism, largely found in the Indian state of Assam. Source: https://en.wikipedia.org/wiki/Satra_(Ekasarana_Dharma)

Aspect of vulnerability	Description of vulnerability	Source of vulnerability: WIH(Name)/CC/ Others	Source of vulnerability: Governance deficit and Development gap	Affected population (Approximate)	Ranking score: From 1 to 5 With 1 being least and 5 being highest
Gender	Women have restricted mobility during flood	Flood, CC	Gender norms and biases, socially assigned gender responsibility	About 1120 women	4
	Unsafe flood relief centers (for women)	Flood & Erosion	Non-implementation of provisions of 'Disaster Management Manual, 2015, GoA',	About 1120 women	2
	Improper disposal of menstrual waste in general but more during flooded condition	Flood	Lack of hygienic awareness, lack of intervention of Government and NGOs	All	3
	Difficulty for pregnant women during flood	Flood	No hospital nearby	Pregnant Women and their families	4
	Restricted mobility of women	Flood & Erosion	Gender norms, lack of proper roads	Women (Approximately 1120 persons)	4
Children	Restricted mobility	Flood & Erosion		Children (Approximately 250 persons)	4
	Highly prone to water induced diseases	Flood	Tender age, inadequate experience, prone to diseases	Children (Approximately 250 persons)	4

Aspect of vulnerability	Description of vulnerability	Source of vulnerability: WIH(Name)/CC/ Others	Source of vulnerability: Governance deficit and Development gap	Affected population (Approximate)	Ranking score: From 1 to 5 With 1 being least and 5 being highest
Governance	Absence of early warning of flood and erosion prediction	Flood & Erosion	Lack of Governments; early flood warning arrangement; administrative bottleneck in dissemination of advanced flood information	100% population	4
	Insufficient relief and compensation	Flood & Erosion	Improper implementation of existing Disaster Management Manual; Inappropriate policy	100% population	4
	Lack of consultation with local community about development of infrastructure & programs		Inappropriate policy and practice; Lack of space in Government programs for community participation	100% population	4

***NB**: Governance deficit or Poor governance: Lack of proper policy, non-implementation of existing policy and programs, Lack of functioning of existing institutions, lack of attributes of good governance e.g. efficiency, coordination transparency, participation etc.*

Name of study area: Borboka village and Kamjan Alengi village, Salmora Mouza Panchayat: Bongaon, Revenue Circle: Majuli,

Development Block: Majuli Kamalabari,

District, Majuli

Table 4: Summary Table for Adaptation

Aspect of adaptation	Adaptation strategy	Individual/Household/Community	Autonomous/Planned	Source of external support from Government/NGO
Physical skill	Swimming & boating known to almost all	Individual	Autonomous	Not Applicable
Mental resilience	Acceptance of the challenge of living in unfavourable condition since there is no feasible alternative in sight	Individual, Household, Community	Autonomous	Not Applicable
Preparedness	Remaining prepared to deal with flood by storing food, water, fuelwood, medicine cash money etc.	Individual, Household, Community	Both	Government, NGO
Cultural	The Vaishnavite spiritual tradition of Majuli teaches them to have unshaken faith on God and seek God' blessings to face their personal and social problems	Individual, Household, Community	Autonomous	Not Applicable

Aspect of adaptation	Adaptation strategy	Individual/Household/Community	Autonomous/Planned	Source of external support from Government/NGO
Housing	Living in stilted houses overcoming cultural barriers	Household, Community	Autonomous	Not Applicable
Social support	Quality of helping one another in times of distress and need	Community	Autonomous	Not Applicable
Livelihood and Economic	River based livelihood: Efficient use of River borne resources for livelihoods such as Potter' soil for making earthen pot and driftwood in pottery making, carpentry and boat making	Individuals, Household, Community	Autonomous	Not Applicable
	Out- migration of young people seeking jobs outside the island and supporting their families monetarily	Household	Autonomous	Awareness, information and motivation come from young men of the community who have already migrated
	Practice of alternative livelihoods like weaving, carpentry, sericulture,	Individuals, Household	Both	Government, NGO
Gender role	Women's proactive role in livelihood generation. Women participate in livelihood generation through pottery making and weaving;	Individuals, Household, Community	Both	NGO, Government

Aspect of adaptation	Adaptation strategy	Individual/Household/Community	Autonomous/Planned	Source of external support from Government/NGO
WASH	More people using sanitary toilets especially in het flood free seasons	Household	Planned	Government
	Use of sanitary napkins has started among women	Individual	Planned	Government, NGO
	Shifting of pregnant women to other places	Household	Autonomous	Not Applicable
	Health Card to each family	Individual and Family	Planned	Government
DRR infrastructure and programs	Construction of spurs and embankments; Laying of RCC porcupines, geo bags; for containing floods and arresting erosion	Community	Planned	Government
Development programs	Subsidy on water pumps	Individual	Planned	Government
	Construction of raised tube wells and toilets	Household	Planned	Government, NGO
	Pension to the elderly & free education to students	Community	Planned	Government

Name of study area: Kobu Chapori,

Panchayat: Silley, Circle: Jonai, Block: Murkongselek Tribal Development Block

District: Dhemaji

(Climate change is a factored into all water induced hazards)

Table 5: Summary Table for vulnerability

Aspect of vulnerability	Description of vulnerability	Source of vulnerability: Disasters(mention) /Climate change (CC)/Lack of awareness/Lack of good governance/Others	Affected population (Approximate)	Ranking score: From 1 to 5 With 1 being least and 5 being highest
Physical	Natural disaster becoming more damaging and unpredictable	CC	Entire population (About 3000 people)	5
	Damage to road and bridge	Flood, Inadequate quality of development infrastructure, poor governance	3000 people	5
	Damage to houses	Flood, Erosion, lack of properly built stilted house, lack of structural flood proofing e.g. embankment	1500 people	4
	Sand deposition in agricultural land	Flood, sandcasting, CC	3000 people	5
	Loss of landmass of the island	Erosion, lack of erosion protection measures	1000 people	3
Social	Damage to community hall and religious places	Flood, erosion	3500 people	3
	Loss of identity of people due to displacement	Flood, erosion, sand casting, lack of proper R&R policy	1500 people	3
	Schools are partially damaged	Flood, erosion; lack of flood proofing	1000 people	4

Aspect of vulnerability	Description of vulnerability	Source of vulnerability: Disasters(mention) /Climate change (CC)/Lack of awareness/Lack of good governance/Others	Affected population (Approximate)	Ranking score: From 1 to 5 With 1 being least and 5 being highest
Economic and livelihood	Crop damage: The cultivated paddy and other crops are damaged by sand deposition near the Riverine areas and due to inundation by flood waters	Flood, sand casting:	3500	5
	Loss of livestock: The cattle and poultry are washed off (cow, buffalo, goat, pig, chickens, etc.)	Flood, No early warning, Absence of proper High-Rise Platform (HRP) for animals	2200	4
	High price of commodities	Flood and Climate Change; Lack of price control policy	3500	5
	The weaving materials and agriculture tools are damaged.	Flood	1000	3
	The farming materials are damaged	Flood	1500	4
Cultural	Loss of cultural identity due to the displacement	Flood & Erosion, sand casting	3000	5
	Loss of traditional practices	Flood, climate change	3500	5

Aspect of vulnerability	Description of vulnerability	Source of vulnerability: Disasters(mention) /Climate change (CC)/Lack of awareness/Lack of good governance/Others	Affected population (Approximate)	Ranking score: From 1 to 5 With 1 being least and 5 being highest
WASH	Water-borne diseases, children are highly susceptible	Flood, climate change	1200	4
	Lack of access to safe drinking water during floods	Flood, lack of NGO intervention, lack of execution of Government's programs	3500	5
	Open defecation	Lack of sanitation awareness and facility, Non-implementation of Swach Bharat Abhiyan	3500	5
	Health hazard due to deposition of sludge and garbage	Flood, lack of community action	500	3
Gender	No safe and private sanitation facilities available for the women and girls	lack of execution of Government's programs, flood	1000	4
	Problem for pregnant women	Flood, lack of medical facility	1500	4
	No Women SHG	Lack of awareness and action by community, NGO and Government	All women	3
	Trafficking of women and girl children andmigration for work prevails.	Flood, erosion, CC, poverty	200	4

Aspect of vulnerability	Description of vulnerability	Source of vulnerability: Disasters(mention) /Climate change (CC)/Lack of awareness/Lack of good governance/Others	Affected population (Approximate)	Ranking score: From 1 to 5 With 1 being least and 5 being highest
Children	High child-labour, child marriage	Flood, erosion, CC, displacement, poverty	500	4
	No Immunization	Flood, lack of communication, poor awareness, lack of Government's programs	800	5
	Anganwadi Centre (AWC) and Integrated Child Development Scheme (ICDS) not functioning	Flood, poor governance	300	4
Connectivity: Transport, communication	Poor facility for transport, communication: No Government run ferry services	Flood, lack of surface connectivity with mainland (bridge, road), bad condition of roads and bridges, insufficient	3500	5
	No connecting road and bridge connectivity to mainland	Lack of attention of decision makers	3500	5

***NB**: Governance deficitt or Poor governance: Lack of proper policy, non-implementation of existing policy and programs, Lack of functioning of existing institutions, lack of attributes of good governance e.g. efficiency, coordination transparency, participation etc.*

Name of study area: Kobu Chapori,

Panchayat: Silley, Circle: - Jonai Block: Murkongselek Tribal Development Block

District: Dhemaji

Table 6: Summary Table for Adaptation

Aspect of adaptation	Adaptation strategy	Individual/Household/Community	Autonomous/Planned	Source of external support from Government/NGO
Mental and psychological	Mental toughness and the quality of adjusting psychologically to adversities	Individual, Household, Community	Autonomous	Not Applicable
Physical skill	Skill in swimming, operating boats, collection of driftwood	Individual,	Autonomous	Not Applicable
Housing	Construction of stilted or raised houses, houses on high ground	Household, Community	Both	NGO
Preparedness	Storage of food item, fuel wood, medicines, fodder for animals; Keeping boats ready	Household, Community	Both	
	Formation of Village Defense Force(VDP) and provision of help to villagers in distress	Community	Both	Panchayat
Efficient use of boats	Use of boats for communication, transport, shelter	Individual, Household, Community	Autonomous	Not Applicable

Aspect of adaptation	Adaptation strategy	Individual/Household/Community	Autonomous/Planned	Source of external support from Government/NGO
Livelihood and economic	Adoption of alternative livelihoods like Rabi crop, fish catching, fire wood collection from River	Household	Autonomous	Not Applicable
	Labour out migration	Individual, Household	Both	Information and support provided by previous migrants of het community
	Seed preservation in households and Community seed bank	Household	Both	NGO
Community action	Tree plantation and installation of bamboo porcupine to reduce erosion.	Community	Both	Panchayat
WASH	Health awareness and treatment is provided occasionally by Boat Clinic	Community	Planned	National Health Mission (NHM)
Gender	Women generate family income by rearing livestock, tailoring and selling kitchen garden products	Household	Autonomous	
Development infrastructure and programs	Construction of village road and High Rise Platform through MGNREGA	Community	Both	Panchayat

India Water Partnership (IWP) is a non-profit organization with a goal of promoting Integrated Water Resources Management (IWRM) in India and possesses 12AA & 80G from Income Tax Department, Government of India. It is also accredited by the Global Water Partnership (GWP) headquartered at Stockholm, Sweden as Country Water Partnership of GWP and hence also known as GWP-India.

Aaranyak is a leading wildlife NGO[1] based in Guwahati. It is a Scientific, Industrial Research and frontline environmental organization of India. It works all over the eastern Himalayan region on nature conservation, natural resources management, climate change, disaster management and livelihood enhancement of marginalized communities through research, education and advocacy.

Complete Address of the Organizations is given below:-

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