

# Climate Smart Agriculture

Assessing the Effectiveness of Climate Smart Agricultural  
Methods in Different Regions of Bangladesh

Md. Jakariya, PhD

PROFESSOR, ESM &  
DIRECTOR, Climate Justice and Research Center, North South University

# **Final Report**

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## **Principal Investigator**

Md. Jakariya, PhD

Professor

Department of Environmental Science and Management, &

Director, Climate Justice and Research Center

North South University

## **Study Team**

Dr. Kamrun Nahar

Md. Sajadul Alam Saimon

Turasa Nahla

Tazin Mahmud Ashik

Ragib Ahmed Amor

Ashiqur R Leon

Lamia Mahzabin

Nazmul Akash

Afif Saman

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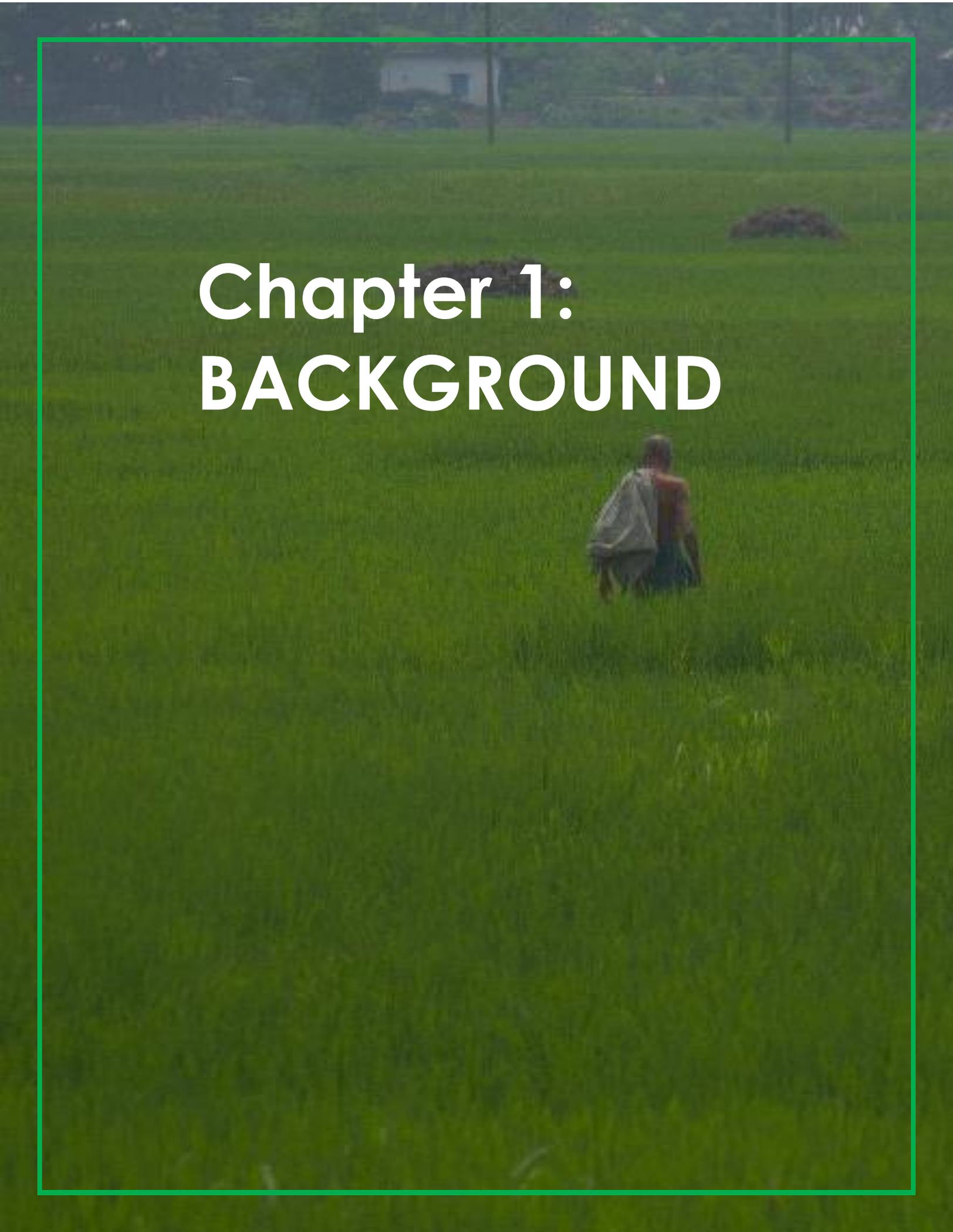
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A person is seen from behind, walking through a vast, lush green field. The person is wearing a light-colored shawl or blanket draped over their shoulders. In the distance, a small white building with a blue door is visible on a slight rise. The overall scene is peaceful and rural. The text 'Chapter 1: BACKGROUND' is overlaid in white on the left side of the image.

# Chapter 1: BACKGROUND

## 1.1 Overview

Agriculture of Bangladesh plays a vital role in country's economy. In 1972, it contributed around 52% to GDP. However, in recent times, from around Fiscal Year 2016-2017 the agricultural sector only contributes 14.79% to the GDP (Rezvi 2018). The fall in contribution is due to the adverse effect on agricultural production due to increase in population, unprecedented rainfall and hot flashes, drought, flood and mostly climate change. Not only the economy sector is affected, but also there are around 62% of the country's people who are engaged in agriculture farming to manage their subsistence from agriculture production while their lives and livelihood depend on it (Rezvi 2018). Hence, if due to the changing climate there is a slightest impact on agriculture, then it directly costs the people who highly depend on it (Nelson, et al. 2009).

According to Nelson and his fellow authors, the wellbeing of people depending on agriculture will be adversely affected by climate change, mostly residing in the South Asian region. The developing countries in the South Asian region, will face severe decline in yield for the important crops or crops which are highly depended on irrigation. Gradually, the most significant agricultural crops—rice, wheat, maize, and soybeans—will see more price hikes as a result of climate change and thus, will be difficult for its consumption. Additionally, there will be absence in calorie availability which can increase child malnutrition by 20 percent by 2050. It was stressed to raise calorie consumption which will be enough to offset the negative impacts of climate change on the health and well-being of children.

The climate acts as a fundamental component in agricultural productivity as temperature and rainfall are the major drivers of crop production and food security. Hence, the intensity and frequency of climate change in form of extreme climatic events (drought and flood), soil salinity in coastal areas, and increase in pests and diseases incidence will bring significant effect on crop productivity and efficiency, which will lead to irreversible changes in agricultural outcomes.

In Bangladesh, there has already been a noticeable increase in temperature and changes in the pattern of rainfall. Over the past four decades, Bangladesh's daily average temperature has risen by 0.103°C annually. Changes in geographical variability and rainfall pattern have also been reported. According to predictions, Bangladesh's temperature would continue to rise by 1°C by 2030, 1.4°C by 2050, and 2.4°C by 2100 as a result of global warming. Increasing

evapotranspiration and the atmosphere's capacity to hold moisture will result in rising temperatures, which will change the seasonal and annual variability of rainfall and its geographical distribution. An agro-based nation like Bangladesh, where more than 50% of the entire population directly employs in the agricultural sector and accounts for 14.74% of GDP, can be severely impacted by such climate changes (Imdad 2021, Bangladesh Economic Review 2017). For 149.77 million people, crop farming is their main source of food, and it is responsible for ensuring food security for both urban and rural populations.

Climate Smart Agriculture (CSA) is a new profound concept in the agricultural sector to transform agri-food systems towards green and climate resilient practices. The practices under CSA approach are widely adapted and the attention is growing in the recent years due to the intensity of the climate change impacts. In places like Bangladesh, due to arable land and limited natural resources the need of developing new agricultural technologies such as heat, salt, and submergence tolerant crops and short-duration seed varieties are significant. These technologies will help increase productivity and meet food demand which indicates the need for popularizing the concept of Climate Smart Agriculture in Bangladesh.

According to our extensive survey we observed that the people are still not familiar with the definition of CSA in Bangladesh. The government, NGOs or farmers themselves are introducing new crop production practices, maintenance and technologies to better combat climate change without even realizing that they are promoting Climate Smart Agriculture. If proper knowledge is disseminated to the stakeholders about CSA, then the existing methods that they are introducing to the farmers would be more effective in terms of food security, mitigation potential and adaptive capacity.

Recently the early flashflood in North Eastern part of Bangladesh was a massive blow to the agricultural sector, livestock sector and many lives and livelihood of people residing in parts of Haor regions. There is a strong relationship between climate change and the early monsoon that has led to flash-floods across the borders of India-Bangladesh, leaving millions of people stranded and creating a humanitarian disaster. About 6.0 million people are now stranded in these districts, and suffering from shortage of food, sanitation and water (Wardad 2022). The unprecedented rainfall followed by extreme dry periods will increase and due to this, the agriculture sector would bear the brunt of these disasters - ranging from crop losses to fish farms washed away. Hence, in

the collaborative research “Assessing the Effectiveness of Climate Smart Agriculture methods in different regions of Bangladesh” funded by World Vision, Bangladesh and implemented by Climate Justice and Research Center, North South University collaboratively has played a significant part together to find feasible solution from climate smart agriculture to bring positive changes on the livelihood of the vulnerable communities.

The entailment of CSA has encouraged the project to explore the existing Climate Smart Agricultural activities adopted by farmers in the five physiographic divisions of Bangladesh. The objectives of the study are to explore the current status and effectiveness of CSA practices, to understand the effectiveness of the current CSA practices in selected regions, and to assess the existing policies related to CSA on research analysis and identifying policy gaps.

Given the importance of growth in the agricultural sector for food security and the major impacts that climate change is already having on agricultural growth strategies, the first step in implementing a climate-smart agriculture approach is to develop a robust evidence base.

# Chapter 2: METHODOLOGY



## 2.1 Overall Approach and Process

A three-stage approach of field survey was used for assessing the CSA status with special emphasis on livelihood and child-wellbeing of farmers practicing CSA and also non-CSA at the selected study location.

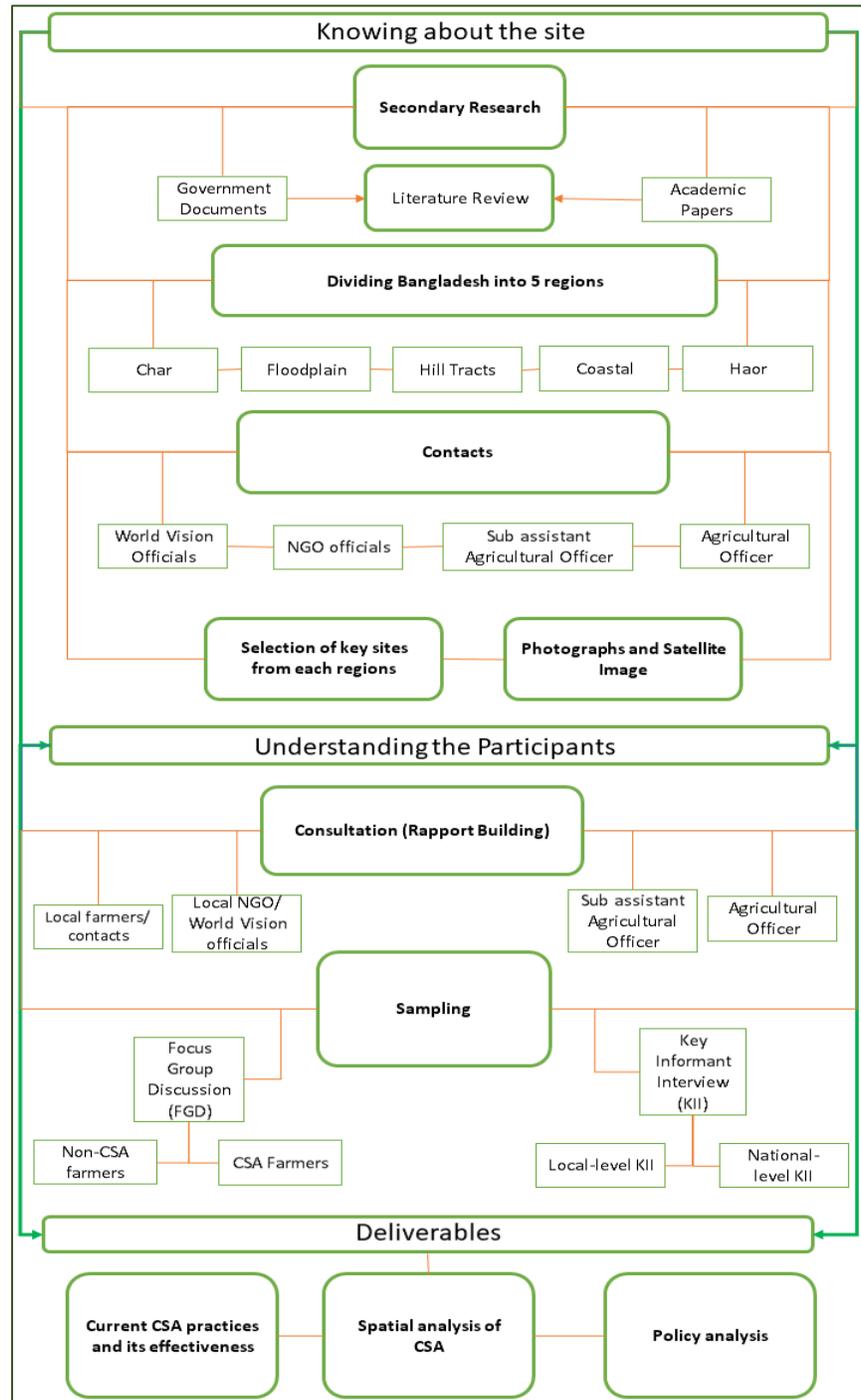


FIGURE 1: THE OVERALL PROCESS OF THE STUDY

The stage shown in figure 1 includes the following:

1. Knowing about the site
  - Literature review
  - Local contacts
  - Key informant with agricultural officers, subsistent agricultural officers, NGO officials, World Vision officials.
  - Photographs
  - Satellite image
2. Knowing the participants
  - Sampling
  - Consult (Rapport Building)
3. Context setting
  - Boundary (Physical, Temporal and Semiotic)

Before conducting field survey, a comprehensive knowledge was gathered about the site through literature review, local contacts and satellite image. To study more about the sites, select them and understand the relevance and presence of CSA practices there, visits were arranged through local contacts and few key informant interviews with agricultural officers, subsistent agricultural officers, NGO officials, and World Vision officials. Once the key features like the strategic importance of the site, farmer's link with CSA etc. were known about the location, a field study was initiated to conduct for a selected site. The selected site/village was observed and consulted thoroughly with the locals; then the surveyor team informed about their presence in the village before starting the survey. The study was separately conducted with the CSA and non-CSA group of the village simultaneously to maintain accuracy and avoid biased perception. The surveyor sat with a group of 3-5 or more farmers of the village to coordinate the survey.

## 2.2 Study Location

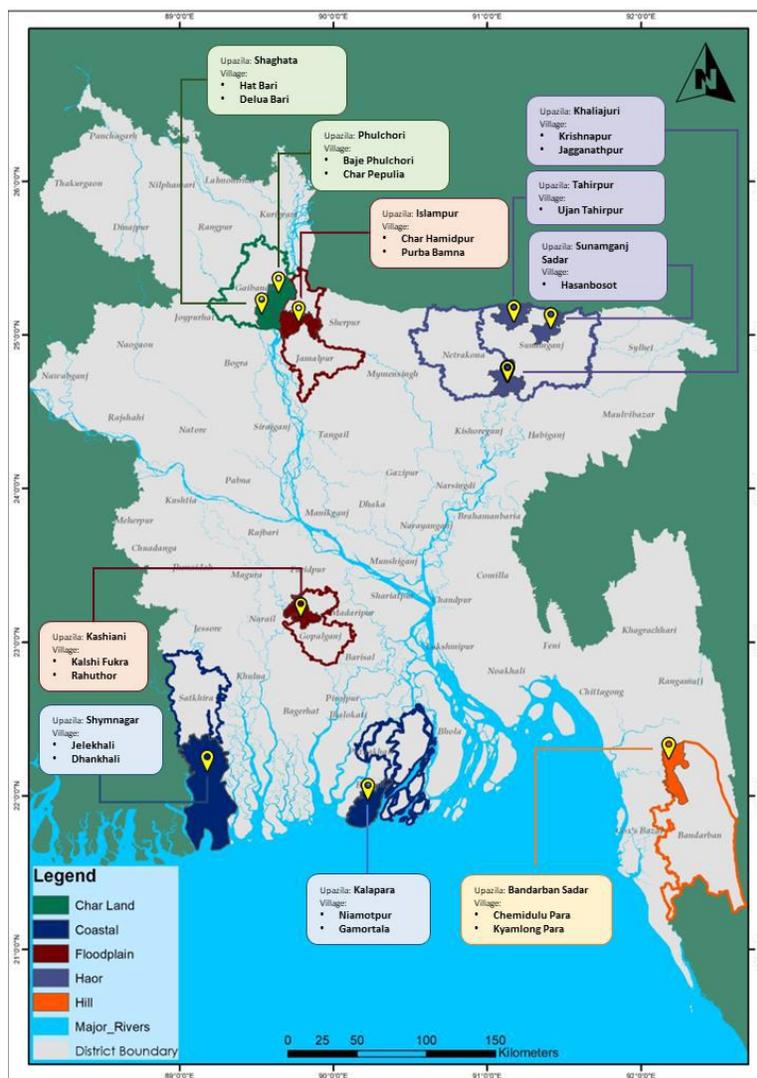


FIGURE 2: STUDY MAP

The study locations were selected through intensive literature review and key informant interview with the agricultural officers, subsistent agricultural officers, NGO officials, World Vision officials and locals, which helped the study to find out key features of each region on CSA. There are five agro-regions which are selected for the study: Haor region, Char region, Hill-Tracts region, Floodplain Region, and Coastal region of Bangladesh. Under each region, relevant Upazilas were selected, where two villages were determined by the project team. Fig 2 shows the following selected regions followed by Upazila and villages.

## 2.3 Tools Used

### 2.3.1 Focus Group Discussion (FGD)

Focus Group Discussion (FGD) has been conducted with farmers at the village level. The study divided the farmers into two groups, the first group has included farmers those who practice Climate Smart Agriculture and the second group has included farmers who don't practice Climate Smart Agriculture. Then we compared these two groups of farmers on selected variables like income, child wellbeing, social stability etc. Also, from the conduction of these FGDs we tried to calculate yield increases, efficiency, soil quality and environmental benefits after and before CSA implementation. A separate section was added to the questionnaire which highlights on the willingness of the community on crop insurance due to climate hazard.



FIGURE 3: FOCUS GROUP DISCUSSION IN BANDARBAN

sl. no.	Region	Location	Number of FGD	Total Number of FGD	Specific Location	Participants	Number of participants
1	Haor	Khaliajuri, Netrokona	4	8	Krishnapur village, Krishnapur union	CSA and Non-CSA farmers	16
					Jagannathpur village, Khaliajuri union	CSA and Non-CSA farmers	12
		Tahirpur & Sunamganj	4		Hasanbosot village	CSA and Non-CSA farmers	23

		Sadar, Sunamganj			Ujan Tahirpur	CSA and Non-CSA farmers	14
					Char Hamidpur, Sharifpur union	CSA and Non-CSA farmers	23
		Jamalpur	4		Purbo Bamna, 3 no. Chinaduli union.	CSA and Non-CSA farmers	18
					Kalshi fukra, Fukra union	CSA and Non-CSA farmers	14
2	Floodplain	Gopalganj	4	8	Rahuthor, Hatiara union	CSA and Non-CSA farmers	16
		Shymnagar, Satkhira	2		Jelexhali village	CSA farmers	13
					Dhankhali village	CSA farmers	18
		Kalapara, Patuakhali	2	4	Niamatpur, Nilganj, Kalapara, Patuakhali	CSA farmers	16
3	Coastal				Gamortola, Nilganj, Kalapara, Patuakhali	CSA farmers	7
			2		Chemidulu para village	CSA and Non-CSA farmers	15
4	Hill Tracts	Bandarban Sadae	2	4	Kyamlong para village	CSA and Non-CSA farmers	15
			2		Hat Bari and Deluabari Village in Shaghata upazila	CSA and Non-CSA farmers	24
5	Char	Gaibandha	2	4	Baje phulchari and Char pepulia village in Phulchari upazila	CSA and Non-CSA farmers	21

### 2.3.2 Key Informant Interview

KII (Key Informant Interview) was conducted with different stakeholders in the union level of the five-climate vulnerable agro-ecological zones. The KII included Agricultural Officer, Block Supervisor, Union Chairman, Schoolmaster and academics/professional in the field of agriculture. Through this KII, we tried to acquire the ground knowledge about indigenous CSA practices and detailed, in-depth consultation and advice where new CSA practices can be implemented.



FIGURE 4: KEY INFORMATIVE INTERVIEW IN JAMALPUR

sl. no.	Region	Location	Total Number of KII	Specific Location	Participants	Number of participants
1	Haor	Khaliajuri, Netrokona	2	Khaliajuri upazila agriculture office	Md. Jasimuddin, Upazila Agricultural Officer	1
				Khaliajuri upazila agriculture office	Rashedul Islam, Subassistant Agricultural Officer	1
		Sunamganj	4	Sunamganj Sadar	Agriculture officer	1
				Sunamganj Sadar	Sub Assistant Agriculture officer	2
				World Vision office, Sunamganj Sadar	Program officer, World Vision	1
				CCDB office	Upazila agricultural officer	1
2	Floodplain	Jamalpur	6	Jamalpur Sadar Upazila Agriculture Office	Dilruba Yeasmin (Agriculture officer)	1
				Jamalpur Sadar Upazila Agriculture Office	Md. Shahanuzzaman (Sub Assistant Agriculture Officer)	1
				Unnayan Sangha	Minara ParvinMina (Program Manager of Unnayan Sangha, Jamalpur)	1
				Unnayan Sangha	Md. Ferdous Ahmed (Field Officer, Unnayan Sangha)	1
				World Vision	Sunil Kumar Mridha (Agriculture Specialist)	1

					Ruma Yeasmin (Gender, DRR, and CCA Specialist)	1
		Gopalganj	5	Kashiani upazila agriculture office	Md. Monirul Huda (Agriculture extension officer)	1
					Rakibuddin (SAAO Kashiani union)	1
				Kalshi fukra, Fukra union	Ishanur Rahman (SAAO)	1
				Rahuthor, Hatiara union	Kongkon Bala (SAAO)	1
					Swarup Kumar Saha (SAAO)	1
3	Coastal	Shymnagar, Satkhira	4	Jelekhal village	Field Facilitator	1
				Dhankhal village	Field Facilitator	1
				LEDARS main office	Program officer	1
				CCDB office	Upazila agricultural officer	1
		Kalapara, Patuakhali	3	Kalapara Agriculture Office	Upazilla Agriculture Officer	1
					Sub Assistant Agriculture officer	1
		Gamortola Village	Sub Assistant Agriculture officer	1		
4	Hill Tracts	Bandarban Sadar	6	Bandarban Sadar Agriculture Office	Sukumar Sur, Sub Assistant Agriculture Officer (SAAO)	1
					Munmun Biswas, Sub Assistant Agriculture Officer (SAAO)	1
					Kyahlau Marma, Sub Assistant Agriculture Officer (SAAO)	1
				WorldVision Office	Hlagiyu Marma, Field Officer, GRAUS	1
					Tulu Marma, Project Manager, GRAUS	1
					M A Aziz, Field Technical Program Program Specialist, World Vision	1
5	Char	Gaibandha	4	Shaghata Upazila	Agriculture officer	1
					Deputy assistant plant protection officer	1
				Phulchari Upazila	Upazila coordinator, Sufal.	1
					Program Manager, SKS.	1
6	Dhaka	Virtual	4	-	Dr Chayan Kumar Saha, Member, technical committee of Agricultural Mechanization, DAE	1
					Dr. Mohammad Shahidul Islam, CSO and Chief, Krishi Totto Sector, BRRI	1
					Kamala Ranjan das, Additional Secretary, Ministry of Agriculture	1

					Munshi Rashid Ahmed, Chief Scientific Officer, Bangladesh Agricultural research institute (BCAS)	1
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### 2.3.3 Case Study Interview

The study also included two case studies on local farmers to get in depth knowledge on the particular CSA practices conducted in these five agro-ecological climate vulnerable regions in Bangladesh. Alongside, GPS coordinates was taken from the on-ground CSA practices of the selected sites to generate GIS map of the existing CSA practices in Bangladesh.

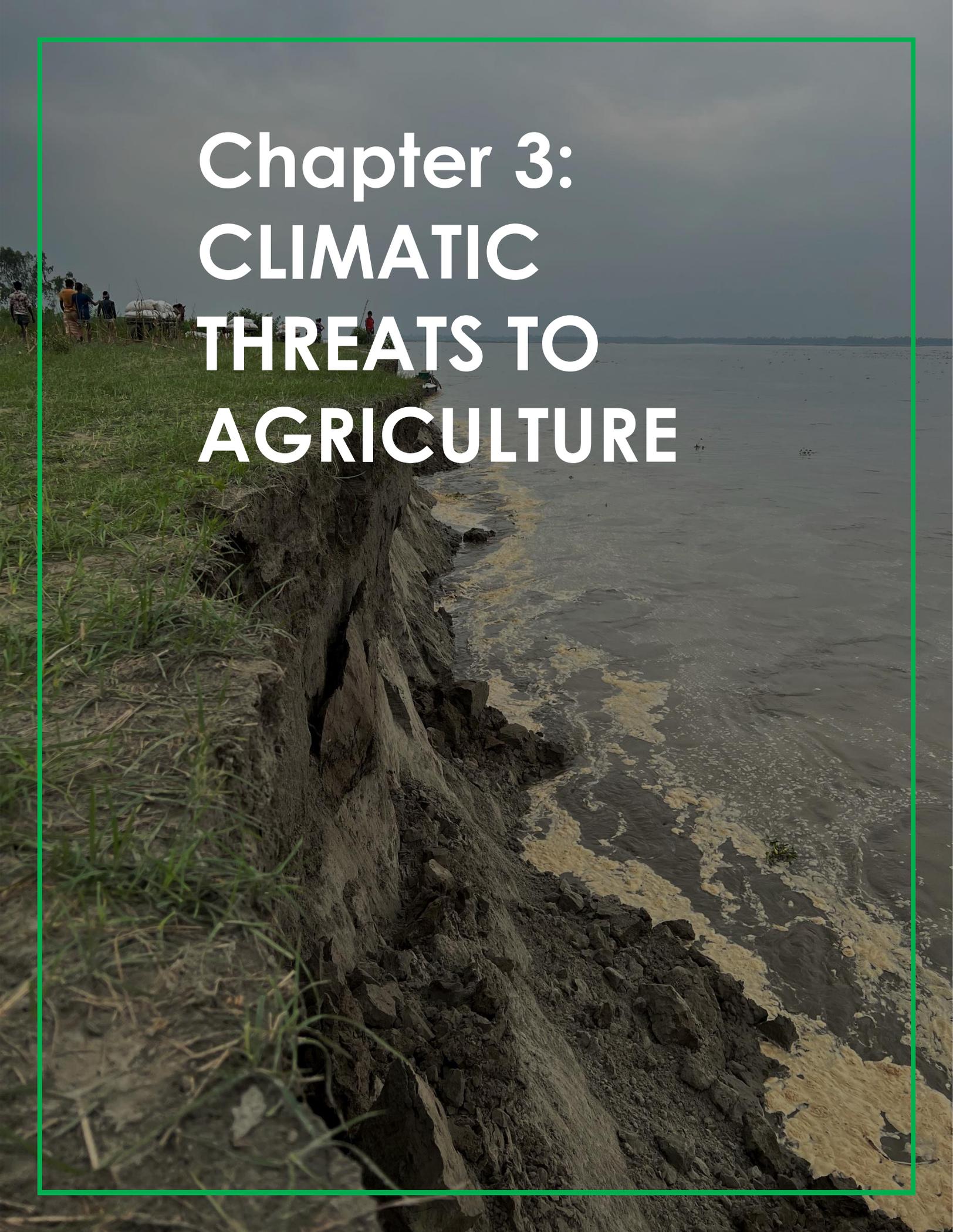
### 2.3.4 Community Village Map

A community map was created consulting with the farmers who have shifted from one crop practice to another. The historical progression of the land-use change was reflected through the map.

### 2.3.5 GPS coordinates

GPS coordinates were taken while doing FGD, KII and community map accordingly.

# Chapter 3: CLIMATIC THREATS TO AGRICULTURE

The image shows a significant erosion of an earthen bank. The soil is dark and appears to be composed of clay or silt, with a vertical crack running down its face. At the base of the bank, there is a rocky and pebbly shoreline. The water in the foreground is turbid and yellowish-brown, indicating that the eroded soil is being carried into the water. In the distance, a group of people is standing on a grassy area, and a small boat is visible near the water's edge. The sky is overcast and grey.

### 3.1 Climatic Threats

The agriculture practices in Bangladesh face different climatic threats depending on the climatic zones of the different parts of the country. The linkage between climate and agriculture in five different regions that have been divided according to their agro-climatic conditions has immense differences from one another. One region’s agricultural method is different from another based on climatic conditions. The study divided Bangladesh into five regions based on the topography and climatic conditions. Different topography consists of different climatic conditions such as Char land, Floodplains, and Haor is more susceptible to flood and river bank erosion, and drought whereas, Coastal areas are more prone to saline intrusion due to storm surge. On the other hand, landslides and shortage of water are major threats to hill tracts.

TABLE 1: REGION AND CLIMATIC THREATS

Region	Climatic Threats
Coastal	<ol style="list-style-type: none"> <li>1. <b>Cyclone:</b> After the devastating cyclone Sidr &amp; Aila, the coastal people have faced a huge damage in their agriculture and livelihood.</li> <li>2. <b>Salinity intrusion:</b> Since the cyclone Sidr and Aila, the salinity intrusion has been increasing till the present days. It has become very difficult for the crops and the villagers to cope up with it.</li> </ol>
Hill Tracts	<ol style="list-style-type: none"> <li>1. <b>Heavy Rainfall:</b> Within the last 5 to 10 years, heavy rainfall has become more frequent which has resulted in severe flooding. It also decreased water retention capacity.</li> <li>2. <b>Extreme Drought:</b> Water bodies have dried up which resulted in irrigation problem.</li> <li>3. <b>Temperature fluctuation:</b> Changes of temperature has resulted in widespread of different types of pests which destroys crops.</li> </ol>
Floodplain	<ol style="list-style-type: none"> <li>1. <b>Seasonal Flood:</b> It has become more frequent and its time of occurrence is very unusual than before.</li> <li>2. <b>Extreme Drought:</b> It is making the soil very unfertile for any kind of vegetation.</li> <li>3. <b>Temperature Fluctuation:</b> extreme heat at day time and severe cold at night. It is triggering the rodents and the pests.</li> <li>4. <b>Hailstorm:</b> Within the last 3 years, the hailstorm has increased and it has been damaging the crops a lot.</li> </ol>
Haor	<ol style="list-style-type: none"> <li>1. <b>Flashflood:</b> With 2 to 3 days of rain, the villagers are facing flashfloods from the overflow of water from the rivers.</li> <li>2. <b>Extreme drought:</b> Soil moisturizer dries up very quickly and it has become more frequent than before. ‘Chita’ disease is common due to it.</li> <li>3. <b>Temperature fluctuation:</b> Extreme in day time and very cold in the night. Crops are getting damaged due to it.</li> <li>4. <b>Siltation:</b> Elevation of land is increasing and it becomes difficult for irrigation.</li> </ol>

<b>Char</b>	<ol style="list-style-type: none"> <li>1. <b>Seasonal Flood:</b> The villagers face seasonal flooding as the villages are located close to Jamuna River.</li> <li>2. <b>Hailstorm:</b> frequent hailstorm in the last 5 years. It is damaging the crops and degrading nutrient level in the field</li> <li>3. <b>Extreme Drought:</b> Within the last 5 year, farmers observed severe drought. Ponds are getting dried up, soils are getting hard and muddy.</li> <li>4. <b>River Erosion:</b> River erosion is becoming more frequent and it has become for villagers to cultivate crops in the side of the river.</li> </ol>
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## Char

According to our study, we have investigated the climatic threats that the agricultural practices are facing in different regions, specific to the villages as well. In the **accretion land (Char)**, the selected villages under Gaibandha are more prone to flood and river bank erosion as they are located close to the Jamuna River. Based on the farmers' observation, within the last 5 years, they are witnessing an immense change in the climate as they are facing severe drought in the summer period and extreme flood in the monsoon season, and even the advent of seasons earlier from its usual. Hence, it is getting difficult for them to track the period of every season for maintaining balance in their steps of cultivation. During extreme drought (mostly faced in the Char Pepulia village and Baje Phulchori under Phulchori Upazila of Gaibandha), the farmers cannot produce rice or any kind of vegetables on the hard and muddy soil. On top of that, numerous small ponds get dried up which eventually makes it challenging for the farmers to irrigate the last remaining surviving crops. There is sometimes newly accreted land (sand char) but they can only grow nuts because of its low fertility which eventually has a lower economic value to the farmers.

On the other hand, the monsoon season now usually arrives in the form of Hailstorms, which has been a frequent event in the wet season for the past 5 years. It damages the well-grown crops on the field, immediately. Also, it degrades the nutrient level of the soil in the field which affects the production of the next crops to grow on the same field. Due to heavy rainfall, the flash floods wash away the cultivated crops as early flood sometimes comes in the most unusual times. In recent years, the people residing in Hatbari and Deluabari villages under the Shaghata Upazila of Gaibandha faced recurring river erosion. They encountered two catastrophic erosions last year from March 2021 to September 2021. Due to the river erosion, many farmers lost their crops, cattle, housing structures, and even farmlands. According to Upazila agricultural officer and Deputy Assistant Plant protection officer, the temperature is too high and has dry moisture

whereas, at night the area faces heavy rain. This pattern is occurring within the last 5 years in this area which has brought uncertainty to the agricultural sector of Gaibandha and it has been difficult for the government agricultural officers to set strategies that are suitable for the farmers to adjust and adapt. Even when the government agricultural officers are stressing over the extreme floods and hailstorms in Gaibandha, the local NGOs are more concerned about the long period of droughts which severely damages the crops and eventually affects the farmers of Char lands.

### Haor

Meanwhile, in the **Haor regions**, the climatic conditions are different from the char lands. Some parts of the selected areas such as Khaliajuri and Sunamganj under the Haor region stay inundated for 6 months and for the rest of the 6 months the farmers get the scope to cultivate crops. These areas are most prone to annual flashfloods and for generations, the farmers had adapted to it as they were well familiar with the flood's arrival. However, within the last 10 years, the people residing in this region are struggling to forecast the flood timings compared to the year before and also the heavy rainfall thus, they are facing severe damages in terms of agriculture, livestock, and fisheries. Even before the harvesting time, the crops get washed by the early flood water with unprecedented heavy rainfall which leaves the farmers devastated and brings misfortune to their lives and livelihood. For example, the Hasanbosot village of Sunamganj Upazila is adjacent to the Surma river hence, whenever there is continuous heavy rain for 2-3 days, the river reaches its dangerous level and overflows the village while already suffering from flashfloods uphill.

In the past 4-5 years, the heavy rain comes in the form of hailstorms, which destroys the crops and means the end of the growing season for the crop or substantial yield loss. In 2109, due to a hailstorm, there were no crops left for the farmers to harvest by the end of a 30-minute-long hailstorm in the villages of Sunamganj Upazila. It's not only just the flood season that is bringing misfortune but also during summer time, the farmers face long-lasting damage to their crops due to a steep rise in temperature for the last 8-7 years. Due to extreme heat, the soil moisture dries up and as a result, the crops become difficult to cultivate. Recently, within 2-3 years, the heatwaves are more frequent than usual and hence, they are encountering droughts often. For example, in Khaliajuri, due to heatwave, the rice crops are suffering from a disease locally called 'Chita' which leaves the rice crops into patches of holes, totally unsuitable for harvest. Additionally, there is an increase in the presence of pests and rodents due to the fluctuation of the temperature, according

to the agricultural officer and local farmers of Khaliajuri Upazila. Khaliajuri also faces flood damages due to climate fluctuation like Sunamganj as well, but the farmers and agricultural experts of Khaliajuri have pointed out the rising problem of siltation after the flood for agriculture. Annual siltation changes the elevation of the land unevenly which makes it challenging for irrigation. Also, both the Upazilas have recently been facing huge fluctuations in weather in one day, for instance, during winter, in the daytime, the temperature remains high but at night the temperature drops which causes extreme cold. As a result, the crops in the Rabi season get damaged as they froze in the cold and become unsuitable for harvesting.

### Floodplain

Similarly, the **floodplain** regions such as Jamalpur and Gopalganj Upazila share similar climatic threats but, their lands do not stay inundated for 6 months like the Haor regions. Both the Upazilas usually face seasonal floods and the agricultural practices have been shaped accordingly for generations to this annual flood. However, the seasonal flood has become more of a nightmare than a blessing to the farmers in both Gopalganj and Jamalpur. This is because there is frequent heavy rainfall in the area at the most unusual time which causes sudden floods and waterlogging. The perennial flooding makes the harvesting period a lot difficult for the farmers as a result, sometimes they have to harvest it way earlier or in a rush before an uncalled flood hits. In Jamalpur, hailstorm has become a common event, and they face it in both day and night time during monsoon season. The jute fields mainly get damaged by the hail which has been a serious issue for the farmers as they are facing frequent hailstorm for the last 3 years. On the other hand, in the past 6 years, since 2016, the farmers of Gopalganj Upazila have been facing extreme heatwaves which damage their crops in a way that they are no longer suited to harvest.

On the other hand, Jamalpur Upazila suffers severe heat in the daytime and severe cold at night during the monsoon-winter period for the past 6 years. According to the agricultural officers, this situation affects the growth of the crops with various diseases which eventually leads to yield loss. As there is a visible temperature fluctuation, the government agricultural officers and the local farmers anticipate that it has triggered the pest and rodent infestation in Gopalganj Upazila. Even though it was common in Gopalganj, the local farmers and agricultural experts stated that the degree of damage has been increasing over the last few years, possibly 2-3 years. As a result, the two Upazilas faces longer period of droughts which leaves the soil dry and unfertile for growing

any kind of vegetation or crops. The fact that Gopalganj occupies a number of low-lying areas between the Ganges Floodplain and the Ganges Tidal Floodplain, there were current reports on salinity intrusion in Kumar-Madhumati River. The local farmers claimed that the soil salinity has increased slightly but it might increase in the coming years which can be a huge threat to their existing crops.

### Coastal

Along with Gopalganj, saline intrusion is a serious threat to agriculture to the **coastal region** of Bangladesh. The severity of saline intrusion in Gopalganj is still low but in the villages of Shyamnagar Upazila and Kalapara Upazila of Patuakhali is extreme. Therefore, normal crop production is hampered due to inadequate irrigation water source. In 2009, Cyclone Aila had the greatest impact on Shyamnagar Upazila with noticeable impact of saline intrusion. Both the villages named Jelekhali and Dhankhali faced serious agricultural, fisheries and livestock damages due to salinity. The farmers stressed that salinity intrusion not only destructs their crop yield but also causes a loss of total crop production on highly salt concentrated soil. On the other hand, in the Kalapara Upazila, Niamatpur and Gamortola village are facing salinity since Cyclone Sidr in 2007 after which it contaminated the surface water and groundwater reserves which has disrupts the water source for irrigation. While a cyclone hits or storm surge occurs, it floods the nearby villages adjacent to rivers as a result, the villages become prone to salinity induced waterlogging hence, in both the Upazilas, the traditional agricultural practices become totally ineffective as they are unable to tolerate the saline water. However, the temperature has progressively risen in the past 10 years, making these areas unsuitable for farmers to cultivate their traditional crops. During summer season, there is a presence of water scarcity in terms of drinking and as well as for irrigation thus, the saline clay shows cracks and becomes rough for cultivation, making it challenging for the farmers.

### Hill tracts

In contrast with the other regions, Bandarban being a part of **Hill-Tract region** of Bangladesh has a unique physiography and topography which was reflected in the climatic threats to agricultural sector of Bandarban as well. In the past 5-10 years, rainfall has become heavily erratic in Bandarban. Sudden rainfall and storms occur, which results in croplands and houses being flooded. However, the water retention capacity in the catchment areas has decreased because of the

inconsistency in rainfall. There are some regions which face severe drought. Nearby water bodies have dried up, and the farmers have resorted to artificial methods of irrigation. Water crisis is a huge impediment to the agricultural practices. Farmers face difficulty in cultivating crops which need intensive irrigation, for example boro rice. They have started growing aman and aush rice that need less water. Local farmers of Chemidulu para have experienced an increase in temperature. Change of temperature has resulted in widespread arrival of new pests, such as “current poka”, “mazra poka”, white fly, ant, locust, grasshopper etc. Current poka destroys crops like a wildfire, and white fly penetrates the fruits and rots them.

# Chapter 4: CSA PRACTICES & TECHNIQUES



## 4.1 Definition of Climate Smart Agriculture (CSA)

In this section of the report, the study will present a brief idea about the perception on-ground of the different actors under agricultural sector on CSA and how would they define CSA based on the relevant issues on their area and why they think the practices on-field could be defined as a CSA practice in Bangladesh. This information was particularly collected through primary data collection. However, firstly we need to have a comprehensive understanding of CSA's definition worldwide before delving into the local perception of CSA through secondary research.

Globally, climate smart agriculture has established a definition highlighting the agricultural practices which increases **productivity, builds resilience towards climate change, and decreases greenhouse gases**, where possible (CGIAR 2016, FAO 2013, The World Bank 2021). If any of these three criteria are matched, we can call an agricultural practice Climate Smart Agriculture. FAO first introduced the concept of CSA in 2010 at the Hague Conference on Agriculture, Food Security and climate change. After the conference, there were 30 countries in Sub-Saharan countries that have recognized it. After that, FAO published a module on CSA which was divided into three parts: A) Concept learning module: emphasizing on providing a comprehensive introduction on climate smart agriculture, B) Production and Resource module emphasizing CSA on different sectors like water management, livestock production, crop production and soil & land management and, C) enabling frameworks module: allowing and guiding many CSA related actors to make sound decisions for CSA implementation at scale. There are countries like Kenya and the United Republic of Tanzania who are promoting climate smart agriculture under FAO through farmer-to-farmer training; and evaluating their impacts on yield and food security, as well as finding their potential to reduce greenhouse gas (GHG) emissions on farms and throughout the landscape.

Currently, World Bank Group is already scaling up climate smart agriculture in different countries since 2014. A CSA profile was developed by CCAFS, research program by WB, which indicates that there is a presence of knowledge gap to provide clarity on CSA terminology, components, relevant issues, and how to conceptualize them under different country conditions. In Bangladesh, the study has seen a similar absence in knowledge of the concept and terminology of CSA. The study also discovered that there are agricultural practices that match the initial criteria of CSA (productivity, adaptation and mitigation) in Bangladesh, such as practices that increase

productivity or climate resilient crop/method, but the government, NGOs and farmers are unaware of the measures that could be taken to scale-up these practices following the CSA's criteria to properly connect it with the concept of CSA.

As the study divided Bangladesh and project activities according to five regions, the definitions are assembled according to the regions as well. The interesting finding was that different regions and even different Upazilas have defined climate smart agriculture differently on the basis of the degree of exposure to natural calamities, allocation of projects/fundings, and experience of the government officials/field officers.

In the **floodplain region**, the agricultural experts from Jamalpur have described CSA as the introduction of new crop species which are tolerant to natural disasters. However, they did not highlight new cultivation technique as a CSA to combat climate change impacts. This is because they think if drought-tolerant species or flood-tolerant species are more introduced in this area, it would work as a climate smart agriculture as these crops would be effective for the productivity and could be resilient to climate change but if new techniques are introduced such as changing seed alignments, or using nets while drying crops, it would not show immediate result to climate change as introducing disaster tolerant crop species.

On the contrary, the agricultural experts of Gopalganj and experts of **Char region** stressed that both introduction to new tolerant species and new cultivation technique can be defined as CSA as both increases productivity and acts effectively to adapt to ever-changing climate. For example, in the selected villages of Char, the new cultivation techniques were more effective than new tolerant species such as techniques of seed dispersal as line-based technique, right-dose of fertilizers, post-harvesting technique, and seasonal loans produced double the amount of production of their crops than before.

The experts of Bandarban and areas under Coastal regions have opined that CSA is seen in an area-specific spectrum. According to them, the practices could be called or defined as CSA when the outputs of the cultivation, harvesting and production methods are suitable with each climatic condition of specific area. When the crops survive the chain considering the uniqueness of the location's climate then the practice could be considered as CSA. Additionally, the Hill Tracts regions underlined the importance of scientific presence in the method and modifying old

techniques of their areas through scientific evidence could be called as CSA whereas, in the **Haor regions**, the experts are more inclined to the idea of considering socio-economic valuation/conditions of the farmers while defining CSA.

Meanwhile, the experts in Haor regions expressed that along with the importance of introducing tolerant crop species or introducing new techniques, the definition of CSA should include the significance of capacity building of the farmers with scientific knowledge. The capacity knowledge should not be just limited to the farmers but also government officials or NGOs who has the potential to build the farmers capacity. They think that new technologies and methods can be introduced but if the front-liners do not have a clue what CSA is or how it can be implemented then the existing CSA practices which are on-ground in an initial stage will also be ineffective in the long-run.

However, the government policymakers and higher authorities from MoA, DAE, BRRI and BCAS have defined CSA which aligns perfectly with the global definition. According to them, CSA refers to the production of weather independent crops using smart technology to increase productivity and ensure food security. It includes conservation agricultural practices where soil is less disturbed, water content and nutrient value remain intact during crop production. Also, it aims to reduce or limit the emission of greenhouse gases and convert waste to energy.

The vast disparity in definition between the national level experts and local level experts indicates an immense knowledge-dissemination gap among the two levels on climate-smart agriculture. Even though, it is a widely known concept to the national experts, it is still a vague concept to the local ones. Hence, if the local experts are not equipped with the concept of climate-smart agriculture, Bangladesh could lose the potentiality of the existing ones which are at its initial level.

## **4.2 Current CSA practices & techniques**

The following section presents agricultural management practices and techniques for climate change adaptation and mitigation while increasing crop productivity. It comprises both measures that concurrently lower production risks and techniques with a clear focus on adaptation to unique climate conditions. The majority of these techniques help farmers in reducing or adapting to certain climate change concerns. To adjust to new climate conditions, it may also be necessary to make drastic modifications, such as transferring to a totally different agricultural production method.

The on-ground practices are listed down below according to regions with impacts on three CSA pillars: productivity, adaptation and mitigation. Nevertheless, these existing CSA practices have the potential to meet the mitigation pillar (lowering GHG emission) if properly maintained, managed and with further research.

The most vulnerable region in Bangladesh due to climate change is the **coastal region** (Minar, Hossain and Shamsuddin 2013, Ahmed, et al. 2019, Shamsuddoha and Chowdhury 2007). The areas are more prone to cyclones, storm surge and salinity (Dasgupta, et al. 2010, Rahman 2018, IFRC 2020, Rezaie and Haque 2022, Alam and Javed 2015, Ali 1996). The intensity and frequency of these calamities are increasing day by day and people are forced to adapt to the loss and damage every year (CFE-DM 2020, Planning Commission, Ministry of Planning and Asian Development Bank 2021, Huq 2020, Rahman, Rahman and Rahman 2017). The farmers of the coastal region are mostly hit by the disasters, not just during the disasters but post-disasters as well. The extension of salinity intrusion damaged the traditional way of crop cultivation and they had to switch to a whole new crop variant for production method which can withstand the everlasting salinity. The study has selected such vulnerable villages called Jelekhali and Dhankhali from Shyamnagar Upazila and Niamatpur and Gamortala village from Kalapara Upazila. These villages are prone to saline-intruded disaster since cyclone Sidr and Aila. Hence, they have to totally switch to other crop-species for sustaining their livelihood. Other than just rice variant, they are cultivating vegetables, or different techniques like sack method or sorjan method etc. to combat climate challenges while protecting their productivity and livelihood. The figure 5 shows the major CSA practices in terms of productivity and adaptation, their administrative support and the most popular among the farmers in terms of cost and feasibility of the Coastal region.

# Coastal

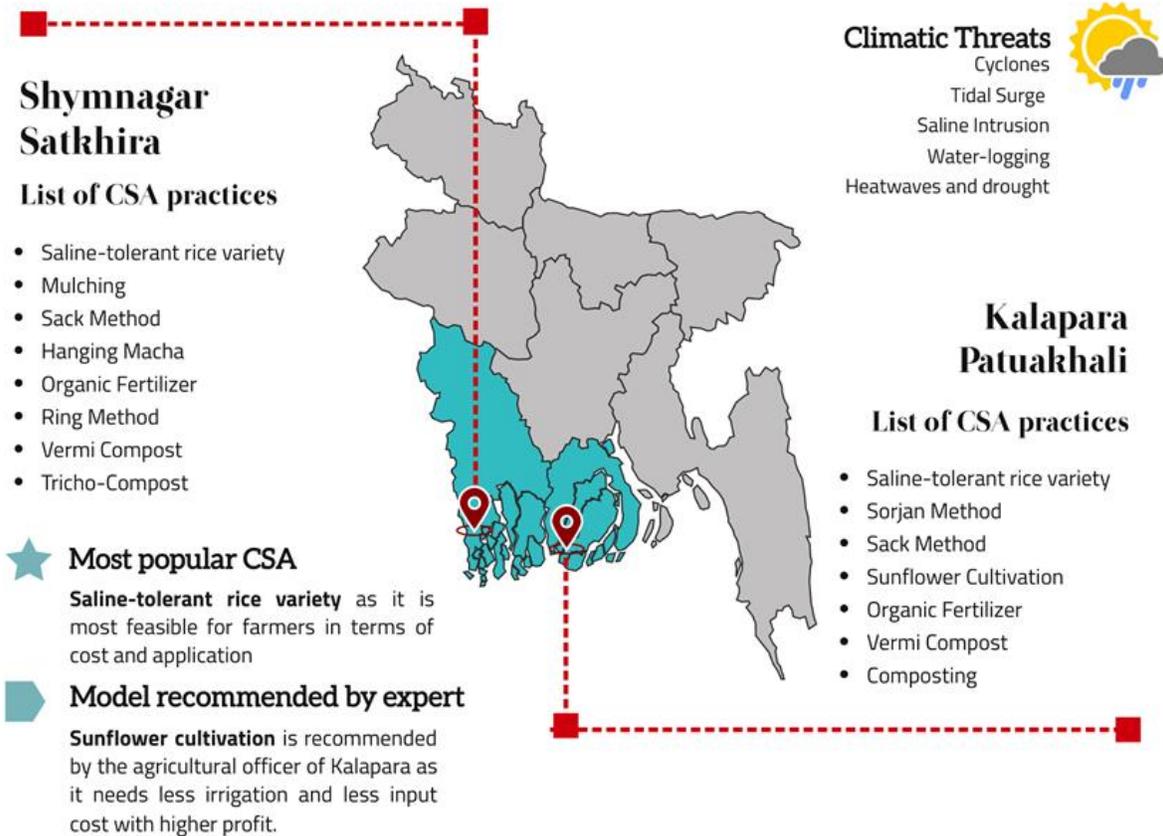


FIGURE 5: EXISTING CSA IN COASTAL REGION

## 4.3 CSA Practices of Coastal Region

### 4.3.1 Saline Tolerant Rice Variety:

In 2007, when cyclone Sidr hit the coastal region, Niamatpur and Gamortola villages under Kalapara Upazila had severe damage to agricultural lands which left the farmers not only helpless during the cyclone period but they couldn't grow traditional crops as the area was inundated with saline water. The saline intrusion has totally destroyed the prospect of cultivating normal traditional crops as a result, government agriculture officers and local NGO aided them by introducing new rice variety (such as BRRI 47, 52, 53,54,59,64,68; BINA7,10) which would tolerate salinity in their area at 2008. On the other hand, in 2009 a similar situation was faced by the Jelekhali and Dhankhali villages when Cyclone Aila hit their area. Hence, right after the damage, in 2009, the government agricultural officers

introduced the farmers with the saline tolerant rice variety and since 2011, the local NGOs provides technical support to the farmers regarding cultivating and harvesting saline tolerant rice variety. Since the major cyclones, the areas are frequently hit by cyclones in the recent years and therefore, the land mostly stays saline. Due to the long-lasting salinity, almost all the farmers gradually became dependent on it for subsistence use. In Kalapara, varieties like BIRI Dhan 25,47,51,52,54,67,68; SwarnaGota and Swarna Moshuri are some of the saline-tolerant varieties which helps resist the soil and water salinity to some extent. These varieties are mostly cultivated during the summer season (March- June). Since the farmers switched to the new saline tolerant rice variety, the productivity has increased where they could now cultivate 17-18 mound of crops in 1 acre of land and profit around 15000-16000 BDT with low investment cost. It also increased the capacity of farmers to restrain exposure of the crops to climate risks. Simultaneously, farmers noticed that these varieties increases the accumulation of soil biomass which enhancing soil fertility. However, the challenges that they faced at first is due to the change in taste of the saline-tolerant variety which was not flavourable as the rice varieties they used to cultivate before.

#### 4.3.2 Sunflower Cultivation:

Other than being saline tolerant rice-species introduced to the farmers of Kalapara Upazila, the current government agricultural officer has introduced a saline tolerant crop, the cultivation of sunflower to be introduced to the farmers. Recently in 2022, the farmers are cultivating sunflowers. Due to water scarcity, when other crops are difficult to cultivate, sunflowers tend to have high tolerance to saline water, needs less irrigation while having less input cost with higher profit gains, according to the agricultural officer. This cultivation is used as an alternative for rice in terms of commercial purposes. It can be grown only during Rabi and Kharif season.

### 4.4 CSA Techniques of Coastal Region

#### 4.4.1 Sack Method

Apart from saline-tolerant rice cultivation few farmers in the villages of both the Upazilas grows vegetables to meet their daily nutrient value of food. However, once tidal surge hits overflowing embankments or through breaching, their house and cultivating lands get

inundated and the vegetable get washed away or stays submerged due to water logging. Hence, a sack method was introduced by the Government agriculture officers and local NGO in Kalapara during 2016 whereas, in Shyamnagar it was introduced in 2017 by the local NGO in order to withhold the vegetables from getting washed away by flood. The method is used by keeping fertile soil inside a sack and placing it in a higher reach from the water danger level so that flood water does not wash it away. Vegetables like bottle gourd, gourd brinjal, chilli and cucumber are cultivated in sack method. They can grow it all season but they mostly cultivate for themselves and not for commercial purposes.

However, when the farmers face a good yielding year and has surplus, they sometimes sell few amounts of vegetables in te market along with rice. They sell usually around 5 – 7 kgs of vegetables which are cultivated in sack method where they gain around 40-50 taka per kg which is not enough to cover their input cost. Before this method, they couldn't even save vegetables for themselves when water logging occurred



FIGURE 6: SACK METHOD

hence, the little production they are getting now after the introduction of this method is highly appreciated by the farmers and also in terms of adaptability, the method is effective as atleast they can now restrain their vegetables while their area faces waterlogging.

#### 4.4.2 Zero Tillage

After the harvesting period of rice, the farmers tend to grow some vegetables to the same cultivating land by using ash and organic fertilizer to the vegetables for better growth and yeild. This technique is popularly known as “Bina Chash e Shobji” in Bengali by the locals. The use zero tillage is done while cultivating vegetables right after rice harvesting, is easier and cost-friendly to the farmers as they do not need any ploughing or extra effort to it. Once the rice being harvested, they put the organic fertilizer and ash to the same ground after planting the vegetables seed on the cultivating land. This technique is an indigenous method which has been practiced by the farmers for generation, while soil stays fertile,

they cultivated their vegetables as well. However, government agriculture department in 2012 and local NGOs in 2011 has widely popularized and highly recommended the technique as it helps reduce the salinity of the soil and also increases the soil quality. It has been observed that there is an increase in productivity when zero tillage technique is used to the vegetables and also made the vegetables more resilient to climate induced diseases.

#### 4.4.3 Vermicompost

In 2015, the use of vermicompost was introduced in both the selected coastal Upazilas. In Shyamnagar, it was initiated by the local NGOs whereas in Kalapara Upazila both the government agricultural officers and local NGOs were involved to demonstrate the use of vermicompost to the farmers. It was established mainly because vermicompost reduces the usage and risk of chemical fertilizers while making the soil more fertile. As a result the risk of climate-induced diseases decreased which increased its productivity to the farmers alongside adaptability as well according to the agricultural officers and local farmers who are practicing CSA.

#### 4.4.4 Sorjan Method

In the coastal area, the sorjan method was only seen practiced at the Kalapara Upazila among the two Upazilas selected under this region. It is a method where there is raised bed and lower sinks constructed horizontally in order to grow dry crops and wetland crops at the same time. Due to the scarcity of freshwater for irrigation, it was introduced by the Government



FIGURE 7: SORJAN METHOD

Agriculture officers with the help of Local NGO in 2012. After that the farmers started to cultivate cabbage, broccoli, dragon fruit etc. in this method. As it can be cultivated throughout all the season, the productivity doubled since now they can cultivate two genre (dry & wet) of crops simultaneously which saves their time and increases their output level.

#### 4.4.5 Composting

While cultivating vegetables in Kalapara, the farmers now use compost which is a mixture of ingredients used to fertilize and improve the soil. It is commonly prepared by decomposing plant and food waste and organic recycling materials. The process is introduced by the government agricultural officers in 2015 to help reduce the salinity and make production easier. Since the composting technique, the farmers has noticed an increase in yeild, and soil quality. As well as it reduces the amount of waste transported to landfills, while creating some nutrient-rich soil.

#### 4.4.6 Tricho-compost

In Shyamnagar, Tricho-compost are used by the farmers since 2015 when it was introduced by the local NGO. Although the technique is still flourishing and initiated by only 20% of the farmers in two villages of Shyamnagar, they understand the significance of it's use to make the soil fertile and moistured. The use of this technique is increasing as the organic residue are easily accesible to them and they get better outcome of the harvest.

#### 4.4.7 Ring Method

Ring method is still not popularized as very few (20%) farmers use this technique in the two selected villages under Shyamnagar. The technique was practciied mostly in their homestead gardening where they use concrete ring of toiet as a barrier to salinity and flood to cultivate vegetables. It is recently re-introduced by local NGOs in 2021. It has the potentiality to increase production, adaptibility and highly encourgaes GHG emission reduction.



#### 4.4.8 Hanging Macha

The two selected villages under Shyamnagar, are mostly vulnerable to water logging and thus, to restrain damages to cultivate vegetables, the farmers plant creeper plants in a technique called hanging macha. It is generally practiced by few (20 – 30 percent) farmers who were introduced to this method by the local NGO in

FIGURE 8: RING METHOD

2016. The farmers have diverse options now to cultivate vegetables and not restrict themselves to grow rice varieties.

#### 4.4.9 Mulching

During extreme drought, the farmers of Dhankhali and Jelekhali village of Shyamnagar practices a mulching technique to retain moisture of the soil hence, the crops can have sufficient water. Most of the farmers (60-70%) are indulged with this technique since 2010 aided by the local NGO.

The table 2 shows the brief details of the above-mentioned CSA practices and techniques of the coastal region on ground and how it impacts the CSA pillar of productivity (food security), adaptability (resilience towards climate change), and mitigation (reduce GHG emission).

TABLE 2: IMPACTS ON CSA PILLARS OF THE EXISTING CSA PRACTICES & TECHNIQUES OF THE COASTAL REGION

Sl. No.	CSA Practice (P) & Techniques (T)	Location	Starting year	Impact on CSA pillars
1	Saline Tolerant rice variety (P)	Kalapara	2008	<b>Productivity:</b> Increases farmers' ability to restrain the crop from climate-induced risks. In the long term, it enhances soil fertility due to increase in soil biomass accumulation.
		Shyamnagar	2009	<b>Adaptation:</b> Yield stability increased which helped farmers to become resilient to salinity. <b>Mitigation:</b> As it increases accumulation of biomass, it promotes carbon sink and provides minimal reduction in GHG emission per unit of food production
2	Sack Method (T)	Kalapara	2016	<b>Productivity:</b> Farmers able to protect the seed from wind, harsh weather and waterlogging situation, where they can be controlled to yield high crop production.
		Shyamnagar	2017	<b>Adaptation:</b> It creates additional income and employment for farmers while meeting their nutritional needs. <b>Mitigation:</b> promotes carbon sequestration by increasing storage of carbon
3	Organic fertilizer (T)	Kalapara	2012	<b>Productivity:</b> Increase in production due to reduction the soil salinity and also increases the soil quality. The production cost also decreases.
		Shyamnagar	2011	<b>Adaptation:</b> Decrease in climate-induced disease risk of the crops and reduces the use of chemical fertilizers. Better adjust to the effects of climate change <b>Mitigation:</b> only N <sub>2</sub> O emissions and decreases GHG emission compared to inorganic fertilizer.
4	Vermicompost (T)	Kalapara	2015	<b>Productivity:</b> organic residue is easily accessible to them and they get better outcome of the harvest

Sl. No.	CSA Practice (P) & Techniques (T)	Location	Starting year	Impact on CSA pillars
		Shyamnagar		<p><b>Adaptation:</b> the risk of climate-induced diseases decreased</p> <p><b>Mitigation:</b> reduces the amount of waste transported to landfills, reducing GHG emissions. Vermicomposting decreased nitrous oxide emissions.</p>
5	Sorjan Method (T)	Kalapara	2012	<p><b>Productivity:</b> Increase vegetable production throughout the year. Increases economic return from fallow land.</p> <p><b>Adaptation:</b> Increases farmers' capacity to limit the crop exposure to tidal water submergence</p> <p><b>Mitigation:</b> Contributes to increase the above-ground biomass constituting a carbon sink.</p>
6	Sunflower Cultivation (P)	Kalapara	2016	<p><b>Productivity:</b> Less input cost with higher profit gains</p> <p><b>Adaptation:</b> high tolerance to saline water, and needs less irrigation</p> <p><b>Mitigation:</b> N/A</p>
7	Composting (T)	Kalapara	2015	<p><b>Productivity:</b> Increases land productivity, product quality and income.</p> <p><b>Adaptation:</b> Promotes the use of organic waste and eliminates pathogens. Contribute to cover heating needs, reduces pressure on local resources.</p> <p><b>Mitigation:</b> reduces the amount of waste transported to landfills, reducing GHG emissions</p>
8	Tricho-Compost (T)	Shyamnagar	2015	<p><b>Productivity:</b> Increases land productivity, product quality and income.</p> <p><b>Adaptation:</b> Promotes the use of organic waste and eliminates pathogens. Contribute to cover heating needs, reduces pressure on local resources.</p> <p><b>Mitigation:</b> reduces the amount of waste transported to landfills, reducing GHG emissions</p>
9	Ring Method (T)	Shyamnagar	2021	<p><b>Productivity:</b> More options of crop cultivation for farmers to meet their basic nutrients and also extra profits for selling it</p> <p><b>Adaptation:</b> Ability to save their additional crop production from climate change impacts</p> <p><b>Mitigation:</b> The use of organic material promotes the reduction of GHG emission</p>
10	Hanging Macha (T)	Shyamnagar	2016	<p><b>Productivity:</b> More options of crop cultivation for farmers to meet their basic nutrients and also extra profits for selling it</p> <p><b>Adaptation:</b> Ability to save their additional crop production from climate change impacts</p> <p><b>Mitigation:</b> The use of organic material promotes the reduction of GHG emission</p>
11	Mulching (T)	Shyamnagar	2010	<p><b>Productivity:</b> More options of crop cultivation for farmers to meet their basic nutrients and also extra profits for selling it</p>

Sl. No.	CSA Practice (P) & Techniques (T)	Location	Starting year	Impact on CSA pillars
				<p><b>Adaptation:</b> Ability to save their additional crop production from climate change impacts</p> <p><b>Mitigation:</b> The use of organic material promotes the reduction of GHG emission</p>

Alongside coastal region, the **haor region** recently has endured the impact of climate change. It has been evident enough that the haor regions would face frequent flashfloods in a year by how the climate is changing and becoming unpredictable with coming years. However, limited forecasting and measures in terms of preparedness of the agriculture sector towards uncertain disasters has cost immensely on the farmers whose livelihood depend on it. The extreme weather both in dry and wet climate changed the dynamics of agriculture production system. The crops they used to cultivate is no longer feasible to the current climatic conditions which forced them to switch to other crop which can tolerate flood water. Different other varieties of crops were introduced so that there is income opportunities for farmers other than rice varieties. In Sunamganj, two villages known as Hasanbosot and UjanTahirpur village are facing severe damages to their crops due to climatic changes and similarly, Krishnapur and Jagannathpur villages under Khaliajuri Upazila also shares the same tragedy. Nevertheless, the government agricultural officers and local NGOs are working tirelessly to find out ways to minimize the climate change impacts on the agricultural sector at the same time provide a sense of security to the farmer's livelihood. The figure 9 shows the major CSA practices in terms of productivity and adaptation, their

administrative support and the most popular among the farmers in terms of cost and feasibility of the Haor region.

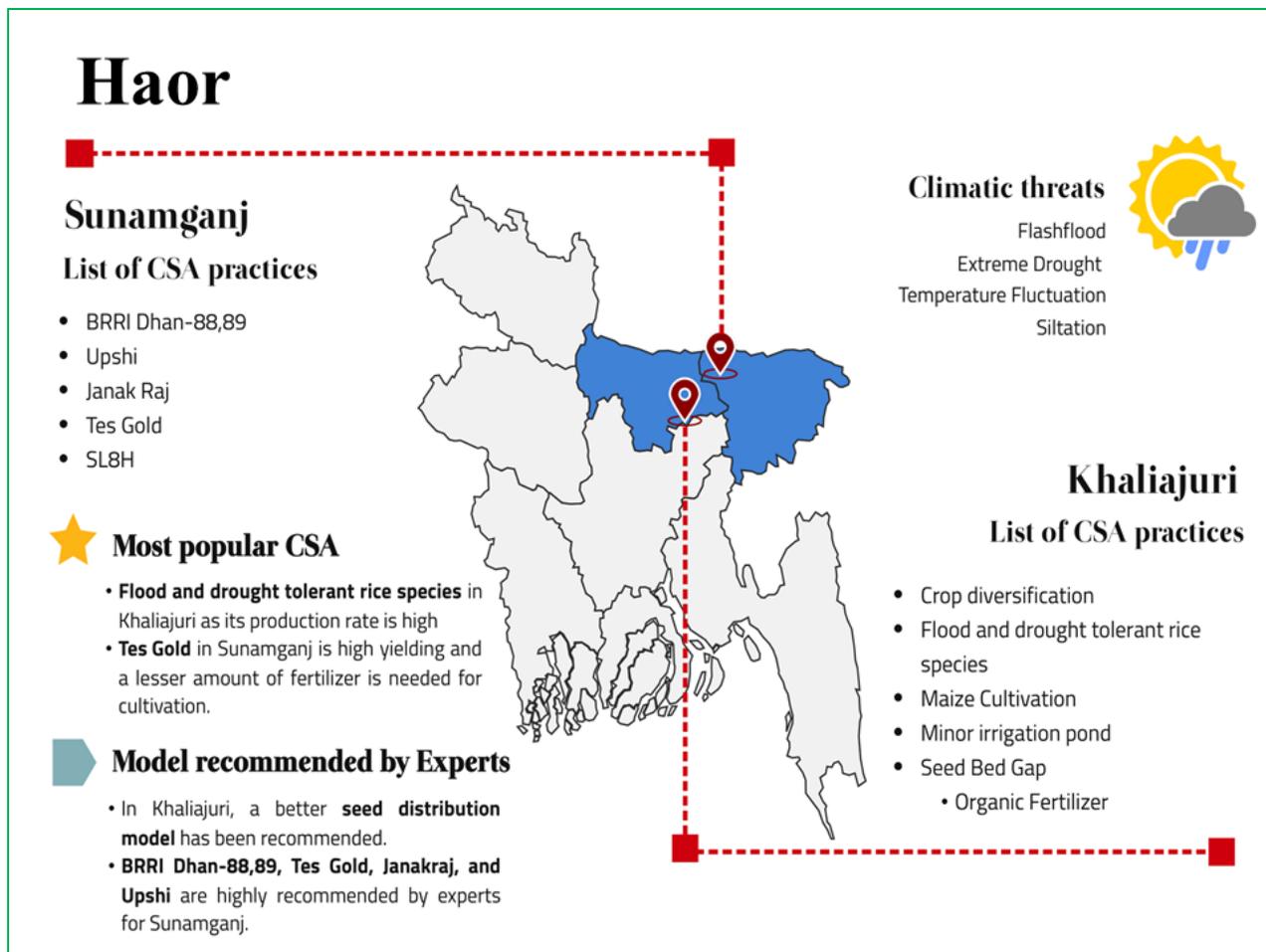


FIGURE 9: EXISTING CSA IN THE HAOR REGION

## 4.5 CSA practices of Haor Region

### 4.5.1 BRRI DHAN – 88,89

In the Hasanbosot and Ujantahirpur village of Sunamganj, are mostly affected by early flooding. Farmers are adapting to it through the introduction of new rice varieties. One of the rice varieties introduced to the farmers in 2018 by government agricultural officers and local NGOs is the BRRI DHAN-88-99. Most of the farmers, around 70-80% farmers from both the villages were seen highly involved in cultivating this rice variety. It is a high yielding variety which provides wholesome rate of production for the farmers in the market which is enough to support their livelihood. Also, the variant is well adjusted with the

climatic fluctuation of rainfall which enables them to harvest it early without any disruption in yield.

#### 4.5.2 Upshi

When the selected villages in Sunamganj gets hit by an early flashflood before harvesting time, The Upshi rice variety acts as saviour to the farmers. There are approximately 70% of the farmers from these two villages who cultivate UPSHI as it is a high yielding & flood tolerant variety to some extent. Due to the success rate and involvement rate of this rice variety, other farmers are also influenced to cultivate it gradually. The agricultural officers and local NGOs introduced this variety to the farmers in 2019 because it can survive in the submergible water for 10-15 days and highly suitable for flood affected area. Upshi as a submergenceresistant and high-yielding variety, promotes high yields per unit area, hence led to potential increase in income. There is a reduction in risk of crop losses caused by temporary or permanent flood conditions. Also, promotes above- and below-ground carbon sinks through increased accumulation of dry matter.

#### 4.5.3 Janak Raj

Janak Raj is another kind of rice variety introduced to the farmers of Sunamganj by the agricultural officer and local NGO in 2019. It is a hybrid variety which is tolerant to the present high temperature in the weather. It also causes less attacks of blast diseases. Janak Raj is one of the popular rice varieties among the other as most (around 80%) of the farmers from two villages use this variety as the production of this variety is very high. In terms of productivity, the rice variety reduces production costs, enhances crop production and quality, hence they faced a potential increase in income. At the same time it increased farmers' capacity to limit the crop exposure to crop damage caused by diseases and reduced the need for external inputs for crop protection. Meanwhile, it also reduces GHG emissions by reducing the use of synthetic pesticides (fungicides) therefore the carbon footprint reduction per unit of food produced.

#### 4.5.4 Tes Gold

In Sunamganj, the agricultural officer and Local NGOs recently introduced a flood tolerant rice variety called Tes Gold in 2020 which currently involves few (around 30%) farmers.

However, it is quickly gaining its popularity as it needs lesser amount of fertilizers compare to other varieties.

#### 4.5.5 SL8H

Average amount (around 50%) of the farmer in Tahirpur and Hasanbosot are using SL8H variety of rice as it is a super hybrid rice. It is tolerant to high temperature and can survive in hail storm. The rice variant was first introduced by the government agricultural officers and Local NGO in 2020.

#### 4.5.6 Crop diversification

Around 60% farmers of Krishnopur and Jagannath village of Khaliajuri are practicing crop diversification where they are introduced to new rice variants like Sunamganj or new species of crop like wheat or maize or vegetable cultivation. As the area faces irregular precipitation, heatwaves, temperature fluctuations, and insect and rodent infestation which causes low quality of the harvest, the crop diversification seems like an effective step for the farmers in terms of productivity and adaptability. It spreads production and economic risk over a broader range of crops, thus reducing financial risks associated with unfavorable weather or market shocks. The practice was introduced by the government agricultural officers in 2013.

#### 4.5.7 Flood & drought tolerant rice species

Almost 90% of the farmers in the study location of Khaliajuri is involved with this practice. This rice variety BIRI 88 and Ispahani 9 are more resistant to drought and flood compared to other varieties. Its production rate is also high compared to other varieties. The season of cultivation is Rabi (Mid-November to Mid-March). The flood & drought tolerant rice species were introduced by government agricultural officers in 2015.

#### 4.5.8 Maize Cultivation

In Khaliajuri, maize cultivation has gradually started to supplement rice cultivation although only 10-20% farmers are involved but the numbers are increasing. It is getting popular with farmers and they claimed that it was more beneficial than rice cultivation as

it excludes the cost of herbicides while cultivating maize. It was introduced by the government agricultural officers in 2015.

## 4.6 CSA techniques of Haor region

### 4.6.1 Minor Irrigation Pond

During extreme drought and heatwaves in Khaliajuri, it is difficult for farmers to cultivate their crops due to insufficient water for irrigation. In the dry season, the reserved water in the irrigation well becomes dry hence, the government agricultural officer in 2017 suggested the farmers to dig a small-sized wells beside the cropland to provide minor irrigation during water scarcity.

### 4.6.2 Seed Bed Gap

In order to prevent disease to be spread and retain proper moisturizer and nutrients of the soil, majority of the farmers (almost 70-80%) are involved Seed Bed Gap technique. It was introduced in 2015 by the government agricultural officers at Khaliajuri to keep a 10 feet gap within the rice bed where the farmers also can easily access the crops.



FIGURE 10: SEED BED GAP TECHNIQUE

### 4.6.3 Organic Fertilizer

In Khaliajuri, even though 20-25% farmers are using organic fertilizer since 2016, there is a inclining prospect to the usage of this technique. There are different kinds of organic fertilizers like the bio-derma, bio-shield, eco-mack etc. are used in the crops which increases productivity and reduces the use of chemical fertilizers.

The table 3 shows the breif details of the CSA practcices and techniques of the Haor regions on ground and how it imapcts the CSA pillar of productivity (food security), adaptibility (resilience towards climate change), and mitigation (reduce GHG emission).

TABLE 3: IMPACTS ON CSA PILLARS OF THE EXISTING CSA PRACTICES & TECHNIQUES OF THE HAOR REGION

Sl. No.	CSA Practice (P) & Techniques (T)	Location	Starting year	Impact on CSA pillars
1	BRR1 Dhan-88,89 (P)	Sunamganj	2018	<b>Productivity:</b> provides wholesome rate of production for the farmers in the market which is enough to support their livelihood.
				<b>Adaptation:</b> well-adjusted with the climatic fluctuation of rainfall which enables them to harvest it early without any disruption in yield.
				<b>Mitigation:</b> N/A
2	Upshi (P)	Sunamganj	2019	<b>Productivity:</b> promotes high yields per unit area, hence led to potential increase in income.
				<b>Adaptation:</b> reduction in risk of crop losses caused by temporary or permanent flood conditions.
				<b>Mitigation:</b> promotes above- and below-ground carbon sinks through increased accumulation of dry matter.
3	Janak Raj (P)	Sunamganj	2019	<b>Productivity:</b> enhances crop production and quality, hence they faced a potential increase in income.
				<b>Adaptation:</b> increased farmers' capacity to limit the crop exposure to crop damage caused by diseases and reduced the need for external inputs for crop protection
				<b>Mitigation:</b> reduces GHG emissions by reducing the use of synthetic pesticides (fungicides) therefore the carbon footprint reduction per unit of food produced.
4	Tes Gold (P)	Sunamganj	2020	<b>Productivity:</b> enhances crop production and quality, hence they faced a potential increases in income.
				<b>Adaptation:</b> increased farmers' capacity to limit the crop exposure to crop damage caused by diseases and reduced the need for external inputs for crop protection
				<b>Mitigation:</b> lesser number of fertilizers compare to other varieties.
5	SL8H (P)	Sunamganj	2020	<b>Productivity:</b> enhances crop production and quality, hence they faced a potential increase in income.
				<b>Adaptation:</b> It is tolerant to high temperature and can survive in hail storm.
				<b>Mitigation:</b> N/A
6	Crop diversification (P)	Khaliajuri	2013	<b>Productivity:</b> It spreads production and economic risk over a broader range of crops, thus reducing financial risks associated with unfavorable weather or market shocks.
				<b>Adaptation:</b> Wide range of crops adapted to climate change impacts.
				<b>Mitigation:</b> N/A
7		Khaliajuri	2015	<b>Productivity:</b> productivity increased for the farmers.

	Flood and drought tolerant rice species (P)			<p><b>Adaptation:</b> highly tolerant to flood and drought</p> <p><b>Mitigation:</b> N/A</p>
8	Maize cultivation (P)	Khaliajuri	2015	<p><b>Productivity:</b> Potential increases in profits due to increased crop yield and reduced production costs.</p> <p><b>Adaptation:</b> Increases moisture retention due to mulching and cover crops, reduced soil erosion caused by heavy rains, and soil tillage.</p> <p><b>Mitigation:</b> N/A</p>
9	Minor irrigation pond (T)	Khaliajuri	2017	<p><b>Productivity:</b> Farmers can now get water to irrigate during dry season which increased their productivity.</p> <p><b>Adaptation:</b> combats water scarcity during summer.</p> <p><b>Mitigation:</b> Less water used as they use rain water to store in the pond.</p>
10	Seed Bed Gap (T)	Khaliajuri	2015	<p><b>Productivity:</b> Leads to potential increases in yield in the long term.</p> <p><b>Adaptation:</b> Reduces soil degradation and erosion. Increases water availability. Frees up time for decision-making for the agricultural officers to take action if crops are attacked by diseases.</p> <p><b>Mitigation:</b> N/A</p>
11	Organic Fertilizer (T)	Khaliajuri	2016	<p><b>Productivity:</b> Increase in production due to reduction the soil salinity and also increases the soil quality. The production cost also decreases.</p> <p><b>Adaptation:</b> Decrease in climate-induced disease risk of the crops and reduces the use of chemical fertilizers. Better adjust to the effects of climate change</p> <p><b>Mitigation:</b> only N<sub>2</sub>O emissions and decreases GHG emission compared to inorganic fertilizer.</p>

On the other hand, in the north-west region of Bangladesh, the farmers in the riverine char of Gaibandha are frequently hit by droughts, river erosion, and floods due to their proximity to the river and affected by this climatic risks due to heavy reliance on agriculture for their livelihoods.

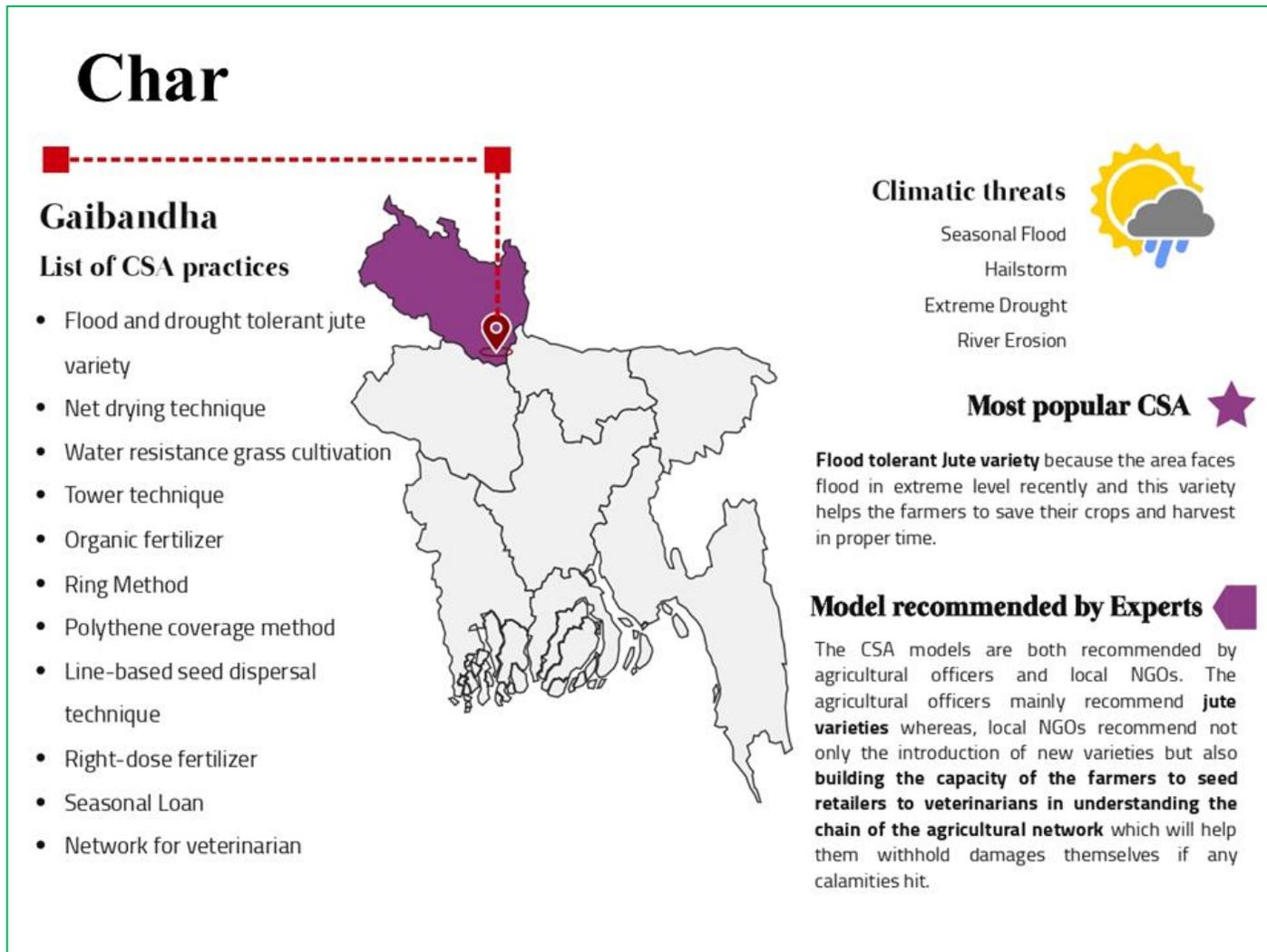


FIGURE 11: EXISTING CSA IN CHAR REGION

The char inhabitant living in Shaghata and Phulchari village of Gaibandha Upazila use a variety of agricultural adaptation measures, such as introducing new or alternative farming practices, altering planting timings, and growing short-duration varieties, in response to the current climate change threats. To implement these climate smart agriculture techniques in these two villages, the government agricultural officers and NGOs like SKS, OXFAM and SUFAL has a great influence on the farmers. The fig 5 shows the major CSA practices in terms of productivity and adaptation, their administrative support and the most popular among the farmers in terms of cost and feasibility of the Char region.

## 4.7 CSA practices of Char region

### 4.7.1 Flood and drought tolerant jute variety:

The flood and drought are the two common disasters the char people face in their land. The intensity and frequency of these two disaster became extreme which led the farmers of the char land to depend mostly on flood & drought tolerant jute cultivation since 2017-2018, introduced by the government agricultural officers.

### 4.7.2 Water resistance grass cultivation

Due to uncertain river erosion and flood, the farmers who owns livestock cannot provide sufficient fodder to their domestic animals. Hence, a waster resistance grass cultivation was introduced by the NGO: OXFAM in 2018 where around 40% farmers who have farms and livestock are involved in cultivating water resistance grass to feed their livestock. It can survive in excessive water and can provide food for domestic animals during a flood season.

## 4.8 CSA techniques of Char region

### 4.8.1 Net drying technique

The farmers of Shaghata and Phulchari villages of Char rasion, used to dry their crops directly in the soil after harvesting which used to degrade the quality of the crops. To reduce discoloration and product quality, they now lay polythene or net on the soil and dry the crops on it to avoid contact



FIGURE 12 NET DRYING METHOD

with any kind of mud. It was introduced to them in 2020 by local NGO (SKS Foundation) since then, above 60% farmers are involved with this technique. They observed that due to this process, the crops' quality enhanced and has increased demand in the market.

### 4.8.2 Tower technique

The tower technique is an effective vegetable cultivating method in flood-prone areas. It is also initiated in the Char regions by the NGO(SUFAL) in 2017. Around 50% farmers are

involved in tower gardens as flood is a common phenomenon for the farmers in Shaghata and Phulchari villages. It has the capability to save the crops from getting washed away by flood water. With very little space required, tower technique produce heavy yields without chemical pesticides and herbicides while also significantly reducing water consumption compared to conventional growing practices. It has been integrated commercially and residentially, making it accessible to all.



FIGURE 13: TOWER TECHNIQUE

#### 4.8.3 Organic fertilizer

The government agricultural officer has encouraged the farmers of Gaibandha to use organic fertilizers since 2015. Till now most (more than 80%) of the farmers use this method on the same land after the jute is harvested. As the usage increased, it avoids or largely excludes the use of synthetic fertilizers, pesticide, and livestock feed additives and rely on crop rotation, crop residues, and animal manures. Organic fertilizers are carbon-based compounds that increase the productivity and growth quality of crops.

#### 4.8.4 Ring Method

Similar as Shyamnagar, the ring method is still not popularized as very few farmers use this technique in the two selected villages under Gaibandha. The technique was practiced mostly in their homestead gardening where they use a huge concrete ring of the toilet as a barrier to salinity and flood to cultivate vegetables. It is recently introduced by local NGO (SKS) in 2021. It has the potentiality to increase production, adaptability and highly encourages GHG emission reduction.

#### 4.8.5 Polythene coverage method

Gaibandha is frequently hit by hailstorm over the last 5 years, and the jute cultivation is mostly damaged by the hail. Hence, the local NGO (SKS) has introduced a polythene coverage technique to the farmers in 2017 to protect their jute from hailstorm. As they wrap

the bundle of jute in the polythene, it can remain strong during windy condition. Most farmers cultivate jute hence, around 70% farmers use this method.

#### 4.8.6 Line-based seed dispersal technique

The farmers used to disperse and scatter the seeds randomly on the soil in the selected two chars of Gaibandha. Since 2014, the local NGO (SKS) has selected few farmers to practice the line-based seed dispersal technique which changed the production of their crops in an inclining trend. Now gradually the number are increasing from small to medium scale farmers getting involved in this technique which enhances their production as well as the quality of the crops.

#### 4.8.7 Right-dose fertilizer

The farmers of Gaibandha only used to know about urea fertilizer and used it immensely on the crops which were extremely toxic to the seed and greatly reduced yields. Hence, in 2014, the local NGO (SKS) build knowledge-based capacity of the farmers on the dosage of fertilizer on different crops they are cultivating. Now, they have adequate knowledge of the quality of the varieties of fertilizers and understand the dosage of fertilizer use in their crops which increased productivity as well as maintains soil quality.

#### 4.8.9 Seasonal Loan

In Gaibandha, the farmers used to take weekly loans and have to return installment weekly against the loan. However, for a lot of farmers, it became difficult to return the installment weekly. After the problems were identified, seasonal loans were introduced by the local NGO (SKS) where the farmers will take loans when they want to cultivate crops and return them once there is the production of the crops.

The table 4 below shows the brief details of the CSA practices and techniques of the Char regions on ground and how it impacts the CSA pillar of productivity (food security), adaptability (resilience towards climate change), and mitigation (reduce GHG emission).

TABLE 4: IMPACTS ON CSA PILLARS OF THE EXISTING CSA PRACTICES & TECHNIQUES OF THE CHAR REGION

Sl. No.	CSA Practice (P) & Technique (T)	Location	Starting year	Impact on CSA pillars
1	Net drying technique (T)	Shaghata	2020	<b>Productivity:</b> quality enhanced and productivity increased
		Phulchari		<b>Adaptation:</b> Protects from the direct contact with muddy soil. <b>Mitigation:</b> N/A
2	Water-Resistance grass cultivation (P)	Shaghata	2018	<b>Productivity:</b> livestock are involved in cultivating water resistance grass to feed their livestock
		Phulchari		<b>Adaptation:</b> withstand excessive water and can provide food for domestic animals during a flood season. <b>Mitigation:</b> N/A
3	Organic fertilizer (T)	Shaghata	2015	<b>Productivity:</b> Increase in production due to reduction the soil salinity and also increases the soil quality. The production cost also decreases.
		Phulchari		<b>Adaptation:</b> Decrease in climate-induced disease risk of the crops and reduces the use of chemical fertilizers. Better adjust to the effects of climate change <b>Mitigation:</b> only N2O emissions and decreases GHG emission compared to inorganic fertilizer.
4	Tower Technique (T)	Shaghata	2017	<b>Productivity:</b> increased as farmers now can protect it from flood water
		Phulchari		<b>Adaptation:</b> withstand from getting washed away from flood water <b>Mitigation:</b> N/A
5	Ring Method (T)	Shaghata	2021	<b>Productivity:</b> More options of crop cultivation for farmers to meet their basic nutrients and also extra profits for selling it
		Phulchari		<b>Adaptation:</b> Ability to save their additional crop production from climate change impacts <b>Mitigation:</b> The use of organic material promotes the reduction of GHG emission
6	Polythene coverage method (T)	Shaghata	2017	<b>Productivity:</b> no damages bring more crops production to sell in the market.
		Phulchari		<b>Adaptation:</b> it can remain strong during windy condition <b>Mitigation:</b> N/A
7	Line-based seed dispersal technique (T)	Shaghata	2014	<b>Productivity:</b> increased productivity of crops and quality assurance
		Phulchari		<b>Adaptation:</b> compensate for the loss due to climate change. <b>Mitigation:</b> N/A
8	Right-dose fertilizer (T)	Shaghata	2014	<b>Productivity:</b> Increase in production due to reduction the soil salinity and also increases the soil quality. The production cost also decreases.

		Phulchari		<p><b>Adaptation:</b> Decrease in climate-induced disease risk of the crops and reduces the use of chemical fertilizers. Better adjust to the effects of climate change</p> <p><b>Mitigation:</b> only N2O emissions and decreases GHG emission compared to inorganic fertilizer.</p>
9	Seasonal Loan (T)	Shaghata	2014	<p><b>Productivity:</b> Productivity increased as the farmers feel a sense of security due to seasonal loan</p> <p><b>Adaptation:</b> depending on the climate, the loans can be taken by the farmers which reduces loss and damage,</p>
		Phulchari		<p><b>Mitigation:</b> N/A</p>
10	Flood and drought tolerant jute variety (P)	Shaghata	2017-2018	<p><b>Productivity:</b> productivity increased for the farmers.</p> <p><b>Adaptation:</b> highly tolerant to flood and drought</p>
		Phulchari		<p><b>Mitigation:</b> N/A</p>

# Floodplain

## Jamalpur

### List of CSA practices

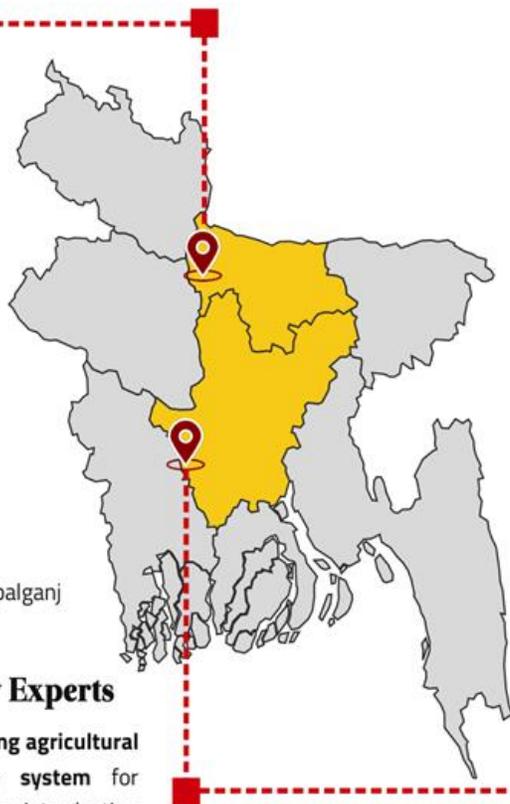
- Seasonal crop varieties
- Homestead vegetable gardening
- Maize cultivation
- Pheromone trap
- Composting
- Polythene Shed
- Hanging Macha Method

### ★ Most popular CSA

Flood tolerant rice species in Gopalganj and Sack Method in Jamalpur

### ➤ Model recommended by Experts

Modernization of **traditional floating agricultural technique** and **Buried pipeline system** for irrigation in the Gopalganj whereas, introduction of **Line plantation** and **Tower method** were recommended in Jamalpur.



### Climatic threats

- Seasonal Flood
- Extreme Drought
- Temperature Fluctuation
- Hailstorm



## Gopalganj

### List of CSA practices

- Alternative cropping
- Flood tolerant rice species
- Maize cultivation
- Buried pipelines
- Floating Agriculture

FIGURE 14: EXISTING CSA IN FLOODPLAIN REGION

Similarly, Jamapur and Gopalganj under the floodplain regions shares similar climatic threats to its agricultural sector. Char Hamidpur and Purbo Bamna villages of Jamalpur Upazila and Kalsi Fukra and Rahuthor village of Gopalganj Upazila are the villages which are mostly vulnerable to seasonal flood , extreme drought, temperature fluctuation and hailstorm. The fig 14 shows the major CSA practices and techniques in terms of productivity and adaptation, their administrative support and the most popular among the farmers in terms of cost and feasibility of the floodplain region to combat the everchanging and fluctuating climate of the region.

## 4.9 CSA practices of floodplain regions

### 4.9.1 Seasonal crop varieties

Due to irregular climate condition in terms of rain, heatwaves, drought and flood; the government agriculture officers has distributed or categorized the crops in a year based on climatic requirements as different seasons are characterized by different climatic characters that normally affects crop germination, growth, flowering, harvesting period and finally yield. The rice and vegetable crops are divided into three seasons: Kharif I, Kharif II and Rabi, where they can understand which crop or vegetable will be vulnerable or prone to which climatic conditions, or diseases. It influences crop yield highly as the farmers now know in which season, they will get higher production from which crops. Also, it helps track them the climatic changes every year. Around 70% farmers follow these seasonal crop varieties in the two villages of Jamalpur.

### 4.9.2 Homestead vegetable gardening

Around 90% farmers in the villages of Jamalpur are practicing homestead vegetable gardening in their own households apart from rice cultivation. They produce vegetables in their backyard or in front of their lawn house, which they can use in their daily cooking and sell those in nearby markets. It is an additional income option for the farmers when there is surplus of vegetables cultivated in their backyard. They can get sufficient nutrients for their family as well as extra space is not needed for the cultivation. It was promoted by World Vision and implemented by Unnayan Sangha which encourages small holder farmers to improve their nutrient and economic empowerment through homestead vegetable gardening.

### 4.9.3 Maize cultivation

In Jamalpur, around 30% of the farmers from the two villages cultivate maize. They observed that the maize cultivation needs less use of pesticides and herbicide which increased the production rate drastically. On the other hand, in the selected villages of in Gopalganj, the farmers are dependent mostly on wheat but gradually they are cultivating maize as well because there is severe rodent infestation in cultivating wheat due to changes in flooding pattern. Although around 20-25% farmers are involved in this practice, the

number is seen to be gradually rising in the coming years as it is more cost-efficient than wheat production. The farmers have cattle or goats as livestock are more likely to cultivate maize as the crop body is popular livestock food intake.

#### 4.9.4 Alternative cropping

The Gopalganj area is frequently hit by irregular precipitation, flood, heatwaves, temperature fluctuations, and insect and rodent infestation which lower the quality of traditional rice or jute crops. Hence, since 2010, the government agricultural officers are influencing farmers to cultivate alternative crops to substitute for rice and jute which might become obsolete due to the changing climate. The alternative cultivation involves different kind of rice species which can tolerate flood or drought, also techniques which can let the farmers adapt to the changing climate and have potential high sale value or a specialized benefit to the farming system.

#### 4.9.5 Flood tolerant rice species

There are 90% of the farmers in Gopalganj, who depend hugely on the flood tolerant rice species which is one of the ways towards alternative cropping. Almost every farmer in the study location is involved with this practice introduced by the government agricultural officers in 2015. It has the potential to restrain from annual floods and prolong waterlogging in the areas.



FIGURE 15: FLOOD TOLERANT RICE SPECIES

#### 4.9.6 Floating Agriculture

Almost 70-80% farmers living in low-lying areas of the study location in Gopalganj are involved with Floating Agriculture. It is an indigenous technique but later modified by the Department of Agriculture Extension in 2015 by providing them technical support and extending the practice in a large scale. As Gopalganj face long-term water logging during monsoon and post-monsoon seasons, farmers practice cultivating on a soilless platform made from organic matter to ensure livelihood and nutrients. There is evident increase in

income due to harvesting of multiple crops in one season. Also, generates additional income from the sale of seedlings produced. The benefits of the practice are that it reduces the risk of complete crop failure, allows optimum use of natural and local available resources, and creates additional cropping area for the farmers.

## **4.10 CSA Techniques of Floodplain Region**

### **4.10.1 Pheromone trap**

In Jamalpur, the farmers use pheromone traps to attract insects which damages their crops. They hang up a chemical pouch that attracts opposite sex of the insect thus the production remains stable as the crops get rid of these insects. Around 40% of the farmers in the selected villages are involved in this technique.

### **4.10.2 Composting**

The farmers in Jamalpur who are practicing homestead gardening are using household biodegradable waste to fertilize and improve the soil quality. This technique has reduced the use of inorganic pesticides which harms the soil immensely. The 70% farmers of the two villages of Jamalpur are noticing an increase in yeild, and soil quality. As well as it reduces the amount of waste transported to landfills, while creating some nutrient-rich soil.

### **4.10.3 Polythene Shed**

There are 30% of the farmers in the selected villages of Jamalpur who use Polythene coverage technique to protect their vegetables, jute or other plants from extensive rainfall just like Gaibandha farmers. The loss and damage of the crops decreases which leads to farmer's increased production of crops for the markets.

### **4.10.4 Hanging Macha**

There are places in the Char Hamidpur and Purbo Bamna village of Jamalpur where the areas remain submerged under 4 – 5 feet for 5-6 months. In those places, the hanging macha technique is very popular as it withstands the flood water or water logging situation and does not let the water damage the crops which are cultivated on sticks and bamboos placed higher from the water surface. Around 40% farmers of the selected villages are using this technique.

#### 4.10.5 Buried pipelines

In Gopalganj, the government agricultural officer has started an initiative of providing surface water for irrigation through a buried pipeline system. It was built in 2020 for the farmers so that less damage is faced by the farmers due to prolonged drought. However, the number of motors allocated is inefficient compared to the demand for irrigation in dry season and only 10-15% of the farmers get access to it.

The table 5 below shows the brief details of the CSA practices and techniques of the Floodplain regions on ground and how it impacts the CSA pillar of productivity (food security), adaptability (resilience towards climate change), and mitigation (reduce GHG emission).

TABLE 5: IMPACTS ON CSA PILLARS OF THE EXISTING CSA PRACTICES & TECHNIQUES OF THE FLOODPLAIN REGION

Sl. No.	CSA Practice (P) & Technique (T)	Location	Starting year	Impact on CSA pillars
1	Maize Cultivation (P)	Jamalpur	2015	<b>Productivity:</b> Potential increases in profits due to increased crop yield and reduced production costs.
		Gopalganj		<b>Adaptation:</b> Increases moisture retention due to mulching and cover crops, reduced soil erosion caused by heavy rains, and soil tillage.
				<b>Mitigation:</b> N/A
2	Alternative cropping (P)	Gopalganj	2010	<b>Productivity:</b> More options of crop cultivation for farmers to meet their basic nutrients and also extra profits for selling it
				<b>Adaptation:</b> Ability to save their additional crop production from climate change impacts
				<b>Mitigation:</b> N/A
3	Flood tolerant rice species (P)	Gopalganj	2015	<b>Productivity:</b> productivity increased for the farmers.
				<b>Adaptation:</b> highly tolerant to flood and drought
				<b>Mitigation:</b> N/A
4	Buried pipeline for irrigation (T)	Gopalganj	2020	<b>Productivity:</b> Farmers can now get water to irrigate during dry season which increased their productivity.
				<b>Adaptation:</b> combats water scarcity during summer.
				<b>Mitigation:</b> Less water used as they use surface water from the buried pipeline.
5	Floating Agriculture (P)	Gopalganj	2016	<b>Productivity:</b> Increases in income due to harvesting of multiple crops in one season. Generates additional income from the sale of seedlings produced.

				<p><b>Adaptation:</b> Reduce risk of complete crop failure. Allows optimum use of natural and local available resources. Creates additional cropping area.</p> <p><b>Mitigation:</b> N/A</p>
6	Seasonal crop varieties (P), (T)	Jamalpur	2015	<p><b>Productivity:</b> More options of crop cultivation for farmers to meet their basic nutrients and also extra profits for selling it</p> <p><b>Adaptation:</b> Ability to save their additional crop production from climate change impacts</p> <p><b>Mitigation:</b> N/A</p>
7	Homestead Vegetable gardening (P)	Jamalpur	2017	<p><b>Productivity:</b> More options of crop cultivation for farmers to meet their basic nutrients and also extra profits for selling it</p> <p><b>Adaptation:</b> Ability to save their additional crop production from climate change impacts</p> <p><b>Mitigation:</b> The use of organic material promotes the reduction of GHG emission</p>
8	Pheromone Trap (T)	Jamalpur	2017	<p><b>Productivity:</b> productivity increased as the damages due to pests decreased</p> <p><b>Adaptation:</b> protects from crop diseases or destroyed by pests</p> <p><b>Mitigation:</b> N/A</p>
9	Composting (T)	Jamalpur	2016	<p><b>Productivity:</b> Increase in production due to reduction the soil salinity and also increases the soil quality. The production cost also decreases.</p> <p><b>Adaptation:</b> Decrease in climate-induced disease risk of the crops and reduces the use of chemical fertilizers. Better adjust to the effects of climate change</p> <p><b>Mitigation:</b> only N<sub>2</sub>O emissions and decreases GHG emission compared to inorganic fertilizer.</p>
10	Polythene Shed (T)	Jamalpur	2016	<p><b>Productivity:</b> no damages bring more crops production to sell in the market.</p> <p><b>Adaptation:</b> it can remain strong during windy condition</p> <p><b>Mitigation:</b> N/A</p>
11	Hanging Macha (T)	Jamalpur	2017	<p><b>Productivity:</b> More options of crop cultivation for farmers to meet their basic nutrients and also extra profits for selling it</p> <p><b>Adaptation:</b> Ability to save their additional crop production from climate change impacts</p> <p><b>Mitigation:</b> The use of organic material promotes the reduction of GHG emission</p>

Apart from floodplains, the agricultural, poultry, and livestock activities of the **Hill Tracts** region have been also significantly impacted by climate change. In this area, deforestation, joom cultivation, teak culture, pineapple cultivation, and hill cutting were the primary causes of prompt climate change impacts. The farmers of Bandarban grow different type of rice, vegetables and fruits. However, agricultural techniques have changed significantly as a result of climate change. Therefore, many high yielding rice species are introduced to the famers so that they could support

and secure their livelihood and also producing different fruits and vegetable reproduction as alternative cropping for additional income. The figure 16 shows the major CSA practices in terms of productivity and adaptation, their administrative support and the most popular among the farmers in terms of cost and feasibility of the Hill tract region.

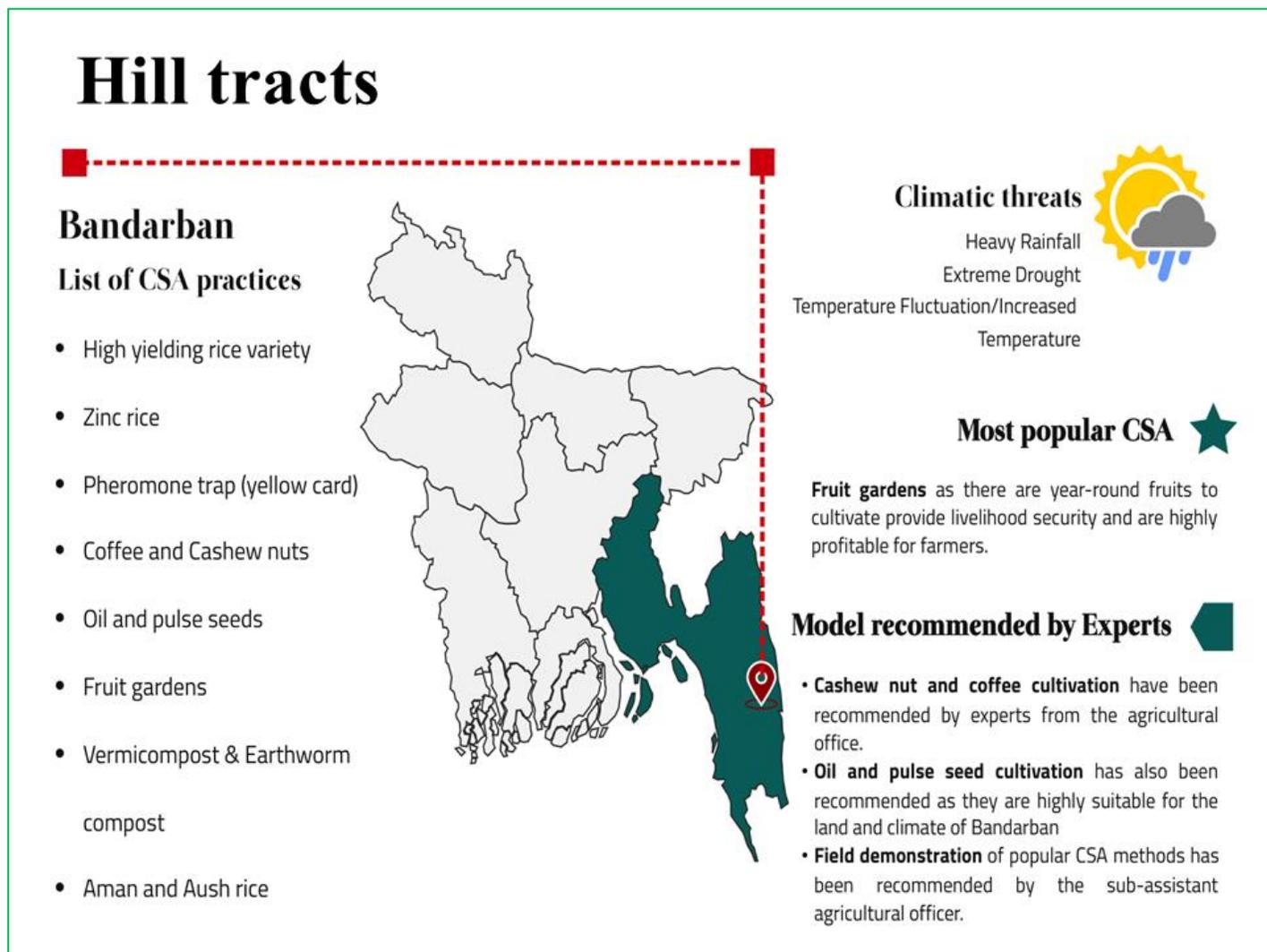


FIGURE 16: EXISTING CSA IN HILL TRACTS REGION

## 4.11 CSA practices of Hill Tract regions

### 4.11.1 High yielding rice variety

There are 80-90% farmers in both the selected villages of Bandarban where they practice high yielding rice variety as it is much profitable in the market. It reduces production cost

as a result there is an increase income and profit for farmers. The practice was implemented by the local NGO and governmental agriculture officers.

#### 4.11.2 Zinc rice

There are about a few (1-2%) farmers who are practicing to cultivate zinc rice in their lands. However, the rice species is very much rich in nutrient which is healthy for the children of the farmer's family. The zinc rice variety is introduced recently by the WorldVision and still not commercially feasible even though it has much potential to grow in terms of subsistence use.

#### 4.11.3 Coffee and Cashew Nuts

Bandarban shares a very unique climate compared to the other regions. According to their climate, the government agricultural officer suggested that the cultivation of coffee and cashew nuts are highly suitable for the land and climate of Bandarban as there will be higher yield also, higher production and higher returns than its production costs. Around 15-20% of farmers are indulged with this cultivation through the help of NGO and government agricultural officers as it is profitable for the farmers.

#### 4.11.4 Oil and Pulse Seeds

Same as the coffee and cashew nuts cultivation, the oil and pulse seeds are also suitable for the land and climate of Bandarban. It optimized the use of available soil moisture contributing to avoid crop loss and also increases water use efficiency. Around 10-20% farmers are being encouraged by NGO and governmental agriculture officers as it increases farmer's income and profit due to reduced production costs.

#### 4.11.5 Fruit Gardens

The practice of fruit gardens among the farmers of Bandarban is mostly popular as it provides them with year-round fruits, and livelihood security. It is highly profitable in the market as for instance, by selling papayas their total earning will be Tk. 96,000 from which the harvest cost will be around Tk. 25,000, so they will gain profit of nearly Tk. 71,000 at the end which is highly profitable. Around 60-70% farmers are involved with it and it is implemented by the farmers themselves.

## 4.12 CSA Techniques of Hill Tract Region

### 4.12.1 Vermicompost and Earthworm compost

The vermicompost and Earthworm was introduced by the NGO to the farmers in Bandarban. Only a few (10-20%) farmers use this technique to make the soil more fertile and replace chemical fertilizers. However, its usage is increasing gradually.

### 4.12.2 Pheromone trap (yellow card)

The farmers who grow vegetables and fruits are frequently hit by pests due to changing climate, they are unable to track which pest will attack on which season. Previously they used to use chemicals to save their crops from pests but it used to do more damage to the crops in long term. Hence, a pheromone trap technique is used by 30-40% farmers to trap pests. It was a technique which was practiced by the farmers themselves but recently NGOs are helping them to flourish this indigenous idea in a larger scale through scientific back-up and make the technique for efficient.

### 4.12.3 Aman and Aush rice

As the Aman and Aush rice takes less water for irrigation and very cost effective, the farmers of Bandarban are moving towards cultivating Aman and Aush rice for subsistence purposes. Only 20% of farmers are involved in cultivating it but gradually it is becoming popular in the area.

The table 6 below shows the brief details of the CSA practices and techniques of the Hilltracts regions on ground and how it impacts the CSA pillar of productivity (food security), adaptability (resilience towards climate change), and mitigation (reduce GHG emission).

TABLE 6: IMPACTS ON CSA PILLARS OF THE EXISTING CSA PRACTICES & TECHNIQUES OF THE HILLS TRACTS REGION

Sl. No.	CSA Practice (P) & Technique (T)	Location	Starting year	Impact on CSA pillars
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1	High yield rice variety (P)	Bandarban	2013	<b>Productivity:</b> Promotes high yields per unit area hence an increase in income and profit due to reduced production costs.
				<b>Adaptation:</b> Optimizes the use of available soil moisture contributing to avoid crop loss. Increases water use efficiency.
				<b>Mitigation:</b> N/A
2	Zinc Rice (P)	Bandarban	2017	<b>Productivity:</b> Promotes nutrition and income for the farmers due to the prospect in market for the production.
				<b>Adaptation:</b> Optimizes the use of available soil moisture contributing to avoid crop loss. Increases water use efficiency.
				<b>Mitigation:</b> N/A
3	Pheromone trap (yellow card) (T)	Bandarban	2015	<b>Productivity:</b> productivity increased as the damages due to pests decreased
				<b>Adaptation:</b> protects from crop diseases or destroyed by pests
				<b>Mitigation:</b> N/A
4	Coffee and cashew nut (P)	Bandarban	2019	<b>Productivity:</b> Promotes high yields per unit area hence an increase in income and profit due to reduced production costs.
				<b>Adaptation:</b> Optimizes the use of available soil moisture contributing to avoid crop loss. Increases water use efficiency.
				<b>Mitigation:</b> N/A
5	Oil and pulse seeds (P)	Bandarban	2019	<b>Productivity:</b> Promotes high yields per unit area hence an increase in income and profit due to reduced production costs.
				<b>Adaptation:</b> Optimizes the use of available soil moisture contributing to avoid crop loss. Increases water use efficiency.
				<b>Mitigation:</b> N/A
6	Fruit gardens (P)	Bandarban	2017	<b>Productivity:</b> More options of cultivation for farmers to meet their basic livelihood needs and also extra profits for selling it
				<b>Adaptation:</b> Ability to save their additional production from climate change impacts
				<b>Mitigation:</b> N/A
7	Vermi-compost, earthworm compost (T)	Bandarban	2015	<b>Productivity:</b> Increase in production due to reduction the soil salinity and also increases the soil quality. The production cost also decreases.
				<b>Adaptation:</b> Decrease in climate-induced disease risk of the crops and reduces the use of chemical fertilizers. Better adjust to the effects of climate change
				<b>Mitigation:</b> only N <sub>2</sub> O emissions and decreases GHG emission compared to inorganic fertilizer.
8	Aman and aush rice (P)	Bandarban	2014	<b>Productivity:</b> Promotes high yields per unit area, hence potential increase in income.

				<b>Adaptation:</b> Increases resilience to biotic stress and climate shocks. Enhances water use efficiency.
				<b>Mitigation:</b> N/A

## 4.13 Non-CSA Practices & Techniques

According to the concept and definition of Climate Smart Agriculture, the agricultural practices and techniques which are impacting the three pillars (productivity, adaptability and mitigation) positively are considered as Climate Smart Agriculture. Hence, there are some practices and techniques found in five regions which does not meet the pillars of CSA and hence, are categorized as non-CSA practices or techniques. These are the practices or techniques which are unable to adapt to the changing climate, provides low productivity/profit and contributes hugely to GHG emission. The non-CSA practices under each region are as follows:

### 4.13.1 Haor Region

In Khaliajuri, the paddy cultivation was the primary cultivation but in recent times, due to the increase in climatic threats to agriculture, the paddy cultivation has become challenging for the farmers. It gets frequently damaged due to heat or cold-stress but around 10-15% of the marginalized farmers still cultivates it as they are unable to take risk with little investment on other crop cultivation, according to the non-CSA farmers through FGD. As the marginalized farmers have little to invest on new techniques, they are also looked down upon the sub assistant agricultural officers in terms of providing them awareness, and technical support. Due to lack of interest, the marginalized farmers get demotivated to cultivate any other crops but stick to paddy cultivation or nearly extinct crops such as sesame, linseed, mustard or kaun even the production rate is extremely low.

On the other hand, in Sunamganj, there are still few farmers cultivating BRRIDhan 28 and 29 which are considered as non-CSA as it is not suitable for this adverse climate anymore. However, marginalized farmers are still cultivating it despite huge damages once any disaster strikes and destroys their crops. They try to secure their livelihood with whatever left to harvest after any disaster strikes. The inability to switch to other advance CSA crops is due to lack of technical support from the governmental agricultural officer. Also, the marginalized farmers who do not own lands are mostly deprived of significant information, incentives and knowledge regarding agricultural facilities by the agricultural officers.

#### 4.13.2 Floodplain Region

In Jamalpur the main crops were paddy, jute, and wheat which are facing similar situation as Haor regions due to intense and fluctuating climate. Some farmers (around 10-20%) still hold on to cultivating these crops as they are afraid to accept new practices and techniques all of a sudden. Since, their income is very low due to cultivating crops mostly vulnerable to climatic changes, they are unable or do not have the courage to invest on new techniques or practices in agriculture with limited gains. They are unwilling to take high risks on the only field they own. Moreover, they get less support from government agricultural officers as well as the NGOs to build capacity or confidence on taking risk of investing on CSA practices or techniques.

Similarly, in Gopalganj the farmers who are practicing Boro rice without any kind of tolerant variant and Jute on their field cannot withstand the impacts of extreme weather. They are stuck on this vicious cycle of agricultural loss in terms of yield, production and profit gains. Thus, the marginal farmers eventually cannot afford the risk of trying a new CSA practices or technique. Also, it was observed that the farmers who do not practices CSA are mostly uneducated and not aware of the benefits of it since there is a huge communication gap between them and the government agricultural officers. Only few (around 15-20%) farmers who practices non-CSA also cultivate a local species of rice which are used to make “Puffed rice” to make a few money out of it or for subsistence use.

#### 4.13.3 Char Region

Even when flood and drought tolerant jute are introduced to the farmers, there are around 10% farmers in the two study villages under Gaibandha where they practice to cultivate the authentic jute on their land. This is because the modern hybrid seeds are not obtained by these farmers from government officials or non-governmental organizations, according to the farmers and hence they have to cultivate jute with the traditional seeds which is accessible to them.

#### 4.13.4 Hill tracts Region

The landless farmers in Kyamlong para and Chemidulu para of Bandarban have resorted to growing different kinds of vegetables and spinach throughout the year which is widely adaptable to the climate and hence, make enough profit from the practices and techniques to sustain their livelihood. This indicates that the introduction of CSA practices and techniques is growing.

Although, there are a very few farmers who are still doing Joom cultivation, its trend is decreasing day by day. The reasons behind discarding Joom cultivation are:

- Government embargo and discouragement
- Requirement of more effort and time
- Less profit
- Environmental degradation

This indicates that this agricultural practice falls hugely as a non-CSA as it is not meeting the three pillars of CSA.

#### 4.13.5 Coastal Region

In Shyamnagar and Kalapara Upazila, the scenario was different. As the places are situated very close to the coast, it is immensely affected with salinity. As a result, the farmers are bound to cultivate saline tolerant rice variety. They are unable to grow any other type of rice variety in this area other than saline tolerant rice variety. Hence almost all the farmers are involved in CSA practices according to the CSA pillars. Only the impoverished farmers who have no land or are engaged in other occupations do not follow such farming methods but completely shifted to alternative livelihood such as auto-rickshaw drivers, local small-restaurant business etc. They provide day labor to other's land when the cultivating or harvesting season arrives.

### 4.14 Stakeholders Involved

All the five regions: Floodplain, Coastal, Haor, Char and Hill tracts receive various sorts of agricultural help from various organizations and authorities. The Department of Agricultural Extension (DAE), a service provider under the Government of Bangladesh, has the responsibility of offering agricultural extension services to farmers in order to help them make the best use of their resources in order to increase their nutritional status and achieve self-sufficiency in food production. The DLS, DoF, NGOs, Input merchants (dealers), and private sector businesses are the other partners of agricultural extension services.

Nevertheless, the Upazila Agriculture Office along with Sub assistant agricultural officers (SAAO) is primarily in charge of advising, supervising, and assisting farmers with relation to agricultural activity at the field level. Also, there are local-level NGOs who are directly working with small-

scale farmers to build their capacity to practice new rice varieties or agricultural techniques which suits best with the climate and supports their livelihood. The study discovered that farmers' and locals' interactions with government representatives and NGOs are region-specific and also Upazila specific. In some areas, the NGO plays a significant influence in the presence of government agricultural officials whereas in other areas the government agricultural representatives influence the farmers towards CSA.

#### 4.14.1 Haor Region

In Khaliajuri, the study has observed a greater influence of government agricultural officers over the farmers. They are introducing new crop variants and techniques to the farmers in order to build their capacity to fight the changing climate and secure their livelihood. The government officials created a group within the farmers through which they disseminate knowledge, information, seeds, and conduct trainings and demonstration of new species on the groups. The farmers who are in this group are highly supported by the government agricultural officers but there is a hierarchal discomfort presence among the group as the large-scale farmers get benefitted most compared to the medium-scale farmers who needs higher attention from the SAAOs. Despite of government officials' in-depth involvement on-ground, there is an absence of communication between the most marginalized farmers of the community and the government agricultural officers. The government tends to include only the large-scale and medium scale farmers who has the capital and affordability to try new variants or crop techniques which leaves the marginal farmers naturally excluded from the farmers group. Majority of the medium-scale and small-scale farmers expect to seek help or assistance from the government-level officials as they are the most active on their area rather than NGOs since NGOs tend to be in support for a shorter period of time.

On the other hand, Sunamganj farmers are both supported by local NGOs and government agricultural officers. The farmers tend to be more tilted to get support from the local NGOs as till now they are getting much more comprehensive assistance from the NGOs more than the government officials regarding the cultivation process of different hybrid-rice species in their area. The farmers highly praised the support of the local NGO like World Vision, Bangladesh as they expressed their full trust on them whereas, they are disappointed with the support of the government officials as they are mostly unavailable in their time of needs. The marginalized farmers who don't own lands are mostly deprived of significant information, incentives and

knowledges regarding agricultural facilities by the agricultural officers however, they are being benefitted by the local NGOs. However, all-scale of farmers did express the willingness to get more support from the government would benefit their cropping system more.

#### 4.14.2 Floodplain Region

In CSA practices of Jamalpur main stakeholders are local farmers, NGOs, Agriculture officers, seeds and fertilizer companies. The local farmers who practice CSA especially family nutrient gardening who are directly beneficiary of Unnayan Sangha and World Vision and the NGOs (World Vision, Unnayan sangha). They receive suggestions, seed, fertilizers, insecticides, herbicides from the agriculture office and NGOs. Farmers also receive early warning of extreme meteorological events from the local agriculture office. However, the number of these farmers is few as government funds and manpower is limited. The excluded farmers often feel deprived of attention and thus a communication gap creates between them. Government deals with the medium to large scale farmers and on the other hand, NGOs like (Unnayan Sangha, World Vision) work with the small to medium scale farmers. The farmers who are the beneficiaries only those are under this CSA project, rest have tried it but not for a long time. Agriculture pest companies are also under this stakeholder and their involvement is much appreciable as they proved all sorts of fertilizer, seeds to the farmers.

On the other hand, the main stakeholders of Gopalganj's study area are the government agricultural officers and the local farmers. All of the CSA practicing farmers of Kalshi Fukra village receives regular support, suggestions and information from the local agriculture officials whereas, the non-CSA practicing farmers of Kalshi Fukra villages stated that they have a communication gap with the agriculture office because very few projects are suitable for the marginal farmer community of the area. Also, they claimed that they were being ignored by the agriculture office because they officers didn't know them beforehand. Nevertheless, the CSA practicing farmers of Rahuthor village mostly practice floating agriculture technique, but the number of farmers involved in government funded "Vashoman Chash Jonopriyokoron" are a few compare to the total number of farmers in that village.

#### 4.14.3 Coastal Region

The CSA farmers under the study site of Shyamnagar are tightly involved with local NGOs like LEDARS in order to cultivate CSA practices or initiate CSA techniques. They are supported with different adaptive strategies, support and knowledge to overcome and tackle the climatic threats. The farmers were given different sorts of incentives like cash, seeds or materials to adapt in the CSA practices. Despite having a strong relationship with the local NGOs, there is a communication gap between the farmers and the agricultural officers in these two villages. The Agricultural officers hardly visit and give any strong solution during the disastrous time, according to the farmers. They expect equal amount of support from the agricultural officers as they get from the local NGOs because they believe it could enhance their crop productivity more and learn about the changing climate if they get support from both stakeholders.

However, the scenario is different when it comes to the farmers in the study areas of Kalapara Upazila. The agriculture department of the government benefited farmers in Niamatpur and Gamortola villages, which indicates that there is an excellent working relationship between the farmers and government officials. Different adaptation tactics, assistance, and expertise have been provided by Upazila agricultural officers and sub assistant agriculture officers to confront and combat climate risks. Farmers were offered various incentives, such as cash, seeds, or supplies, to encourage them to adopt Climate Smart Agriculture methods. In addition to government authorities, a variety of non-governmental organizations (NGOs) aid and advise farmers in various ways. Salt Solution, Caritas, and CODEC are notable local NGOs. In addition to government officials, a number of NGOs provide assistance and advice to farmers in various ways. Notable among the local NGOs are Salt Solution, Caritas, and CODEC. There was no coordination of work between the government and NGOs, but the farmers believe that they would benefit more if they could work collaboratively.

#### 4.14.4 Hill tracts Region

The farmers in Kyamlong para and Chemidulu para were the beneficiaries of NADP, World Vision and GRAUS. The NGOs have given the farmers different adaptive strategies, support and knowledge to overcome and tackle the climatic threats. The NGOs and agriculture officers are active in providing support to the farmers. However, coordination among land owners, water catchment area owners, farmers and other stakeholders is urgently needed.

#### 4.14.5 Char Region

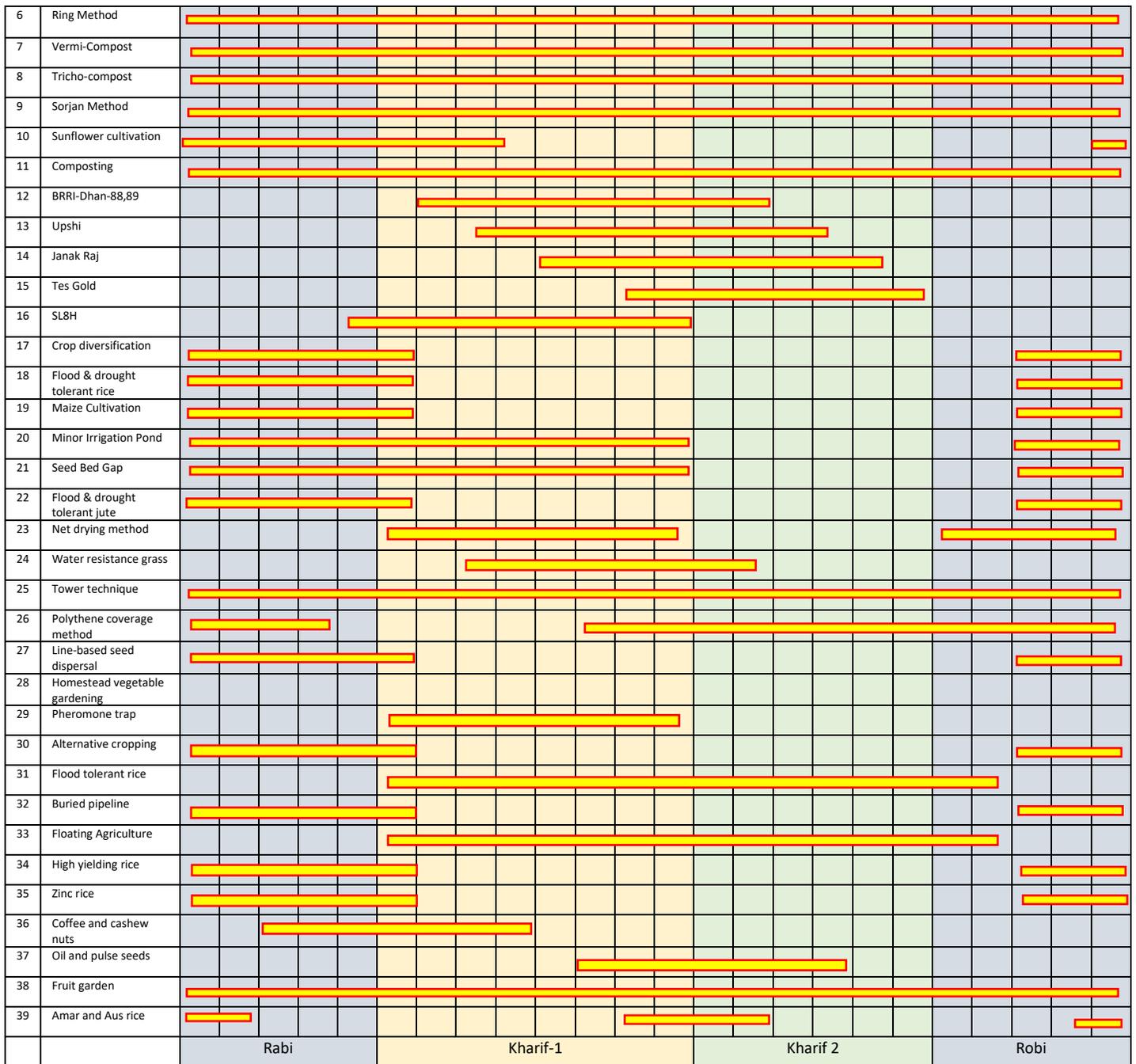
The villages in Gaibandha where CSA are practiced is a great example of stakeholder involvement, The government agricultural officers, NGOs (SKS, OXFAM and SUFAL) and local farmers are working as a team in a cooperative manner. Both the stakeholders had a great influence on the farmers as the success rate of implementing CSA and farmer’s involvement is high. Each week they arrange a meeting between the three parties and exchange each other’s points of view, by which this is a win-win situation for both parties. In the recent rabi season, 4,261 farmers were given subsidy. They also have a BA-MIS portal where they provide all the climate-related information to farmers who need to know about the climatic situation.

Overall, farmers and Upazila agriculture administrations can communicate well in some places. Local Department of Agricultural Extension (DAE) offices offer information, technical know-how, and regarding resistant cultivars as well as fertilization, disease and insect infestation, and improved agricultural methods. Sometimes, as a result of poor communication, farmers place more faith in seed dealers or local NGOs than in them. However, other farmers claimed that SAAOs seldom go to their regions and that they believe SAAOs know little about climate-resilient technologies, such as resistant or tolerant crop types. SAAOs, however, occasionally express a lack of enthusiasm in making field trips, this might be because they are not provided with any formal transportation options or funding to tour agricultural fields or attend farmers’ organization meetings which decrease their motivation. However, a collaborative approach among government officials, local NGOS, farmers and seed dealers can have an effective impact on scaling-up CSA practice and techniques in the long run.

### 4.15 Seasonal Calendar

TABLE 7: SEASONAL CALENDAR FOR DIFFERENT CSA PRACTICES

	CSA practices	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
1	Saline-tolerant rice variety												
2	Mulching												
3	Sack Method												
4	Hanging Macha												
5	Organic fertilizer												



The seasonal calendar shows the usage of CSA practices and techniques throughout the 12 months of a year. It has shown that the techniques are used mostly all season however, the cultivation of different crop varieties or rice species, varies from season to season. However, this is an effective tool which disseminates the current annual and cyclical seasonal pattern of the on-going CSA in five regions of Bangladesh.

However, the table 7 denotes the current seasonal calendar of the CSA practices and techniques but as the climate changes in 5-10 years, this seasonal calendar will be an effective tool to compare whether there is an impact of climate (rain fall and temperatures), crop sequences (pests and diseases), and food availability issues regarding the change. According to KII and FGD, it has been anticipated that there might be an issue in time of planting the crops in the future. Many crops might have to be cultivated early or late in the season due to unusual weather patterns. It is determined by the government agricultural officers and agricultural experts that the weather fluctuation will change the previous timings of the crop cultivation that has been practiced now.

Even with the techniques, the season might change even though they are used throughout the whole year. For examples, many techniques can be obsolete to the changing climate or the frequency of the use can be more than the usual.

#### **4.16 Spatial Analysis**

The study identified the spots where CSA practices are initiated at the selected study sites of the five regions of Bangladesh. The GPS coordinates of the cultivated CSA plots were taken and also a community map survey was conducted to understand where the CSA plots are. Through community map, they study also discovered the agricultural practices on the same plots, 10 years ago from now. Thus, the progression data of the CSA practices portrays the plots where the current CSA are practiced and simultaneously shows what crops they used to practice on the same plot, 10 years ago from now.

The spatial data of each plot will serve as baseline information for CSA activities in order to monitor their progression after 5 to 10 years. Further data will provide us with an understanding whether the current CSA practices which are practiced in one plot, have the potentiality to survive for 10 more years. A trend can quickly be generated through the spatial map data to identify the effectiveness of any CSA practices.

For instance, the present rice tolerant variety won't be enough to endure the salinity level in the coastal region. New saline tolerant rice varieties have to be introduced, which will be more tolerant to salinity so that in the future, people don't have any failed harvest or yield. The farmers of the study area are very keen to know more knowledge about the CSA practices as their life is getting

better from it. Hence, there is a scope of providing them proper guidance and knowledge distribution regarding CSA which can make their lives more tolerant to the climatic threats.

The study has created an example of the plotting on the google earth image in Figure 17 where in plot 101 they used to cultivate Choitaboro (Rice), vegetables, Aush (rice), Jute and Aman, vegetables before 10 years, now they cultivate BRRI-29, Vegetables, Spices, Jute, BR-23 (rice), Summer Tomato and Maize, Late summer vegetables, Rice in the same plot. The other GIS maps of different CSA plots have been attached to the appendix.

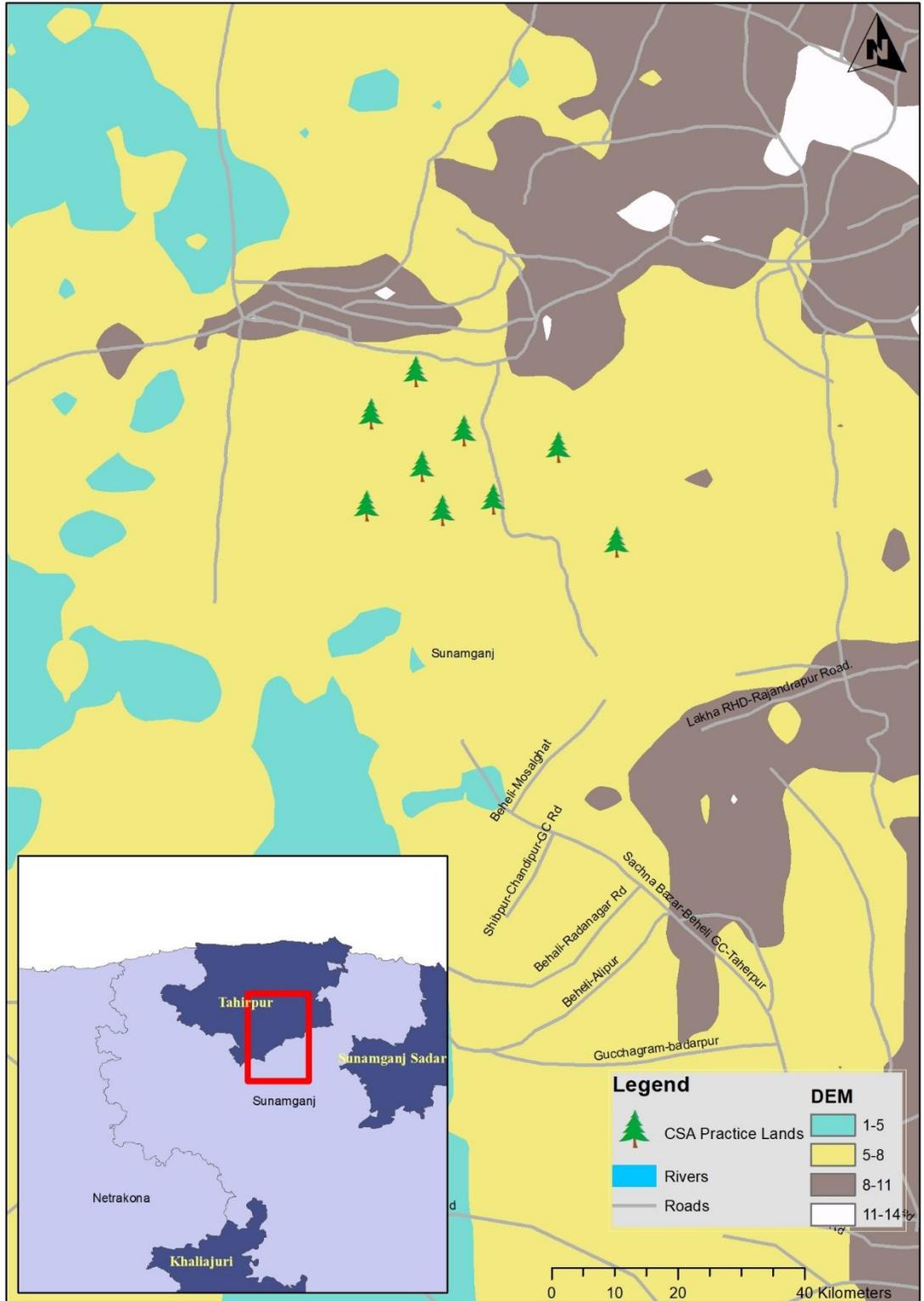
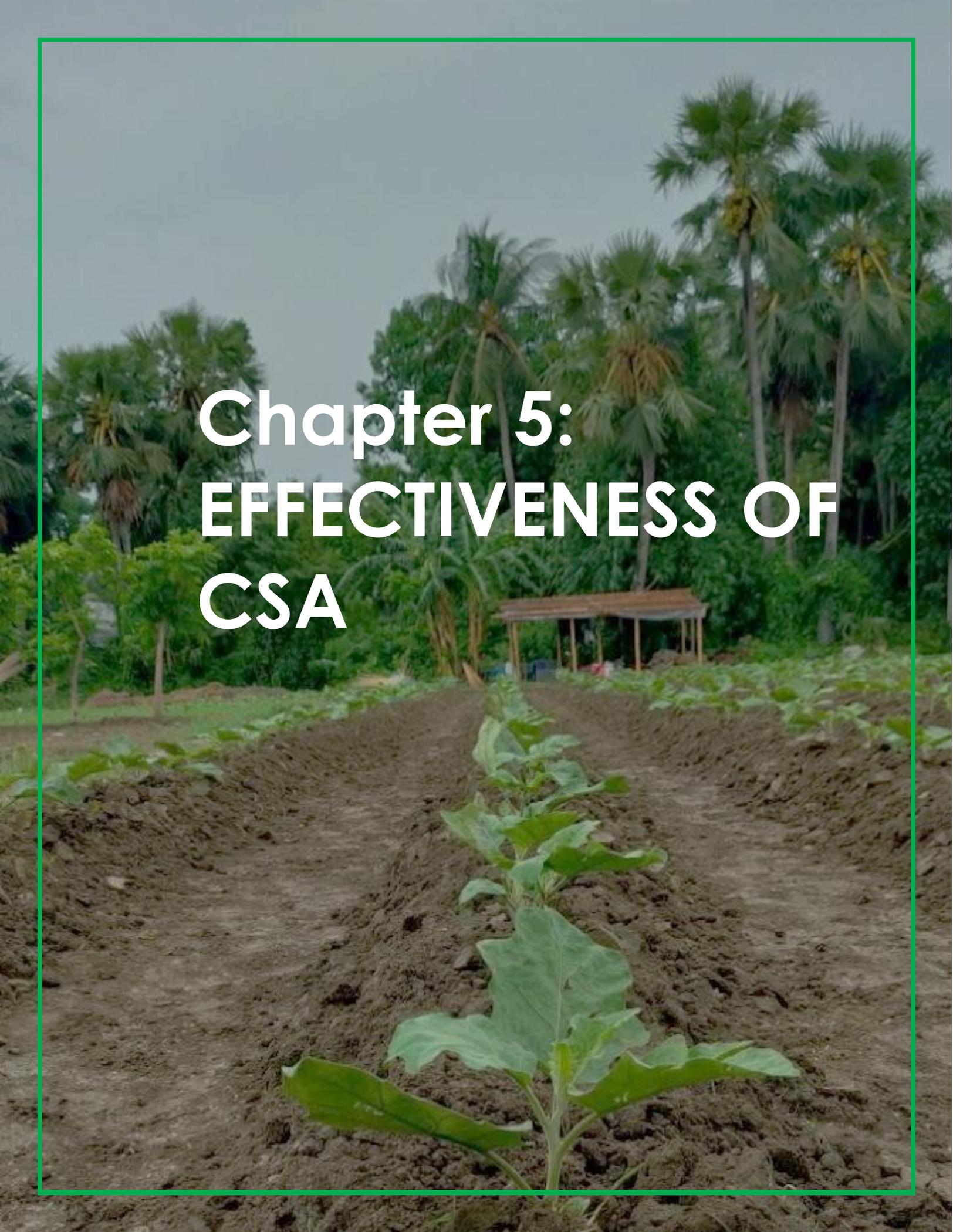


FIGURE 17: PROGRESSION MAP OF TAHIRPUR UPAZILA OF SUNAMGANJ DISTRICT



# Chapter 5: EFFECTIVENESS OF CSA

## 5.1 Most Popular CSA practices

The popular CSA among the community varies from region to region. The five regions consist of different CSA practices and techniques which are popular among the farmers shown in Fig 18. The popularity depends on how the practices and techniques are bringing them fortune in terms of

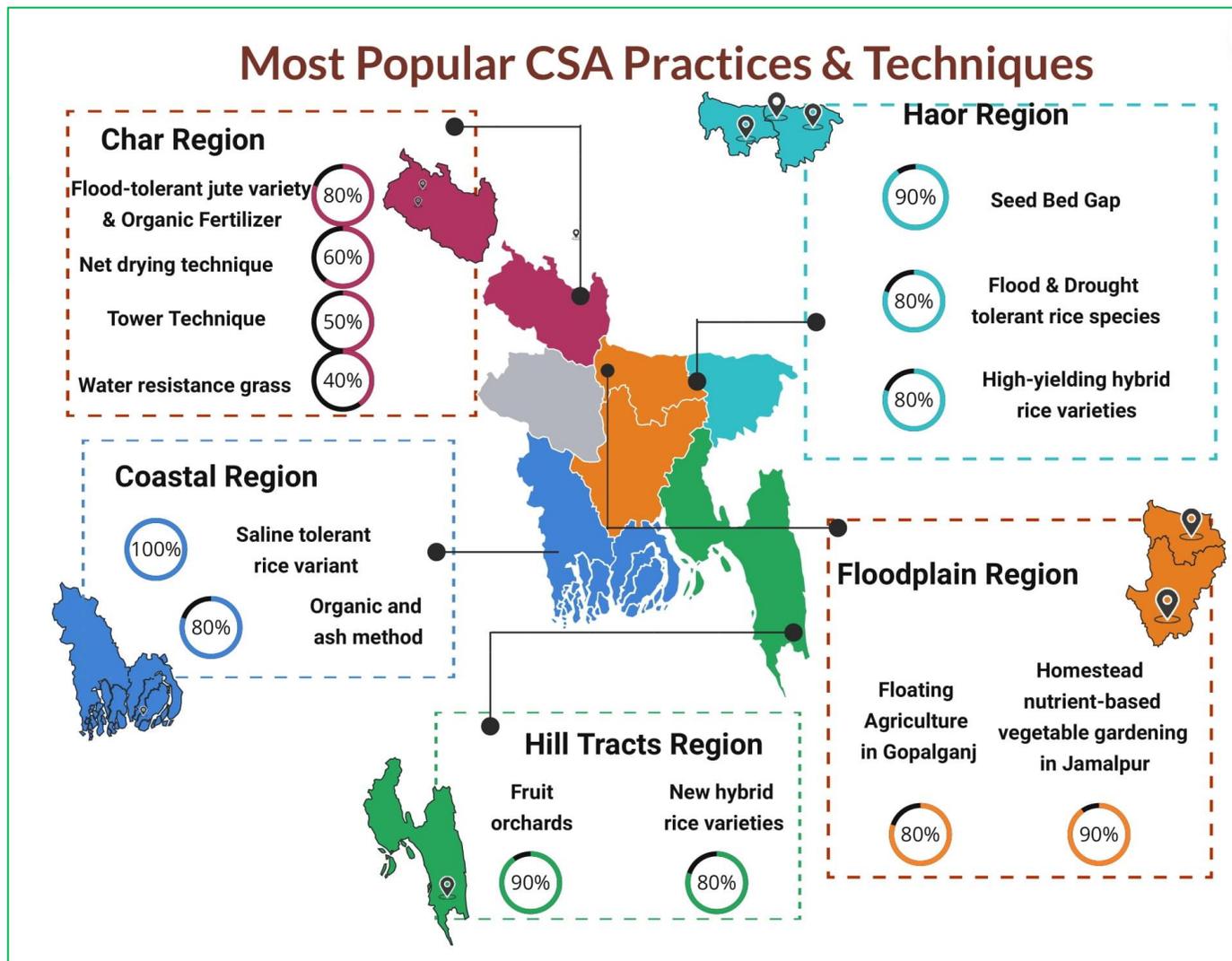


FIGURE 18: REGION-WIDE DISTRIBUTION OF THE MOST POPULAR CSA PRACTICES & TECHNIQUES

yield, harvest, production, adaptability and climate mitigation. However, there are places like Coastal regions where there are farmers who are highly dependent on saline tolerant rice varieties due to high salinity which leaves them with no choice but bound to cultivate it to secure their livelihood. Hence, it has eventually become the popular CSA practice among the farmers as the crop has become like a survival kit for them. Thus, the study can conclude that along with the

increase in popularity due to high production level and high returns, the dependency of farmers due to climate change also acts a major factor for a CSA practice and techniques to be popular. The table 8 shows the current status and challenges of the popular CSA practices and techniques in five different regions.

Region	Popular practices	Status	Reason for the popularity	Challenges
Haor	Seedbed Gap	Implemented	It is seen to be a potential technique to avoid any spread of crop diseases. Also, the gap formed in between two beds can be used for irrigation and drainage purposes.	If the soil is not fertile enough, additional fertilizers and other chemicals need to be added which increases cost for seedbed gap preparation. Additionally, lot of manpower and effort is needed for this technique.
	Flood and Drought tolerant rice species	Implemented	It can produce both efficiency gains—through better and less variable yields—and equity gains—benefiting heavily populated marginal, lower caste farming communities.	Marginalized farmers still cultivate normal rice variants as they are unable to take risk with little investment. The inability to switch to other advance CSA crops is due to lack of technical support from the governmental agricultural officer. Also, the marginalized farmers who do not own lands are mostly deprived of significant information, incentives and knowledge regarding agricultural facilities by the agricultural officers.
Char	Flood-tolerant jute variety	Implemented	The intensity and frequency of flood became extreme which led the farmers of the char land to depend mostly on flood tolerant jute cultivation since 2017-2018.	the modern hybrid seeds sometimes, are not obtained by few farmers from government officials or non-governmental organizations, hence they have to cultivate jute with the traditional seeds which is accessible to them.
	Net-drying technique	Implemented	As the crop doesn't hit the mud directly and keeps the quality of the crops intact hence, the productivity also increases with high profit gains	Even when the technique demonstrated a positive outcome, few farmers still dry their crops directly on the ground thinking, the net is an extra cost. However, the challenge can be negligible if proper supports and

				awareness are provided to them.
	Tower Technique	Implemented	It is an effective vegetable cultivating method which has the capability to save the crops from getting washed away by flood water. With very little space required, tower technique produce heavy yields without chemical pesticides and herbicides while also significantly reducing water consumption compared to conventional growing practices.	Few farmers do not have the ability to finance or invest in extra infrastructure to cultivate more crops.
	Water resistance grass	Implemented	It can survive in excessive water and can provide food for domestic animals during a flood season.	40% of the farmers are involved in this technique who are supported under the projects by the NGOs.
Coastal	Saline tolerant rice	Implemented	It helps resist the soil and water salinity to some extent and also increased the capacity of farmers to restrain exposure of the crops to climate risks. Simultaneously, farmers noticed that these varieties increases the accumulation of soil biomass which enhancing soil fertility.	As the salinity increases, the experts are afraid that the current saline tolerant rice varieties will not be enough to withhold the coming intensity of the saline water and become obsolete.
	Zero Tillage	Implemented	Good amount of profit through the zero-tillage method. In Bangla they call it "Bina Chash e Shobji" where they use the organic fertilizer and ash in the same land right after the rice is being harvested, without ploughing it and cultivate vegetables in it which decreases the preparatory effort and cost for cultivating another crop.	There is a risk of carrying over diseases.
	Individual Irrigation Pond	Implemented	When there is scarcity of water, the irrigation pond becomes a potential	The technique gets disrupted if there is an uncertain pattern of rainfall and farmers are

			technique to support their crop cultivation.	unable to store water for irrigation in their pond.
<b>Hill-Tracts</b>	Fruit Orchards	Implemented	they could cultivate any kind of seasonal fruits all throughout the year, it has been becoming widely popularized in the hill-tracts where around 90% of the farmers are involved in fruit cultivation.	Hill Tracts are turning into a fruit cultivation ground which is hugely disrupting the ecosystem.
	New hybrid rice varieties	Implemented	It Increased yields, and increased resistance to diseases and insects.	The seeds are expensive hence farmers are discouraged to cultivate it.
<b>Floodplain</b>	Homestead vegetable gardening	Implemented	It is widely in demand for the farmer as it has been a revolutionary change for them due to the easy access to sufficient nutrients for their family. It doesn't need any extra space since they can cultivate those behind their backyards and limited space too. Also, it can be a good income source for the family as just by switching to this, they are earning near BDT 1 lac in every season.	Few of the farmers do not have the courage to invest on new techniques or practices in agriculture with limited gains. They are unwilling to take high risks on the only land they own. Moreover, they get less support from government agricultural officers as well as the NGOs to build capacity or confidence on taking risk of investing on CSA practices or techniques.
	Floating Agriculture	Implemented	An indigenous practice of floating cultivation has flourished as this technique requires a long-term water logging scenario	It was observed that the farmers who do not practice it, are mostly uneducated and not aware of the benefits of it since there is a huge communication gap between them and the government agricultural officers. Only few (around 15-20%) farmers who practices non-CSA also cultivate a local species of rice which are used to make "Puffed rice" to make a few money out of it or for subsistence use.

TABLE 8: CURRENT STATUS AND CHALLENGES OF POPULAR CSA PRACTICIES AND TECHNIQUES

The most popular climate smart agriculture practices according to the farmers' perception are as follows:

The farmers of the **Haor regions** are more likely to improve rice cultivation through different new rice species/variant cultivation or rice cultivating techniques to combat climate change impacts. The most popular according to their perception were the seed bed gap which is practiced by almost 90% of the farmers in the study areas under Haor regions. Apart from this rice cultivating technique, they prefer flood and drought tolerant rice species which provides them with high yield and production. It also builds their capacity to decrease crop exposure to climatic impacts themselves. In Sunamganj, the agricultural government officers and local NGOs primarily focused on popularizing high yielding hybrid rice varieties which brings high rate of profit in the market. Some of the popular rice varieties are BRRI Dhan-88,89, Upshi, Janak Raj, Tes Gold in Sunamganj Upazila.

Similarly, the **coastal region** is also dependent highly only on the saline tolerant rice or paddy species. The cultivation of previous crops is not possible without salinity tolerance varieties of paddy. As the yield of salinity tolerance varieties is much better than the earlier cultivated crops, the practice is widely popularized. Some of the most popular and used varieties are BIRI Dhan 25, 47, 51, 52, 54, 67, 68, Swarna Gota, and Swarna Moshuri in Kalapara whereas BRRI Dhan 25, 53, 47 and 67 in Shyamnagar. Other than saline tolerant crops, most of the farmers (around 80%) expressed that they are having good amount of profit through the zero tillage method. In Bangla they call it “Bina Chash e Shobji” where they use the organic fertilizer and ash in the same land right after the rice is being harvested, without ploughing it and cultivate vegetables in it.

However, in the **floodplain region**, the significance of promoting indigenous vegetable based gardening or agricultural practices are much more popularized. In Jamalpur the homestead nutrient-based vegetable gardening is widely in demand for the farmer as it has been a revolutionary change for them due to the easy access to sufficient nutrients for their family. It doesn't need any extra space since they can cultivate those behind their backyards and limited space too. Also, it can be a good income source for the family as just by switching to this, they are earning near BDT 1 lac in every season. Similarly, in Gopalganj an indigenous practice of floating cultivation has flourished as this technique requires a long-term water logging scenario.

Moreover, in the **Hill tract region**, the farmers are shifting to prioritize cultivating fruit orchards such as mangoes, lychees, coconuts etc. As they could cultivate any kind of seasonal fruits all

throughout the year, it has been becoming widely popularized in the hill-tracts where around 90% of the farmers are involved in fruit cultivation apart from rice.

Apart from popularizing rice-varieties, vegetables and fruits, **Char region** is focusing on the techniques which are increasing their productivity in immense level. For instance, apart from flood and drought tolerant jute variety, net drying method is highly popularized in the villages of Gaibandha as the crop doesn't hit the mud directly and keeps the quality of the crops intact hence, the productivity also increases with high profit gains.

## 5.2 Comparative analysis against other CSA initiative (local & global)

The world's most vulnerable regions to the impacts of climate change include South Asia. A significant proportion of South Asia's population relies on agriculture for a living, making it significantly vulnerable to climate change. Experts predict that between 10 and 50 percent of the region's agricultural output may be lost by the end of the century. Countries in the South Asia have adapted to different types of Climate Smart Agricultural techniques in order to accomplish their nationally decided commitments in lowered GHG emissions, increase productivity and to adapt or become resilient to climate change.

Similar to Bangladesh; India, Philippine and Vietnam also released saline tolerant rice varieties like Luna Sampad, Luna Suvarna, Luna Sankhi, Salinas 1-9. The Salinas 1-9 varieties are very effective in restoring the land productivity in some of the islands in Philippines where salinity intrusion is prominent. During the year 2009 to 2011; India released drought tolerant rice variety named Shahbagi Dhan; Philippines released Sahod Ulan 1,3,4,6 and 8 and Nepal released Shookha Dhan 1,2 and 3. India, Indonesia, Philippine and Nepal also used sub-merge tolerant rice varieties like the Swarna Sub-1, INPARA-3,4,5; Submarino etc.

In Bhutan, mulches are being adopted to improve the soil moisture conservation, reduce weed intensity, and improve soil fertility mainly in vegetables and fruit crops along with other protected cultivation practices. Their major crop productions are paddy, maize, potato and vegetables. More than 95% of their farming is natural and organic farming. In India, location specific and crop specific mitigation practices such as system of rice intensification (SRI), direct seeded rice cultivation (dry and wet methods of cultivation), soil test-based fertilizer application, rational application of nitrogen, integration of trees especially fruit trees in the arable systems, efficient

irrigation methods such as drip and sprinkler which can reduce the energy use while irrigating field crops, demonstration of zero tillage cultivation are being done.

In some islands in Maldives, field crops, such as sweet potatoes, cabbage, cassava, chilies, watermelons, papaya eggplant, pomegranate, gourds, eggplant and pumpkins are grown throughout the year in small-scale. To enhance food security, Maldives is still prioritizing research and development on promoting alternate technologies to make agriculture more resilient. As it is a country with multiple islands, they also focus their climate resilient strategies on reef biodiversity too. Some of the major CSA efforts made in Nepal are: System of Rice Intensification (SRI); green manure; conservation tillage practices; minimum/zero tillage (direct seeding –wheat and rice); use of plastic house and water sprinklers; sustainable agriculture soil and water conservation; slope stabilization and landslide control; rainwater harvesting, plastic ponds; rangeland and forage improvement; cultivation on river beds and shrub land; livestock shed improvement; bio-energy; and adoption of biogas.

High temperature tolerant, drought tolerant, submerge tolerant varieties of rice, maize and wheat are being cultivated also. Straw and plastic mulching, compost manure, weather forecasting, rain water collection, crop rotation, intercropping and mixed cropping are also some of the methods used in Nepal.

Some of the best practices of climate change adaption in Pakistan are zero tillage, rooftop rainwater harvesting, rain water harvesting pond etc. Most of their practices are advanced technology based like solar power drip, Fertilizer Band Placement Drill, dug well solar pumping system, Solar PV Pump for Mini dam/Farm Pond with high efficiency irrigation systems etc. One of the staple crops of Sri Lanka is Maize. The harvest of Maize was double from 2003 to 2013. Conservation of genetic diversity of indigenous crop varieties is the foundation for the sustainable development of new varieties is also one of their prime focuses on climate smart agricultural practices.

Apart from these Sri Lanka also cultivate saline tolerant rice variety like at 354. Ultra-short duration and drought escaping rice varieties e.g. Bg 250 are also being cultivated. Other than rice varieties they also use the techniques like mulching, rain water harvesting, Integrated Pest Management (IPM), organic farming, intercropping, crop diversification etc.

### 5.3 Model Recommended by Experts

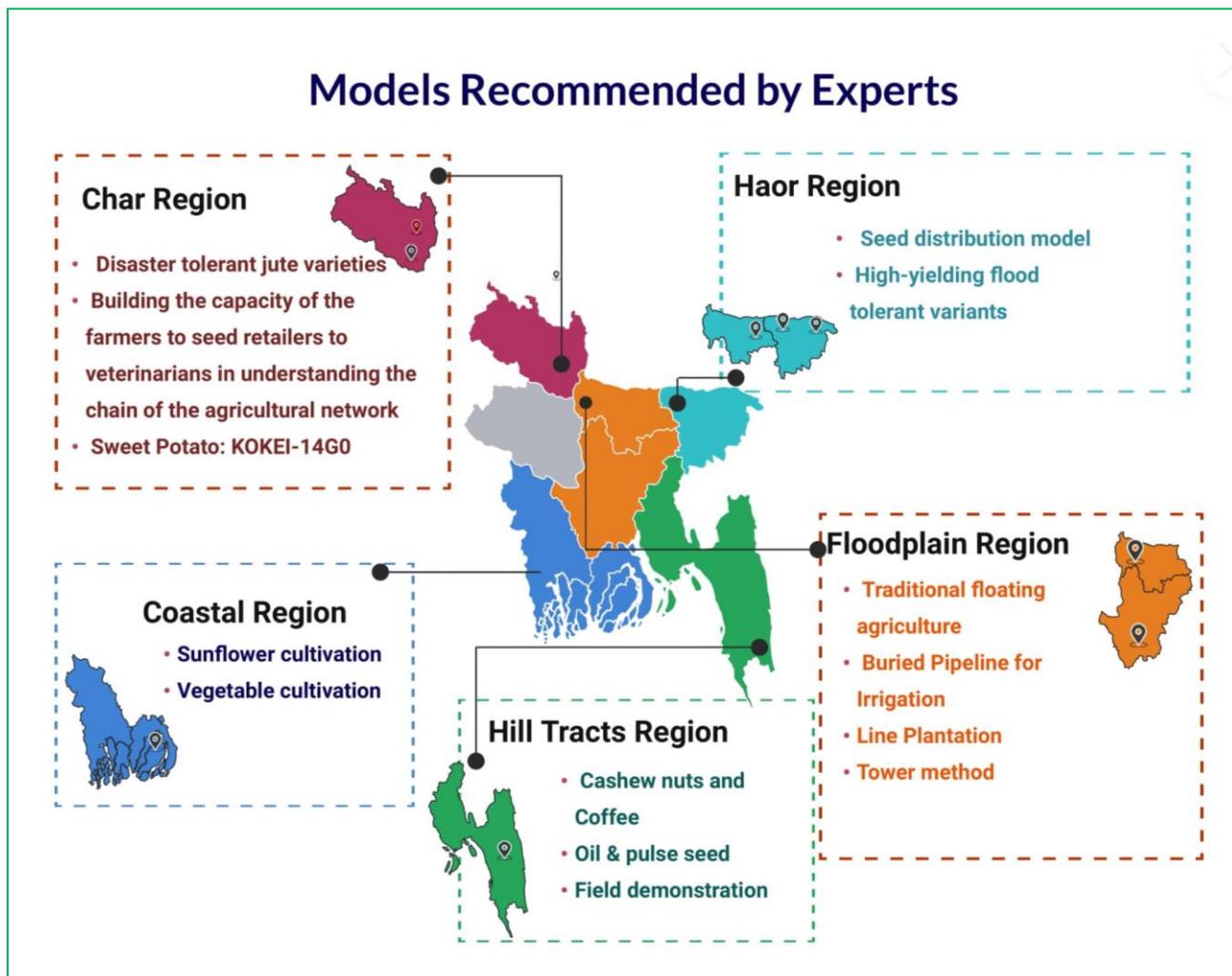


FIGURE 19: MODEL RECOMMENDED BY EXPERTS

In the **Haor region**, the land stays inundated for six months and other six months of the year, the land stays dry where the farmers practices different cultivation. However, the dynamics of the climate is changing and the flood water arrives earlier than before which disrupts many crops field. Even though the time duration of wet season and dry season is changing, the experts claimed that the time of the distribution of crop seeds from the government is the same for every region which doesn't seem feasible for the haor region as once they get the seed, it gets too late to cultivate for the farmers and hence, the agricultural government officer suggested that there should be a separate seed distribution model for the haor regions as the cropping season and patterns are different from

other regions. Simultaneously, the agricultural government officers along with SAAOs in Khaliajuri are trying to implement floating agricultural practices over the hyacinth-made floating rafts. However, the strong current in haor regions during monsoon and post-monsoon, breaks and sweeps away the raft. There is also severe heating condition in the local climate before monsoon which burns the water hyacinth that was kept for making floating rafts. While in Sunamganj, Bangabandhu-100 is a very highly recommended by agriculture officer, world vision and field facilitator as it is a high-yielding flood tolerant species. It is still on trial phase but it has the potential to adapt to the sudden flood water and bring high yield and production to the farmers.

On the other hand, in Jamalpur under floodplain region, World Vision has recommended a project which was implemented by Unnayan Sangha named “Nutrition Sensitive Value Chains for Smallholder Farmers (NSVC) project”. The number of beneficiaries under this project is around 20,000 families. The goal of this project is to improve nutrition and economic empowerment of 20,000 smallholder farmers and their households in three sub-districts of Jamalpur District in Bangladesh. The Upazila agriculture office tried to implement combined cultivation but it did not work out that much fruitfully. There were lack of communication and cooperation between farmers, with regional NGOs even with the agriculture officers which led it as a failure project for them. On the other hand, in Gopalganj under **floodplain region**, the agricultural government officers recommend to modernize the traditional floating agriculture techniques more as it supports the livelihood of farmers in Gopalganj at a larger scale. Moreover, the installation of buried pipeline system was introduced by the Upazila agriculture office. The technology is designed for providing irrigation service in the dry season to the farmers of Kashiani Upazila. This system uses surface water for irrigation in nearby crop fields in dry season through buried pipeline. The number of motors allocated is limited in comparison to the demand for irrigation.

In the **coastal region**, apart from saline tolerant rice variety, the local NGO highly recommends Sack method, Ring method, hanging macha, mulching, organic fertilizers, vermi-compost and trico compost to cultivate vegetables. These techniques are already active among the famers but in very smaller-scale. The expert suggested that cultivating vegetables will bring nutrition to their family as well as additional items to sell in the market if there’s a surplus. In Kalapara Upazila, the government agricultural officers highly recommend to cultivate sunflower as it needs less irrigation and less investment with higher profit gains.

Meanwhile in **Char region**, most of the techniques and practices are recommended by the local NGOs. Once the recommended techniques are practiced by the local farmers, they have experienced progressive changes in productivity and quality of the crops. Whereas, the government agricultural officers are mostly focused on introducing new rice or vegetable variant that increases productivity. They have currently recommended the farmers to cultivate a sweet potato variety named KOKEI-14G0.

In Bandarban under the **hill tracts region**, the agricultural government officer highly recommends the cultivation of cashew nut and coffee cultivation and also oil and pulse seed cultivation since they are suitable for the Hill tracts climate. Both the government agricultural officers and NGOs recommend the technique of field demonstration of the CSA methods which will spread the practices among larger scale of farmers. The table 9 below shows the current status of the CSA model recommended by the experts, reason behind recommending and challenges faced in implementation.

Region	Model Recommended	Status	Reason for Recommending	Challenges
Haor	Seed distribution method	Suggested	As the Haor region stays inundated for 6 months and doesn't share a similar physiographic conditions like other regions, the seed distribution to the retailers and government officers can be distributed way before other regions depending on the climatic factors.	As they receive seeds as the same time as the other regions, it becomes difficult for the seed retailers and agricultural officers to distribute it to the farmers on the right time when it's needed the most.
	High-yielding flood tolerant rice species	Implemented	It Increased yields, and increased resistance to sudden flood situations.	The seeds are expensive hence farmers are sometimes discouraged to cultivate it. Current flood tolerant species might become obsolete to the future flood conditions.
Char	Disaster-tolerant jute varieties	Implemented	The intensity and frequency of flood became extreme which led the farmers of the char land to depend mostly on flood tolerant jute cultivation since 2017-2018.	Few farmers are not willing to switch to disaster tolerant jute varieties due to high seed cost.

	Sweet Potato	Suggested	Low input cost and high profit gains.	As it is still new, few farmers are willing to take the risk to cultivate it.
<b>Coastal</b>	Sunflower cultivation	Newly Implemented	Due to water scarcity, when other crops are difficult to cultivate, sunflowers tend to have high tolerance to saline water, needs less irrigation while having less input cost with higher profit gains. This cultivation can be used as an alternative for rice in terms of commercial purposes	The farmers still prefer to keep the rice variants as commercial purposes.
	Vegetable cultivation	Implemented	Additional crops for the farmers to depend on or support their livelihood when disaster hits and at the same time increases their nutrition intake.	Few farmers do not have the ability to finance or invest in extra infrastructure to cultivate more crops.
	Individual Irrigation Pond	Implemented	When there is scarcity of water, the irrigation pond becomes a potential technique to support their crop cultivation.	The technique gets disrupted if there is an uncertain pattern of rainfall hence, farmers are unable to store water for irrigation in their pond.
<b>Hill-Tracts</b>	Cashew Nuts and Coffee	Newly Implemented	It Increased yields, and suitable for the regions' climatic characteristics.	The seeds are expensive hence farmers are sometimes discouraged to cultivate it. Farmers are more into fruit cultivation
	Oil and pulse seeds	Newly Implemented	It Increased yields, and suitable for the regions' climatic characteristics.	The seeds are expensive hence farmers are sometimes discouraged to cultivate it. Farmers are more into fruit cultivation.
<b>Floodplain</b>	Buried pipeline for Irrigation	Newly Implemented	less damage is faced by the farmers due to prolonged drought	If the surface water is far away then the infrastructure cost might be high. The number of motors allocated is inefficient compared to the demand for irrigation in dry season and only 10-15% of the farmers get access to it
	Floating Agriculture	Implemented	The benefits of the practice are that it reduces	If there is no enough water hyacinth, then

			the risk of complete crop failure, allows optimum use of natural and local available resources, and creates additional cropping area for the farmers	floating agriculture becomes difficult.
	Tower method	Implemented	It is an effective vegetable cultivating method which has the capability to save the crops from getting washed away by flood water. With very little space required, tower technique produce heavy yields without chemical pesticides and herbicides while also significantly reducing water consumption compared to conventional growing practices.	Few farmers do not have the ability to finance or invest in extra infrastructure to cultivate more crops.

TABLE 9: THE CURRENT STATUS OF THE RECOMMENDED MODELS BY EXPERT, REASON BEHIND RECOMMENDING AND CHALLENGES FACED

## 5.4 Profitability Analysis of CSA practices & techniques

The significance of implementing climate smart agricultural practices and techniques has been encouraging farmers to embrace high crop production, eventually making them almost self-sufficient and resilient towards climate change. The CSA practices and techniques are gradually adapted by the farmers as they can see evident changes in their crop productivity, quality and high profitability returns. Even if in some places, they have to practice CSA based crops due to the climate suitability but the farmer's main drive to practice this comes from the high returns of profitability from the practice or techniques.

TABLE 10: PROFITABILITY ANALYSIS

Region	District	Type of Crops	Cultivated land area	Cultivated crop amount	Income from crop (BDT)	Expenditure (BDT)	Profit in 1 season (BDT)
Coastal	Satkhira & Patuakhali	Saline tolerant rice variety	3.025 Bigha	22 maund	22,000	5,000 - 7,000	15,000
Hill Tracts	Bandarban	Hybrid rice	1.21 Bigha	12 maund	30,000	15,000	15,000

		Mango	1.21 Bigha	3500 kg	75,000	25,000	50,000
<b>Floodplain</b>	Gopalganj	Eggplant	1 Bigha	700-800 kg	14,000 - 18,000	10,000	4,000 - 8,000
	Jamalpur	Pepper	1 Bigha	25-30 maund	17,500 - 21,000	15,000-17,000	2,500 - 4,000
<b>Haor</b>	Sunamganj	Hybrid rice	1 Bigha	17-18 maund	17,000 - 18,000	2,000 - 3,000	10,000 - 15,000
	Netrokona	Vegetables	1 Bigha		150,000	100,000	50,000
<b>Char</b>	Gaibandha	Corn	3.025 Bigha	40-50 maund	56,000 - 70,000	15,000	55,000

#### 5.4.1 Char Region

In the char regions, the most profitable returns come from the corn production according to the farmers. For instance, they produce 40-50 maund of corn in 1 acre of land for which they invest around 15,000 BDT. After harvesting, they sell it in the market for 1400 BDT per maund. Hence, their profit gains are around 55,000 per acre of land which is satisfactory to the farmers as they used to earn half of the amount compared to the profit they are getting now.

#### 5.4.2 Hill tracts Region

According to the farmers, they can sell hybrid rice at the price of 30,000 BDT by selling 12 maund of rice that they harvest from their land. After deducting the cost of production which is around 15,000 BDT, they are left with 15,000 BDT as their profit gains which are moderately good for the farmers in Bandarban. This is because, at the same time, they are earning from cultivating fruits too. For instance, in summer season, they earn around 75,000 BDT by selling 3500 kg of mangoes with investment cost around 25,000 BDT leaving them with profits around 50,000 BDT in total.

#### 5.4.3 Coastal Region

The saline tolerant rice variety is the only product from the CSA practices, that the farmer's sell on the market to support their livelihood in the coastal regions. In 1 acre of land, they can cultivate around 22 maund of rice. In the market they sell 1 maund of rice in 1000 BDT, hence from 22 maund of rice they get 22,000 BDT. Their total expenditure in 1 acre of land is 5,000 to 7,000 BDT. We can say that in 1 season their profit from saline tolerant rice variety is around 15,000 BDT. However, it is not as much profitable for the farmers compared to the investment cost yet they are bound to cultivate it due to the climatic impacts.

#### 5.4.4 Floodplain Region

In the floodplain region, the farmers in Gopalganj profit more from the Eggplant cultivation through floating agriculture. It requires around 10000 BDT to cultivate eggplant in 1 bigha of land.

They could get a 700-800 kg of harvest and the price of harvest could vary from 14-18000 taka per bigha.

In Jamalpur, the pepper production was found profitable. In 1 bigha land they cultivate 25-30 maund (1110 kg) of pepper. They sell 1 maund (37kg) of pepper in 700 BDT. Their investment for per bigha land is 15-17 thousand BDT. Their profit is almost 4 thousand BDT in 1 Bigha (33 Shatak = 1 bigha).

#### 5.4.5. Haor Region

The Sunamganj Upazila has hybrid rice as CSA. In 1 bigha of land they cultivate 17 to 18 mon of rice. Their investment for per bigha land is 2-3 thousand BDT. In the market they sell 1000 BDT per maund and profit around 10-15 thousand BDT in 1 Bigha (33 Shatak =1 bigha).

In Netrokona, most of the farmers suffered a great amount of loss from the BRRI 58 variety and now they are switching to vegetables cultivation. They have adapted their practices to vegetables where their input is around 1 lac BDT in 1 Bigha of land. The cultivation rate is 1.5 lac BDT in which their profit is around 50,000 BDT.

# Chapter 6: THREATS & VULNERABILITY ANALYSIS



## 6.1 Livelihood & Child Wellbeing

The livelihood of the farmers hugely depends on the agricultural sector. A slight change in climate or agricultural practice can hinder immensely on the livelihood and wellbeing of the farmers. As we have seen recently how climate has a greater influence on the agricultural productivity. There are crops which became obsolete in Bangladesh, just because it does not adjust with the current climate dynamics. The introduction of climate smart agriculture to the farmers is mostly discovered to be beneficial to their livelihood but differs from region to region. The region-wise and area-specific-wise livelihood impacts are as follows:

### 6.1.1 Haor Region

The farmers of Haor regions are prone to seasonal flooding and flash flood which destroys the staple crop and their livelihood overall. The changing climate has become a severe threat to their livelihood and food security. For the last 4-5 years, they have been introduced to the new varieties of crops which can withstand extreme weathers like flood and drought. After they started practicing these variants on their land, they have noticed increasing trend on their income compared to previous income. Previously, they now gain double the amount they used to gain before. After adapting to cultivate flood and drought tolerant rice species, the family has a steady income to send their children to schools, colleges, and even some universities. Some of the children are gaining higher education in agriculture and applying their knowledge in the fields. Previously, these children were involved in agricultural work instead of going to school to pursue education hence, it is a huge progress in the lands of Haor region where farmers practicing CSA are seeing good progress in their livelihood and child-wellbeing. However, the land in Hasanbosot village in Sunamganj is very pricey for the farmers. Hence, they have to cultivate in limited amount of space and are skeptical sometimes in trying new varieties in fear of loss.

### 6.1.2 Coastal Region

According to the farmers in coastal region, they have fewer diseases compared to their previous dire situation. They also have Pond Sand Filter technology which is used to filter the salinity of the water to some extent. Hence, they are having less gastric problems. More toilets are being placed and they are being more hygienic. Recently, the farmers now celebrate different types of programs and festival in the villages since their livelihood is getting better in the last 5 years.

Previously, when the farmers used to struggle with their agricultural crops, their children used to help them on their agricultural activities. Since their development has occurred in the agricultural sector, the farmers are sending their children to the schools and colleges. When the farmers have a good harvest by cultivating saline tolerant rice, they can easily afford and send their children to go to the educational institutes. Also, the additional vegetable cultivation in different methods has allowed them to provide extra nutrients in their family.

### 6.1.3 Hill Tracts Region

The landless and marginal farmers are the most vulnerable communities. They make minimal income by working in other's land on lease. Ownership of land and water is a big issue in these two villages. The owners do not share their resources with neighboring owners or other farmers. The owners of uphill land often build dams and barrages to capture water for irrigating their land. But as a result, the owners of downhill land face water crisis. With the increase of income, the farmers have become more solvent and are able to send their kids to school for education. But the difference of livelihood between the CSA and non-CSA farmers was not apparent. On average, livelihood and well-being of all farmers have improved despite their method of agriculture.

### 6.1.4 Floodplain Region

In Gopalganj, CSA farmers practicing mainly floating agriculture, have stated that they got benefited financially by practicing CSA. They can now send their children to schools and can provide more safety to their family. Similarly, in Jamalpur, farmers' livelihoods have improved overall, which is highly witnessed due increased female participation. The percentage of school-going children has also increased since before, with their well-being. Non-CSA farmers do not want to take such a risk as they are poor, so their livelihood remains the same as before.

### 6.1.5 Char Region

People in flatland suffer mostly from overflowing rivers. Farmers state that compared to their former poor circumstances, they have fewer diseases and illness. High macha method for domestic animals, which somewhat protects the animals from flood water. More toilets are being built which are more stable. Farmers now celebrate various events and festivals in their localities as their livelihood improves. Farmer's wives are now working side by side with the farmers from making the seedbed until the harvest time. Their opinions are valued the most during the harvesting time.

Farmers' children used to assist them with their agricultural activities while they were failing with their agricultural crops. After practicing CSA and introduction of CSA technique, the farmers are sending their children to schools, colleges and universities as a result of their advancement in farming production. Farmers can easily afford to send their children to educational institutes when they have a successful harvest.

## **6.2 Women Involvement & Participation**

The agriculture sector is not only the largest sector with regard to employment generation for Bangladesh; it is also the largest space for women's participation and social dynamism. It is the women's contribution in tasks like cattle rearing, poultry farming, paddy husking, boiling and drying, processing and preservation of food which maintains the whole process of agricultural sector. Even if these tasks are mostly carried out by women in the villages, the decisions are mostly taken by the male group of the community. Nevertheless, the study has seen a major shift in women's leadership at few study areas, and also constraints or barriers on their involvement. These issues are categorized under each region as follows:

### **6.2.1 Floodplain Region**

In Jamalpur, the experts claimed that the majority of the female population is involved with CSA and non-CSA practices. However, they only face the lack of appropriate scopes to engage them. The Homestead nutrient-based vegetable gardening in Jamalpur has involves large scale of women than men of the community. On the other hand, in Gopalganj, female involvement in CSA is lower than Jamalpur. The experts indicated that the women's involvement is more towards alternative livelihood options like garments.

### **6.2.2 Char Region**

According to the experts, there were high rates of involvement of women in the Char land. This is because, there is a greater influence of local NGO who encourages the involvement of women participation and encourages their role in agriculture. In this way, the local community including women are highly aware of their rights and indulge themselves more in the chain of agricultural network. However, they highly showed concerns on the issue that the women still do not get proper recognition in decision making yet their involvement increased.

### 6.2.3 Hill tracts Region

The hill tract areas, the families follow a matriarchal community where women are the breadwinner of the household. As of this, the female is mostly involved with the CSA practices in Bandarban. For instance, the fruit gardens are mostly managed and supervised by the women, from cultivating, harvesting to marketing the products. The whole chain of production to distribution are maintained by the women of the hill-tracts.

### 6.2.4 Haor Region

In the Haor region, involvement of female was found satisfactory, according to the expert's opinion. In Sunamganj, female participation was found higher than Netrokona. The experts of Netrokona stated that they cannot provide appropriate scopes for the female population as they are mostly unwilling to participate even if encouraged. However, the agricultural officers seem to prioritize male participation when it comes to agricultural work.

### 6.2.5 Coastal Region

Female participation was recorded high in both the study location of the coastal region. In Satkhira, the experts noted the problem for the female is not getting proper training in two sectors at a time.

According to the experts from MoA, female participation in CSA is essential for the success of the projects. They noted social stigma as a major problem of female engagement in CSA in some region.

# Chapter 7: POLICY ANALYSIS



## 7.1 Existing policy related to CSA

CSA in Bangladesh is facilitated by a number of significant policies, strategies, and initiatives that deal with issues of agriculture and climate change. The policy cycle categorization refers to three basic stages: policy preparation (indicating to a policy that is in a preliminary development stage/consultation process), policy validation (to indicate the availability of mechanisms for the policy to process at the national level), and policy in active implementation (to indicate apparent progress/outcomes toward reaching broader policy goals, using practical methods).

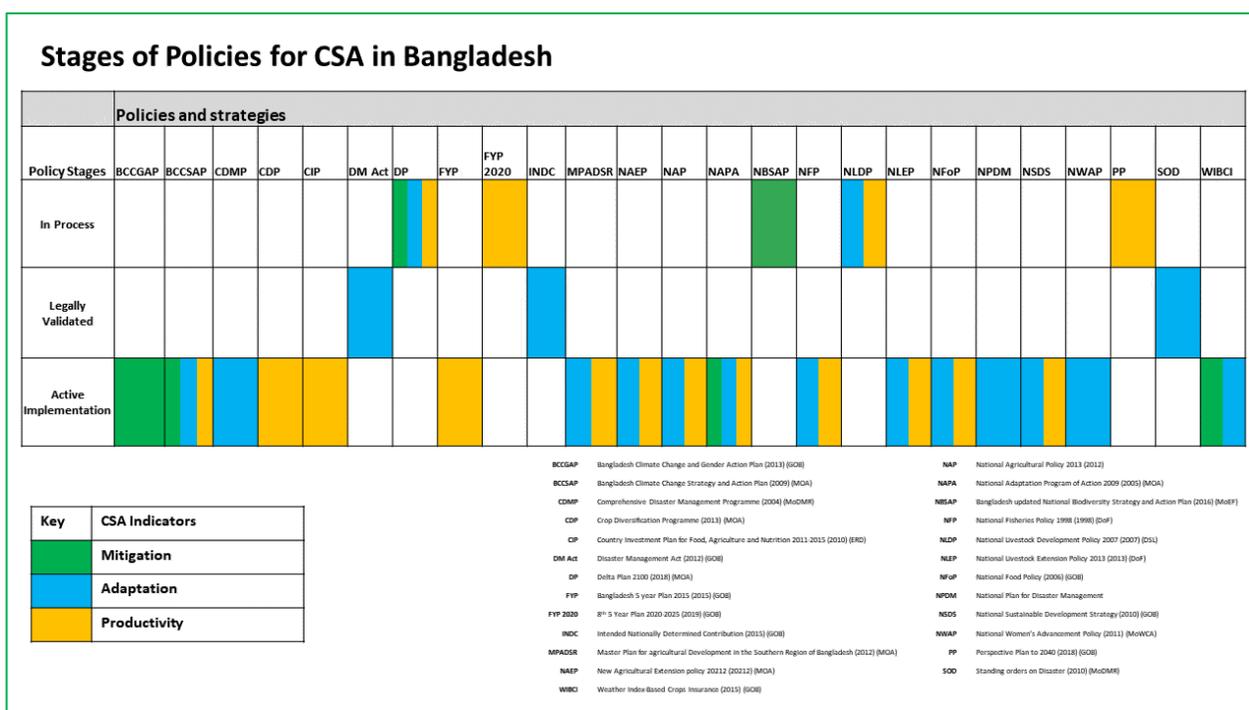


FIGURE 20: THE CURRENT POLICY RELATED TO CSA IN BANGLADESH

The Fig 20 shows the existing policies and strategies which are progressing towards the indicators of CSA. It denotes clearly the existence of CSA policies more progressive towards achieving the CSA pillars: productivity and adaptability as the study found in the field. There are few policies which are meeting the pillars of CSA mitigation but it is still in the preparatory level and needs active implementation in the grass-root level to reach towards national level. Nevertheless, the policies focusing on adaptation pillar shows an impressive progress as it is legally validated and processing at national level.

### 7.1.1. National Agricultural Policy 2018: a regional analysis

The National Agricultural Policy 2018 somewhat aligns and meets the CSA pillars in the grounds of productivity and adaptation even being four years older than now. It is yet to address the mitigation pillar of the CSA which denotes the importance of reducing GHG emissions in the agricultural system. The section will point out the policies which are addressed and policy issues for implementation for each region.

#### Current policies addressed

##### *Haor*

##### **Khaliajuri, Netrokona**

According to National agriculture policy 2018, under the section 3.3.6.1 (Climate change, stress tolerant variety, and Technology), the activities have to be strengthened in order to be more resilient in the climate change impact of the crops

Also, under the section 3.3.6.3 it is said to strengthened the research activities for innovative, cost effective and profitable farming technologies suitable for the adverse environment.

##### *Coastal*

##### **Shymnagar, Satkhira**

Under 8.1.2 of the National Agriculture policy, the agricultural land is recovered from the coastal and water-logged lands.

Under the section 9.1.2 the, suitable crops for coastal regions like sweet potato, wheat, gourd, cabbage etc. are being cultivated.

Under the section 3.3.6.1 (Climate change, stress-tolerant variety and Technology), the activities have to be strengthened in order to be more resilient to the climate change impact of the crops.

All the policies on 9.1 Coastal agriculture are being followed in these two villages of Shymnagar.

##### **Kalapara, Patuakhali**

Section 4.5.1 (Disaster combat and crop protection) brings disaster-prone land under the agricultural program, which both the agriculture officers managed to do. Here they managed to bring saline areas under an agricultural program through rice varieties and CSA methods.

Section 4.5.5 is to provide inputs to the farmer's disaster relief and agricultural rehabilitation, which the agricultural officers gave to the farmers

Under section 8.1.2, the agricultural land is recovered from the coastal and water-logged lands by using them in agricultural cultivation.

According to National agriculture policy 2018, under the section 3.3.6.1 (Climate change, stress-tolerant variety and Technology), the activities have to be strengthened in order to be more resilient to the climate change impact on the crops

Under the section 9.1.2 the, suitable crops for coastal regions like sweet potato, wheat, gourd, cabbage etc. are being cultivated

Also, section 3.3.6.3 is said to strengthen the research activities for innovative, cost-effective, and profitable farming technologies suitable for the adverse environment.

More or less, all the policies on 9.1 Coastal agriculture are being followed in Kalapara.

Section 9.1.3 is not addressed as the agricultural officer blames the water development board for not having a proper dam system and coordination with the agricultural office.

### *Floodplain*

#### **Jamalpur**

According to National agriculture policy 2018, under the section 3.3.6.1 (Climate change, stress tolerant variety and Technology), the activities have to be strengthened in order to be more resilient in the climate change impact of the crops

Also, under section 3.3.6.3 it is said to strengthen the research activities for innovative, cost effective and profitable farming technologies suitable for adverse environments.

Sometimes the elite farmers try to misuse their power over the medium and poor farmers by defaming them Infront of NGO officers and try to get the benefit all by himself. That time other

remaining farmers get deprived from the sources they were promised. Each farmer should participate in demonstration training and should take their rights on those resources.

Under the section 4.5.1 (Disaster combat and crop protection) is to bring disaster prone land under the agricultural program which both the agriculture office and the NGO Unnayan Sangha manage to do.

Under section 4.5.5 is to provide inputs to the farmers disaster relief and agricultural rehabilitation.

Under section 8.2.1 (Change climate and agriculture) sub section 1 and 3 it is said to encourage people to use environment friendly technologies to reduce the GHG emission. Also, to take initiatives to produce healthy and strong seedlings under controlled conditions to face the hostile environment.

Under section 8.2.2 (Conservation of Environment and Natural resource) the subsection 1 to 7 is being addressed in the CSA practices by the stakeholders.

Under 9.2.5 the construction of dams in the events of sudden flood

## **Gopalganj**

### *Regarding Crop diversification (Flood tolerant rice cultivation, Alternative cropping, Maize cultivation)*

- Under the section 3.3.1.2 Enhance hybrid and mutation breeding activities for the cultivation of high yielding, nutritious, economically and hygienic crops, and increase the field and periphery of molecular breeding along with conventional breeding practices;
- Under the section 3.3.1.3 Strengthen capacity to develop advance, cold and heat tolerant crops, especially rice varieties in the face of sudden and late flooding.

### *Regarding small irrigation (Buried Pipeline):*

- Under the section 5.4.1.1 of the National Agriculture policy, encourage use of pipelines instead of irrigation drains in all possible areas of irrigation for the use of moderate water resources subject to evaluation of water availability;

- Under the section 5.4.1.2 Increase irrigation efficiency for the development of water utility and productivity to ensure regular use of water resources;
- Under the section 5.4.1.3 Achieve the priority of irrigation water resources, and to undertake the activities of sustainable water use technology.

Regarding weather forecasting:

- Under the section 8.3.1 Take initiative to modernize and strengthen hostile weather forecasting system at local level;
- Under the section 8.3.2 Monitor situation and provide forecast of information on the outbreak growth of disease round the year through promotion of advanced and responsible forecasting system.
- Under the section 8.3.3 Encourage all concerned to take necessary initiatives including preparation of crop calendars, seed distribution and follow-up to face the post-disaster situations.

Regarding Hydroponic (Floating agriculture):

- Under 10.2.1, Undertake special initiatives for the development and dissemination of nutritional value and productivity enhancement through Hydroponic culture technology for cultivation of fruits and vegetables;
- Under the section 10.2.2 Provide product support, training and incentives to increase the interest and efficiency of Hydroponic agricultural production
- Under the section 10.5.2 Enhance development activities by identifying profitable crops and agricultural activities.

Regarding Floating agriculture:

- Under the section 10.7.1 Verify the feasibility of floating farm-based crops and to modernize the production system and to undertake branding initiatives for marketing as a heritage product.
- Under the section 10.7.2 Undertake short, medium and long-term programs involving motivated participants to expand region-based needs and appropriate adaptive technologies.

- Under the section 3.3.1.6 Encourage development of crop varieties to meet the preference of special categories of consumers.

## *Char*

### **Gaibandha**

Under 8.1.2 of the National Agriculture policy, the agricultural land is recovered from the char and river bank erosion lands.

Under the section 9.1.2 the, suitable crops for char regions like sweet potato, pepper, corn, nut etc. are being cultivated

Under the section 3.3.6.1 (Climate change, stress-tolerant variety and Technology), the activities have to be strengthened in order to be more resilient to the climate change impact of the crops

All the policies on 9.1 Charland agriculture are being followed in these four villages.

## Policy issues for implementation

### *Haor*

#### **Khaliajuri, Netrokona**

Under the section 4.5.5 is to provide inputs to the farmers disaster relief and agricultural rehabilitation

Under the section 9.2.3 (Haor and wetland agriculture) strengthen the modern technology-based training and extension for area based sustainable agriculture is yet to be done.

Under section 9.2.4 expedite extension activities to popularize flood and submerge tolerant crops is yet to be done extensively.

#### **Sunamganj**

The study learned from KII and FGD that the section 9.2.5 of Haor and wetland agriculture (National Agriculture Policy 2018) is still yet to be addressed properly because the advanced disaster forecasting system is still lacking behind. The farmers suggested that if they could get any

sort of early warning system, it would be better for them. There were no grass and vegetable cultivation in the floating agricultural system which opposes the section 9.2.6.

### *Coastal*

#### **Shymnagar, Satkhira**

Based on FDGs and KII, the study addressed that section 9.1.2 of National Agricultural Policy 2018 is yet to be addressed more where new crops like mung, maize, cotton, wheat, sunflower, etc., can be introduced.

Also, it is seen that section 9.1.8 is to be strongly addressed where a special program is to be arranged to give incentives for the promotion of profitable crops.

Lastly, section 9.1.10 is to be more developed and advanced where awareness and alert have to be created by providing agrometeorological information through monitoring tidal movement, soil and water salinity so that the farmers can have enough time to prepare for any disaster.

#### **Kalapara, Patuakhali**

Under section 3.3.6.2, the research in producing low greenhouse gas emission crop technology and cropping patterns is yet to develop.

With the initiative of the agricultural officer in Kalapara, the coastal people are trying to follow the policy. Except for section 9.1.3, other sections of 9.1, Coastal agriculture is being followed. or in the process of being followed.

- By reviewing the various policies and field implementations, the study identified that the local officials and farmers are not aware of the policies, but the local officials are indirectly following some of the policies on their own initiative. Therefore, it is concluded that if the right direction was given, the policies would be followed properly, and the local farmers and all would benefit.
- The agriculture departments of the government benefited farmers in Niamotpur and Gamortola. Farmers and government officials enjoy an excellent working relationship. Different adaptation tactics, assistance, and expertise have been provided by Upazilla agricultural officers and sub assistant agriculture officers to confront and combat climate risks. Farmers were offered various incentives, such as cash, seeds, or supplies, to

encourage them to adopt Climate Smart Agriculture methods. In addition to government authorities, a variety of non-governmental organizations (NGOs) aid and advise farmers in various ways. Salt Solution, Caritas, and CODEC are notable local NGOs. In addition to government officials, a number of NGOs provide assistance and advice to farmers in various ways. Notable among the local NGOs are Salt Solution, Caritas, and CODEC.

### *Floodplain*

#### **Jamalpur**

Under section 3.3.6.2 the research in the production of low greenhouse gas emission crop technology and cropping pattern is yet to develop.

Unnayan Sangha is developing a project with farmers' children. Those who have smart phones can track weather forecasting of that area with the help of their mobile phone and as most of the farmers are illiterate their children can help them to get a proper news of their present weather situation.

Farmers are trying to get a small technical motor to fit it in their field because they do not have that space also do not have the money to buy a big one, if government coordinate a project with Japan to build small scale motors for that poor farmer, then they can increase their production level within their small capacity in a large scale.

Under section 9.2.3 (Haor and wetland agriculture) , modern technology-based training and extension for area-based sustainable agriculture is yet to be done.

Under the section 9.2.4 expedite extension activities to popularize flood and submerge tolerant crops is yet to be done extensively.

#### **Gopalganj**

- The local agriculture office mentioned a policy gap regarding monitoring after the implementation of project as they received news of farmers exploitation of government given “Pronodona package” for practicing CSA.
- Local marginal farmers suggested increasing the funding from the government.
- Strong and smart policies need to be made and implemented to extend the cooperation of local agriculture office.

- Cost-effective and low input cost-requiring techniques should be promoted to address the local marginal farmer.
- Other types of alternative irrigation besides buried pipelines also need to be introduced.

### *Char*

#### **Gaibandha**

Base on FDGs and KII, the study identified that section 9.1.2 of National Agricultural Policy 2018 is yet to be addressed more where new crops like mung, maize, cotton, wheat, sunflower, etc., are introduced to be done.

Also, it is seen that section 9.1.8 is to be strongly addressed where a special program is to be arranged to give incentives for the promotion of profitable crops.

One issue that needs to be addressed is that the transportation system in Gaibandha is not very suitable for the villagers. Even though they grow the crops on their own fields, if they cannot take them to market, they will not get the proper value of their hard work. They need a proper road to allow big vehicles to take those cultivated crops to the market.

Lastly, section 9.1.10 is to be more developed and advanced where awareness and alert have to be created by providing agrometeorological information through monitoring tidal movement, river water level so that the farmers can have enough time to prepare for any disaster.

### *Hill-Tracts*

#### **Bandarban**

There is no existing policy that addresses the CSA practices specifically. According to the key informants, the existing agriculture policies are a hindrance to the expansion of CSA in Bandarban Upazila because the agricultural practices in this area differ by large margins with that of the other parts of Bangladesh. Therefore, a separate agriculture policy needs to be framed to accommodate CSA practices that are suitable for the unique physiographic and climatic conditions of Bandarban.

Local farmers are mostly unaware of the policies related to agriculture. They are only involved in the implementation phase of the policies in action. Currently, Zinc rice is being introduced to a few farmers in Bandarban. 2-3 farmers in Chemidulu para have received seedlings of Zinc rice for cultivation

## 7.2 Recommended policy by stakeholders

The study discovered that there are existing policies/ strategies (BCCGAP, BCCSAP, CDMP, CDP, CIP, DM Act, DP, FYP, FYP 2020, INDC, MPADSR, NAEP, NAP, NAPA, NBSAP, NFP, NLDP, NLEP, NFoP, NPDM, NSDS, NWAP, PP, SOD, and WIBCI) which are being implemented initially yet there is a massive gap in awareness, communication, management, monitoring, and scaling up the policies towards making the CSA practices and techniques a robust method. The recommendation on the policies came forward as the issues regarding the implementation of CSA is highly depends on region-wise or location specific. Hence, to have in-depth insights on the policy gaps, the recommendation has been presented region-specific to better understand the scope of further study and need of implementation.

### 7.2.1 Haor Region

According to the agricultural experts, the villages under Haor region has a different crop cultivating pattern from other region as it stays inundated for six months. As the climate is changing, the flood water tends to come early which disrupts the stability of crop management. There is policy regarding Weather forecasting but addressing the dynamics of each location-specific issues regarding the weather forecasting method is still absent in the policy. The farmers suggested that a proper early warning system for their area would decrease the loss of their crops as they could know before-hand the impact and make strategy and decision based on the forecasted weather.

Moreover, the agricultural officers expressed that the introduction of new species aligns with the policies suggested. In order to properly address the policies, they are even trying to implement floating agriculture and vegetable cultivation which are suggested crops for the region, but they are failing as the floating bed doesn't suit with the intensity of wind and eventually breaks or flows away. Thus, they think just suggesting crops on the policies are not feasible but there could be a bottom-up approach where the policies are shaped based on the failure of such crops suggested in the grassroots level.

Even if different crops and cultivation techniques are introduced by the local experts and adapted by the farmers according to the policies but they showed concerns regarding the timing of receiving seeds and fertilizers, in Khaliajuri. They receive the seeds and fertilizers at the same time as other

Upazilas of Netrokona whereas they face inundation nearly 1 month earlier compared to other. Hence, it comes difficult for them to manage the distribution to the farmers and eventually farmers face challenges in cultivating the crops. Therefore, the agriculture officer of Khaliajuri Upazila suggested reforming the policy for receiving government-given seeds, and fertilizers a month earlier or depending on the seasonal flood pattern of every area in Haor regions.

It is evident that farmers are aware of the policies regarding agriculture or CSA but it is the responsibility of the SAAO and agricultural officers to educate them on the policies where they can contribute in identifying gaps and a need-based policy can be generated. However, through FGD and case studies, the farmers stressed to include the significance of strengthening cooperation between higher-level stakeholders like government officers with them. Also, the marginal farmers stressed that the policy should address that they have little scope of adopting a new technique due to a lack of capital and how they could be more included in adapting to new CSA practices. Overall, their suggestions to address the policy gaps focuses on (1) government officers and field workers need more communication with the farmers, (2) location specific allocation of funds and resources, (3) strengthening local beneficiary farmer groups and (4) increase their accountability for the implemented project works.

### 7.2.2 Floodplain Region

The areas under the floodplain regions are mostly addressing the practices according to the policies which promote CSA. For instance, in Jamalpur the local NGOs and government agricultural officers are aligning with the existing policy by providing guidance, trainings, and materials to local marginal community to increase their nutrient security at the same time introducing scientific technique of crop cultivation to eradicate malnutrition and elevate poverty of the local marginal farmer community. On the other hand, the experts in Gopalganj are assessing the status of ongoing agriculture practices in a region and proving a sustainable mechanism for cultivation to all farmers through introducing new techniques and crops suitable to their climate based on the policy suggested regarding agricultural improvement scopes in floodplains. In Jamalpur, the Unnayan Sangha is developing a project to train the farmers' children with smart phones in order to track weather forecasting of that area. As most of the farmers are illiterate their children can help them to get proper news of their present weather situation. This practice is perfectly aligning with the existing weather forecasting policy.

However, there is an existing management, collaboration and monitoring issues in both the locations which they are unsuccessful to align with the policy. The experts reported policy gaps such as no fixed assessment technique of selecting beneficiaries, marginal farmers cannot participate due to lack of capital & appropriate machineries, the risk of losing effectiveness of invented climate resilient crops due to rapid onset of climate change impacts, and complex socio-economy of different regions are not assessed before implementing any livelihood project.

Therefore, they recommend the policy to address (1) the development of strong monitoring and continuous evaluation, (2) providing region-specific technology, (3) increasing government man power, (4) establishing integrated approach in planning and implementation, and (5) evaluating performance of disaster resilient crops species yearly/seasonally.

### 7.3.3 Coastal Region

The farmers residing in the coastal region are the most vulnerable community to climate change compared to other regions. They are already facing the aftermath of climate change. Saline intrusion has been disrupting normal variant crops which had to be totally replaced by saline variant crops in order to sustain their livelihood. The new variants are there to support the existing policies but the experts also stressed that as the level of salinity is increasing -triggered by frequent tidal surges and cyclone, the existing saline tolerance variants might not be enough to tackle the salinity in the long-run. Eventually, the farmers will face difficulty and their livelihood issues will be on threat. Thus, the experts recommend that policy should open doors on the possibility of suggesting techniques or practices in agriculture considering long-term prospects.

The coastal areas have moderate to good forecasting method in terms of cyclone where they can take preparatory actions to reduce loss and damage of the farmers. However, it is yet to follow and address policies on developing and advancing alert or warnings by providing agrometeorological information through monitoring tidal movement, soil and water salinity so that the farmers can have enough time to prepare for any disaster.

In some areas of coastal region like in Kalapara, different adaptation tactics, assistance, and expertise have been provided by Upazila agricultural officers and sub assistant agriculture officers to confront and combat climate risks. The farmers are offered various incentives, such as cash, seeds, or supplies, to encourage them to adopt Climate Smart Agriculture methods which align

with the policy to promote CSA. However, there should be policies where special program will be arranged to provide initiatives to those farmers for their profitable crops in order to promote CSA in the long run.

#### 7.4.4 Char Region

The villages in Char regions have the most effectiveness in terms of promoting and implementing climate smart agriculture on-ground. The farmers are noticing huge change in their productivity, yield and profit gains. The practices are implemented by both the government agricultural officers and local NGOs collaboratively which aligns with the policy and the experts encourages this stakeholder engagement to be implemented and practiced in other regions as well because of its success rate. Hence, the expert also recommends that the policy should stress the stakeholder engagement to be promoted when it comes to flourishing CSA in Bangladesh.

One issue that needs to be addressed and highlighted in the policy is the relationship of transportation and agriculture. For instance, in Gaibandha, even when the farmers are successful in growing the crops on their own fields, they cannot reach the market due to lack of transportation services and thus, they don't get the proper value of their hard work.

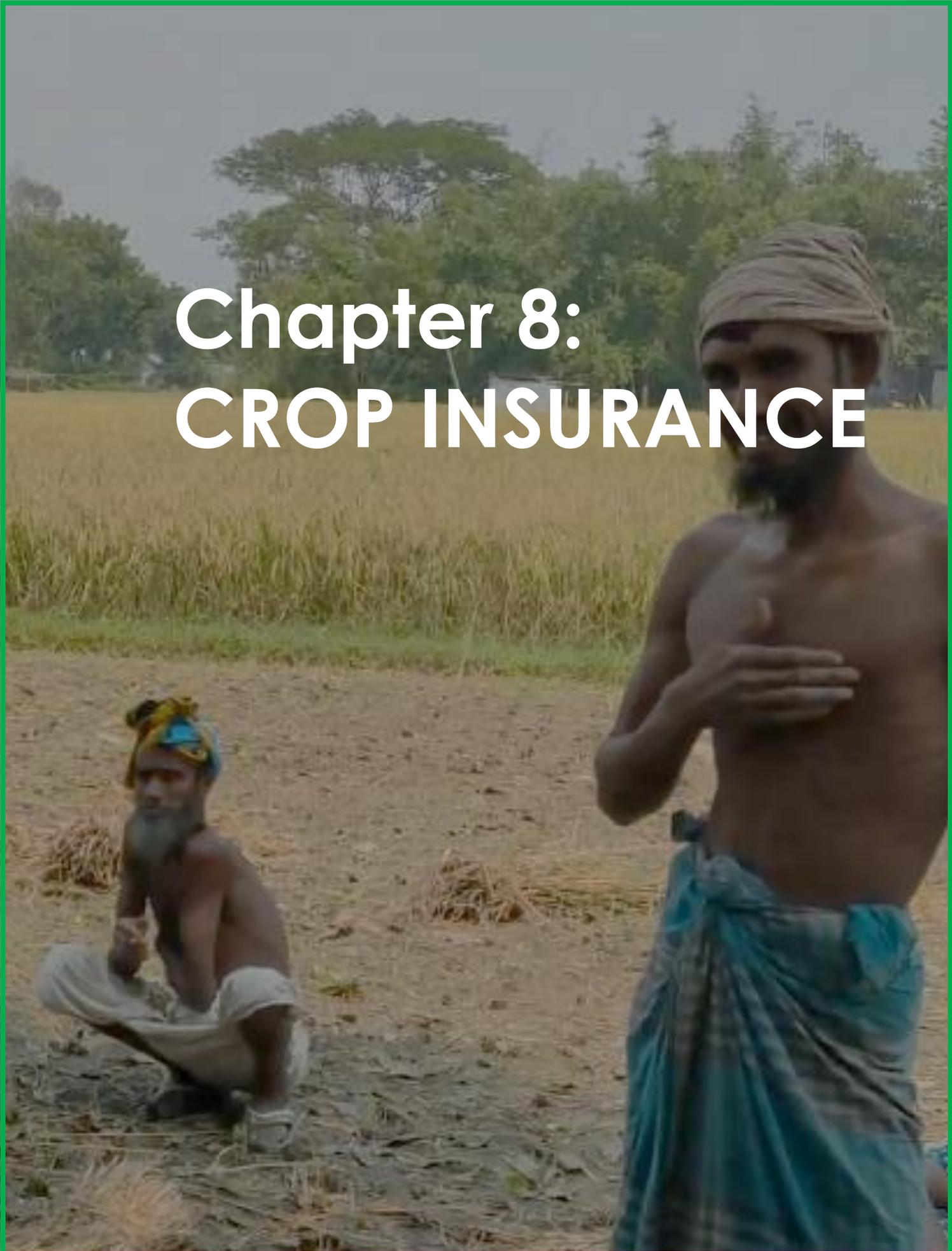
#### 7.4.5 Hill tracts Region

The experts like agricultural officers are following the existing policies by providing seeds, fertilizer and trainings for implementing modern cultivation methods. There are some practices which are indigenous and locally adapted method promoting climate smart agriculture. The experts mentioned policy gaps, such as new projects take too long to be accepted by the locals because of slow expansion of the project, lack of monitoring and evaluation, lack of intra-regional policy. They suggested that total socio-economic evaluation and assessing local physiography should be done before planning a project, project beneficiaries need to be selected from all class of farmers, and ensuring long term commitment with the beneficiary farmers.

According to the key informants, the existing agriculture policies are a hindrance to the expansion of CSA in Bandarban Upazila because the agricultural practices in this area differ by large margins with that of the other parts of Bangladesh. Therefore, a separate agriculture policy needs to be framed to accommodate CSA practices that are suitable for the unique physiographic and climatic conditions of Bandarban.

Based on the review of various policies and field implementation, the study discovered a common ground that most of the local officials and farmers seem to be unaware of the policies, yet the local officials are seen to be indirectly following some of the policies with their own initiative. Therefore, it is concluded that if the right direction was given, the policies would be followed properly, and the local farmers would be more benefited. It is also found that the research in producing low greenhouse gas emission crop technology and cropping patterns is yet to be developed in all the regions.

# Chapter 8: CROP INSURANCE



## 8.1 Crop Insurance

Crop insurance is a new concept which can be widely adapted in Bangladesh due to its climatic circumstances and threats faced by the farmers. It is a process where the farmers can be benefited or subsidized by the government to protect against either the loss of their crops due to uncalled natural disasters, such as hail, drought, cyclones and floods, or the loss of revenue due to declines in the prices of agricultural production. As Bangladesh is the most exposed country to natural disasters, including floods, cyclones, and droughts, the small and marginalized farmers are the worst sufferers. Hence, a qualitative study has been conducted with the farmers of 5 different regions in Bangladesh to understand their perspective of crop insurance in order to reflect the scope and prospects of introducing it as a long-term climate adaptation and mitigation measure.

The study discovered that the farmer's perspective lies towards positivity once they understand the concept of crop insurance.

They expressed that it will be beneficial to them as it will be easier for them to minimize the immediate loss and damage during an uncalled disaster. It will no longer be challenging for them in terms of duration, to recover from the loss they face as they can immediately invest on the next crop cultivation thus, their productivity and profit will be constant. As a result, they also hope that this could mean they will not have to face difficulties or financial constraints in sending their children to schools or college. However, they are skeptical of the management and distribution of crop insurance from the government. In some places the farmers cannot rely on the government officials at the field level due to communication gap, and therefore thinks it will not be as effective as anticipated. Nevertheless, the farmers also highly recommended the need of their constant participation in the management of crop insurance process which could be beneficial to both the stakeholders in the long-run.

# Chapter 9: SCALE-UP OPPORTUNITIES



## 9.1 Scale-up Opportunities

According to the study, it could be concluded that the agricultural practices and techniques in Bangladesh which we are calling climate smart agriculture based on the three CSA pillars are still at their initial stage. Nevertheless, it has the potential and scope to scale-up in terms of effectiveness, efficiency and expansion. The study of CSA allows the stakeholders, practitioners and policy makers to identify the concrete actions which are needed to be taken and how certain agricultural tools that are already implemented can link into CSA planning approach.

Every CSA practice and technique that the study identified has most likely emerged depending on the disasters that have been affecting each area. Even though these practices and techniques are meeting the productivity and adaptability pillars of CSA, there is a huge necessity to strengthen scientific and technical research on the mitigation pillar of the CSA in Bangladesh which denotes how much GHG emission each of the CSA is contributing in reduction.

Additionally, there is an opportunity to scale-up with the help of seasonal calendar on the current CSA practices and techniques identified which are now adaptable to the current climate. However, in the coming years, the climate will change its course and pattern rapidly hence, further data of seasonal calendar of this exact CSA (ex: after 5-10 years) will help understand a comprehensive shift of season on a particular practice or technique by keeping the current one as a baseline. To conclude, the change in seasonal pattern can also guide us to understand whether it can be called as a climate smart agriculture.

The study also delivers progression data of the CSA practices which portray the plots where the current CSA are practiced and simultaneously show what crops they used to practice on the same plot 10 years ago from now. This progression map through spatial analysis has a possibility to scale up as it will also work as a baseline to understand whether the current CSA practices which are practiced in one plot, have the potentiality to survive for 10 more years. Whether the current CSA practiced in a plot will stay feasible for it in the coming changing climate can be interpreted from the map.

For instance, the present rice tolerant variety won't be enough to endure the salinity level in the coastal region. New saline tolerant rice varieties have to be introduced, which will be more tolerant to salinity so that in the future, people don't have any failed harvest or yield. The farmers of the

study area are very keen to know more about the CSA practices as their life is getting better from it. Hence, there is a scope of providing them proper guidance and knowledge distribution regarding CSA which can make their lives more tolerant to the climatic threats.

Additionally, there is a scale-up opportunity for agricultural institutions to expand the CSA practices and techniques towards livestock and fisheries sector. According to Ministry of Agriculture, the use of livestock residue into biogas through co-digestion or hydrogen energy has the potential to reduce GHG emission. Even though collaborative work is done with Dhaka University, BUET and private sector, there is still an absence of CSA contribution in the grass-root level. For instance, according to local experts, the scope of CSA establishment in Bandarban regarding livestock is low and challenging as there is a presence of land ownership issue which leaves limited and unaffordable pasture land for grazing the livestock. On the other hand, there might be a possibility for CSA on fish cultivation but challenges such as lack of water body, and frequent dryness of streams comes as a barrier. In Haor regions, there are opportunities to scale-up CSA in terms of livestock and fisheries but due to inability to afford, and food shortage during inundation period, the scope of expansion gets limited. However, in Gopalganj, farmers who own livestock also practice Maize cultivation so that they can feed their livestock, which works as a good diet for them. On the other hand, in Char areas, the built macha beds, which are higher than flood water level for keeping them safe during flood, can be considered as one of the CSA techniques. Hence, there is a ray of opportunity for the local NGOs, government to flourish their climate smart practices and techniques towards livestock and fisheries.

Even if CSA becomes a wide-spread concept to practice for the farmers considering livestock and fisheries, the further implementation of it should consider that there is a minimal scope for the marginal farmers to switch to CSA practices and techniques otherwise supported intensively by local NGOs and government for a long period of time. Most of the time, the small and marginalized farmers are not willing to switch to new crops or techniques in fear of loss, low on investment cost or no land of their own. As a result, they get excluded from practicing new CSA practices and techniques even if they want to initiate it. Hence, there is an opportunity to scale up cost efficient and low-tech methods of CSA region-wise to bring marginal farmer community under the umbrella of climate smart techniques.

The study concludes that the scale-up opportunities for CSA in Bangladesh have the potential to withstand the agricultural loss and damages due to climate change. This will highly depend on building strong knowledge networks and fostering learning among local farmers, local NGOs, private sectors, and agricultural government officials.

Additionally, there is a scale-up opportunity at Jamalpur where Farmers are trying to get a small technical motor to fit it in their field because they do not have that space also do not have the money to buy a big one. If government coordinates a project with Japan to build small scale motors for poor farmers, then they can increase their production level within their small capacity in a large scale.



# Chapter 10: WAY FORWARD

## 10.1 Way Forward

The discussion regarding the emerging concept of Climate Smart Agriculture is consistently centered between the science behind agricultural practices and how policy is influencing CSA into implication at the ground level. Although it addresses the urgent need for an effective strategy to manage agricultural and food systems under climate change, CSA has sparked a spirited discussion in both the scientific community and civil society. As we already know CSA is targeted by three criteria simultaneously (i) productivity, (ii) adaptation, and (iii) mitigation.

However, the study on CSA reveals a clear contradiction between these three goals, highlighting the fact that CSA is frequently and exclusively focusing on adaptation rather than mitigation and productivity at the policy level while practices impacting production section of CSA is gradually increasing at the field level. We need to respond to the needs of CSA in terms of site-specificity and potentiality for adoption by farmers because it is strongly based on local practices.

Moreover, we need to think beyond just agricultural production and adaptation which targets the CSA pillar, but also conduct a comprehensive scientific study on the two currently overlooked dimensions which are (i) mitigation and (ii) trade-offs and synergies between the three criteria. Hence, it can influence to suggest climate change mitigation-based strategies at the policy level.

According to the chapter where a comparative analysis of CSA was expressed between global and local, the study has seen different kinds of tools and methods that are used in the similar agricultural zone as Bangladesh. The methods focusing on irrigation method (Pakistan), weather forecasting (India) or crop insurance (India) can be developed for Bangladesh. By inducing those techniques with proper funding, CSA practices will bring a huge change for changing adverse effects of climate change on agriculture. Alongside funding, there should be proper monitoring and evaluation system of the on-going projects which has the potential to promote CSA and influence should be maintained as suggested by the local experts to ensure the success of the projects.

Additionally, weather forecast is a major issue for the local farmers as they are unable to get proper information on the status of the weather at the right time, which leaves them with no option but to suffer the crop damages due to extreme weather conditions. To combat this issue, implementation of ICT based information dissemination will be an effective tool. In places like Gaibandha, ICT-

based tech has already been developed called BA-MIS which farmers can access to understand the climatic related information impacting their crops. On top of that, in Jamalpur, government officials are providing training to the youth community (children of the farmers) to understand how they can tell the status of weather just through their phone so that they can help their parents with the information. Hence, the study believes this kind of ICT-based technology should be proposed and funded to better practice CSA. Simultaneously, policy should stress the existing strategies on Crop insurance for implementation as farmers will be able to get compensation for the loss and damage due to uncertain climatic impacts.

As a way forward, a comprehensive sequence of investments, transitions, and outcomes on the road to CSA implementation and effects at scale is required. In summary, the way forward of CSA falls under the umbrella of (1) strengthening the base of CSA evidence of Bangladesh. (2) region-specific or location-specific drivers (climate change impacts), (3) knowledge management and partnerships of the stakeholders, (4) strengthening monitoring and evaluation, (7) capacity development of farmers, government agricultural officers and NGOs through co-learning within the research in development paradigm, (7) attention to gender and other marginalized farmer communities, (8) promoting ICT services, and (9) establishing policy engagement for productivity and mitigation pillars of CSA.

# Annexure

