Floodplains Ecosystem Services Survey Report

TROSA 2.0: Rivers, Rights and Resilience (3R)

Documentation of the riverine ecosystems services and socio-economic conditions of the riparian communities around 30 villages in the Barak Valley, southern Assam, India

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Acknowledgements

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Contents

Introduction – Setting the Context

Natural ecosystems -- both terrestrial (forest, grasslands, deserts etc.) and aquatic (rivers, streams, floodplains, wetlands, swamps, lakes; Ocean, reefs and coast etc.) -- are critical for human survival and all other life forms on the Earth. Ecosystems provide habitats for diverse living beings – from micro-organisms to plants and animals. However, humans derive the most of the benefits that maintain, revitalize, and sustain their lives, economy and wellbeing. Freshwater wetlands are said to be the most productive ecosystem, supporting nearly 40 per cent of all plants and animal species (UN 2024). They also act as natural filter for all kinds of pollutants, help recharge aquifers, storage of water, regulate floods and nutrient recycling. And yet, according to the Living Planet Report (WWF, 2024), freshwater ecosystems are the most degraded and threatened across the world.

In the last 50 years (1970-2020), freshwater populations (plants and animals) "have suffered the heaviest declines, falling by 85%, followed by terrestrial (69%) and marine populations (56%)," the report stated. Much of the habitat degradation and biodiversity loss is attributed to over- exploitation and unsustainable use of aquatic resources. The impact of climate change – extreme weather events, changing rainfall patterns, rising temperature and flooding etc - on the freshwater ecosystems accelerated the process of degradation and loss of habitats and biodiversity. The poor and marginalised people, who largely depend on the resources of the freshwater ecosystems, have become more vulnerable to the climate change impacts.

India has about 15.26 million hectares of wetlands and other water bodies, as recorded in the National Wetlands Atlas, 2011. Most of these inland wetlands (69 per cent) are less than two ha in size, as per the remote-sensing based assessment made in the course of the wetland mapping. However, a recent situation analysis report (Kumar, R., Bhatt, J. R. and Goel, S., 2017. New Delhi: Wetlands International South Asia.) suggests that since 1940, India has lost about 30 per cent of natural wetland area as a result of alteration of natural hydrological regimes – by structural interventions such as, construction of embankments and sluice gates (for flood control and irrigation purposes) -- degradation of catchment areas, over-exploitation of resources, pollution, unregulated tourism etc, and above all, uncertain climate events (erratic and extreme rainfall and rise in temperature) are posing serious threat to wetland ecosystems and biodiversity.

India's north-eastern region, which is drained by two of the country's largest river systems – Brahmaputra and Barak – is blessed with abundance of freshwater, forest, wildlife and biodiversity, supporting the lives and livelihoods of nearly 50 million people. A large population is settled across the flood plains of the Brahmaputra and the Barak river basins in Assam and are vulnerable to recurrent floods and river bank erosion.

The flood plains of the Barak river basin in southern Assam have been facing the brunt of erratic climate behaviour for the past several years. The devastating flood of June 2022 in Cachar that had almost drowned the Silchar city, the commercial hub of the Barak valley, was a stark reminder of the emerging environmental challenges. The unexpected flooding of the city was triggered by the spurt in water of the river Barak due to days of incessant rains. The swollen river breached an embankment and swept across the city, wrecking houses and properties, and displacing thousands of people. A flood post mortem report, carried out by the Department of Ecology and Environmental Sciences, Assam University, said the valley

received a total of 1670 mm rainfall within May-June 2022, an unprecedented precipitation, which was unseen in a decade. In addition to this extreme rainfall, unplanned construction activities, human settlements, land use changes in the flood prone areas, and choking of all natural drainages were responsible for the flood mayhem, the report observed.

Of late, research interests about the Barak-Meghna trans-boundary river systems have grown among scholars as well as policy-makers in India and Bangladesh in the context of addressing the contentious issues of water sharing, flood and climate change-induced disaster management across the river basin between the two countries. However, there is no gainsaying that all these issues cannot be resolved unless there is cooperation between countries sharing the river basin.

The Trans-boundary Rivers of South Asia (TROSA) project Phase 2.0 is one of such international efforts that pledges 'to support climate-resilient livelihoods for vulnerable natural resource-dependent communities' of the Barak-Meghna river basin. It also aims at developing a paradigm of 'inclusive river governance' across the Ganges-Brahmaputra-Meghna trans-boundary river basin. The code, 3R, encompassing three thoughtful words -- Rivers, Rights and Resilience – is quite imaginative as much as it is powerful and purposive!

The underlying idea behind the coinage of these words seems to compel one to contemplate on the nature of the conjoined relationship between the humans and the natural environment they inhabit along with other living beings. Therefore, it is necessary to ponder that when one thinks of 'river, rights and resilience', whose rights are being talked about and sought to be secured? Is it simply for serving the various needs of the human society and its economic growth and prosperity by exploiting the natural resources? Or, is this an advocacy also about river's right to be free from pollution and human interventions that hinder its ecological/environmental flow, which is essential for maintaining the ecosystem functions and services?

In the present context of the Barak valley, the project hopes to initiate conversation on riverine landscape, aquatic ecosystems and biodiversity among the stakeholders. Such engagement with the riverine villages, it is expected, may help create awareness of the need for reclaiming and maintaining the environmental flow of rivers, the integrity of aquatic life and biodiversity. At the same time, efforts are being directed towards mobilising the affected riparian communities, securing their consent, co-operation and participation as well as building their capacity in planning and decision-making process at the local level. All this will certainly help enhance the resilience of the local communities in coping with the adverse impacts of climate change and adapting to the unforeseen situation.

It is with this background the documentation works have been set out. The principal objectives are as follows: (i) to make a general assessment of the current state of the riverine ecosystems functions and services, as perceived by the riparian communities; (ii) to assess the vulnerability of the river side villages and their inhabitants to the climate change-induced calamities and the impact on their lives and livelihoods as well as the riverine ecosystem services; (iii) to help improve local capacities to enhance their resilience to climate change through training and advocacy; and finally, to secure sustainable livelihoods of the affected communities.

A Caveat

The timeline for completion of the assignment was set for a period of eight months (February-October 2024), but the preparatory works for initiating the study could begin only by the end of May 2024, nearly four months behind the schedule, and close to the onset of the monsoon months. Between the months of June-September, the Barak valley and its flood plains receive the maximum rainfall of the year, often inundating many parts of the valley, disrupting all transport and communication networks, and thus unsettling the normal life of the people. So, it is quite expected that the field works had to be adjusted according to the prevailing meteorological conditions, and availability and willingness of the people to co-operate and participate in the mutually agreed activities.

Besides the timeline, the scope of work as well as the work plans also had to be reorganized and substantially modified due to: (i) the absence of any active local organisations in the project areas; (ii) lack of trained and experienced survey workers; and (iii) non-availability of adequate budget for carrying out detailed village-wise data collection. Moreover, the recent baseline report (Baseline Assessment Report 2024) on the Meghna (Barak in India) river basin does not have any quantitative information on the project villages, except for providing some general situation analysis related to climate change as well as the livelihood of the local communities.

Therefore, considering all these constraining factors, it was decided after consultation with the local project members that instead of village-wise household survey in the 30 project villages, some qualitative data on socio-economic conditions could be generated through focus group discussions, drawing key informants from all the project villages. In addition to this, an app-based (Kobo toolbox) survey on these project villages should also be conducted especially to gather information about the local communities' perception of climate change impact on the riverine ecosystem services as well as their livelihoods.

Approach & Methodology

An interdisciplinary approach (a socio-ecological perspective) has been employed to explore and understand the nature of relationship between the local communities and the surrounding natural resources, including ecosystems functions and services, which people are dependent on for their livelihood. For this purpose, to start with, this consultant took a tour to the project areas both in the upstream and the downstream of the river Barak in the valley region to understand its bio-physical characteristics and acquire some basic knowledge about the place, local population and their livelihoods, including patterns of their resource uses.

The understanding of the critical functions of the riverine ecosystems and the economic value of the services they render is crucial for improvement of livelihoods and over all wellbeing of the local communities which depend on those resources. Since the study is confined within the project areas, the assessment of diverse ecosystems, their functions and services has been 'localised' around a few village clusters, namely, in Katigorah, Binnakandi, and Badarpur (Karimganj) Blocks. A series of transects had been done starting from the Katigorah stretch at the Meghalaya-Cachar boundary, defined by the Malidor (Baleswar in

Cachar) stream in the west, to the east up to Lakhipur (Jirimukh), criss-crossed by several streams and rivulets flowing out of the Borail hill ranges in the North Cachar Hills.

For more information, resources of the existing literature and data in the form of published research papers, books, policy documents, and various study reports related to ecosystem services and biodiversity in the Barak-Meghna River Basin have been utilized. Literature review is a part of research methodology that helps assess: (i) the state of the past and current knowledge; (ii) update the existing knowledge and data base; (iii) identify knowledge gap and deficiency, if any, and find clues to new areas of research etc. Apart from the review of the secondary data, other tools have also been used to generate some quantitative and qualitative data on the status of ecosystem services and the nature of dependencies of the local communities on the available resources. A few of these tools are as follows:

• Questionnaire method for socio-economic survey of the project villages

• Visual documentation of riverine landscapes (riverbanks, floodplains, wetlands and other water bodies) and various land use patterns -- agriculture, irrigation, wetlands, water transport and mobility etc.

• Focused Group Discussions (FGDs) with community leaders and elders

• Interviews with key informants

• Expert-based information gathering (domain-experts' viewpoints) through direct interaction with selected subject specialists (Department of Ecology and Environmental Sciences, Assam University and G.C College, Cachar)

Initially, a simple questionnaire (Annexure 1) was prepared for the field workers in the project villages for gathering first-hand information about the project area. The questionnaire comprised three broad sections (i) village socio-economic profile; (ii) identification of ecosystems services that the local communities depend on; and (iii) questions related to impact of climate change, including disaster (flood and erosion) and the coping process, among others.

However, in the middle of the ravaging floods, it was difficult to mobilize the marooned and flood-affected families and secure their consent and cooperation for the survey. Even after the flood, it was felt not quite appropriate to press them for answering questions, while they had been struggling to recover and repair their losses. Many of them were reluctant to get engaged, instead asked: "what benefit shall we get?" Nonetheless, efforts were made to get in touch with a few villages, where impact of flood was less severe.

In few places, some participatory mapping of local ecosystems and their resources with the local communities has been tried out to create curiosity and interest among them about the surrounding environment and make them understand the rationale for conservation of resources that benefit them. One revelation was that the local communities were not much aware of the terms 'climate change' or 'ecosystem services' or the word like 'nutrient recycling' or, for that matter the language of the climate change narrative used in official meetings, seminars and conferences. Therefore, even though the questions were asked in vernacular, the villagers could not articulate their replies to the questions related to climate change issues or relate the impact of the changing climate events to their lives and livelihoods.

Under these circumstances, considering the lapsed time (almost five months) and limited funds, the project team members have suggested that additional information can also be collected as well as verified during community consultations, training activities with the community or FDGs with the project villages.

In addition to all these mentioned above, a few brief case studies on different categories of ecosystems with certain special features have also been done to explain how these factors contribute to multi-dimensional challenges and manifestation. One of these special aquatic ecosystems is the Rupaibali *anua* (Ox-bow lake), which was formed by the changing channel of the Barak. Then there is the peculiar case of Old Tukergram, an island village bordering Bangladesh on one side and the Kushiyara river on the other, separating the village from the administrative district of Karimganj; it is connected with the district only by a ferry service. Another category is the village Harinagar located at the tri-junction of the Barak river and its two branches -- Surma and Kushiyara. Besides, there are several villages, which are settled on the northern bank of the river Barak and are vulnerable to annual floods and riverbank erosion. Each of these sites presents certain serious environmental mitigation and adaptation challenges, which have been briefly documented in three case studies.

Literature Review – An overview

Research and studies on Freshwater Ecosystems and Biodiversity in the Barak Valley

Information related to floodplains ecosystems, biodiversity and other bio-physical aspects of the Barak river basin has been found to be scanty and scattered. Academic research and study of the riverine landscape of the Barak and its bio-geo-morphological systems began at the Assam University with a small faculty of the Department of Ecology and environmental Sciences. Studies were initiated on the floodplain ecosystems and bio-resources of the Barak river basin, including some notes on the nature of resources extraction and land use practices, especially tea plantation (Gupta, A. 2001, 2006). A decade ago, Das et al, (2013), surveyed and published the Flora of Barak valley, Vol. I, which, since then, has not been updated.

A bunch of research papers found online was mostly contributed by a few research scholars and the faculty members of the department of ecology and environmental sciences and the department of life science, Assam University. All these articles cover only some parts of the river basin, which mostly focus on the Chatla wetland. However, for the purpose of this documentation work, about a dozen research-based articles have been chosen for review that is relevant for this brief study. These articles reveal different aspects of the Chatla wetland and the status of its ecosystem services. Chatla may not represent all the diverse freshwater ecosystems of the entire Barak basin, but over the last two decades, this wetland has been widely studied by the researchers and scholars because of its proximity to the Assam University.

The articles covered a wide range of issues related to the Chatla wetland, which has been described below:

Firstly, some assessment of the supporting ecosystem services of Chatla wetland of the Barak Valley, especially for enhancing fish population, has been reported. There are studies that

explain how the annual flood enriches the floodplain wetlands with nutrients, supporting the growth of aquatic flora (*phytoplanktons*) and fauna (*zooplanktons*), which produce food for fish and other aquatic animals. During the dry months (Nov-April), when the flood water recedes, some parts of wetlands are used for culture fishery or agriculture. In one study (Jan-Mar) at the Chatla wetland, researchers used two sets of fishery ponds – some ponds are inside the wetland and some are adjacent to Chatla. Both the types of ponds were stocked with same fish species such as *Labeo rohita, Labeo bata, Cirrihinus mrigala, Cyprinus carpio, Catla catla, Punctius sarana, Notopterus notopterus*, etc to observe their growth and compare productivity. The researchers also noted the water quality, phytoplankton and zooplankton population as well as recorded the air and temperature parameters between the two types of ponds. It was observed that the presence of planktonic communities in the ponds inside the Chatla wetland was quite rich, which have contributed to better productivity and growth of the fish population compared to the ponds outside and adjacent to the wetland.

Another study explored the potential for concurrent rice-fish culture in wetlands of Assam. It looked at the rice fields in the low-lying areas of the Chatla wetland and observed that the rice fields have abundance of nutrient rich water with huge presence of phyto and zooplankton communities. All this provides for suitable conditions for rice-cum-fish farming, which should be utilized for improving income from both rice and fish in the low-lying areas of the wetland. By adopting the rice-cum-fish farming practices in the low-lying areas of the wetland, the marginal farmers can easily earn additional income from fish production and meet their protein and nutritional needs.

Secondly, some articles highlighted various anthropogenic pressures on the seasonal wetlands, especially overexploitation of aquatic resources, mainly fish, which have led to disappearance of many local species and degradation of natural ecosystems. Since a large number of poor people depend on the resources of the wetlands, the articles suggest that there is need for taking some regulatory measures and setting up a protocol for sustainable use of resources. In a case study on Chatla, the article investigates the nature of resource extraction by various communities settled around the wetland. Each community has its own cultural practices and livelihood preferences, which affect resources of the wetland. It was observed that while the Kaivarta community whose traditional vocation is fishing, was largely involved in fishery, the Deswali and Adivasi communities sustained their lives and livelihood by utilizing soil and other materials of the wetland for pottery and craft-making activities.

Thirdly, apart from anthropogenic pressures, the seasonal floodplains are also severely impacted by erratic and extreme weather events as a result of climate change, triggering changes in the seasonal hydrological regimes. All these factors affect not only the ecosystem functions and services but also the patterns of assemblage of aquatic plants and animal communities. Of course, variation in species composition is influenced by micro-topography and hydro flow regime (water flow velocity and discharge), an article concluded in a case study on Chatla. The researchers chose five locations with varied micro-topographic and 'flow parameters' within the wetlands and studied 'species composition, assemblage pattern, and vegetation carbon stock' during the three flooding phases – early, middle and post-flood periods and the nature of their interaction.

The study revealed that plant species composition and richness exhibited variation at different locations as per micro-topography and flow regime, which also determined the

vegetation carbon stock. The study postulated that any modification of parameters by anthropogenic activities such as, mining and quarrying, may 'influence the carbon potential of seasonal floodplain wetlands' and therefore suggested that 'appropriate measures should be taken to maintain the integrity of the natural topographic features of such wetlands.'

Fourthly, seasonal flooding, causing changes in the structural components of the wetland ecosystem, determines the type and quantity of provisioning ecosystem services as well as diversification of economic opportunities for the communities residing around the water body. The researchers showed in a case study how structural changes of the Chatla wetland during the dry and winter months offered different services to the local communities. In the monsoon months, much of the wetland areas get inundated with flood water, which bring with it nutrient rich soil and plenty of fish, thereby providing good livelihood opportunity for the local population. And during the dry months, when rains stop and water level recedes, the nutrient laden soil deposit on the wetland bed becomes fertile ground for agriculture, especially rice and vegetable production.

In another study (2013-15) researchers investigated different provisioning ecosystem services of the Chatla wetland, which riparian communities largely depend on for the sustenance of their lives. For example, from the supply of fish, harvesting paddy to numerous NTFPs such as, thatch grass, fuel wood, fodder, cane and common donax that are available within a calendar year. It is therefore important to improve governance of the wetland to ensure sustainability of the ecosystem services. The researcher also tried to assess the economic value of various provisioning services.

Chatla wetland in the Cachar District

Some research papers highlighted the role of wetland forest ecosystem in climate change adaptation (Nath, et al. 2015). The study claims that *Barringtonia acutangula* (locally known as Hijal tree) forms floodplain forest ecosystem, a versatile tree used by the fishing communities in fishery management. The fisher communities have developed a unique technique of coppicing and pollarding the tree to increase tree density and rapid growth of branches. The fishers use the branches of the hijal tree, which provides habitats for fish and

protects them from predators. Besides, the Barringtonia forest also provided a variety of ecosystem services – fuel wood, fodder, controlling flood and erosion as well as helped carbon sequestration.

Finally, about the fish diversity, the Department of Life Sciences, Assam University (Kar et al, 2023) has done some work on a few oxbow lakes (*anuas*) of the Barak valley, including Rupaibali lake. *Anuas* or oxbow lakes are created due to the meandering characteristics of a river. Claimed to be a pioneering taxonomical work on fish fauna, the study listed out as many as 45 species of fish in the *anua*s, which are also found in the river Barak. Out of these 16 species were found at the Rupaibali *anua*. The availability of the fish species in *anuas* suggest that it remains connected to the river ecosystem.

Apart from fish fauna, a group of Assam researchers (Mazumder, M.K et al. 2017) has been working on the river dolphin (*Platanista gangetica gangetica*) population in the river Barak. A few decades ago, dolphins were regularly sighted in Barak and its tributaries, especially at the confluences (Biswas. S.P, 1995, 2007), but over the years, the dolphin has gradually declined with loss of their habitats because of anthropogenic disturbances such as, use of motor boats, sand mining, sewage and industrial pollution. River dolphins are rarely sighted, and now, in the name of developing national inland waterways and infrastructure (river dredging for creating navigational channel), researchers fear that dolphin population will be extirpated beyond recovery. They pointed out that another important aquatic resident of the Barak river, gharial (*Gavialis gangeticus*) and marsh crocodile (*Crocodylus palustris*) have already been reported 'extinct'. Dolphins are also likely to face the same destiny unless urgent efforts are initiated to reclaim their habitats by way of ensuring prey abundance and restoring the natural ecological links between the floodplain wetlands (*beels* and *haors*) with Barak and its tributaries, the researchers urged.

What emerges from the brief review of the secondary data and information gathered from these academic articles and research papers are as follows:

• There is no comprehensive basin-wide study done by academic or research institutes as yet on the Barak river, integrating both the human system (People, government, economy and infrastructure) and the natural environment (biophysical -- soil, water, drainage, biodiversity, ecosystems etc.).

• Knowledge about the Barak river basin is limited to domain specific academic research and studies in the universities, especially the Assam University. Hence data is scanty and scattered and needs to be brought up-to-date.

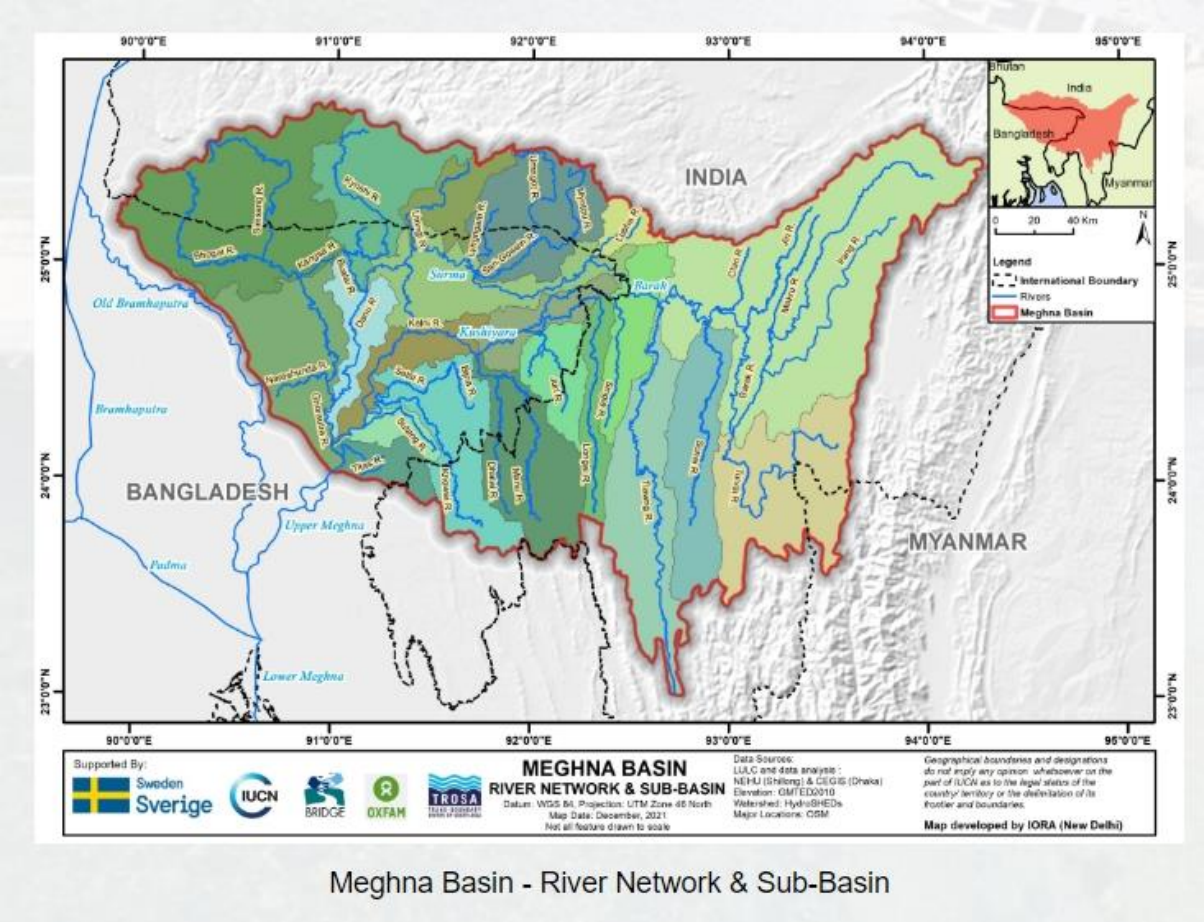
• Anthropogenic pressures – growth of human settlement, infrastructure, economy and livelihood etc. – have led to disruption of natural hydrological regime, alteration of the floodplains ecosystems, and degradation of natural environment across the Barak valley.

• Impact of climate change (extreme and erratic rainfall pattern and rising temperature) on natural ecosystems, especially aquatic ecosystems is accelerating the collapse of ecosystem functions and services as well as loss of species and biodiversity.

• Diminishing dividends from ecosystem services increase vulnerabilities of the rural poor as their livelihood mostly depend on the healthy ecosystems; and therefore, restoration, conservation and protection of life-supporting floodplains ecosystems are critical for sustainable human future.

The Barak-Meghna basin – an overview

Unlike the Ganges and the Brahmaputra river basins with glacial origin, the Barak-Meghna river basin is entirely rain-fed; its total catchment covers an area of approximately 82,000km^2 comprising parts of north-eastern states and parts of north-eastern Bangladesh. Considering hydrology and climate, the basin broadly consists of three parts, namely: (i) the Barak basin, named after the river Barak, which, along with its numerous tributaries, drains the south-eastern catchment areas comprising the states of Meghalaya, Manipur, North Cachar Hills (Dima Hasao) of Southern Assam, Mizoram, and Tripura; (ii) the upper Meghna basin, which is formed by the Surma and the Kushiyara sub-basins of the river Barak; and (iii), the lower Meghna basin, including Padma river sub-basin in Bangladesh. Padma river originates at the confluence of river Ganga and Jamuna (Brahmaputra when enters Bangladesh) near Goalondo and flows towards southeast direction before joining the river Meghna at Chandpur, which together form the lower Meghna river basin.



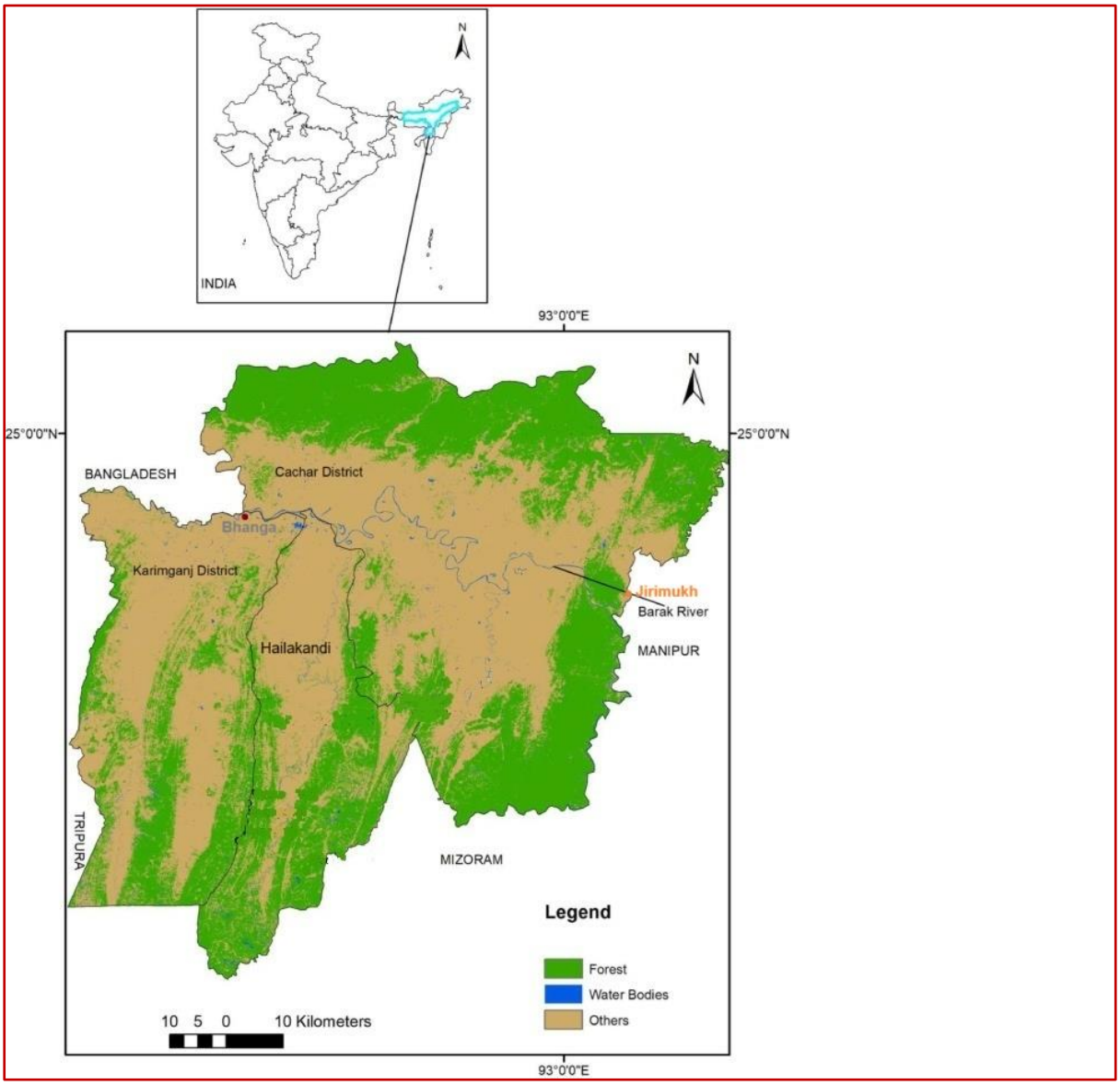
Meghna Basin - River Network & Sub-Basin

However, this study is concerned with the Indian part of the Barak (Meghna in Bangladesh) river basin, especially the Barak valley through which the Barak river runs from the east at Jirimukh towards the west up to Bhanga in the Karimganj district, where it enters Bangladesh.

The Barak valley consists of three districts -- Cachar, Hailakandi and Karimganj -- in southern Assam, covering a total geographical area of 6,922 km^2. It is located between 24^o 8’

and 25° 8' N latitude and 92° 15' and 93° 15' E longitude, and is almost surrounded by its neighbouring four hilly north-eastern states – Meghalaya in the northwest, Manipur in the East, Mizoram in the south, and Tripura in the southwest. The valley also shares about 126 km long international land border with Bangladesh through the Karimganj (98.3 km) and Cachar (27.3 km) districts.

River Barak, the second largest river system after the mighty river Brahmaputra in the north-eastern region, rises from the northern ranges of Manipur bordering Nagaland and flows towards south western direction until it reaches Tipaimukh at the confluence of Barak and Tuivai river, a hill stream coming from Mizoram and, from there, Barak takes a sharp upward-turn towards north and is joined by another stream, Jiri, at Jirimukh near Lakhipur in the district of Cachar.



From its origin Barak travels a distance of 524 km within India, a part of which forms the Indo-Bangladesh riverine frontier. Along with its long journey from the hills through the valley, Barak receives many tributaries joining it from both the northern and southern banks. The major northern streams – starting from the east to the west – are: Jiri, Chiri, Madhura, and Jatinga, while on the southern bank, the tributaries flowing from Mizoram are: Sonai-

Rukni, Ghagra, and Dhaleswari-Katakhal. Apart from these tributaries of Barak, there are a few other streams – Gumra-Kalainchera and Balesswar (Malidor), which fall out to Surma, while Singla and Longai tributaries join Kushiyara.

The navigable stretch of the river Barak, when it reaches the valley, covers a distance of 121 km from Lakhipur (Cachar district) to Bhanga (Karimganj district), where the river gets bifurcated assuming new names as Surma and Kushiyara before flowing out in two opposite directions to Bangladesh. Historically, the Barak-Meghna water ways have been extensively used for mobility, all kinds of trade and commerce connecting the Bay of Bengal with Assam and other northeastern states of India. Recently, this traditional river trading route has been declared as the National Waterways 16 (NW16) to promote trade and tourism with Bangladesh and the South East Asian countries.

The topography of the Barak valley consists largely of fertile alluvial plains and undulating hills and low-lying hillocks, sprouting up intermittently across the valley. It is surrounded in all sides by forests and hills, including the majestic Borail hill ranges (North Cachar hills), which has shaped its drainage systems, the flood plains and the riverine landscape. The average altitude of the Barak valley varies between 14 and 20 meter above mean sea level, while the elevation in the northern hills rises to 1500 meters. During the British colonial rule the low-lying hills or *tilla*s amidst the floodplain areas have been effectively utilized for developing tea plantation (Gupta et al 2014).

The floodplains wetlands and smaller streams have provided diverse services, especially fishing, for supporting livelihood of the surrounding local communities. In fact, the Barak valley is dotted with numerous water bodies – wetlands.

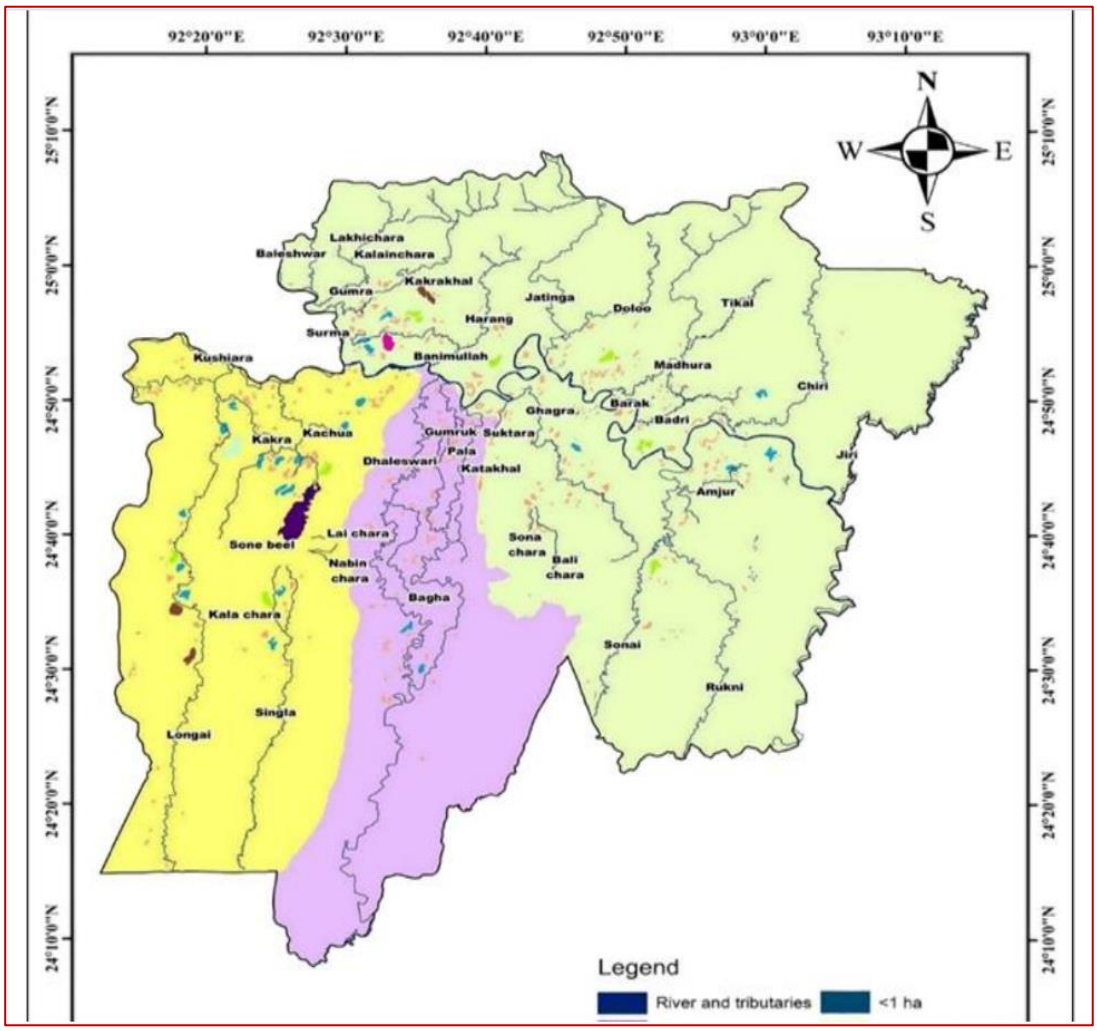
District/Region	Wetland type	Number	Area (ha)
Cachar	Lake/Pond	57	1151.5
	Ox-bow Lake/Cut-off Meander	29	592.5
	Seasonally Waterlogged	231	4869.5
	Swamp/Marsh	19	564.5
	Total	**336**	**7178.0**
Karimganj	Lake/Pond	6	95.0
	Ox-bow Lake/Cut-off Meander	1	87.5
	Seasonally Waterlogged	53	4667.0
	Swamp/Marsh	10	870.0
	Total	**70**	**5719.5**
Hailakandi	Lake/Pond	7	322.5
	Ox-bow Lake/Cut-off Meander	4	37.5
	Seasonally Waterlogged	36	480.0
	Total	**47**	**840.0**
Barak Valley	**Grand Total**	**453**	**13737.5**

Source: Space Applications Centre (ISRO), Ahmedabad, India (2000).

An official survey (ISRO 2000) mapped 453 wetlands in the valley covering a total of 13737 ha. Some of the prominent beels (wetlands) are Sonbeel, Rata beel, Salchapra beel, Doloo beel, Petumara beel and Hairuguri beels among others; some of the important haors are Puneer haor, Chatla haor, Hilara, Jabda, lucca, Bauwa, Bakri haor etc.; and a few major anuas are Banskandi anua, Rupaibali anua, Sibnarayanpur anua, Fulbari anua, etc.

However, a recent detailed study (Reang, De & Das, 2018) on the 'surface water bodies' of the entire Barak valley enumerated nearly 550 freshwater bodies, including those human modified ponds/lakes. A team of scholars from the Department of Ecology and Environmental Sciences, has come up with a drainage map of the Barak river system, incorporating all the tributaries, their sub-tributaries as well as the floodplain wetlands. They mapped for the first time all the water bodies of the Barak valley by using high-resolution (5.8 meter) satellite data (IRS-R2 LISS4 FX) of 2011 to 2013 and GIS techniques.

Source: Reang et al.2018



They also identified and carried out detailed mapping of the major sub-basins constituting tributaries and sub-tributaries of the river Barak along with other water bodies, including wetlands (*beel* and *haor*) and oxbow lakes (*anua*) for the first time. All together 549 'surface water bodies', covering a total water area of 21, 186 ha, have been mapped and listed. The size of most of these water bodies is between one ha and 50 ha as they appeared during the dry months when the survey was done. The Sonbeel has been found to be the largest wetland

(1348 ha), and perhaps the only perennial wetland, which has still retained some of its natural native ecosystem.

"The present study is the first attempt to spatially assess the water distribution of both lentic (slow flowing or standing water) and lotic (fluvial or running water) system of Barak Valley," the researchers claimed. Since the valley remains largely submerged during the monsoon months and thereafter, they chose the dry season for satellite data collection, while identifying the "water bodies for better representation, delineation and ground truthing."

In the Barak valley, besides the rivers and streams, three types of water bodies can be observed which are locally known as: (i) *Beels* (permanent wetlands connected with river and streams; (ii) *Haors* (seasonal flood plains wetlands); and *Anua*s (ox bow lakes, created as a result of shifting of river channel, which may or may not be connected with the river). The map above illustrates a detailed network of tributaries, sub-tributaries, streams and rivulets on the both north and south banks of the river Barak, forming critical sub-basins across the valley and the floodplains, supporting thousands of riparian families.

The Project Study Sites

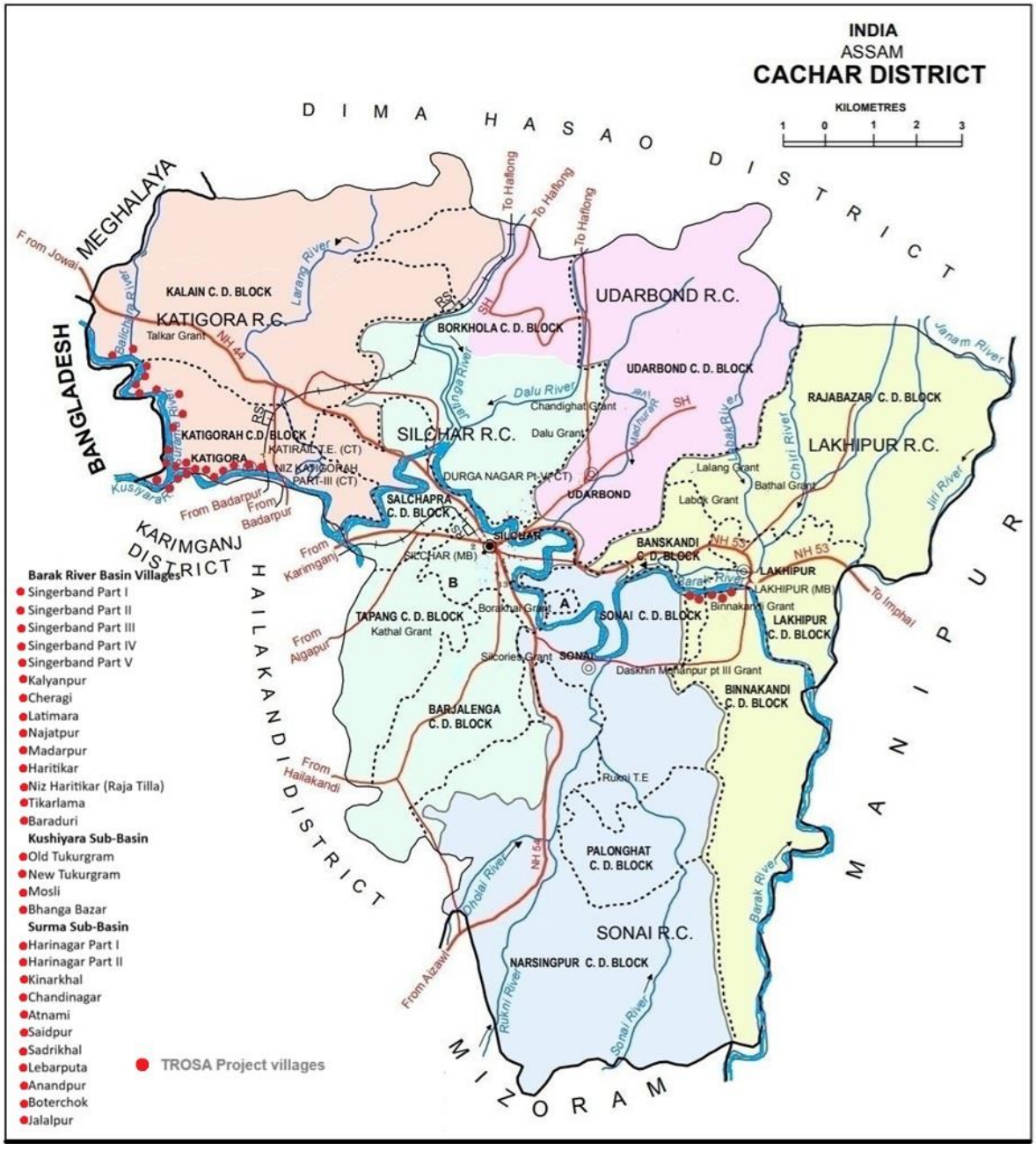
Altogether 30 villages (marked in red dots) located along the Barak river and its two trans-boundary sub-basins – Surma and Kushiyara – have been chosen for the study. Five villages are in the upstream of Barak river under the Binnakandi development block; Nine villages are in the downstream of the Barak under the Katigorah development block; 12 villages lie on the bank of the Surma river (all these villages are in the Cachar district, and remaining four are on the banks of the river Kushiyara in the Karimganj district. The location of these project villages has been displayed with red dots on the map below.

It may be useful to briefly describe the bio-physical features, including land use patterns in the four study sites, namely (i) the upstream of Barak valley – the Binnakandi stretch; (ii) the downstream of Barak – the Katigorah floodplains; (iii) the Surma sub-basin; and (iv) the Kushiyara sub-basin in the Karimganj district.

The Binnakandi block is bounded by river Barak in the north, the Bhuban hills in the east and Mizoram hills in the south. The five project villages are located on the southern bank of the river Barak in the north-eastern part of the Rukmini-Sonai sub-river basin. Both the hill tributaries emerge from the uplands of Mizoram and run through the Cachar plains and fall into the Barak. During the monsoon months, these tributaries, swollen with huge surface run off water from the upland catchment, flush it all to the floodplains, triggering floods all over the basin. Mercifully, being perched on a relatively higher elevation (42 meter above mean sea level), the project villages under the Binnakandi block are not so much affected by flood water as much as some of them are threatened by river bank erosion in several places along the Barak.

However, the nine project villages in the downstream of the river Barak under the Katigorah revenue circle are the most vulnerable as they face the fury of annual flooding as well as the river bank erosion, especially those river-side villages on the north bank of the Barak. The Katigorah floodplains are particularly vulnerable to massive flooding and waterlogging as several northern tributaries and their sub-tributaries flowing out of the eastern Meghalayan

hills as well as the Borail range of the North Cachar hills awash the plains with raging runoff water.



The villages located on the banks of the two trans-boundary distributaries of the river Barak namely, Surma and Kushiyara, face special challenges – one posed by the problems of recurring flood and river bank erosion, while the other emerges out of national security concerns, as both the branches of Barak form the riverine frontier between India and Bangladesh. Not only that, due to the barbed wire fencing along the river banks, large chunks of agricultural lands of these border villages (12 on the Surma sub river basin, and four on the Kushiyara sub river basin) have fallen outside the border fence. Though individual farmers are allowed to cultivate those riverside farmlands, their farming activities are strictly regulated by the border security personnel, which disrupts normal cultivation activities and adversely affects harvesting and productivity. Moreover, villagers say the construction of the raised border road, which also acts as an embankment, has also disrupted the natural drainage, causing waterlogging and resultant floods in many places along the border villages.

Socio-ecological Survey and Analysis

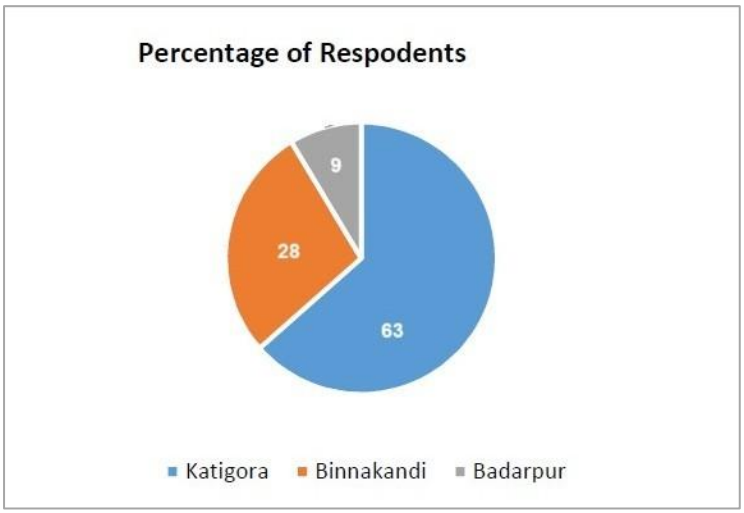
As mentioned earlier, there were two kinds of surveys: One based on focused group discussions and the other based on random app-based (Kobo tool box) online survey across the project villages. There were 10 FDGs carried out on ten locations with members of local communities (a total of 2282 households) drawn from 30 project villages. Each FGD location covers adjoining project villages. Take the example of Madarpur village, which is located at the zero point on the bank of Barak. So, in this location, members from the river front project villages facing threat of erosion, such as, Latimara, Nazatpur, Haritikar, participated in the discussion. The other locations were: Singerband Part V and Singerband Part I village under the Binnakandi block, upstream of Barak and Harinagar III in the downstream of Barak; Harinagar I, Harinagar II, Boterchok villages (all on the banks of Surma river) under the Katigorah block; Masli I, Tukergram Old, Tukurgram New villages on the bank of Kushiyara in the Karimganj district.

In terms of (i) floodplains ecosystems types, functions and services; (ii) bio-resources and rural socio-economic lifestyle; and (iii) traditional land use practices and livelihood patterns, the selected 10 villages are found to be quite representative of all the project villages. The data table below has been prepared based on the information provided by the field survey workers. However, more specific information requires to be collected for ensuring reasonable data fidelity and accuracy in the survey results. The table below provides information about the total Households and their landholding pattern in 10 selected project villages. Land and its resources (water, forest and biodiversity) are vital for sustaining human economy and wellbeing.

Sl.No	Village	Landless	<1 B	>1<5	>5	Total HH
1	Singerband Part V	30	150	95	75	350
2	Singerband Part 1	90	30	205	25	350
3	Madarpur	70	100	165	25	360
4	Harinagar III	40	90	125	10	265
5	Harinagar I	65	107	90	50	312
6	Harinagar II	55	120	85	15	275
7	Boterchok	35	30	45	5	115
8	Masli I	0	25	0	0	25
9	Tukergram Old	20	35	50	5	110
10	Tukurgram New	40	23	50	7	120
	HHs	445	710	910	217	2282
	% of HHs (Average)	20	31	40	10	100

The village survey covered three different aspects – (i) general information of the village, total number of households and land ownership; (ii) economic activities/livelihood; and (iii) some information related to ecosystems services, climate change, including disaster.

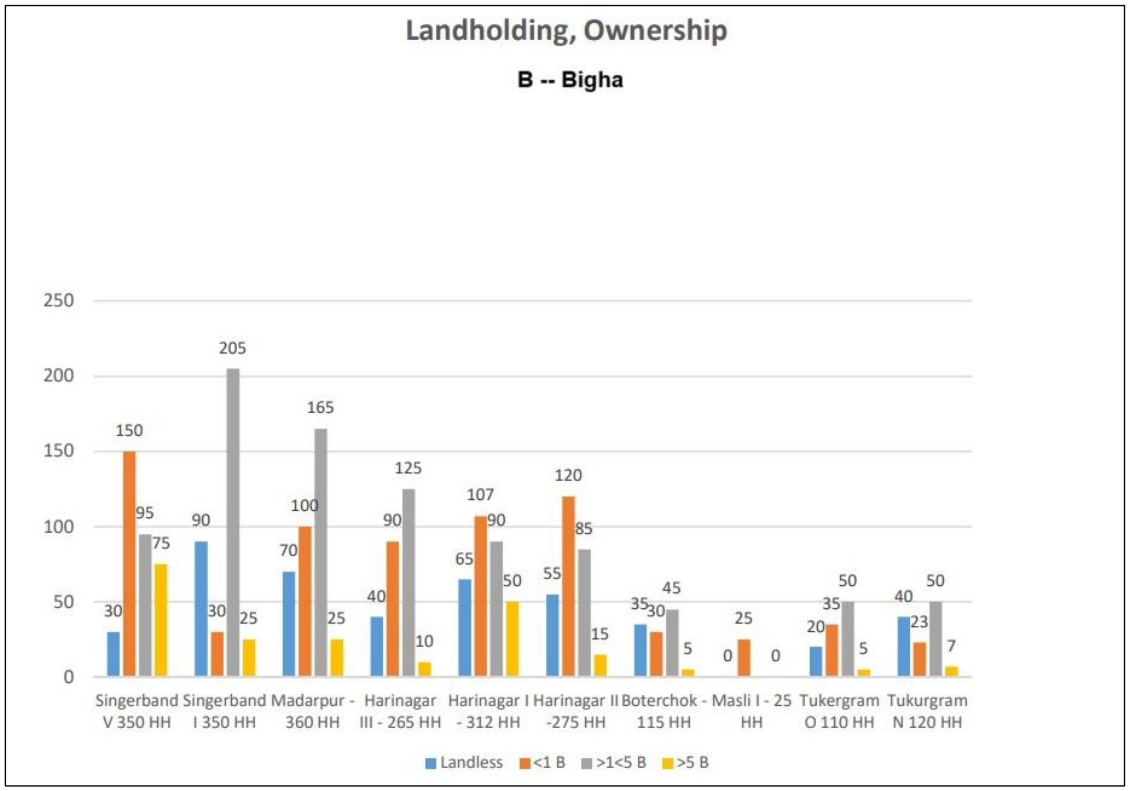
In addition to that, an online survey on flood plains ecosystem services has been done by using an App (Kobo toolbox). A total of 452 individuals from the project villages have participated in the mobile-based survey. Out of the total respondents, 364 (80.53%) were men and 88 (19.47 %) individuals were women, including youth. The block-wise respondents were as follows:



A total of 287 (63 per cent) were from Katigora; 126 (28 per cent) from Binnakandi, and 39 (nine per cent) from the Badarpur (Karimganj). Total 452 respondents.

Results: What does the survey reveal?

First of all, let's take the land holding parameter – land ownership as well as access to land, which is vital for sustainable rural livelihood. Of course, land holding size and ownership data will be different from village to village. Therefore, information about land holding in these 10 villages may not represent all the project villages. Most of the households (80 % on an average shown in graph 1) in these surveyed villages own land, although the size of landholding varies from less than a bigha (30 % of HH) to more than one to five bigha (40% of HH) and up to more than five bigha (10% of HH). On the other hand, on an average, about 20 per cent of the total households in these villages do not have farmland. However, all of them have been reported to have access to land for cultivation, either as share cropper or having leased land.



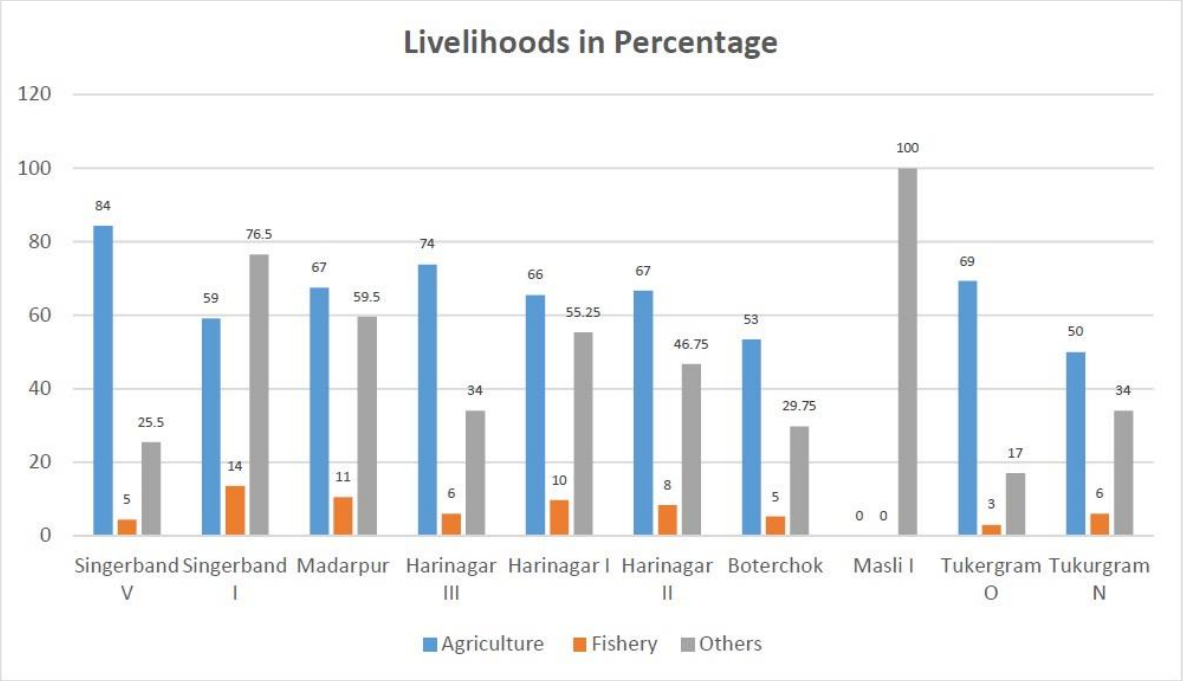
Graph 1

*Pl. note: *Masli Part I is a revenue village. However, the FDG was held with members of a scheduled caste community, which is settled in one part of the village on the bank of Kushiyara. There are 25 families, many of them lost their farmlands because of river erosion, but each family has small homestead lands (less than a bigha). That's why landlessness among them has not been recorded.*

So far as the economic activities or livelihood issues are concerned, about 50 to 80 per cent households in these surveyed villages are dependent on agriculture and allied activities (cultivation of paddy and vegetables, livestock and poultry); five to 15 per cent of families are involved in fisheries, while the remaining 10 to 15 per cent households earn their livelihood as wage labour, shop-keeping and other vocations. However, when data is disaggregated, the livelihood pattern in each village may be different as reflected in the Graph 2. Because much of the livelihood options for the rural population depends on the availability of and access to land and its resources as well as the diverse ecosystem services within their respective village areas.

In addition to this, households with education, local skills, and entrepreneurship have diversified their livelihood activities by using land and resources drawn from various government schemes and bank loans, and are now promoting agri-business (rice business, poultry and dairy etc. in Singerband areas of the Binnakandi block).

(Graph 2)



Moreover, local people in the project villages settled along the rivers (Barak, Surma, Kushiyara), or around the wetlands and lakes have adopted livelihoods which are based on the local resources available for use. Broadly speaking, people owning land across the floodplains in the Barak valley largely depend on farming (mainly cultivation of rice and seasonal vegetables) or fishing (nearly 20 per cent) or combining both or different other components (rearing cattle and buffalo along with cultivation or, adding goat, poultry and duck to their livelihood planning).

Ephemeral 'Commons', Changing Ecosystem Services

Riverine landscape, including floodplains and wetlands, undergoes changes during the monsoon and winter months. The nature and availability of ecosystem services also gets impacted both by natural process and human interventions. During the rainy season (May to September/October), spreading over three phases – pre-monsoon, high-monsoon and post-monsoon – the vast floodplains of the Barak valley begin to wear a new look with the arrival of the monsoon rains when farmers commence their sowing activities, especially paddy (rice being the staple food of the tropical region). All the seasonal wetlands (*haors*), the dried-up streams and depressed lands come to life bathed with the early rains. But very soon as the monsoon progresses, all these lands and water bodies are filled with rushing water from the hills through the networks of surged streams and rivulets, turning all into a deluge. Many agricultural areas come under water and thousands of farmers lose their main source of livelihood.

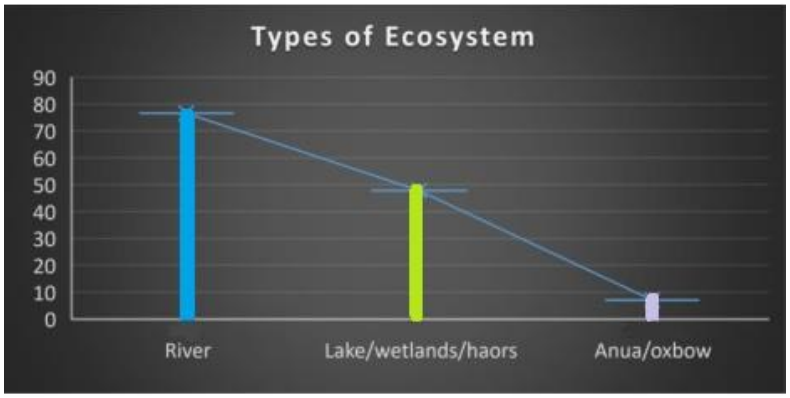
At the same time, the riverine landscapes undergo spatial change with floodwaters and different freshwater ecosystems (river, wetlands, lakes, swamps etc.) converging into massive pools of 'water commons.' In this situation, the flooded areas, including the submerged agricultural fields, become sites of fishing activities, particularly for the fisher

community. Many flood-affected farmers also try their hands in capture fishery. Boats replace motor vehicles, while water ways takeover roads and become the principal mode of transport and mobility. Households having boats in the flood-marooned villages use them for different purposes – from fishing to ferrying people and goods for earning some wages. And at the time of disaster, boats are effectively deployed to carry out rescue and relief works.

Chandinagar wetland area in the Katogora block: Pictures (left) in July-August and (right) in Nov-December

In the post monsoon months (October-November), once floodwaters start receding and the farmlands, laden with nutrient rich sediment, reappear, farmers waste no time to make good with the enriched soil for cultivation of diverse winter crop. The short-lived 'water commons' disappear, and the villagers scramble for reclaiming and taking possession of their respective lands held by individual owners. During the dry winter months (November to February), all the floodplains water bodies (wetlands, *haors*, lakes) as well as the water-logged low-lying areas are put to use for diverse economic activities, such as, culture fishery and cultivation of paddy and vegetables. Even the riverbanks, including parts of the river bed along the Barak and other tributaries are extensively used for growing vegetables, mostly different types of beans, pumpkins and water gourds. Besides, potato, radish, cabbage, cauliflower and turnip are also grown in the fertile riverside lands.

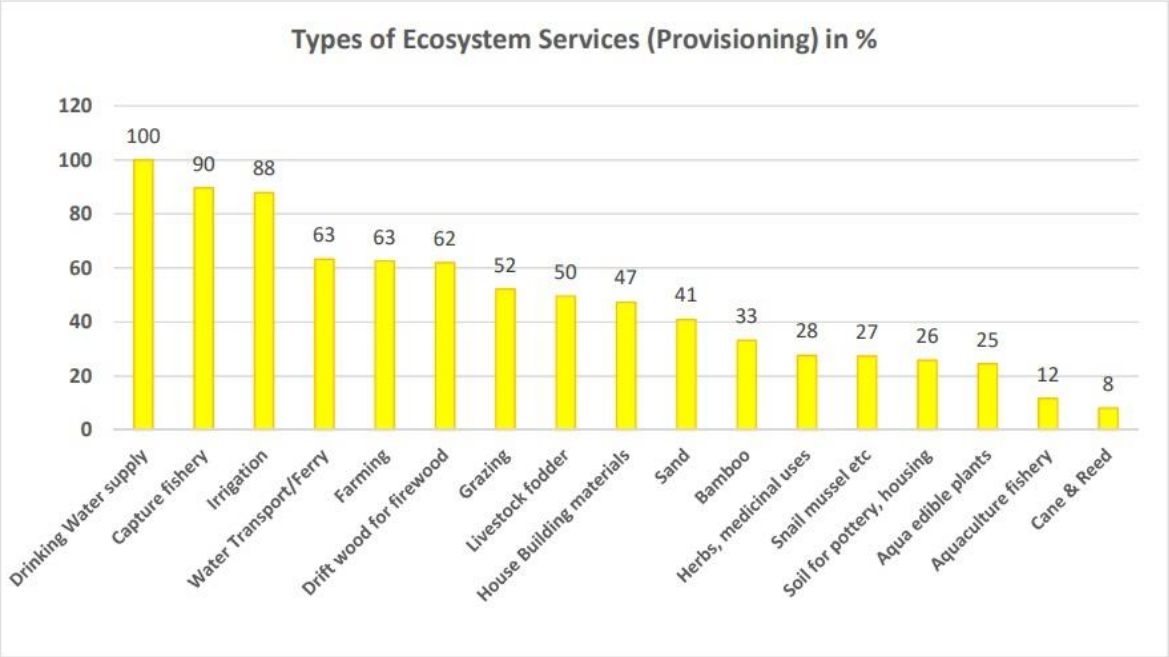
Now, all the project villages are located along the river Barak, while some of the villages are found also around wetlands or lakes (*anuas*), and so, many villages have access to rivers as well as wetlands or *anua*s. However, most of the villages (nearly 80 %) depend on river (Graph 3), while 50 per cent of the villages derive benefits from wetlands, and about 10 per cent of them secure their livelihood from lakes.



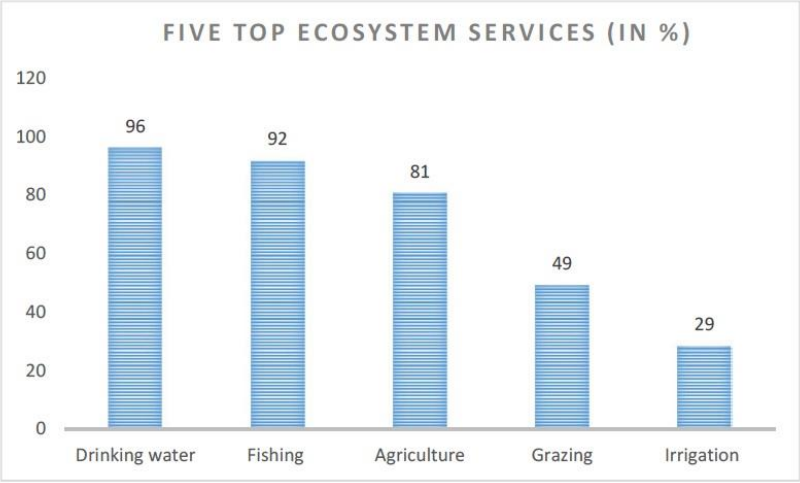
(Graph 3)

As per the Kobo survey, the respondents listed out (graph 4) a host of benefits (food, fuel, drinking water, irrigation, water transport, fodder for livestock, sand, soil for pottery, brick-making, raw material for handicrafts) that the villagers receive from the freshwater ecosystems (river, wetlands, lakes as well as the modified water bodies) that support their livelihood and different economic activities.

(Graph 4)

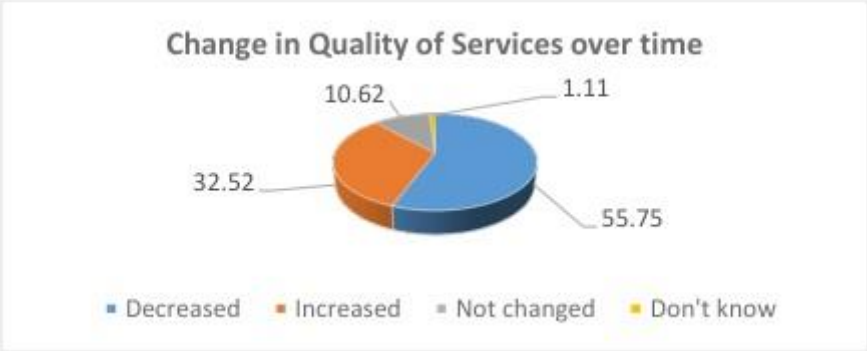


The respondents also listed out top five ecosystem services (Graph 5), which the villagers said are critical for their economic sustenance.



(Graph 5)

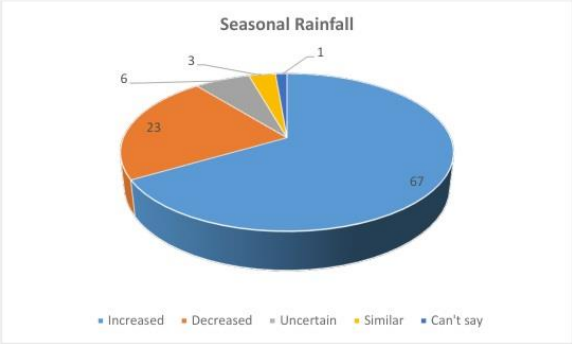
However, they also expressed their concern over the diminishing resources of the wetlands as well as the changing climatic conditions (Graphs 6). Almost 56 per cent respondents said there was decline in provisioning services, while 32.5 per cent claimed that they could exploit the resources better. Others said nothing much has changed.

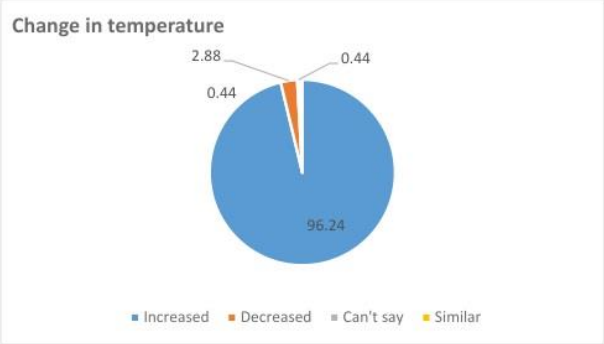


(Graph 6)

Apart from the surveys, in the course of transect or random conversations with wayside villagers near a wetland, or a lake or with fisher folks by the riverside, most of them pointed out much of what they do for their livelihood have become not only difficult but also uncertain because of changing rainfall patterns, intensity of flood and erosion and over all degradation of the surrounding ecosystems (Graph 7). Everything has become unpredictable.

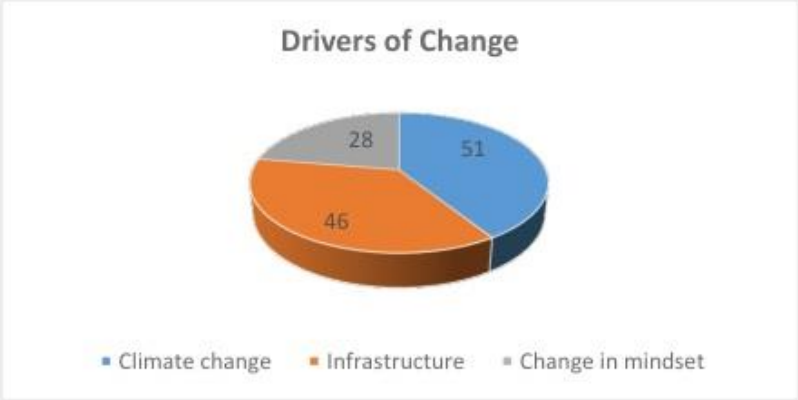
(Graph 7)





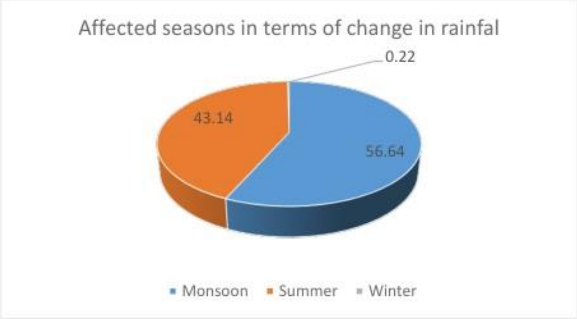
When asked what might be the reasons for the change in seasonal rainfall pattern and its impact on agricultural activities, they could not explain why season was changing but said the erratic and unpredictable rainfall has certainly affected the crop calendar as well as the productivity. However, they attributed the flood problems to haphazard construction of road without taking care of drainage, filling of water bodies by flattening the hillocks, and lack of timely repair and maintenance of many sluice gates constructed to regulate water flow.

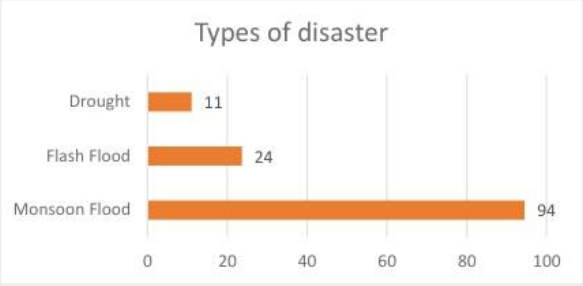
(Graph 8)



Monsoon is the most affected season (about 57 per cent), while 43 per cent felt the summer season is badly affected by changing rainfall pattern; and among the natural calamities, flood has been identified as the major source of disaster (graph 9).

(Graph 9)





In many ways, the villagers said, it's not only climate change, there were various other contributing factors, including people's changing mind set and profiteering tendencies (land use change for profit over maintaining natural ecosystems), which might impact the ecosystem functions and services. For example, the value of ecosystems is often measured in terms of human needs and benefits, ignoring the requirements of other non-human lives such as, converting agricultural fields, a pasture (grazing, habitats) or parts of wetlands (habitat for aquatic animals, water fowl etc.) into brick fields for production of construction material and profit. So, with 'better' (from the economic point of view) land use, service value of ecosystem may increase for some (as graph 6 showed) but ecosystem functions and services (from ecological point of view) may substantially reduce for others (fisher folks, birds and animals), who are dependent on various aquatic and other resources of the diverse ecosystems.

Then there could be certain special bio-physical factors and anthropogenic conditions that may act as barriers for ecosystem management and supporting sustainable livelihood for people. The following three case studies may illuminate some of these aspects.

Case Studies:

1. Rupaibali Anua – A fisher folks' tale

In the late evening of 15th August, 2024, a group of fisher folks gathered at the Rai Basti temple premise. There were about a dozen or more people, young and elders but all men, who expressed their concerns over the dwindling catch of the Rupaibali lake during an informal conversation. How old is this lake? Can anyone tell how this lake came about? There was a spell of silence, as they looked up among themselves for some kind of answers. "Oh, this lake is very old," replied an elder, "*eta amader baap thakur dadar somoy thakiya asey* (it was there from our forefather's time)." He said, "As a child, I remember much about this place, which was full of jungle and the size of *anua* was much bigger then."

Of course, none could say how the lake came into being, whether or not it was created after the river changed its course. Only thing they have said is that the lake is connected with a small channel which flows out of the river Barak. During the months of May-June or July-

August) when the river Barak swells up, water enters through this channel and flows into the *anua*, and also inundates a lot of area, including farmlands around the lake. The flood water of Barak would carry with it a variety of fish along with nutrient rich sediments. And when the river water recedes, the lake starts draining out the excess water through the same outlet. So, this channel works both as an inlet and outlet of the flow regime. In other words, Rupaibali anua acts as a natural reservoir for flood water, which also rejuvenates the lake with fresh water, restocks its fish populations and replenishes nutrients to enrich the lake flora and fauna.

Rupaibali oxbow lake: Fishermen of the Rai community are sharing their views on various issues

There are four revenue villages (Singerband Part I, II, III and Niz Rupaibali) comprising approximately 800 to 1000 households located surrounding the lake. Nearly 200 fishing families are totally dependent on the lake for their livelihood. Among them, 40 fishing families belonging to the Rai community fish in the lake daily for securing their livelihood.

“40 years ago, we used to get 12 to 15 types of fishes in the anua,” Dulon Rai, 60, recalled. However, things began to change after the village road was raised as an embankment to protect agricultural crops from annual flood, and a bridge over the channel (locally called ‘*anuar khal*’) connecting the road (now also an embankment) was replaced with a narrow concrete utility duct just to regulate water flow from the river Barak.

Dulon Rai spelt out a host of issues associated with the regulatory structure on the channel, which has disrupted the natural flow of water to and from the Rupaibali lake as well as the renewal of fish stock in the *anua*. Then there is the problem of highly invasive water hyacinth, which has rapidly spread across the water body, which spoiled the water quality. Many households use the lake water for drinking purposes, even though its quality has deteriorated due to overwhelming presence of water hyacinth. He claimed that the roots of hyacinth go deep into water and reach even the bed of the water body. The rotten hyacinth emits foul smell from the water. Fish also don’t get to access the nutrients from the soil which is overwhelmed by the hyacinth roots. In this way, the presence of hyacinth in the lake

affects both the quality of water as well as disrupts the nutrient cycle of the soil of the lake bed.

Moreover, they said that due to the problem of hyacinth they find it difficult to use large nets for fishing. On an average, each of them spent about 10 to 12 hours daily in the lake for fishing on boats. Dulon Rai admits that the lake ecosystem has severely degraded over the years, which can be seen from the drastic decline of fish catch as well as the fish diversity. Earlier, during his childhood, he recalled, "I have seen my father bringing in different varieties of fish in boat loads, but now it has reduced to just a kg or two. And all that is found are mostly *chapila, moka* and small prawns." Now, "one would be lucky if he got a big fish, though once in a while one gets lucky," he added.

Of course, villagers acknowledge that the embankment with the duct has helped protect many farmlands from flood waters, but the water regulatory mechanism has adversely impacted the ecosystem functions of the lake. The lake area has already shrunk and become shallow, due to anthropogenic activities, including expansion of agriculture.

Another elder Sunil Rai, 65, flagged the issue of leasing out of a big chunk of the lake area to a private individual, who now indirectly controls the fishing enterprise out of the lake. Though it's not clear whether or not the lake has any management system, he claimed that the water body is now fragmented into several parts. "We do not have any land right here even though we are living around the lake for decades and generations. We are actually surviving at the mercy of the lease-holder," Sunil Rai said.

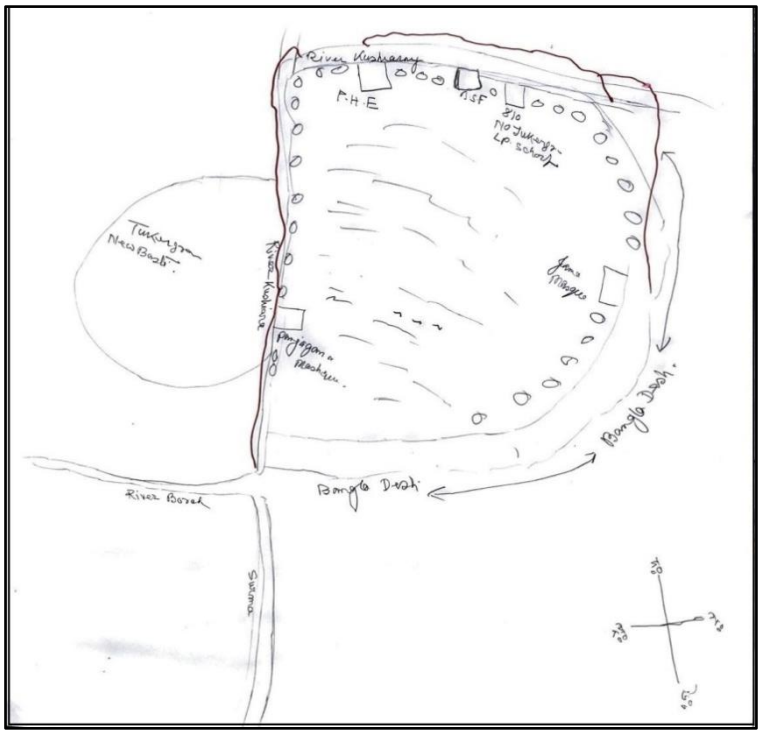
Earlier, it was the cooperative department, which used to issue lease order on the basis of an open tender bid, now it's the fishery development corporation which issues the lease. They pointed out that because of this open tendering process, most of the time it is the people from outside who manage to secure the lease. But the lease-holder hands over the lake to a local sub-contractor for running the fishing business. The local sub-leasee then sets the rules of the trade. He also imposes limits of the fishing area for others.

"Sometimes, we are debarred from fishing for three-four months," another fisherman said. The leasee also does not bother much about the Hyacinth. The narrow duct has been built in such a way that hyacinth cannot pass through it and instead chock the water outlet. This has exacerbated the situation, the fishermen say. "We are now compelled to remove the hyacinth from the lake, which is very difficult to control," one of them complained. They say they do not have enough resources for timely removal of hyacinth, and wished that government addressed the issues faced by the poor fish folks.

2. Old Tukergram – An 'island' village

The village is inhabited by Bengali Muslim community and most of the families are involved in farming activities for their livelihood. For the last few decades, the people of Tukergram have been facing an existential crisis. This is primarily because of continuing river bank erosion of Kushiyara, which has already bitten off a large tract of village land over the years. Many families have lost both of their houses, homestead and farmland to the hungry river, forcing them to migrate to the south bank of the river.

Old Tukergram also faces a peculiar situation because of its geographic location – on one side, the village boundary runs along the Indo-Bangla border, and on the other side, there



flows the Kushiyara river, which branches out of the river Barak near Bhanga. As a result, the villagers face multiple problems and challenges, especially, being a border village, there are restrictions on people's mobility because of the security concerns.

A participatory community map of Old Tukergram prepared by the villagers

Another equally grave concern for the villagers is the problem of river bank erosion. In the past decades, many families had lost their ancestral land due to the fury of the Kushiyara river and were forced to move out of the village and find shelter on the opposite side of the river, which is now called, New Tukergram.

Currently, there are only 120 households left in the Old Tukergram. Most of the families solely depend on agriculture to sustain their lives, and about 20/25 families, which had lost their agricultural land to erosion, work on hired/leased land to cultivate paddy and other vegetables.

The ferry service to Old Tukergaon

During the monsoon, the water from Kushiyara spills over the river bank and engulfs the entire village, causing severe damage to property, crops and livestock. The village does not have high grounds for taking shelter from flood; nor is there any community land in the village for construction of a temporary shelter. Therefore, in the event of emergency, families along with livestock are evacuated temporarily to safer places. “We don’t have even boats for evacuating the flood affected people,” rued Abdul Jalil, 67, a village elder.

In case of any emergency, the villagers seek the help of the BSF stationed at the riverside entrance of the village. Some years back, the state government, following a former chief minister’s visit, sanctioned one motorised boat, which now ferry people and goods. “We are connected to the district only through the ferry. People end up spending at least Rs 100 each per day on the ferry service, as we need to cross the river several times, while carrying out our daily chores outside the village,” lamented 62-year-old Moniul Hoque.

“We feel our children have no future here. Most of the youth leave the village to earn their living, or those who can afford, for better education,” Sajid Ahmed, 33, said.

3. Harinagar II – A fenced village

Harinagar part II is the last village on the north bank of the river Barak, which sits on the tri-junction of Barak and its two distributaries - Surma and Kushiyara; from this point, Barak gets bifurcated and flows in two opposite directions, both assuming the transboundary character.


View of Surma from Harinagar; right, a farmer sowing paddy by the river side of Barak at the tri-junction

Being the international riverine frontier between India and Bangladesh, the villages settled along the Surma or Kushiyara rivers remain under strict security scanner. Harinagar II and other 11 project villages under the Katigorah Block are all located along the Surma river as it runs towards north in Bangladesh. Above all, from Harinagar II up to Jalalpur touching the Cachar-Meghalaya border, the entire Surma stretch has also been fenced with barbed wire to secure the border and regulate people’s movements. Therefore, Harinagar II and all other riverine border villages is highly vulnerable not only to annual floods and river bank erosion, the village and the local population are also constrained by border security regulations and psychological pressures, which affect local people’s normal lives and livelihood challenges.

There are over 300 families at Harinagar II, majority of them are engaged in farming. However, villagers have said they face a difficult situation. About 250 families have their paddy fields outside the border fence along the bank of Surma river, and many of their farmlands are located on the other bank of the river, bordering Bangladesh. The villagers are required to report to the BSF outposts before entering their riverside farmlands. The BSF personnel regulate their daily movements through the huge iron gates, set up at several points along the border fence. At the gate, before entering their respective agricultural fields, the farmers have to write down their names on a register, show their identity cards (issued by the BSF) and then leave them at the outpost as per the time-table imposed by the security personnel posted there. That is the daily drill!

Harinagar: Border fence along the Surma that runs up to Meghalaya border

Under such restrictive circumstances, farmers said it was very difficult to carry out agricultural and other land management activities outside the fence. During the cultivation season, farmers need to take their cattle and buffalo and even small farming machineries for ploughing and different farm activities. “Every day, you need to argue, negotiate, plea with BSF personnel for one thing or the other, which is quite exhausting,” said a farmer not wished to be named. Besides, farmers face a harrowing time during the harvest period as their ripe croplands across the barbed-wire fence are left unprotected. So, all these challenges, both natural and human-induced, have severely heightened the vulnerabilities of the riverine villages – threat to community life, livelihood, economy, and environment.

ES Survey: Broad Conclusions

The socio-ecological survey and the community perspective of climate change and its impact on the floodplain ecosystems (rivers, streams, lakes and wetlands) as well as on people’s lives and livelihood across the project areas in the Barak river basin deliver the following broad messages:

Firstly, over the past decades, the natural hydrological regime and bio-physical environment of the Barak river basin have been substantially altered and degraded, triggering changes in the floodplains ecosystem functions and services. This resulted in the sharp decline in the freshwater ecosystems services and loss of aquatic biodiversity across the valley, severely weakening the carrying capacity of the available riverine ecosystems. The drivers of such drastic changes are attributed mainly to population growth, expansion of agriculture, industry and economic infrastructure development for meeting the growing demands of food, water, habitat and livelihood. All these anthropogenic actions have led to pollution of soil, water, air, and eventually, rise in temperature and climate change. Both the secondary research review and the outcome of this scoping survey in the TROSA 2.0 project areas have reached this conclusion.

Secondly, the riparian communities are mainly involved in agriculture, including poultry and animal husbandry, and fishery activities in the Barak valley. Thousands of poor and vulnerable families depend on the resources of floodplains -- river, streams, lakes (*anua*), and wetlands (*haors* and *beels*) for sustaining their lives and livelihoods. Therefore, healthy floodplain ecosystems are critical for enabling continuation of ecosystem services for people, plants, animals and other life forms sharing the same riverine landscape.

Thirdly, unpredictability and extreme weather events have become a 'new normal' climate. All these impose such conditions on people that compel them for making intuitive choices and taking rational actions towards adaptation, mitigation as well as disaster management. But the vulnerable riparian communities do not have required understanding, capacities, and resources to deal with the impact of climate change and the looming challenges.

Fourthly, communities in the project villages appeared to be quite unaware of unfolding environmental and economic challenges due to the impact of climate change. They are also unable to perceive as to how the declining ecosystem services and biodiversity from the surrounding natural environment are impacting their lives and livelihoods. It was perhaps because of lack of education and environmental awareness, the villagers were not able to articulate their responses to the questions related to climate change and ecosystem services. In many of the project villages, people said there was no such awareness programme or discussions held at the grassroots level, organised by the Gram Panchayat or any other government departments to explain the climate change issues and how to tackle them.

Finally, for most part of the year, the riparian communities are left to fend for themselves to sustain their livelihood and income. Most of the villagers subsist on agriculture, fishing and traditional skill-based wage labour such as, boat-building, bamboo craft, making fishing net, fish-traps and other household implements. However, these indigenous knowledge and skills are disappearing fast, as the local youths are not interested in learning them; instead many of them are migrating to urban towns and cities to earn wages by doing odds jobs.

The riverine people are usually resilient to natural stress. During the flood calamity, the communities cope with the vagaries of nature by using their traditional knowledge and ingenious ways and skills. Of course, the district administration and some NGOs come forward to help and distribute some food and relief materials to the affected families for a few days, but these are grossly inadequate. Moreover, many of those disaster-affected families who might have lost their crop, livestock, and properties, get little support or compensation from the government to rebuild and restore their life and livelihood. This

makes the impoverished flood-affected communities more vulnerable as they lack resources to bounce back.

So, what needs to be done?

Call for Actions – A few recommendations

Now that the major issues and challenges have been outlined above, as this scoping survey revealed, these invite actions in the four key following areas:

First of all, at the bio-physical level, there is an urgent need for (i) repair and reclamation of the degraded local riverine ecosystem services that the communities depend on for subsistence; and (ii) protection and conservation of wetlands for mitigation of floods, environmental pollution, and maintenance of floodplain ecosystem functions, which are vital for enhancing resilience and integrity of the aquatic ecosystems.

Secondly, at the community level, an enabling support system has to be created for the vulnerable riparian communities to deal with the whole spectrum of climate change-related issues and challenges – adaptation, mitigation, and disaster risk reduction. The supporting ecosystem has to be built around the community by setting up village-level institution, which is absent in the village. The elected local governance institutions, such as Gram-Panchayat, are party-based, and thus not all inclusive by design.

Under the TROSA 2.0 project, a couple of village-level community institutions may be piloted among the selected project villages. Of course, for that, sustained efforts have to be made by staying engaged with the members of the riverine communities. Some rigorous activities, preceding the formation of such community institution, have to be taken up: (i) to create awareness among them about the climate change issues and the factors that increase their vulnerabilities; (ii) to do participatory assessment of local ecosystem services and resources the community depends on, including listing out the natural products that the villagers exploit from the surrounding environment; (iii) to educate the local communities about the benefits of conservation and protection of the rivers, wetlands, lakes etc.; (iv) to make the community understand the need for sustainable use of the resources and services of the ecosystems; and finally, through this process, set up community institution and a governance framework by training and enhancing the capacities of the local people to execute the community-led decisions and activities.

Thirdly, time and financial resources have to be invested in the community efforts to carry forward the process and help build the community-led support system, which can be institutionalized to facilitate both development and crisis management activities up to the last mile. These community institutions should also be capable of interacting with elected grassroots bodies, government officials, institutions and agencies, including non-government organisations to secure support and resources as and when required for the affected villages.

Preparation of a community-led disaster risk reduction and management plan may also be piloted in a few selected villages. The role of the proposed community institution is not limited to disaster response alone, such institution could be helpful for development and governance of any conservation plan, say a wetland or an ox-bow lake, or for that matter, implementing any community livelihood project.

Fourthly, it is also important to document all traditional indigenous knowledge -- native architecture, handmade crafts, tools and implements; folk arts and musical instruments; medicinal plants and herbs-based health care and healing practices etc. Despite the development of modern knowledge systems, these ancestral knowledge and practices continue to serve the rural population and are still valuable. Many of these indigenous knowledge systems and practices can be useful for enhancing adaptive capacities of the community. All these must be learned, practiced and preserved for the posterity as part of community identity and cultural heritage before they disappear for good.

Finally, action will be required also at the policy level to recognize the importance of such village-level community institution and its role, say, as the 'first respondent' to call for any support in the villages, especially at the time of natural calamity such as, the problems of recurring annual flood and river bank erosion. In fact, being a non-partisan community institution set up by consensus of a village, it can act as 'agency for last mile delivery of services', if adequately empowered by law and funds. It is imperative for the government to ensure that all houses are built with elevated floor in the flood-prone river side rural areas as per the Prime Minister Awas Yojona for the poor.

It is also essential to think globally, but act locally. Given the fact that humans depend on the resources and services of nature, it has to be ensured that the natural endowments are carefully conserved, protected and preserved. At the same time, the resources have to be used and managed for supporting livelihoods of people and the growth of human economy in ways that are sustainable. Therefore, all development and conservation initiatives must be congruent with steps that ensure protection of nature and integrity of its diverse ecosystems.

Globally, it is now acknowledged that the environmental security, including sustainable management of natural capital, is integral part of human security (wellbeing and socio-economic prosperity). In other words, assessment of economic value of natural capital and ecosystem goods and services are critical for decision-making, policy formulation and planning for conservation and sustainable development. This will also help create awareness of people about the value of local ecosystems and the need for their protection and conservation.

It may be appropriate to mention here that countries all over the world are expected to implement two major global initiatives – the UN Decade of Ecosystem Restoration (2021-2030) along with fulfilling the 17 Sustainable Development Goals (SDG 2030), which all have committed to. Globally, countries may be still far away from achieving those pious goals, but at the grassroots level, if investment and support is commitment, such pledges can certainly be achieved.

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Annexure 1

Questionnaire for socio-economic survey of the project villages and ecosystems services

Village profile

1. Socio-Economic Status

Using the tools-Village mapping and Resource mapping, we will try to visualize data under the following heads:

Name of the Village –

Revenue/Non-Revenue

Name of GP, Block, Tehsil, District

Number of families/Households

Population of the village

No of Households without land in the Village

Household Income/Monthly

No of Households with at least one government employee

No of Households Headed by Women having source of monthly income

No of HHs with any disability (Please specify the type of disability) Male or Female

Status of Education in HHs

Old Age Pension in HHs

How many HHs electrified

Source of Energy for Cooking: Firewood Gas Induction cooker

Religion: Hindu Muslim Christian Buddhist Others

Gender classification

Institutions like school, college, hospital, women's group, SHG, local clubs etc.

Distance from village (School, Health Center, Block Office, Local Market etc.)

Roads: (Metalled, paved, kuccha/muddy road)

Sources of drinking water: (River, Piped water, Deep Well, Bore well, Ponds…)

Water bodies: River Streams Wetlands

Pond/community pond Natural spring Well

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2. Ecosystem services assessment

Riverine basin usually comprises three main ecosystems – River banks, Flood Plains areas and wetlands…

In a village map, identify different types of land use:

(House hold-wise Land Use practices)

Agricultural land: Yes No

Size of farm land: <01 Hector > 01 Ha > 5 Ha

Non-agricultural land (homestead gardens, commercial plantation etc.)

Forest, Community/village/common forest lands

Grazing land: Yes No

Fishery (River, streams, wetlands, lakes etc.) or Household Ponds (cultured fishery)

Seasonal mapping of crop and croplands:

Conduct a timeline mapping of all the products and services received from river over a period of 20 years (i.e 20 Years, 10 years back, and current status). What foresee in near future?

In terms of crops:

Q1. What crops are cultivated by your Family/community throughout the year?

(To prepare a seasonal crop calendar within the annual cultivation activities to understand availability of food crop, fruits and vegetable in the village)

Q2. What type of cultivation is practiced - multiple cropping or mono cropping?

Q3. What type of seeds is used for cultivation - local or hybrid?

(Do you conserve or use your own seeds or buy it from Market?)

Q4. What is the area covered by cultivation of local seeds?

Q5. What is the area covered by cultivation of hybrid seeds?

Q6. The production from your land is used for what purpose - own consumption or business?

Q7. Is there any storage facility available in your village?

Q8. Is agriculture only or sufficient source of your livelihood?

Are there other sources of Income? Please specify

Q9. Do you use chemical fertilizer in your land? What types of fertilizer do you use in your fields?

Q10. What type of foods do you get from your land?

Q11. What challenges do you face in practicing agriculture?

Lack of proper seeds

Lack of fertilizer

Lack of irrigation facilities

Weather uncertainties

Lack of technology

Difficulty in reaching the market

Lack of labour force

Q12. Do you get any input support or any other services from the Agriculture Department?

Q13. Have you heard of climate change? Have you observed any change in climate or weather pattern?

(More or less rain; increasing dry and hot days or draught condition, unpredictable and heavy rains, floods, landslides, storms etc.)

Q14. What are the impacts of climate change you have noticed so far?

On River

On agriculture

On forests

On weather

Q15. What are the services you receive from the river?

Waterway transportation

Water for irrigation

Performing rituals in close connection with river

Flood control services

Water-based sports and recreation

Q16. What are the products you receive from the river?

Food sources including fish, snails, mussels, crabs etc.

Water as a resource

Source of livestock water

Source of drift wood, bamboo during monsoon floods

Q17. What are the products you receive from a wetland?

Food products like fish, snail, vegetables etc.

Flowers

Water hyacinth

Q18. What are the services you receive from a wetland?

a. Water for irrigation

b. Source of livestock water

c. Grazing space for livestock

d. Holding excess water during floods

e. Cultivation of crop when water recedes

Q19. What are the services and products you receive from natural water canals?

Food source, like, fish, snail, crabs etc.

Water for irrigation.

Q20. What are the services and products you receive from a pond?

a. Water for domestic use.

b. Rearing of fish.

c. Reservoir of water for future use.

Q21. Who owns resources (trees, forest) in your area?

a. Government

b. Village commons

c. Individual Households

Q22. What are the services and products you receive from Trees and vegetation in your area?

Maintenance of air quality.

Prevention of soil erosion.

Providing habitat to wild animals, birds, insects etc.

Regulation of temperature

Source of food, non-timber products.

Source of firewood.

Q23. What are the traditional water management practices you have had adopted?

3. Information related to disasters

Timeline analysis of flooding - annually, monthly

Identification of villages at high risk of erosion through mapping

Outlining the trend of erosion in the project villages over a period of past 50 years.

Flood

Q1. What part of the village remains flooded? How long does it remain submerged?

Q2. Do you receive any kind of early warning in the face of disasters?

Q3. If yes, then how?

Q4. What are the water-related disasters you face in your area?

Floods

Erosion

Storms

Water-borne disease outbreaks

Droughts

Q5. What impact have you endured in the face of water-related disasters?

Number of livestock death

Number of human loss

Damage to the habitat

Livelihood/income

Q6. What are the disaster risk response/resilience services available at your vicinity?

Crop insurance

Flood shelter

Livestock shelter

(Collect narratives of the flood experience from the seniors in the community).

Q7. How did the vulnerable population-elderly, children, pregnant woman, differently abled face this disaster?

Q8. What measures were adopted to ensure the availability of livestock feed during floods?

Q9. What impacts have the livestock endured in the face of flooding?

Q10. What patterns of cropping have you adopted in response to floods?

Q11. What is the primary source of flooding in your area?

Q12. Who are the primary stakeholders who responded in the face of the disaster?

Q13. What kind of flood-resilient responses have been managed in your area?

Infrastructure-related

Habitat-related

Installation of early warning delivery

Livelihood-related

Erosion

Q1. What are the impacts of erosion you have endured?

Homelessness

Loss of land

Type of land lost

Q2. Was there any migration due to loss of land by erosion?

Q3. What do you identify as the cause of erosion in your area?

Q4. How many households are at a high risk of erosion in the village?

Q5. How many HHs became landless due to erosion?

Q6. What are the erosion-related risks you face today?

Habitat loss

Livelihood loss/ Loss farmland/ Grazing land

Institution loss like, school, hospital, Community Hall/Center, religious sites etc.

Q7. Who are the primary stakeholders who responded in the face of erosion at your village?

(Need to specify the stakeholders for better understanding of the community)

Q8. What role did the stakeholders play to mitigate the effects of erosion in your village?

Q9. What are the measures adopted for providing relief, rehabilitation and managing resilience in response to erosion?

Drought

Q1. Have you faced any drought-like situation in your village in the last 20 years?

Q2. If yes, then please describe

Q3. What were the impacts of drought you have endured at that time?

Provision of drinking water

On agricultural front.

Q3. Who were the primary stakeholders who responded in the face of drought?

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