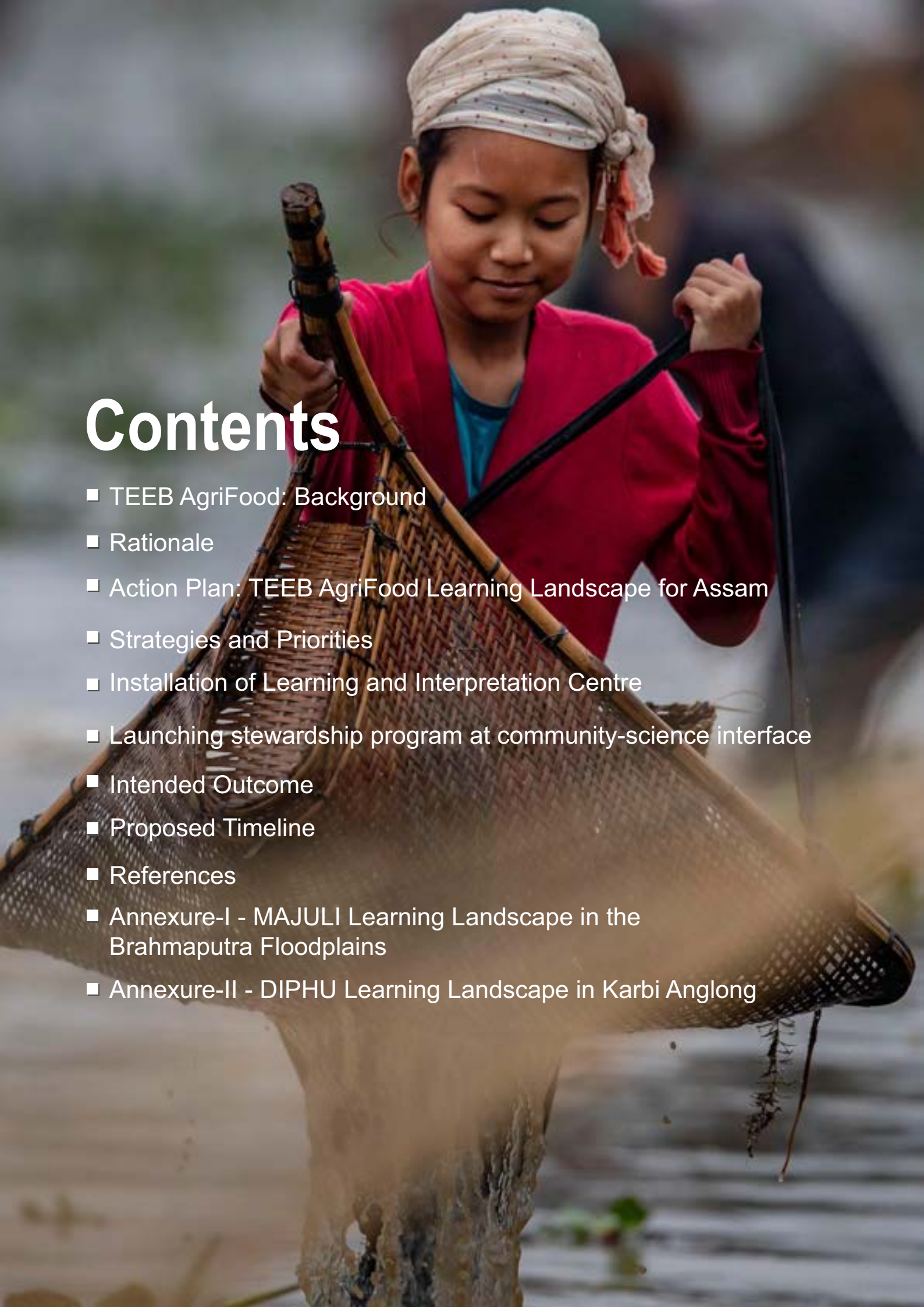
TEEB AgriFood Learning Landscape

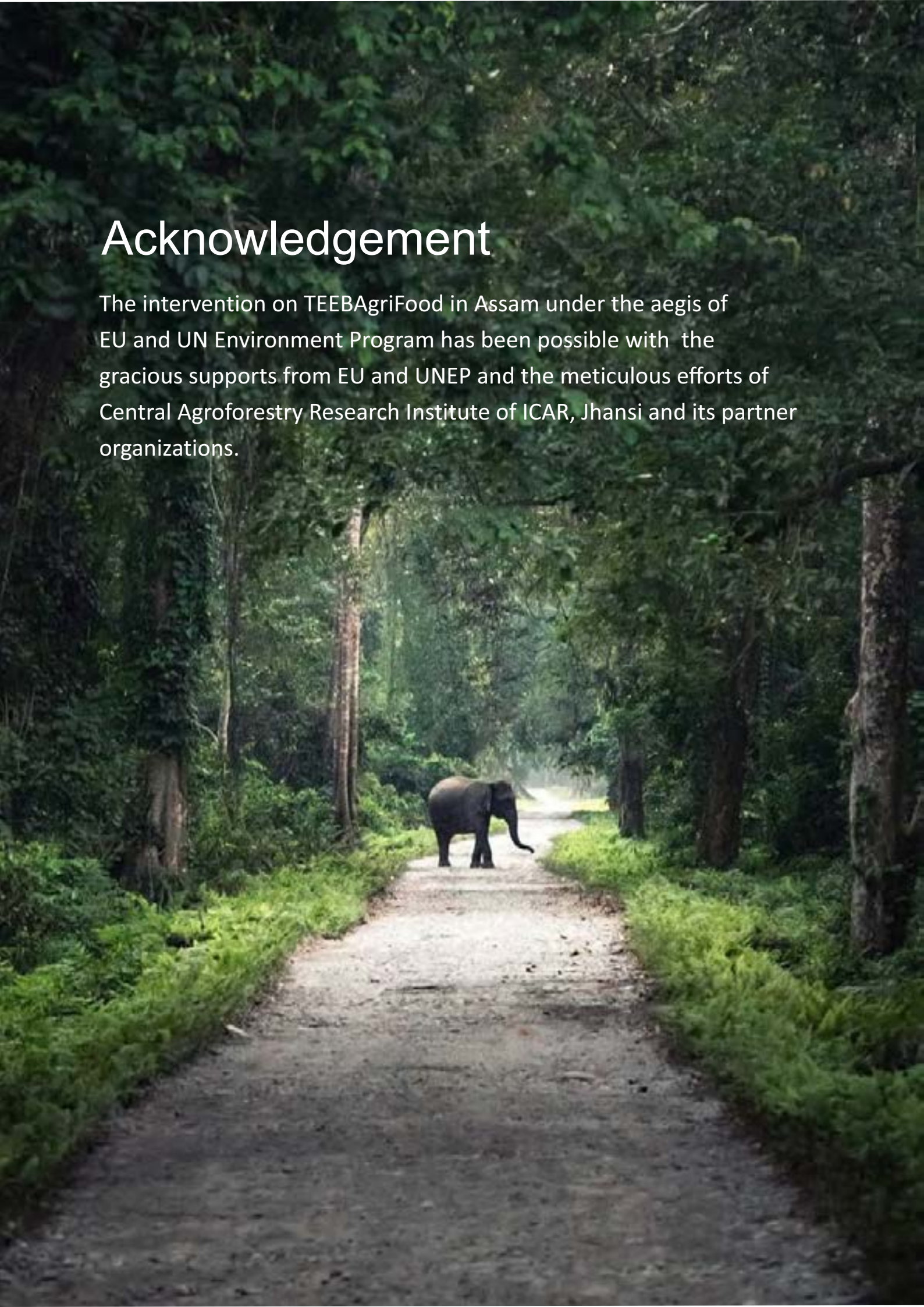
Action Plan



Contents

Acknowledgement

The intervention on TEEBAgriFood in Assam under the aegis of EU and UN Environment Program has been possible with the gracious supports from EU and UNEP and the meticulous efforts of Central Agroforestry Research Institute of ICAR, Jhansi and its partner organizations.



TEEB AgriFood: Background

'The Economics of Ecosystems and Biodiversity: Promoting a Sustainable Agriculture and Food Sector' (henceforth 'TEEB AgriFood') is an intervention under the aegis of EU that has the objective to protect biodiversity and contribute to a more sustainable agriculture and food sector in partner countries of global south mainly. It is therefore, a frame of reference that can enable us to find "what should we value, and why?" and can be used to evaluate a policy question, a business question or an accounting question all intending to sustainable development and inclusive growth in the climate milieu. This project tests the interventions, which have already been applied or are proposed in these countries in scope, that claim to stimulate positive livelihood and biodiversity benefits, and assess their hidden or unaccounted outcomes on natural, human, social and manmade capitals.

TEEB AgriFood India intends to inform the agriculture and food planning process in India by providing comprehensive, scientific evidence to support agriculture and food system policies, specifically in the context of organic farming and agroforestry. The project will respond directly to policy questions from Indian policy makers, with Department of Agriculture, Government of Assam at the state level and Ministry of Agriculture and Farmers' Welfare (MoAFW) and Ministry of Environment Forests and Climate Change at the central level as political focal points. Extending the scope of the project beyond the policy interventions on organic farming and agroforestry already under assessment in Uttar Pradesh and Uttarakhand, namely, the Paramparagat Krishi Vikas Yojana (PKVY), Namami Gange Programme and the National Agroforestry Policy, the Project Steering Committee identified the following policy interventions as priority areas in Assam:

- Mission Organic Value Chain Development for North East Region (MOVCDNER)
- Traditionally Organic Areas in Assam
- National Agroforestry Policy 2014
- National Bamboo Mission

The relevance of the project to other national and state-level policy initiatives is to be assessed through the study scoping phases. The objective of this full TEEB AgriFood analysis is to provide evidence to:

Inform policy about overtime impact of organic farming and agroforestry on ecosystem services, produced capital as well as measures of social and human capital, including but not limited to livelihoods and health Inform policy, institutional and governance solutions that take a food systems approach, promoting coherence across different policy areas (e.g. agriculture, livelihoods, trade, food). Support spatial planning of agricultural production to maximize ecosystem services and evaluate the economic case for scaling up organic farming and agroforestry to form sustainable food production policy intervention, such as policies related to pollution, pesticide and fertilizer use, sustainable value chains, market linkages and certifications.

The project will identify any differences in social, manufactured, natural, and human capital for a predicted Business as Usual (BAU) and at least two Alternative Policy Scenarios, at every step along the value chain. The study shall quantify or evaluate qualitatively the impacts upon humans that are expected from changes to the four capitals under each policy scenario, relative to current business as usual trends. With reference to natural capital, changes in the flows of ecosystem services (or dis-services and residuals) between scenarios are to be used to identify how natural capital contributes to agri-food value chains and how in turn agri-food value chains may impact natural capital stocks.

In furthering with the impact of the study and its modest objectives that suitably addresses the climate challenges, the sustainability of the intervention is sought through an innovative intervention of setting up two learning landscapes in Assam those are representatives of its socio-ecological production profile and has a plethora of sustainability, equity, reciprocity and inclusivity in it for adaptive learning at community-ecosystem interface. The principal criteria for selecting such learning landscapes have mainly been its contrasting socio-ecology or unique Assamese signatures of agro-farming practices, have potentials in promoting both agroforestry and organic farming therein and as well having the ability to enable adaptive in-situ learning for several sustainable agro-farming models through experimentation and technology cooperation at community-ecosystem interface over space and time.

As a part to this end, the main assumptions in selecting the learning landscapes have been deduced from the study on the existing apportioned potential of Agroforestry and Organic Farming in the state of Assam and its projected augmentation through nature-based solution towards sustainable livelihood and leveraging carbon co-benefits as well, in this climate milieu. With regard to this, the points of consideration have been the scopes in

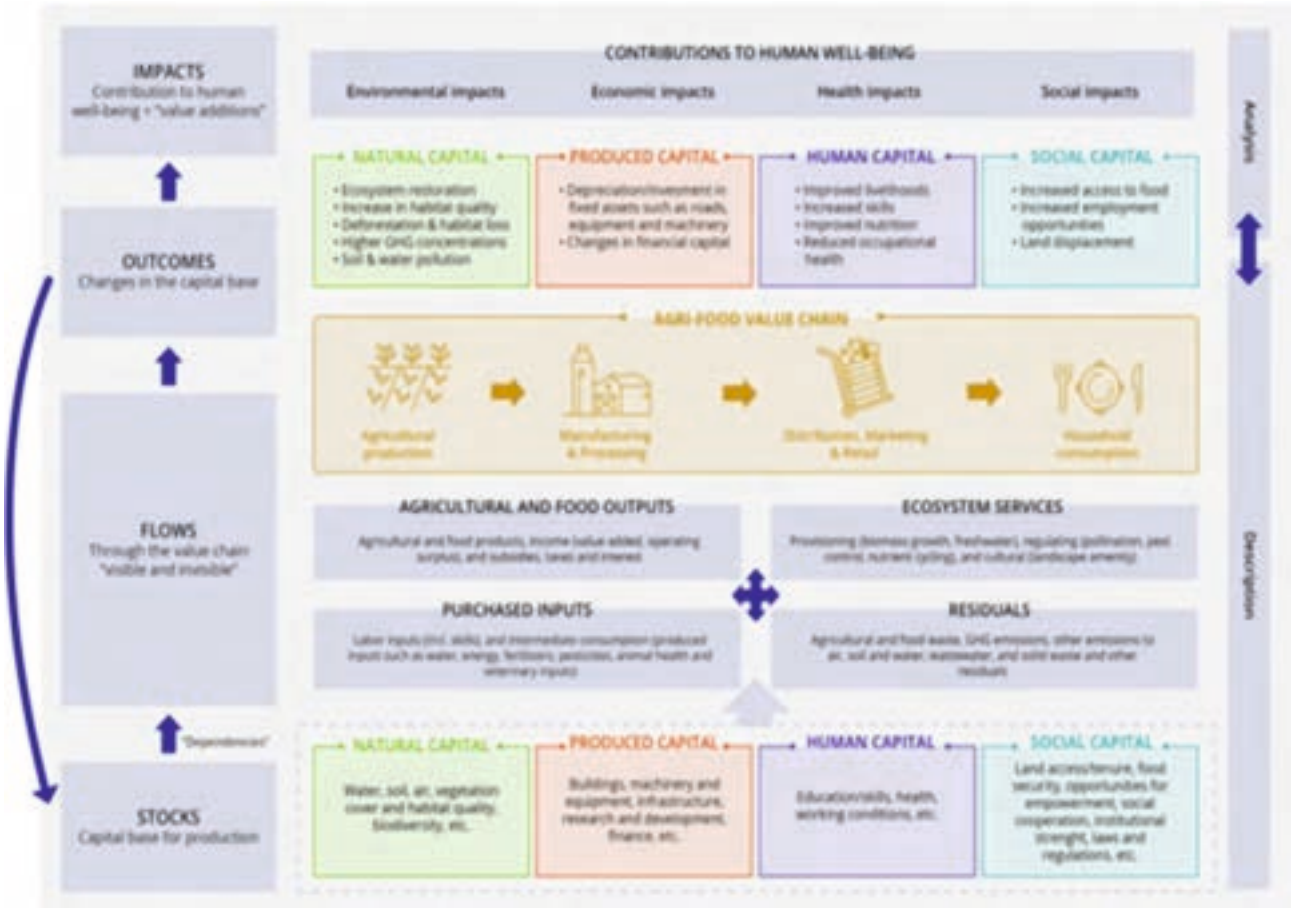
- Enabling studies on a spatial-scale with special references to the socio-ecological contrasts of upper and lower Assam as well north and south bank of river Brahmaputra enabling scenario planning on the growth potentials of Agroforestry and Organic farming in the context of such contrasts, especially in lower and upper Assam on a triannual scale.
- Enabling opportunities in in-depth interpretation on signature agroecology of Assam like rice landraces, medicinal plants, forest woods like Agar, and especially bamboo and tea.

Approach: The intervention will have a four-pronged approach in its design that would essentially comprise of the following facets:

- ***Pragmatic approach:*** It would rely on empirical meta- datasets those are recent and collected scientifically for statistically appreciable and accurate data modelling and interpretation. This would enable cohort-specific studies capturing significant features, unique for the cohort.
- ***Inclusive approach:*** The data interpretation would be comprehensive, leaving no-one behind and over cross- sectoral societal strata, facilitating multi-criteria decision analysis to suggest a more resilient operational framework. It includes age, gender, trade and circumstances pervading all target cohorts for studying.
- ***Equity and reciprocity:*** The interpretations and findings will be peer reviewed in stakeholder workshops and further shared with a random sample of the same cohort for feedback. The feedback-inhibition method will filter data-fads, as well set a participatory paradigm upfront.
- ***Adaptive approach:*** The developed framework would constitute an evidence-based adaptive learning platform that would enable continued research and enable policy implications through research updates, as well expediate recommendable adaptive changes.

Rationale

TEEB AgriFood supports sustainability transformations of the eco-agri-food system by: i) contributing to a more encompassing understanding of the eco-agri-food system, ii) strengthening alliance building to increase the leverage of those interested in changes in the ecoagri-food system by reaching out to a broad range of constituencies, and iii) identifying strategic interventions and setting priorities. TEEB AgriFood is highly relevant in today's global sustainability governance context. The Sustainable Development Goals (SDGs) and the Nationally Determined Contributions (NDCs), despite being significant elements of the global sustainability governance landscape, are also voluntary. The implementation of these voluntary agreements depends on encouraging diverse actors to participate, integrating different sources of knowledge and ensuring that cross-cutting issues are properly considered. TEEB AgriFood can help by providing information and knowledge through valuation. Further, the holistic analysis offered by TEEB AgriFood supports identifying the actors affected by and relevant to changes in the agri-food system. Hence, TEEB AgriFood can contribute to the inclusion of a range of actors of the sustainable agri-food system according to their rights, capacities, and needs. TEEB AgriFood framework can therefore contribute to the successful implementation of global agreements, including the Sustainable Development Goals (SDGs), the Paris Climate Agreement and the Aichi Biodiversity Targets.



Taking essence of this framework, in order to demonstrate the utility of TEEB AgriFood framework for planning sustainable agriculture in different ecological regions, this action plan illustrates how diverse components in the agri-food system may lead to sustainability at landscape level. The engagement strategies are also proposed that may serve as a source of inspiration for others how they can engage with or contribute to the TEEB AgriFood community at landscape level.

Action Plan

TEEB AgriFood Learning Landscape for Assam

Assam a bio-culturally diverse state in the northeastern region has been a hotspot for green development process. The recommendations from multiple TEEB AgriFood consultations held at the state and national level, including discussions during Project Steering Committee meetings for the TEEB AgriFood project implementation in India supported that the application of the TEEB AgriFood framework in Assam to strengthen evidence for scaling organic farming and agroforestry. The following considerations were made to form basis of the rationale:

- Assam being a state in the humid-tropics in the northeast region can further strengthen evidence for organic farming and agroforestry given that the state represents an important agroecology not covered in ongoing valuation studies in the country.
- Impact vis-à-vis biodiversity and livelihood outcomes and governance (i.e. the potential for results-uptake), and distributional aspects (i.e. ensuring that the project is pro-poor and recognizes the gender dimension of the change evaluated) can be well captured in the state of Assam which is amongst the most biodiverse states of the country with ~34% recorded forest cover.
- Assam having shown positive inclination under PKVY and other schemes aiming to promote organic farming, offers an opportunity for the assessment of the Mission Organic Value Chain Development for the North-East Region (MOVCD-NER) currently not covered under the TEEB AgriFood India project.
- Assam offers an opportunity to strengthen evidence on the environmental and socioeconomic benefits of agricultural and agroforestry interventions.
- Assam is amongst the states being covered under the Trees Outside Forests Initiative (TOFI) launched by the Ministry of Environment, Forest and Climate Change and can inform the implementation of agroforestry interventions in the state. As per the economic survey of Assam 2022-23, the state hopes to use TOFI under its new initiative to enhance the forest cover by about 38 percent. This will add momentum to agroforestry in the years to come.
- The Assam Agroforestry Development Board has been set up with the purpose of incentivizing industry to invest in Assam and at the same time encourage communities to plant commercially important species to supply to the industry.

Strategies and Priorities

A. Strategic Assumptions for conservation of this learning landscape

Stakeholder's perception: Stakeholder's opined that establishment of "an initiative" rather than "a mechanism", is imperative since the latter implies a formalized system or procedure with legal and prescriptive implications. This would ensure sustainable intensification, reciprocity and equitable growth.

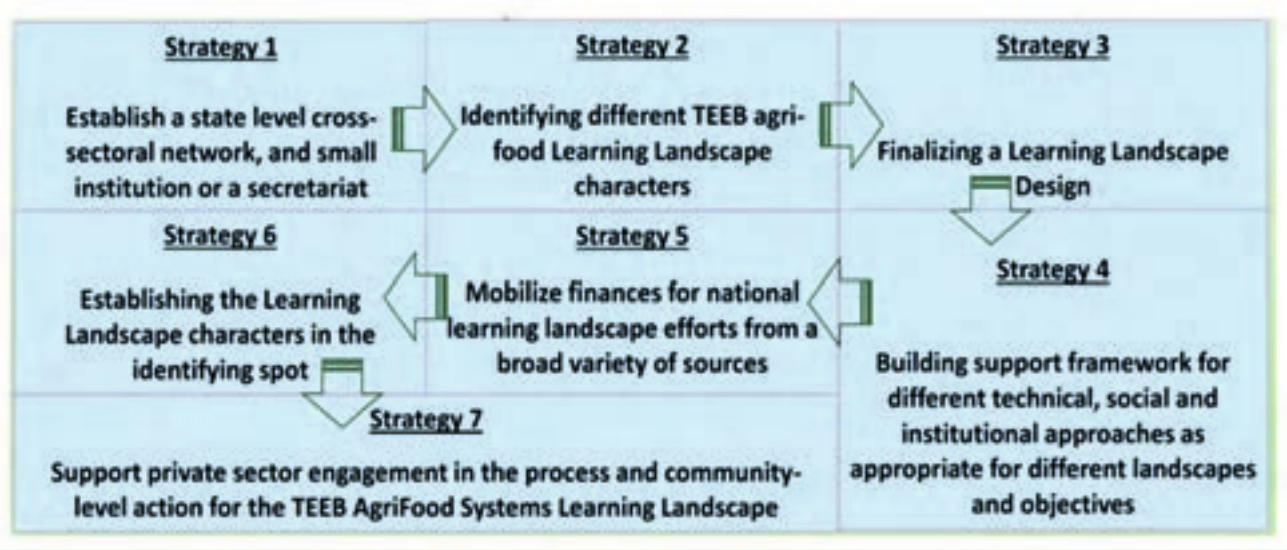
Coverage and nature of the initiative: The initiative would primarily cover a representative landscape unit in the State, ideally spanning around 50-60 hectares. It would be voluntarily contributed or identified by the Govt., non-binding, and open to all districts and agencies who could play differential roles in conserving and sustaining the landscape depending on their interest, needs and experience.

Target: It is recommended to have a target to indicate the scale of the problem, create enthusiasm, connect to the media and mobilize finances. The process of setting the target shall have to combine both the top-down and bottom-up approaches, be based on the country targets, and could set 2030 as time frame to align with SDGs and other international goals. The target should also prioritize areas with both high biophysical and socio-political potential for organic farming, agroforestry, eco-restoration and include both forest land and trees outside forests.

Monitoring: There would be defined activities, outputs and indicators to develop a stringent M&E matrix for progress and sustainability assessment by the stakeholders and plan for adaptive management over space and time.

B. The Core Strategies

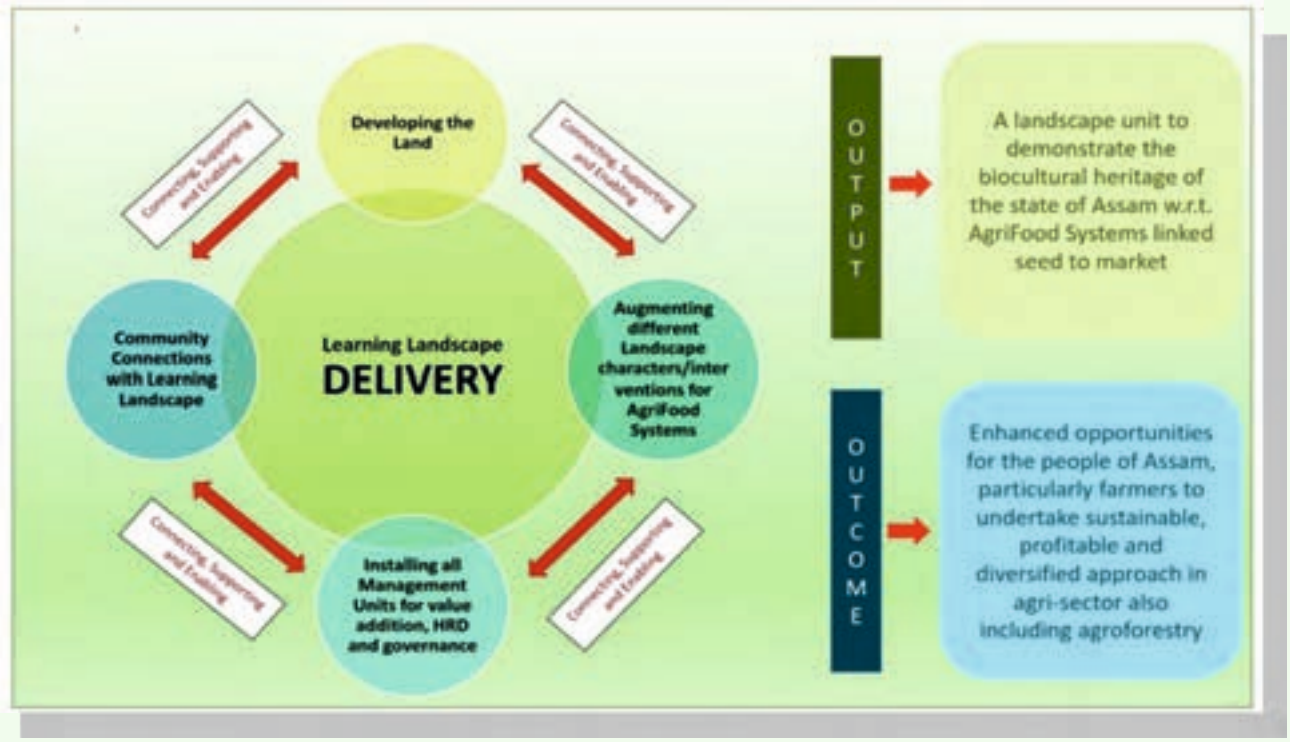
Seven core strategies have been identified and defined for immediate action and implementation by the partners, stakeholders, initiatives and communities depending upon their respective interests and availability of mobilized resources for implementation. These are enunciated below.



C. The Deliverables

The learning landscape unit in Majuli will essentially demonstrate socio-cultural heritage of the riverine island in particular and as well of the state of Assam in general, with special reference to organic farming and agri-food production system through several interventions based on traditional practices and as well scientifically supported decision making and technology for sustainable intensification of production, culture and knowledge.

Systemically, these will be delivered through four interlinked steps, which will be connecting, supporting and enabling each other through a cyclic design-approach to leverage the benefits of circularity in principle. These steps are enunciated below.



1) Developing the land for the landscape

During the phase of developing and scaping the land, a detailed survey, assessment and evaluation of the intervention area will be conducted based on on-site primary data accrual followed by review and interpretation of the data. Outcomes will be the learning anecdotes for building the learning landscapes in each of the sites and this study will be the fulcrum for augmenting different landscape characters and interventions for sustainable intensification of agro-food system. Therefore, the same will be suitably utilized for designing and planning the hub, demarketing the fenced area, creating a buffer zone and defining the stakeholder usages, as well. Such surveys would necessarily include Ecological Assessment (Nature Capital), GIS-RS based mapping and projection studies, ecological modeling etc. to undertake studies on

i. Analysis of changing Land Use and Land Cover data of the intervention sites

For this analysis LANDSAT-TM &LANDSAT 8-OLI datasets will be used. After radiometric and Atmospheric correction supervised classification will be applied which will be followed by ground truthing and Knowledge based classification and accuracy assessment. Finally change detection study will be done to assess the changes in Land use land Cover. Using CA-Markov chain Modelling future prediction of the land cover types of the study area will be done. For generating precise flood hazard zonation map, various geo-environmental factors are needed to be analysed, as the characteristics and location of the flood prone areas varies depending upon these factors. Besides, historical flood point location data are to be acquired from reliable sources like Web Map Service (WMS) maps and various published reports. Various geo-environmental factors including elevation, aspect, slope, topographic ruggedness index (TRI), topographic position index (TPI), geology, Topographic wetness index (TWI) and standardized precipitation index (SPI), rainfall, distance from stream, drainage density, normalized difference flood index (NDFI), soil type, land use/land cover (LULC), landform, normalized differential vegetation index (NDVI), population density, distance to road will be acquired. Open access satellite images and various published reports of different governmental agencies will be used in this regard. TPI, TRI, TWI, and SPI will be derived from DEM using ArcGIS software v10.5. The acquired data sets will be analyzed and synthesized using various GIS and RS techniques for identifying accurate flood hazard zones. This would be followed by *Cluster and Outlier Analysis* for assessing the Disaster Vulnerability (Flood & Earthquake) of the landscape, hotspot zonation and series trend analysis using linear and Mann-Kendall statistics.

ii. Meteorological Data

a) ***Rainfall pattern of the study area:*** TRMM (Tropical Rainfall Measuring Mission) Satellite Imageries will be used. Monthly average rainfall data will be downloaded and using geospatial and statistical analysis, decadal rainfall pattern of the study area will be assessed.

b) Land Surface Temperature pattern: MODIS (Moderate Resolution Imaging Spectro-radiometer) Terra land surface temperature data. Composite Land Surface Temperature imageries of MOD11A2 will be downloaded and using geospatial and statistical analysis decadal land surface temperature pattern will be assessed.

c) Relative Humidity (RH): Relative humidity of the study area will be collected from the Indian Meteorological Department of the available stations within the study area. These data will be incorporated within GIS environment and by spatial interpolation techniques the relative humidity of the total study area will be plotted. Finally using geospatial and statistical analysis decadal relative humidity pattern of the study area will be assessed.

iii. Pedological studies (Profile, Nutrient and CSP) will be done on soil samples of the intervention site using standard methods on N,P,K, ToC etc.

2) Connecting the community and the stakeholders with the landscape:

i. Stakeholder sensitization and concept grounding

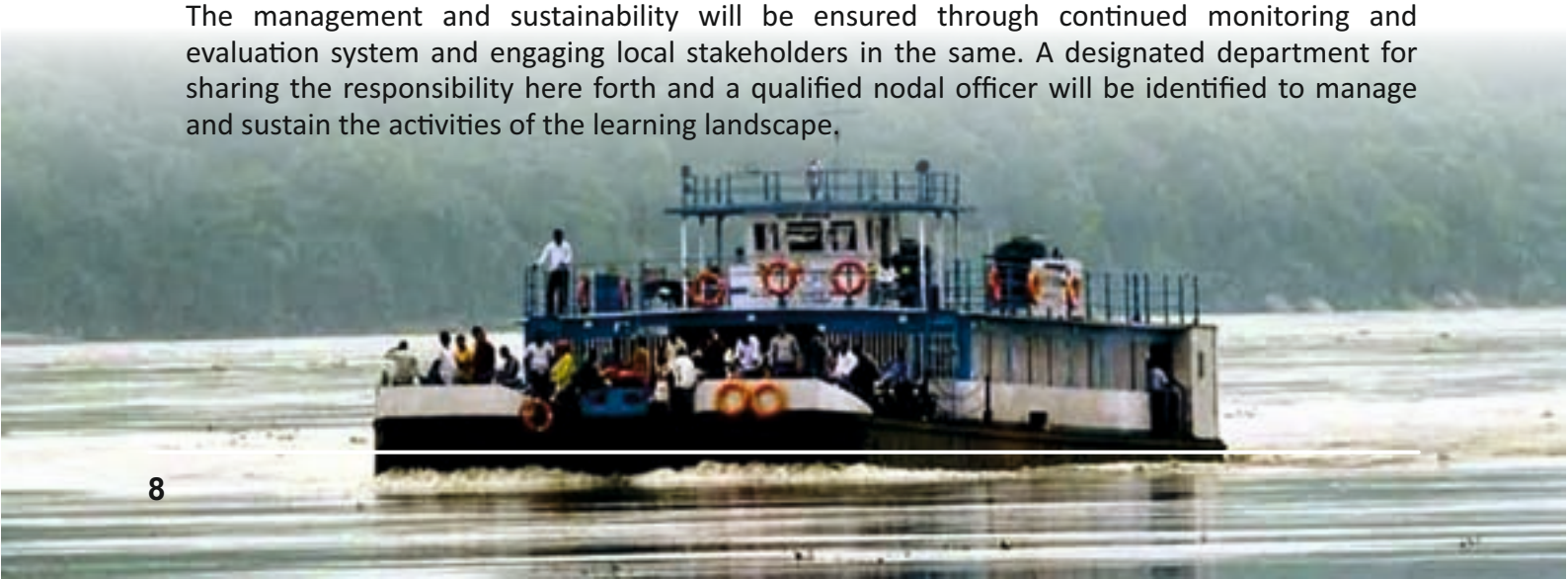
The concepts of the 'learning landscape' pertaining to its objectives, intended outcome and sustainability would be grounded through stakeholder consultation and community sensitization in the respective socio-ecological production landscapes. This phase would enable consultation workshops with the line departments and all other enablers to design and develop the implementation plans, architecture and M&E matrices. Post this the same will be communicated to the community through sensitization meetings, peer review workshops and awareness building campaigns in the areas of intervention. It is intended to engage all major stakeholders during this phase and reach out to at least 30-35% of the community households in the area. Communication media, both social media networking and conventional media may be used for propagating the concepts across the communities and stakeholders.

ii. Building capacities through knowledge nexus

At the onset of the implementation capacities need to be built in the local stakeholders, comprising of both farmers and practitioners from the local community and as well line managers for 'preparing to participate'. This readiness will be imparted by a 'knowledge-nexus', comprising of specialists and experts from national level organizations and international groups and development agencies, through basic level capacity building in developmental planning, participatory action-research, study methodologies, designing and financial budgeting etc. It is intended to pick select community leads (up to 10% of the engaged stakeholders) and line departments to participate in the next phase of assessment and review and as well building plans for the model learning landscape.

3) Installation of Management Paraphernalia:

The management and sustainability will be ensured through continued monitoring and evaluation system and engaging local stakeholders in the same. A designated department for sharing the responsibility here forth and a qualified nodal officer will be identified to manage and sustain the activities of the learning landscape.



Installation of Learning and Interpretation Centre

Annexed to the hub, a Learning and Interpretation Centre will be installed for the stakeholders and learners, wherein there will be facilities for basic research and interpretation, problem identification (related to agroforestry and organic farming) and troubleshooting, capacity building and documentation. The center will be facilitated with a basic analytical field laboratory for soil and water testing, pest and pathogen identification etc., a weather station connected to CIN for early-alert systems, digital interface for knowledge economy and archival, digital documentation system etc. The center would be enabled with capacity building programs on agroforestry, organic farming and as well, advanced programs on organic certification, GI tagging, carbon assessment and financing, financial inclusion and digital literacy etc. The center would produce trained and oriented entrepreneurs to steer ahead community-based interventions on agroforestry models and organic farming.

Launching stewardship program at community-science interface

A community stewardship program will be launched by the center to self-sustain the hub and the interpretation center and as well co-create such units in other suitable areas as entrepreneur models for scaling up and replication. The community stewards' program will be the 'Training of the Trainers' for promotion of organic farming and agroforestry and stewards will be recognized as '*Jaiva Mitra'* (Organic Friends) in the community, who would assist and facilitate the smallholders, entrepreneurs and women farmers to co-create alternative economic opportunity for inclusive and sustainable development. This will also facilitate the documentation and deep-diving in the Traditional Knowledge Systems (TKS) of the indigenous communities therein.

Intended Outcome

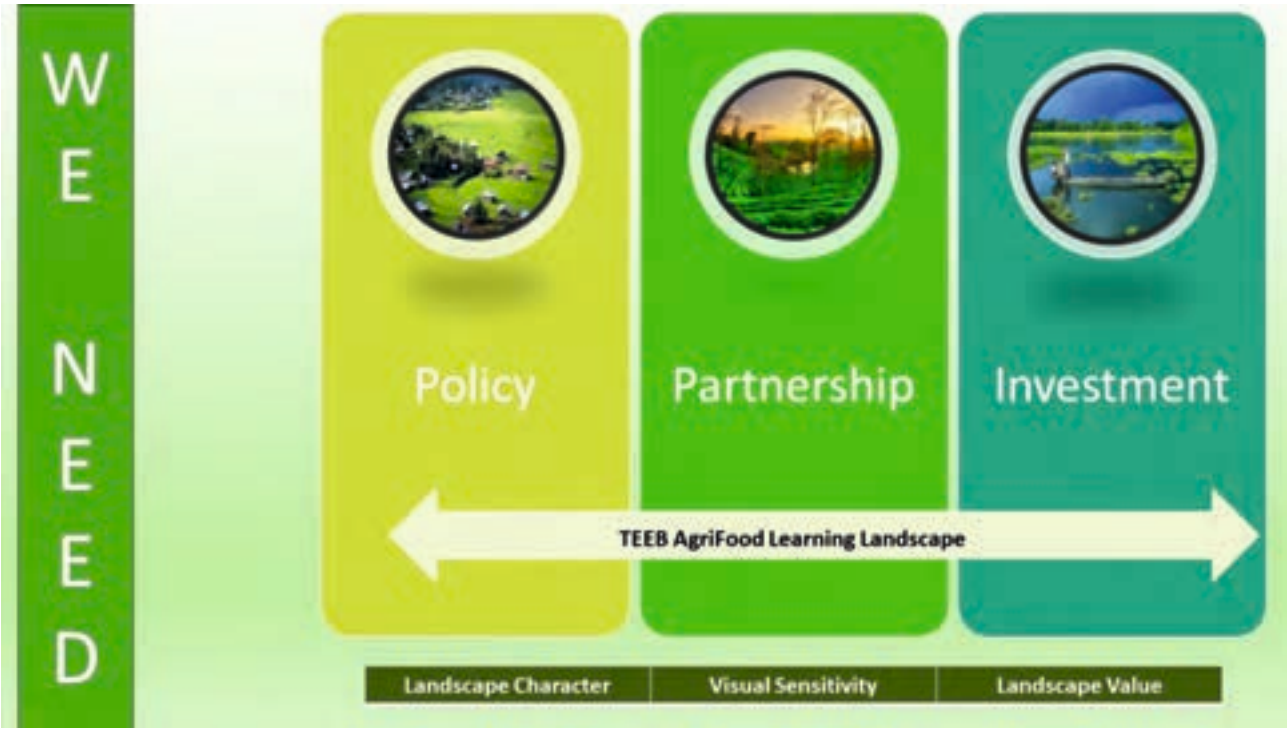
The intervention envisages that the learning landscape will co-create enhanced opportunities for the local inhabitants of Majuli and as well for the people of Assam, particularly farmers to undertake sustainable, profitable and diversified approach in agri-sector, including agroforestry and organic farming.

A protocol for developing a TEEB AgriFood Learning Landscape has been placed in Annexures - I and II representing two different agro-ecological setting.

Proposed timeline

Implementing a Learning Landscape Design

No	Activities	Year 1	Year 2	Year 3	Year 4	Year 5
1	Understanding & developing the area					
2	Boundary selection					
3	Creating a buffer zone					
4	Establishing distinctive landscape characteristics of TEEB AgriFood Systems (diversified agriculture for agro-biodiversity, agri-pisciculture, water bodies and water harvesting structures, irrigation protocol, different typologies of agroforestry, homegardens; processing and value addition units; inbuilt tourism model; museums, workshops, capacity building centre and educatorium)					
5	Connecting physical character with land use – A cultural heritage unit					
6	Linking communities – TKS, Employability, Training and Capacity Building					
7	Institutional Arrangement for Management of the Landscape – Identifying the Nodal Agency					



References

a) Borah, A. (2020). Socio Economic Condition of the Tribes Living in Majuli Sub Division of Jorhat.

b) Borborah, A., Borborah, M. G., & Choudhury, S. (2016). Prospects of Ecotourism in Majuli. In Bioprospecting of Indigenous Bioresources of North-East India (pp. 325-328). Springer, Singapore.

c) Carbon-free tourism initiative in Assam's Majuli from this week. (2017, October 31). The Indian Express. Retrieved October 14,2022, from https://indianexpress.com/article/northeast-india/assam/carbon-free-tourism-initiative-in-assams-majuli-from-this-week-4915018/

d) Chambers, R., & Conway, G. (1992). Sustainable rural livelihoods: practical concepts for the 21st century. Institute of Development Studies (UK).

e) Chetry, B. (2020). Re-theorizing livelihoods: Impacts of floods and traditional adaptation practices in Majuli, Assam. Journal of North East India Studies, 10(2), 1-27. [8] Crouch, G. I., & Ritchie, J. B. (1999). Tourism, competitiveness, and societal prosperity. Journal of business research, 44(3), 137-152.

f) Guha, Amalendu (1984). Neo-Vaishnavism to Insurgency: Peasant Uprisings and Crisis of Feudalism in Late 18th Century Assam. p. 30.

g) Majuli is declared the largest river island in world by Guinness World Records: 10 facts about it. India Today. 3 September 2016. Retrieved 9 September 2020.

h) Manogya Loiwal (18 February 2014). "Majuli, world's largest river island is shrinking and sinking". India Today. Retrieved 5 April 2016.

I) Puranjoy M, Nazir A, Borah D and Kumar Y (2019) Non-timber forest products and their contribution to healthcare and livelihood security among the Karbi tribe in Northeast India. Ecological Processes (2019) 8:41 https://doi.org/10.1186/s13717-019-0194-4

j) Sanyal, J. Terang, B. (2018) Problems and Prospects of Growth of Sandalwood and Medicinal Plants in Karbi Anglong District of Assam with Special Reference to Diphu. AMC Ind. Journ. Of Entrepreneurship. 1(1): DOI: 10.17010/amcije/2018/v1i1/120326

k) Sarma, J. N.; Phukan, M. K. (3 May 2004). "Origin and some geomorphological changes of Majuli Island of the Brahmaputra River in Assam, India". Geomorphology. 60 (1–2): 1–19. Bibcode:2004Geomo..60....1S. doi:10.1016/j.geomorph.2003.07.013.

l) Yardley, Jim (14 April 2013). "A Capricious River, an Indian Island's Lifeline, Now Eats Away at It". The New York Times. Majuli, India.

Annexure-I

MAJULI
Learning Landscape in the Brahmaputra Floodplains

Majuli district in Assam is the only river-island district in the country. The word 'Majuli' means between two rivers and it is truly a water world. The entire island is a giant wetland broken only by embankments which houses the primary human settlements and is in many ways the communication lifeline of the island. The two key issues faced by the inhabitants are the ever-present threat of floods in the monsoon and the erosive capacity of the mighty Brahmaputra and the other rivers which are steadily eroding the island. In a changing world where climate related events are increasingly becoming common, the need of the hour is to increase the adaptive capacity of the inhabitants of such fragile landscapes in a manner which would contribute to their livelihood and preserves the social fabric of these communities. A brief monographic study on the socio-ecological production landscape of Majuli is being proposed here as a learning landscape.

Rationale and Learning Scope

The river island of Majuli is a unique socio-ecological production landscape with a captivated populace comprising of diverse ethnic groups, who thrive in a flood-prone vulnerable habitat that has a plethora of rich biodiversity and cultural heritage dating few centuries. Ostracized from mainstream economy and developmental initiatives, the island has its own chores of sustainable living and adaptive practices that can score for adaptive learning. In the milieu of climate change and increasing threats of flood inundation and erosion, the life and livelihood of people of Majuli has been at stake, requiring immediate interventions for sustainability and inclusive growth. The challenges though remain owing to the ensuing climate events, being in the realms of ENSO and IOD, natural disasters like flood and quake and as well keeping committed to the net-zero vision 2070 in decarbonizing the economic initiatives and ensuring 'just transition', as well. Thus, this landscape enables the opportunity to learn the socio-ecological dynamics in the climate context, with special references to the following features

a) Existing agro-farming practices of the diverse indigenous groups are mostly organic in nature and the same can be brought up more formally in the current context, especially for this captive socio-ecological production landscape. The state government's schemes for organic agriculture and proposals for building carbon-neutral Majuli are conducive to this goal.

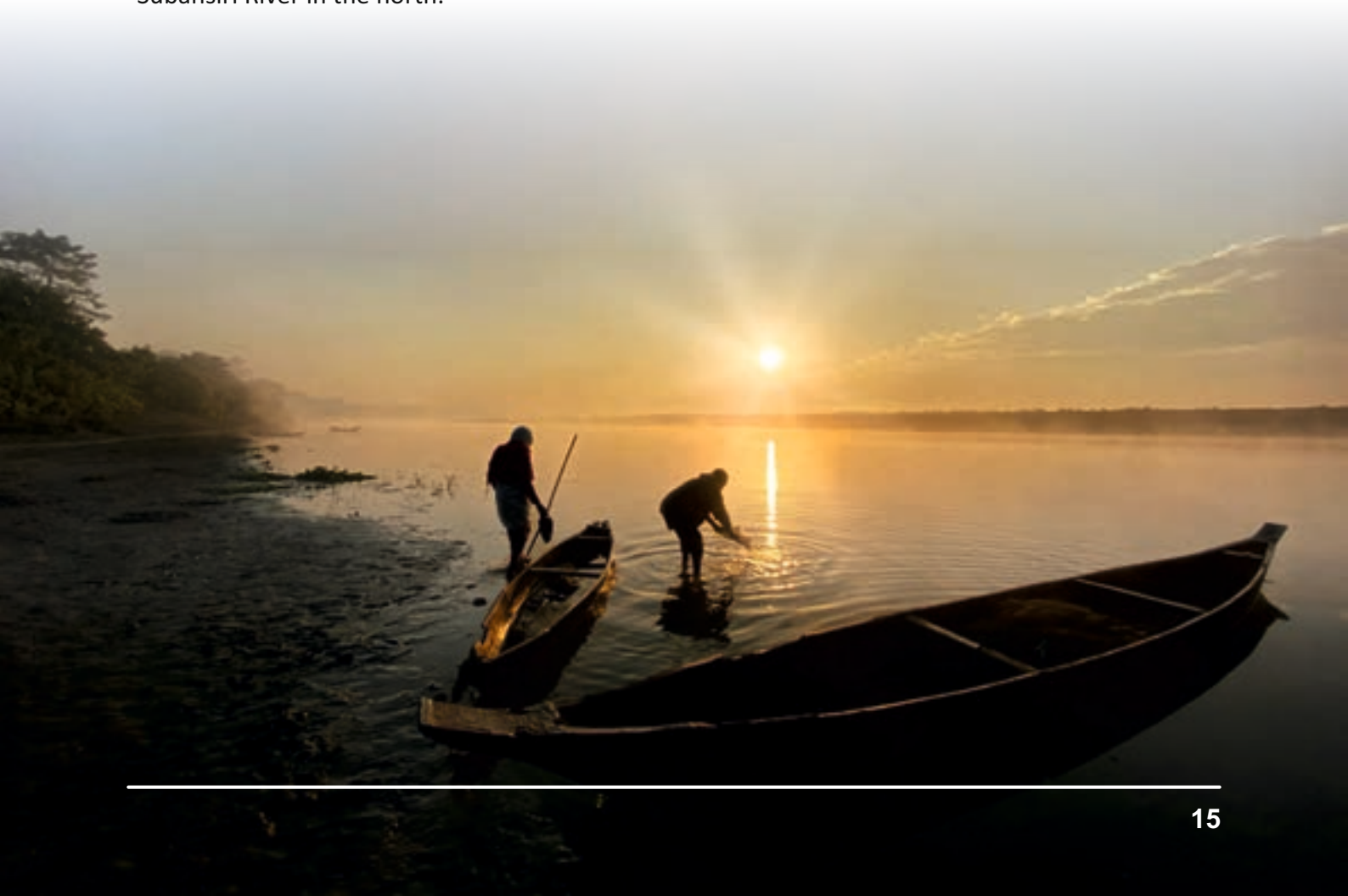
b) Suitably designed agroforestry, can be a twin-solution for livelihood by producing food, fodder and fiber, as well towards disaster risk reduction through erosion abatement and embankment stabilization.

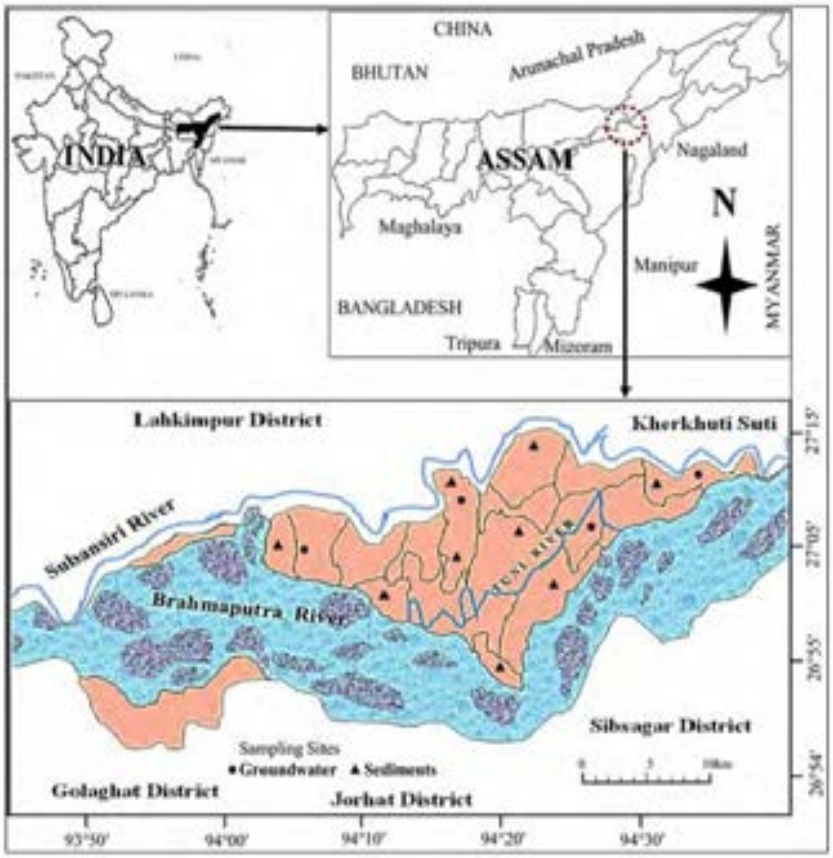
c) Co-benefits of carbon leverages from agroforestry and organic farming can help neutralize the emission loads and as well attract carbon financing for developmental initiatives in the near future.

d) Spin-off reciprocals of conservation like gender equitable development, financial inclusion following LNOB principles and enablers of just-transition would create *in-situ* adaptive learning opportunities for youth, academia and practitioners as well and enrich human resources with built capacities in the same.

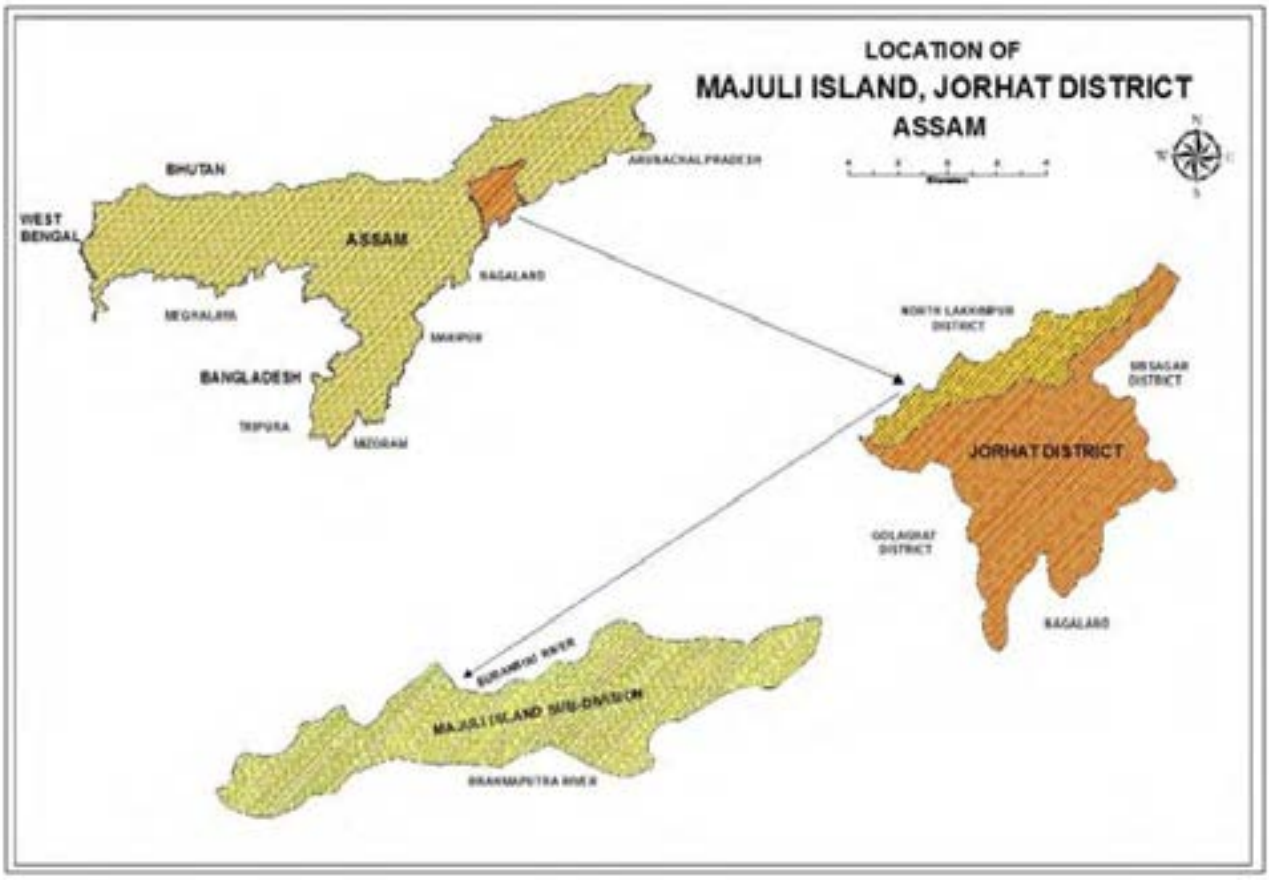
Geo-ecological profile

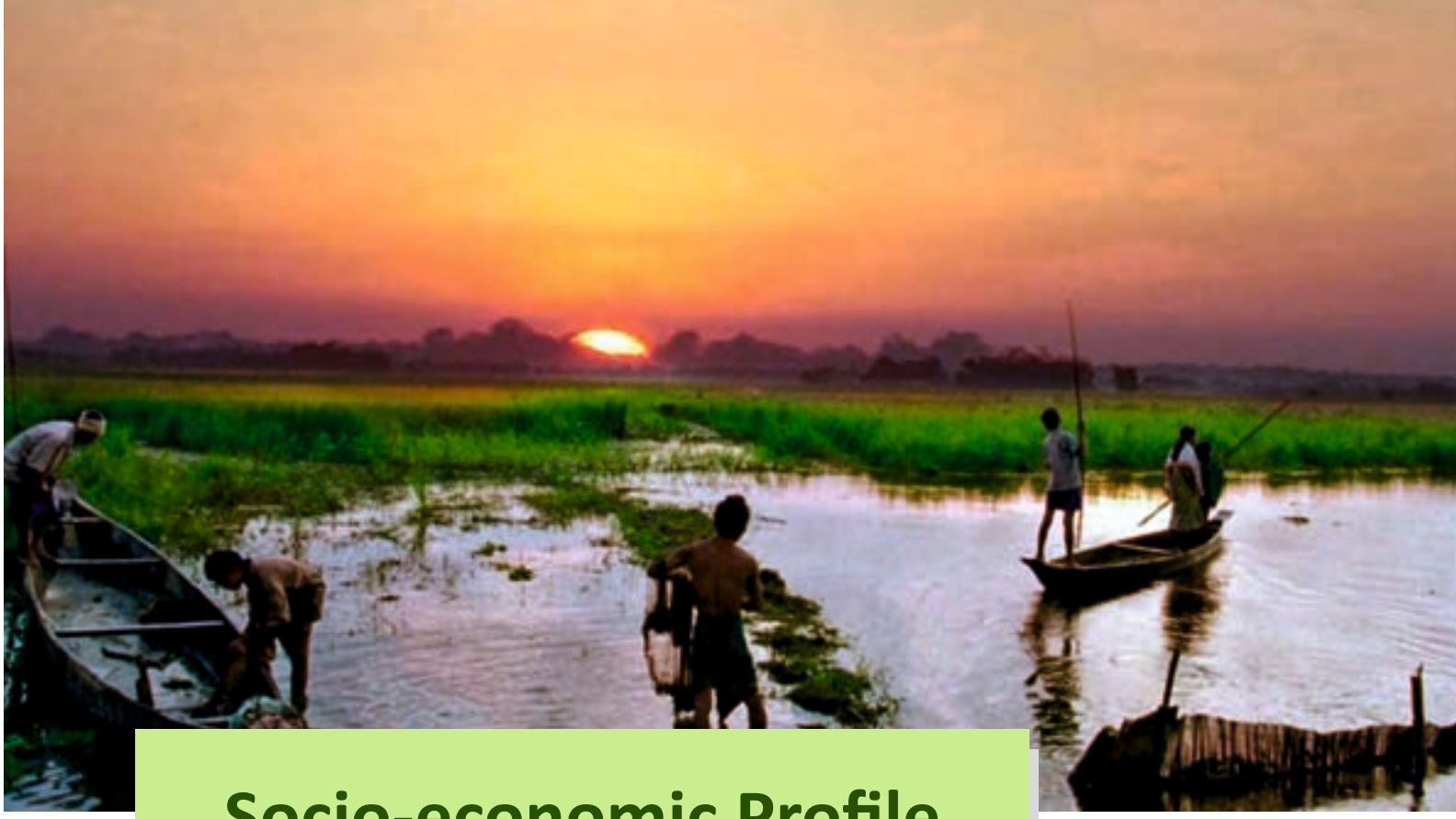
The area of study is Majuli is a Brahmaputra River Island that is located in the state of Assam's upper Brahmaputra Valley. Geographically, Majuli is located between 26°45'N and 27°12'N latitude and 93°39'E and 94°35'E longitude, with an average height of 84.5 metres above sea level (Roy et al. 2020). The island was formed due to course changes by the river Brahmaputra and its tributaries, mainly the Lohit. The island was a long, narrow piece of land called Majoli (land in the middle of two parallel rivers) that had the Brahmaputra flowing in the north and the Burhidihing flowing in the south until they met at Lakhu. It was once known as Ratnapur and was the capital of the powerful Chutia kingdom. Frequent earthquakes in the period 1661–1696 set the stage for a catastrophic flood in 1750 that continued for 15 days, which is mentioned in historical texts and reflected in folklore. As a result of this flood, part of the Brahmaputra discharged southward into what was the Burhidihing's lower channel and Mājuli island was formed. The Burhidihing's point of confluence moved 190 km east and the southern channel which was the Burhidihing became the Burhi Suti. The northern channel, which was previously the Brahmaputra, became the Luit Suti. In due course, the flow in the Luit Xuti decreased, and it came to be known as the Kerkota Suti; and the Burhi Suti expanded via erosion to become the main Brahmaputra River. Majuli island covers 352 square kilometres in total (136 square miles) (Roy et al. 2020). In the 1790s, the island covered an area of 1,300 km (500 square miles). It had an area of 1,255 square kilometres (485 square miles) at the beginning of the 20th century, but having lost significantly to erosion it covers 352 square kilometres (136 square miles) as at 2014, Majuli has shrunk as the river surrounding it has grown. The island is formed by the Brahmaputra River in the south and the Kherkutia Suti, an anabranch of the Brahmaputra, joined by the Subansiri River in the north.





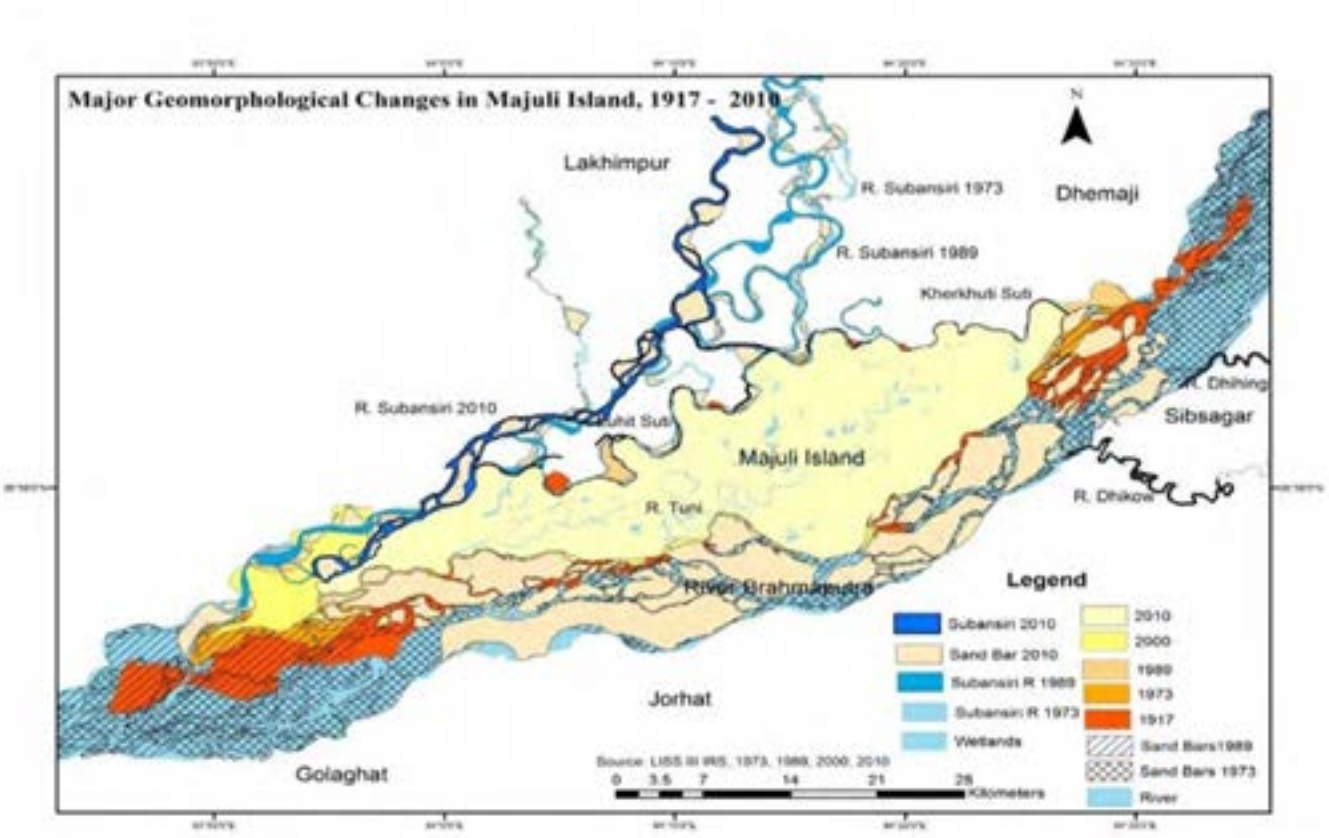
Majuli Island falls beneath higher Brahmaputra Natural Depression Zone. The key soil cluster of the Island is new alluvial soil having sufficient amount of humus content deposited by floods during the summer season. Generally, the soil is less acidic and ofen neutral of highly alkaline, therefore, fit for growing different crops in different crop-seasons.





Socio-economic Profile

It was the first island in India to be designated as a district in 2016 (Sharma & Singh 2016). Its beauty is enhanced by the riverine morphology, the chars (strips of sand and silt deposition),and the flora and wildlife. The Mising, Deuri, and Sonowal Kachari tribes, as well as the Koch, Nath, Kalita, Ahom, Brahmin, and Kaivarta populations that compose the larger Assamese Hindu population, consstite Majuli's ethnically diverse populalati (Borah 2020). The island has established itself as a prominent destinatioas a result of a variety of natural and cultural characteristics (Borborah et al. 2016). Mājuli island is accessible by ferries from the city of Jorhat. The island is about 300–400 kilometres (186–249 mi) east from Guwahati, the state capital. Mājuli is the abode of the Assamese neo-Vaishnavite culture. Majuli is since 2004 in the UNESCO Tentatie List for nominaatioas a World Heritage Site. The populalatiof Majuli comprises the scheduled tribes, scheduled castes, and the non-tribal caste Hindu Assamese. The indigenous ST/SC communities include the Misings, the Deoris, the Kaibartas and the Sonowal Kacharis. The non-tribal caste Hindu Assamese communities include Koch, Kalitas, Ahoms, Sutas, Yogis, etc. The Mising community has the largest population in the island who immigrated from Arunachal Pradesh to Majuli centuries ago along with the Deori, Kaibarta and Sonowal Kacharis. Languages spoken are Mising, Assamese, and Deori. The island has 144 villages with a populationof over 150,000 and a density of 300 individuals per square km. As of the 2011 census, Majuli district has a population of 1,67,304, enntely rural. Majuli has a sex rarat of 955 females per 1000 males. Scheduled Castes and Scheduled Tribes make up 23,878 (14.27%) and 77,603 (46.38%) of the population. Hinduism is the predominant religion, prractice by 99.04% of the populalatio Majuli is famous throughout Assam for its large number of Satras. At the timeof the 2011 census, 54.47% of the population spoke Assamese, 41.01% Mising, 1.66% Bengali and 1.22% Deori as their first language.


Major Geomorphological Changes in Majuli Island, 1917 - 2010
N
Lakhimpur
Dhemaji
R. Subansiri 1973
R. Subansiri 1989
Kherkhuti Suti
R. Subansiri 2010
Majuli Island
Sibsagar
R. Tuni
R. Dhikow
River Brahmaputra
Jorhat
Golaghat
Legend
Subansiri 2010
Sand Bar 2010
Subansiri R 1989
Subansiri R 1973
Wetlands
2010
2000
1989
1973
1917
Sand Bars1989
Sand Bars 1973
River
Source: LISS III IRS, 1973, 1989, 2000, 2010
0 3.5 7 14 21 28
Kilometers

Majuli Biodiversity Heritage Site

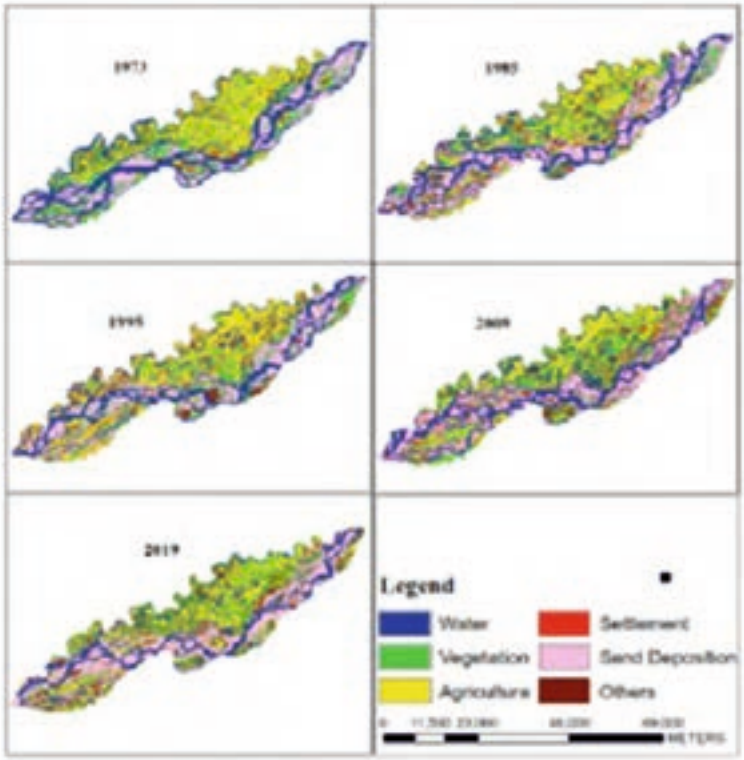
It covers an area of 875 sq. km comprising of large riverine wetland with innumerable small islets, locally called chapories. The main island is surrounded by more than twenty chapories. Majuli with its fertile floodplains and highly productive wetlands forms identical habitat for a plethora of avifauna and animals. Majuli also produces about a hundred different varieties of rice. Among the fascinating arrays grown is Komal Saul, Bao Dhan and Bora Saul. Apart from these, Majuli is known for its unique cultural diversity also, wherein the 15th century saint and fountain head of Assamese culture, Sankardeva, first established a Satra or Neo-Vaishnavite monastery, born of insightful discourses with his spiritual successor, Madhabdeva. Today, Majuli is the principal seat of Vaishnavite faith, culture and practice. Basically, a riverine wetland, Mājuli is a hotspot for flora and fauna, harbouring many rare and endangered avifauna species including migratory birds that arrive in the winter season. Among the birds seen here are the greater adjutant stork, pelican, Siberian crane and the whistling teal. After dark wild geese and ducks fly in flocks to distant destinations. The island is almost pollution free owing to the lack of polluting industries and factories and also the chronic rainfall. The island is under threat due to the extensive soil erosion on its banks. The reason for this magnitude in erosion is the large embankments built in neighbouring towns upriver to prevent erosion during the monsoon season when the river distends its banks. The upshot is a backlash of the tempestuous Brahmaputra's fury on the islet, eroding most of the area. According to reports, in 1853, the total area of Mājuli was 1,150 km and about 33% of this landmass has been eroded in the latter half of the 20th century. Since 1991, over 35 villages have been washed away. Surveys show that in 15–20 years from now, Mājuli would cease to exist. To save the island, the Union Government of India has sanctioned ₹ 2.50 billion (US$55 million) for the protection of the island. The water resource department & The Brahmaputra Board have been struggling to solve the erosion problem of this island for the last three decades but without much success. Recently it was suggested that only a four-lane highway protected by concrete mat along the southern boundary of Majuli and the excavation of river bed of the Brahmaputra River can solve the problem. The project also includes two flood gates for the Kherkatia Suti which is a tributary of the Brahmaputra. The Brahmaputra River Restoration Project is yet to be implemented by the government. However, a nomination has been sent to UNESCO for the declaration of Mājuli as a World Heritage Site. Local environmental activist Jadav Payeng has planted a 550-hectare forest, known as Molai Forest to combat erosion on the island. Much of the island was barren sandbars that were vulnerable to erosion, this forest has become a habitat for animals including elephants, tigers, deer, and vultures.

Agro-economy of Majuli

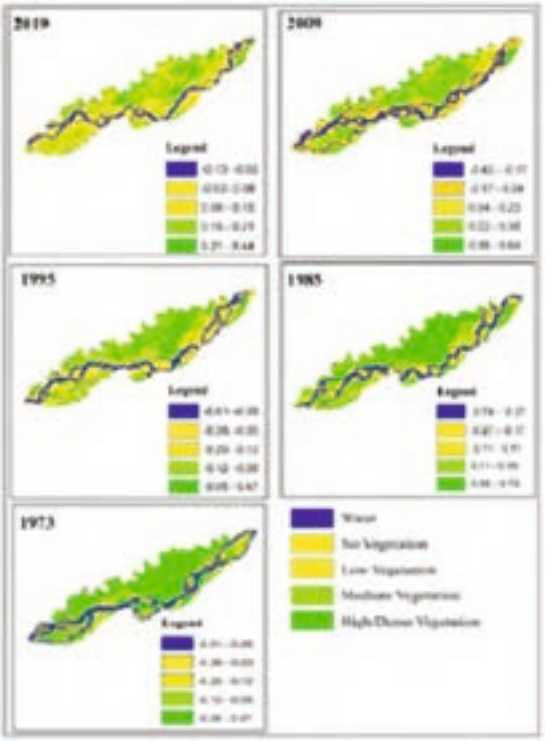
The main industry is agriculture, with paddy being the chief crop. As high as around 80% of the overall population of the Majuli Island accrue their living from agriculture and its allied activities. As per the records of the 2001 census, 80.63% of the total working population of the Majuli Island are cultivators and agricultural workers. Mājuli has a rich and diverse agricultural tradition, with as many as 100 varieties of rice grown. In the naturally fertile soil of Majuli Island, each food and money crops are grown in both Rabii and Kharif crop-seasons. Among the fascinating arrays of rice produced are the Komal Saul, a unique type that can be eaten after immersing the grains in warm water for 15 minutes and usually eaten as a breakfast cereal; the bao dhan, that grows underwater and is harvested after ten months; and the Bora saul, a sticky brown rice used to make the traditional cake with fish is known as pitha. The main Kharif crops are autumn (Ahu) paddy, Winter (Sali and Bao) paddy, along with different summer vegetables, whereas the Rabi crops include summer rice, wheat, oilseeds, pulses, potato and other vegetables. Recently, sunflower is also cultivated in some areas successfully. Among the various pulses cultivated in the Majuli Island, Black gram (Mati Kalai), Green gram (Mung), Peas (Motor Mah) and Lentil (Masur Mah) are important. Sugarcane and mustard are vital annual crops grown within the Island. In recent years, cultivators of Majuli Island have started cultivating different varieties of high yielding paddy like Joya, Push, I.R-8, I.R.-38, Culture-1, Lachit, Kolong, Hybrid-6201 and 6444. Besides, they cultivate autumn (Ahu) paddy as it is generally considered a flood-free season crop. Such crop-cycle planning develops from a natural practice of farming resilience in Majuli. Besides agriculture, fishery and animal-husbandry are two allied activities profitably running in Majuli Island. The floodwater retention period of the sub-division is comparatively long, having 6-8 months in a year which encourages capture fisheries in the natural swamp, that has large variety of fishes owing to its richness in nutrients like organic Carbon, high content of Nitrogen and Phosphorus. Thus, Majuli island could produce marketable surplus of fish which is generally exported to Jorhat, Sivasagar, and Lakhimpur. This augments the possibility of establishing fish processing unit in Majuli Island as a downstream value chain for livelihood intensification. The abandoned Char-Chapories of Majuli are suitable for rearing buffaloes, cow and goats. The natural environment gives impetus for rearing livestock as well as poultry herein. Among the tribal communities, almost all the farm families rear pigs traditionally to earn a substantial income. Dairying, pottery, handloom and boat-making are other important economic activities. Handloom is a major occupation among the distaff population of the villages. Weaving is exquisite and intricate with the use of a variety of colours and textures of cotton and silk, especially Muga silk.

Conservation Challenges

Precise land use and land cover (LULC) change information of a land surface is significant for sustainable development programs as the earth's surface is undergoing rapid changes. Majuli Island is located in the upper reach of the Brahmaputra River in India. It is continuously changing its shape by the action of erosion of the Brahmaputra River, incurring both tangible and intangible losses. Perusal of research studies (Pathan et al 2021) to find out the changes that occurred in the island by analysing the land use and land cover along with channel migration in the Brahmaputra River that occurred in that area over the period 1973 to 2019, shows that area of vegetation has gradually decreased from 365.59 (26.85%) in 1973 to 262.79 km2 (19.29%) in 2019. In contrast, the barren land had increased from 4.82 (0.35%) in 1973 to 31.88 km2 (2.34%) in 2019. Other LULC categories like agricultural lands, built-up areas, water bodies, and sand deposition also have changed significantly. The NDVI values of vegetation cover are also fast changing due to channel shifting, soil erosion, and deforestation.



A. Land use/land cover map of Majuli River Island over the years 1973, 1985, 1995, 2009, and 2019



B. NDVI map of Majuli Island for the period 1973–19

The significant loss of landmass over the period 1973–2019 reveals that the lowland river bank regions and higher population areas are maximumly susceptible to erosion. This loss in landmass needs an effort for their proper management to keep this unique habitat landscape conserved for future learnings. Therefore, there is a need for an in-depth study of geological and hydrologic characteristics to comprehend the physical process and suggest appropriate management for river intervention. Also, it will be beneficial to plan for the growth of vegetation in the floodplain areas using appropriate agroforestry intervention. The riverbank line areas also need timely maintenance as the forest area has changed the land areas into flooded areas resulting in loss of vegetation. A large amount of land areas is lost every year from the river banks resulting in the lateral migrations of the channel, but also sediment deposition takes place to the upstream riverbank areas. Thus, the implications of proper management strategies to mitigate these problems are the need for the hour.

Augmenting landscape characters in Majuli River Island

This would necessarily include diversified agriculture for agrobiodiversity, agri-pisciculture, water bodies and water harvesting structures, irrigation protocol, different typologies of agroforestry, homegardens; processing and value addition units; inbuilt tourism model; museums, workshops, capacity building centre and educatorium etc. Some of the prime interventions are here underneath

I. The Rice Ecology: Rice agrobiodiversity of Majuli is invariably rich having more than hundreds of land races, though intensive cultivation of hybrids has almost taken them to oblivion. The other challenge is getting the Sally-rice seedlings after the flood water recedes for transplantation and the input costs increase largely in procuring the seedlings. Organic farming and bringing back the flood resilient local landraces of paddy as certified local organic produce of Majuli will not only rejuvenate the rice ecology in the landscape, assuring food security, it will also oxygenate the local economy therein. Suitable non-competitive agroforestry interventions splicing the rice landscape will further this.

ii. The Wetland Ecology: Enriched produce of riverine wetlands in Majuli comprising of produces relating food, feed, fodder and fuel remains to be the lifeline of the inhabitants. The age-old practice of sustainable usage of goods and services of the wetland ecosystem is a major learning in this landscape. This will be furthered by adaptive and integrative float-farming and aquafarming to enhance the food yield and nutrition security, as well economic leverages in the days of flood distress.

iii. The Agro-horticulture System: Cropping areas in the landscape for site-specific agro-products like mustard, sugarcane, ginger, betel leaf, will be brought under organic farming regime and the produce will be geotagged as well. Organic farming area in the floodplains will be enhanced with regenerative float-farming in inundated farmlands for horticultural produces like tiger chilly, exotic vegetables etc and as well exclusive medicinal plants, floriculture etc. Medicinal plants are traditionally being farmed by the indigenous communities of Majuli and has an explicit local demand, especially during environmental disasters.

iv. The Agroforestry System:

Sericulture based agroforestry with production value chains for raw silk will embark augmentation of natural capital, while timber-based agroforestry for long-stand canopy development with commercially significant species as well non-timber agroforestry with special drive on bamboo, betel nuts, water hyacinth etc. will sustainably intensify the produced capital. Agroforestry for food and nutritional security will be essentially the core area of intervention, however given the cultural superfluity of Majuli and its religious legacy, experimental agroforestry like astro-agroforestry and floriculture will have new edges of excellence in the current context. In the learning landscape, the carbon leverages of agroforestry as a co-benefit could be tested for climate finance mobilization, which happens to be an important outcome of this intervention.

v. The River System (Embankments and Sand dunes):

Increasing sand deposition and breaching embankments of river Brahmaputra owing to frequently changing channels have built a dynamic ecology that is directly impacting the life and livelihood of the inhabitants. The landscape would enable the studies pertaining to a sustainable equilibrium of this system through embankment slope stabilization with agroforestry intervention, plantation of vetiver in the sand dunes and embankments for feed and fodder, as well bringing back the lost land to primary productivity in the aligned river ecosystem is a unique feature herein.

Annexure-II

DIPHU

Learning Landscape in Karbi-Anglong Hill District

Diphu is a tourist attraction point in Assam owing to its beautiful hilly terrains and free flowing rivers. Literature review reveals that the word Diphu came from Dimasa dialect language, meaning White Water (Di for Water, and Phu for White). Historically, it is said that the stream in Diphu carries large amounts of sediment during the rainy season, giving it a whitish colour, hence its name. Diphu is also a habitat harbouring unique plethora of indigenous hill communities.

Rationale and Scope

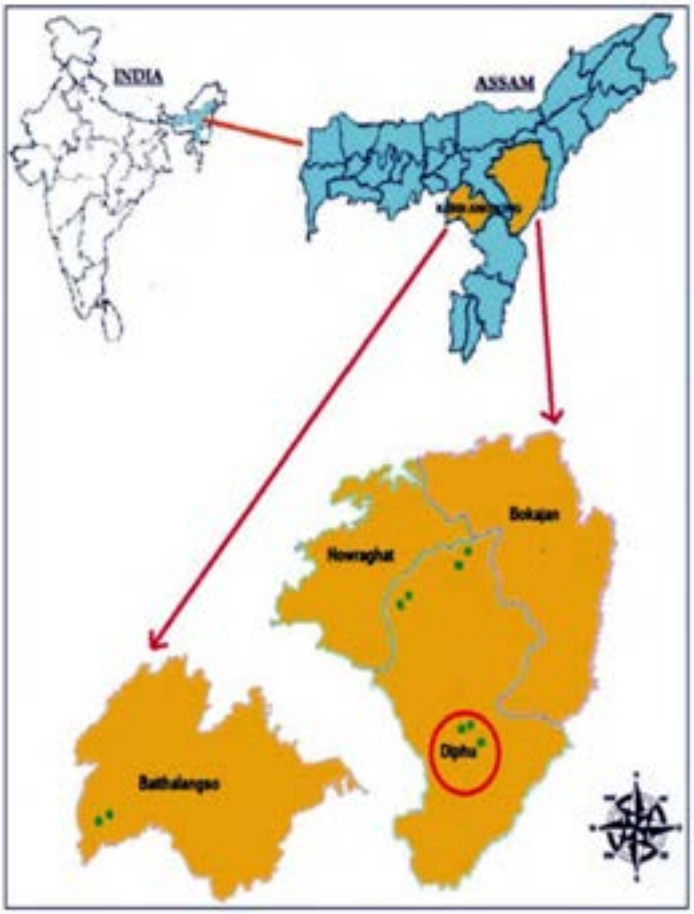
Karbi Anglong itself is rich in natural resources because of fertility of land. The district was divided into two parts in the year 2016 and named as East and West Karbi Anglong. Many valuable trees are grown naturally in this part of the state and some are grown by people taking special initiative in different areas of the district. Apart from different areas of Karbi Anglong, Diphu is making a tremendous progress in growing different types of commercial trees in the last few years which include the plantation of rubber, teak, etc. and this wave is spreading. Along with the cultivation of rubber, in recent years people have started cultivation of the second most valuable tree in the world i.e. sandalwood. In addition, many wild plants are also found which are used in many ayurvedic medicines for the treatment of different diseases both for human beings as well as for animals. Though these are found in forest areas of Diphu, many of the wild medicinal plant are preserved in the bio-diversity cum recreation park which is located at a distance of 4 km from Diphu town on the way to Diphu-Manja road. Perusal on research communiques on the cultivation of sandalwood and medicinal plants as an entrepreneurial venture in the process of economic development reveals that entrepreneurship occupies a significant position in the economic as well as social upgradation of the district. A perception study (Sanyal and Tirang 2018) covering 20 households in the bio-diversity cum recreation park range, located at the road side of Diphu-Manja Road, brought to light the positive attitude of the indigenous society towards cultivation of sandalwood and organic medicinal plants and the entrepreneurship model in propounding the same. The study in this area would bring a learning experience from a contrasting socio-ecological production landscape, wherein the scopes are substantially unique for

a) Understanding the potentials of agroforestry in continuum with the horticultural production landscapes, where Ginger, Pineapple, Banana and other crops as an entrepreneurial upliftment of the indigenous hill communities of Assam.

b) Understanding the potentials of organic farming with regard to potential export crops like ginger and other horticultural fruits.

c) Assessing the potentials of timber-based exclusive forest products like Sandalwood, Agar wood and as well Rubber through agroforestry intervention in the terrain.

Geo-ecological Profile



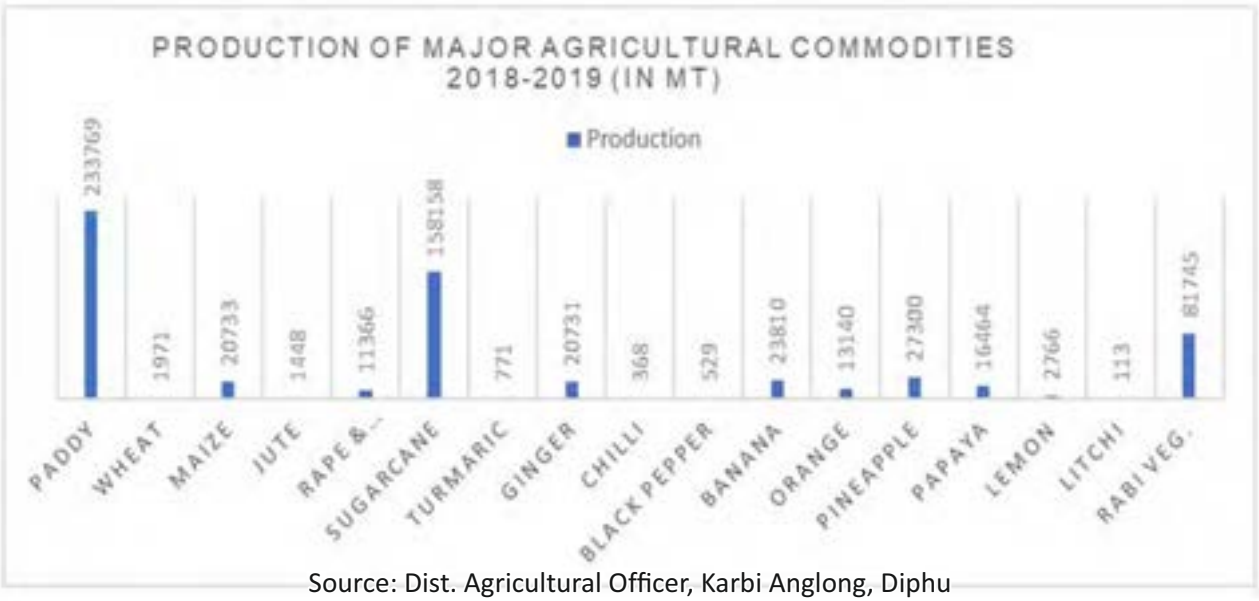
Diphu is located at 25.83°N 93.43°E. with an average elevation of 186 metres (610 feet) and is about 270 km by road and 213 km by railways from Guwahati city. The town is located on hilly terrain and is the head quarter of the district of Karbi Anglong, which is the largest district of Assam and enjoys autonomy under the provision of 6th Schedule of the Indian Constitution. The new district was formally created with some parts of the districts of Sivasagar (now Golaghat), Nagaon, Cachar and United Khasi and Jayantia Hills district of present Meghalaya for all round development of the tribal folk of the Central Assam. This was followed by bifurcation of the erstwhile district of United Mikir and North Cachar Hills district into two separate districts under banner as "Mikir Hills" and North Cachar Hills district in the year 1970. The Mikir Hill district was again rechristened as "Karbi Anglong District" formed out of the Hamren (civil) sub-divisions of the Karbi Anglong district of Assam in 2016 with "Hamren" as its headquarters. The district is a part of “Karbi Anglong Autonomous Council”.

Due to variation in the topography, this hill zone experiences different climates in different parts. The winter commences from October and continues till February. During summer, the atmosphere becomes sultry. The temperature ranges from 6 to12 degree Celsius in winter and 23 to 32 degree Celsius in summer. The average annual rainfall is about 2416 mm. The district is dotted with hills, a few of which can be categorized into Mountain. Among them, the highest is the Singhason Peak which is at about 1360 metres above the sea level. The forest area covered is about 4,922.019 sq. km with 14 State R.F. and 17 District Council R.F. in the district.

Socio-economic Profile

The population of the district is predominantly tribal. The major tribal ethnic groups of this district are Karbis, Bodos, Kukis, Dimasas, Hmars, Garos, Rengma Nagas, Tiwas, Man (Tai Speaking). Besides, a large number of non-tribals also live together in this hill region. Karbi Anglong district is primarily dependent on agriculture and forest products. Main source of income is paddy with surplus production. Rice, wheat, jute, maize, sugarcane are major crops of the district. Agriculture is the main livelihood of the tribal population of the districts. The traditional method of cultivation is the slash & burn one, commonly known as jhuming in hill areas. But in plain area we can see the winter paddy, summer paddy cultivation beside paddy cultivation Karbi Anglong has huge natural advantages for other form of cultivation like Pineapple, Mango, Banana, Maize, turmeric, Ginger, Tapioca, Sugarcane, broom, orange, mausambi, black pepper, papaya, arcnut and field crops like cotton, jute, mesta, wheat & improved varieties of oil seed, pulses & vegetables. The district also has presence of number of rice mills, food processing, spice processing and beverage units. The agro-based industries include (1) Rubber Plantation, (2) Citronella Plantation and (3) Tea Garden: There are a total of 15 (fifteen) numbers of Tea Gardens in the district. There are few big rice mills in Howraghat Development block beside that there are lots of micro and small size of rice mills in Rangkut, Langhin, Bukolia, Uttarborbill, Rangajan, Bokajan, Dongkamukam, Baithalangso, Toradubi, etc. Sugarcane industry is concentered in Kheroni area. Fruits & vegetables unit are mostly in Diphu area. In Karbi Anglong agriculture is the main source of livelihood of people of district which has employed more than 70% workforce and support livelihood for 80 percent population in Karbi Anglong. The Karbi Anglong ginger was granted the Geographical Indication Tag (GI) No– 435 in 2014-15.

Agriculture production data of Karbi Anglong



Source: Dist. Agricultural Officer, Karbi Anglong, Diphu

As of 2011 India census, Diphu had a population of 63,654. Based on population, it is classified as a class-II city (between 50,000 and 99,999 inhabitants). Males constitute 52% of the population and females 48%. Diphu has an average literacy rate of 90%, higher than the national average of 59.5%. The male literacy rate is 94% and female literacy rate is 86%. In Diphu, 13% of the population is under 6 years of age. The major indigenous communities living in Diphu are Karbi, Dimasa Kachari, Garo Kachari, Boro Kachari and Rengma Naga. Karbi is the most spoken language at 25,045 speakers, followed by Bangali at 13,400 and Assamese at 8,007, Hindi is spoken by 5,277 people, Bodo at 1,909 and Nepali at 2,712.

Learning Objectives

The learning objectives in this contrasting socio-ecological production landscape would be the following

a) To compare and contrast the socio-ecological dynamics of production landscapes in floodplains and hilly terrains of Assam with regard to agrarian economic sustainability and 'change resilience' in this climate milieu.

b) To assess the production potentials of organic (horticultural products and tea) produce capitals and supply-side value chains in reaching out to global markets by agro-based enterprises, thereby strengthening local institutions and ensuring financial inclusivity.

c) To evaluate the potentials of timber-based exclusive forest products like Sandalwood, Agar wood and as well Rubber through agroforestry intervention in the terrain as a dual-benefit of commercial produce and carbon storage.

Augmenting landscape characters in Diphu (Karbi Anglong)

This would necessarily include diversified agriculture for agrobiodiversity, hilly terrain farming, forest products and cash crops, different typologies of agroforestry, community and home-gardens; processing and value addition units; inbuilt tourism model; museums, workshops, capacity building centre and educatorium etc. Some of the prime interventions are here underneath

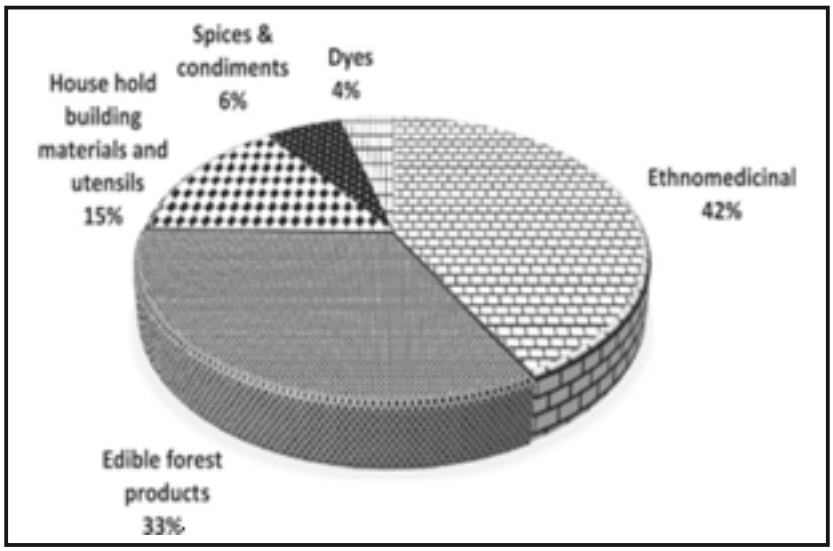
I. The Cereal-farming landscape: Cereal agrobiodiversity of Karbi Anglong district is varied and integrated. Rice, wheat, millet, maize and similar cereals are grown by *jhooming* in the hilly terrains of this district. However, falling productions with shortening of *jhooming* cycles have raised newer challenges. There has been upward shifting of *jhoom* lands and as well introduction of wet rice in the lower valleys. The take-away learning from this diverse landscape would be adopting no-tillage regenerative farming of cereals, especially millet that is being promoted now as *Sree-Anna* for food and nutrition of the marginal communities.

ii. The Horti-Agroforestry Ecology: The district has a legacy of fruit farming and produces considerable number of fruits in the valleys, including pineapple, mango, banana, orange, kiwi, custard apple, sapota etc. This can be well integrated with agroforestry interventions and as well organic farming methods. This will substantially sustain the food security in the valley along with cash flow for the marginal agrarian communities augmenting alternative livelihood.

iii. The Agro-horticulture System: Cash crops like spices (ginger, turmeric etc) and medicinal plants, pulses and lentils etc are already crops-of-choice in this district as indigenous farmers have expertises in these. This can be furthered with integrated farming approaches, introduction of exotic vegetables, mushrooms etc for a coordinated GI Tagged produce for export benefits. Certified organic seed production and seed resilient villages can be alternative economic opportunities and enable suitable scopes for learning community level resilience in the climate milieu.

iv. **The Agroforestry System:** Potentials of agroforestry in the karbi angling landscape is enormous, owing to the hilly terrains primarily and secondarily for the 15 Tea Gardens, wherein plantation of shade trees and fencing trees are low-hanging opportunities. Expansion of Tea Farms would naturally augment this, giving opportunities to study the multi-dimensional features of integrated agroforestry in northeastern India.

v. **Forest landscape and NTFP:** The forest foothills and uplands are unique ecosystems for a number of commercial non-timber forest products and as well biodiversity. These mainly include spices and condiments, dyes, ethnomedicinal herbs, edible forest products like bamboo shoots, materials for building and household utilities etc. A brief and proportionate distribution of these are illustrated in the graphical representation below.



Bamboos make a promising resource from the forests of Karbi Anglong, especially near the periurbs of Diphu. It can support the local paper industries and other handicraft enterprises helping to augment their income. Ethnobotanical studies (Mipun et al 2019) have demonstrated and underscored the dependence of the forest dwellers on this living resource for their livelihood and subsistence. Ethnobotanical knowledge of the locals of this area is significantly diverse and useful. Documentation of TEK and its wise-use will be a major accomplishment from the learning landscape of Diphu in Karbi Anglong. Some recommended agroforestry and NTF species include *Abroma augustum, Amaranthus spinosus, Geophila repens, Aegle marmelos,* and *Abrus precatorius* for further ethnopharmacological studies. The learning hub will essentially develop an effective NTFP policy to link the provision of livelihood security as well as sustenance with biodiversity conservation. The efficient and eco-sensitive extraction of these forest products can not only add value to the forest product but also provide a proper incentive for conservation and sustainable forest management.

TEEB AgriFood Learning Landscapes

These Learning landscapes of Assam would enable an equitable and gender-just platform for adaptive learning and experimentation.

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