ASSAM PROJECT ON
FOREST & BIODIVERSITY
CONSERVATION

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# "CLIMATE CHANGE MANAGEMENT FOR FOREST AND BIODIVERSITY OF ASSAM"

Prepared for

Assam Project on Forest and Biodiversity
Conservation Society (APFBCS)

## For more information

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| | |
|---|---|
| ABS | Access and Benefit Sharing |
| APFBCS | Assam Project on Forest and Biodiversity Conservation |
| ASAPCC | Assam State Action Plan on Climate Change |
| ASRLM | Assam State Rural Livelihood Mission |
| BEI | Biomass Extraction Intensity |
| BMMU | Block Mission Management Units |
| BPL | Below Poverty Line |
| CAMPA | Compensatory Afforestation Fund Management and Planning Authority |
| CCA | Community Conserved Areas |
| CIFOR | Center for International Forestry Research |
| CPREEC | Centre for Policy Research Environmental Education Centre |
| DAY-NRLM | Deen Dayal Antyodaya Yojana-National Rural Livelihoods Mission |
| DST | Department of Science & Technology |
| EBA | Ecosystem-Based Approach |
| EDCs | Eco Development Committees |
| EEARSD | Education, Awareness, Research and Skill Development |
| EEP | Environment Education Program |
| EIACP | Environmental Information, Awareness, Capacity Building and Livelihood Programme |
| EPA | Entry Point Activities |
| FBVI | Forest and Biodiversity Vulnerability Index |
| FCD | Forest Canopy Density |
| FDAs | Forest Development Agencies |
| FFV | Forest Fringe Villages |
| FPI | Fire Point Intensity |
| GHG | Greenhouse Gases |
| GIM | Green India Mission |
| GIS | Geospatial Information System |
| GOI | Government of India |
| HCVA | High Conservation Value Areas |
| IBA | Important Bird Areas |

| | |
|---|---|
| IDWH | Integrated Development of Wildlife Habitats |
| IHR | Indian Himalayan Region |
| IMD | India Metrological Department |
| IOCL | Indian Oil Corporation Limited |
| IPCC | Intergovernmental Panel on Climate Change |
| ISFR | India State of Forest Report |
| IUCN | International Union for Conservation of Nature |
| IUFRO | International Union of Forest Research Organizations |
| JFMCs | Joint Forest Management Committees |
| JLG | Joint Liability Group |
| KBA | Key Biodiversity Areas |
| LPG | Liquefied Petroleum Gas |
| LULC | Land Use Land Change |
| M&E | Monitoring and Evaluation |
| MDF | Moderately Dense Forest |
| MGNREGA | Mahatma Gandhi National Rural Employment Guarantee Act |
| MoEFCC | Ministry of Environment, Forest, and Climate Change |
| MRV | Monitoring Reporting and Verification |
| NAP | National Afforestation Programme |
| NAPCC | National Action Plan on Climate Change |
| NDC | Nationally Determined Contributions |
| NGO | Non-Governmental Organizations |
| NMSHE | National Mission for Sustaining the Himalayan Ecosystem |
| NTCA | National Tiger Conservation Authority |
| NTFP | Non-Timber Forest Produce |
| NVY | Nagar Van Yojana |
| PE | Project Elephant |
| PMUY | Pradhan Mantri Ujjwala Yojna |
| PMVDY | Pradhan Mantri Van-Dhan Yojana |
| RCP | Representative Concentration Pathways |
| REDD | Reducing Emissions from Deforestation and forest Degradation |
| RS | Remote Sensing |

SAPCC State Action Plan on Climate Change

SCAF            State Compensatory Afforestation Fund

SCCP            Scheduled Caste Sub Plan

SDG             Sustainable Development Goal

SDRF            State Disaster Response Fund

SEA             Socio-economic Assessment

SHG             Self Help Groups

SMC             Soil and Moisture Conservation

SOPD            State Owned Priority Development

SPI             Standard Precipitation Index

SPV             Special Purpose Vehicle

TOF             Trees Outside Forest

TSP             Tribal Sub Plan

USAID           United States Agency for International Development

VDF             Very Dense Forest

VDVK            Van Dhan Vikas Kendra

WII             Wildlife Institute of India

# 1. INTRODUCTION

As per the sixth assessment report of IPCC, human activities via Greenhouse Gas (GHG) emissions have resulted in 1.1-degree Celsius rise in global temperature in 2011-2020 from year 1850-1900 (IPCC, 2023). The report has also predicted that relative to the reference period of 1850-190, the global surface temperature by the end of 2100 is likely to be in the range of 2.1 to 3.4 degree Celsius (IPCC, 2023). This projection is modelled after considering the NDCs announced in COP26 until 2030 assuming no increase in ambition thereafter (IPCC, 2023). The changes in temperature around the world has caused widespread changes in atmosphere, cryosphere, ocean, and biosphere. This has resulted in alteration in the species structure and composition, biome transitions and migration from lower to higher altitudes.

Climate change is influencing human ecosystems as well through impact on forest ecosystems (IUCN, 2015). Forests, in addition to regulating climate change, provide a multitude of ecological, social and economic benefits in the form of ecosystem services. Forests, in particular drive the livelihoods which is especially important for a large number of forest dependent communities. Human-induced changes in climate has affected various regions in the form of extreme weather events such as droughts, heatwaves, heavy precipitation, frequent floods, heavy precipitation, tropical cyclones etc. This has led to losses and damage to forest, biodiversity, and people that is distributed across sectors, regions, and systems unequally. As per IPCC Sixth Assessment report 2023, approximately 3.3 to 3.6 billion people are highly vulnerable to climate change. Regions having food and water insecurity, developmental constraints are more vulnerable to impacts of climate change.

International Union of Forest Research Organizations (Seppälä, R., 2009), suggested that in the era of accelerated climate change, warmer world would lead to reduced carbon sequestration potential of forests. The ISFR 2021, using a computer-based modelling, has mapped Representative Concentration Pathways 4.5 and 8.5 (RCP 4.5 and RCP 8.5). It indicates that by 2050, under RCP 4.5, 94% and 6% of Assam's forests will fall under the high and very highly vulnerable categories, respectively while, under RCP 8.5, 85 % and 15 % will fall under the high and very highly vulnerable categories, respectively. In the long-term (2085), under RCP 4.5, 100% of the forests will fall under very high vulnerability while, under RCP 8.5, 78% and 22 % will fall under extremely high and critical vulnerable categories, respectively.

Therefore, devising appropriate mitigation (*A human intervention to reduce the sources or enhance the sinks of greenhouse gases*) and adaptation (*Adaptation is defined, in human systems, as the process of adjustment to actual or expected climate and its effects in order to moderate harm or take advantage of beneficial opportunities. In natural systems, adaptation is the process of adjustment to actual climate and its effects; human intervention may facilitate this.*) strategies for forest ecosystems in the need of the hour in order to enhance the resilience (*The capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation*) and adaptive capacities (*The ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences*) of not just ecosystems but also of the forest-dependent communities. While there has been some progress towards climate change mitigation and adaptation policies globally, there have been large gaps with regards to their implementation, monitoring and evaluation (IPCC, 2023). One of the reasons for this is disparity in the adaptive capacities across regions. This report follows the structure of the long-term objective of

the assignment i.e. to restore forest ecosystem in collaboration with forest dependent communities; to enhance their livelihood and ensure conservation and sustainable use of biodiversity. This report is developed in continuation to the previous reports which presents the vulnerability assessment to assess the impacts of climate change, and identification of drivers of deforestation and forest degradation.

The purpose of this report is to identify strategies in response to climate change mitigation and adaptation that is consistent with the drivers of degradation present in the state of Assam. The presented strategies will also consider safeguarding food security, rural livelihood, and rights of forest dependent communities.

# 2. VULNERABILITY OF ASSAM'S FORESTS

To understand the ambiguity associated with climate change mitigation and adaptation a planned approach aimed at reducing the vulnerability of a system is required. The vulnerability assessment of Assam's forests and biodiversity aims to identify climate change hotspots. Assessing the vulnerability of forest ecosystems, is critical to identify the degree to which forest resources and those dependent on them would be affected. It also aids all concerned stakeholders to make informed decisions regarding forest management practices and designing appropriate mitigation and adaptation strategies specific to the area. The results of vulnerability assessment, its impact on climate change hotspots, and various drivers od deforestation and forest degradation leading to climate change are as follows:

## 2.1 Vulnerability Assessment

Scope-1 of the APFBCS Phase-II project was to assess the vulnerability of Assam's forests and biodiversity and identifies climate change hotspots across the state. The study uses an indicator-based approach for vulnerability assessment of forest and Biodiversity. For forest and biodiversity vulnerability assessment, the entire state of Assam has been divided into grids of size 0.25°, equivalent to the grid size of available IMD gridded data (https://www.imdpune.gov.in/cmpg/Griddata/Rainfall_25_NetCDF.html). The grids that have at least 5% area under forest cover as per the ISFR 2021 forest cover data are being designated as the forest grids and the vulnerability assessment have been done only for these grids. Out of total 178 grids, 140 grids have more than 5% area as forest cover in Assam. Following were the major findings of the study:

1. In Assam, a total of 19 grids (25km*25km) have been identified as very highly vulnerable whereas 68 grids delineated as in highly vulnerable state for forest and biodiversity.
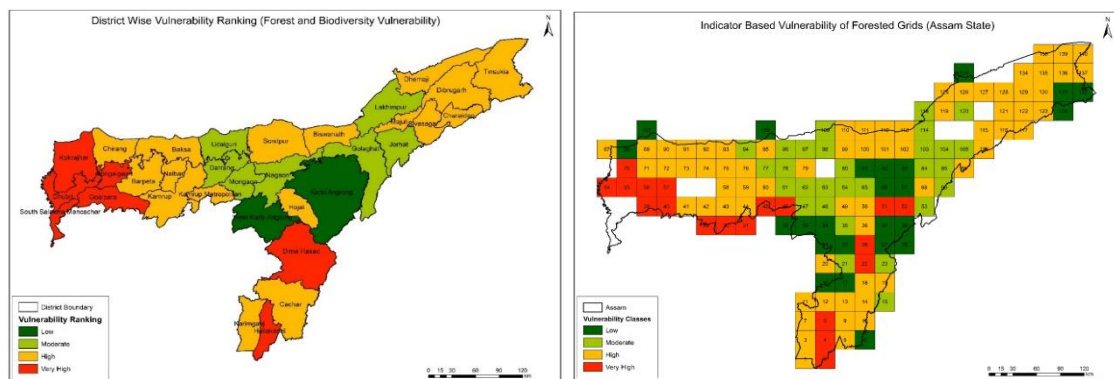


**Figure 1: Spatial distribution (left) and grid-wise distribution (right) of Forest and Biodiversity Vulnerability Index (FBVI)**

2. District wise ranking of FBVI indicates that seven districts of Assam, namely, Kokrajhar, Bongaigaon, South Salmara Mancachar, Dhubri, Goalpara, Hailakandi and Dima Hasao, are identified as the very highly vulnerable whereas 17 districts are identified as highly vulnerable for terms of forest and biodiversity.

**Table 1: District wise Vulnerability rankings of Assam**

| District | Vulnerability Ranking | District | Vulnerability Ranking |
|---|---|---|---|
| Tinsukia | High | Darrang | Moderate |
| Dhemaji | High | Barpeta | High |
| Dibrugarh | High | Nalbari | High |
| Lakhimpur | Moderate | Morigaon | Moderate |
| Sivasagar | High | Kamrup | High |
| Jorhat | Moderate | Bongaigaon | Very High |
| Sonitpur | High | Dhubri | Very High |
| Golaghat | Moderate | Kamrup Metropolitan | High |
| Udalguri | Moderate | Goalpara | Very High |
| Chirang | High | Dima Hasao | Very High |
| Baksa | High | Cachar | High |
| Nagaon | Moderate | Karimganj | High |
| Kokrajhar | Very High | Hailakandi | Very High |
| Hojai | High | Charaideo | High |
| South Salmara Mancachar | Very High | Majuli | High |
| Karbi Anglong | Low | Biswanath | High |
| West Karbi Anglong | Low | | |

3. Grid-wise distribution of climate change hotspot highlights that a total of 38 and 47 grids respectively are identified as grids with very high and high exposure to climate change vulnerability.
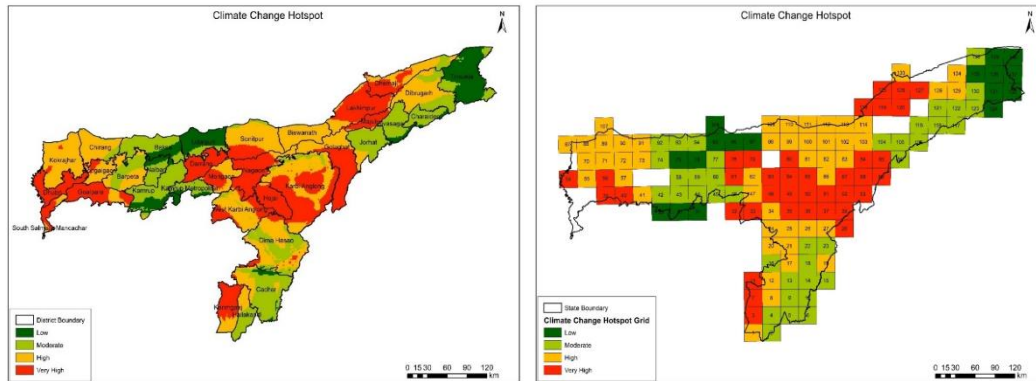
**Figure 2: Spatial distribution (left) and grid-wise distribution (right) of climate change hotspots**

4. Linear regression analysis between the spatial distribution layers of climate change hotspot along with the Forest and Biodiversity Vulnerability Index (FBVI) layer indicates a highly positive correlation with a high R2 value of 0.77.
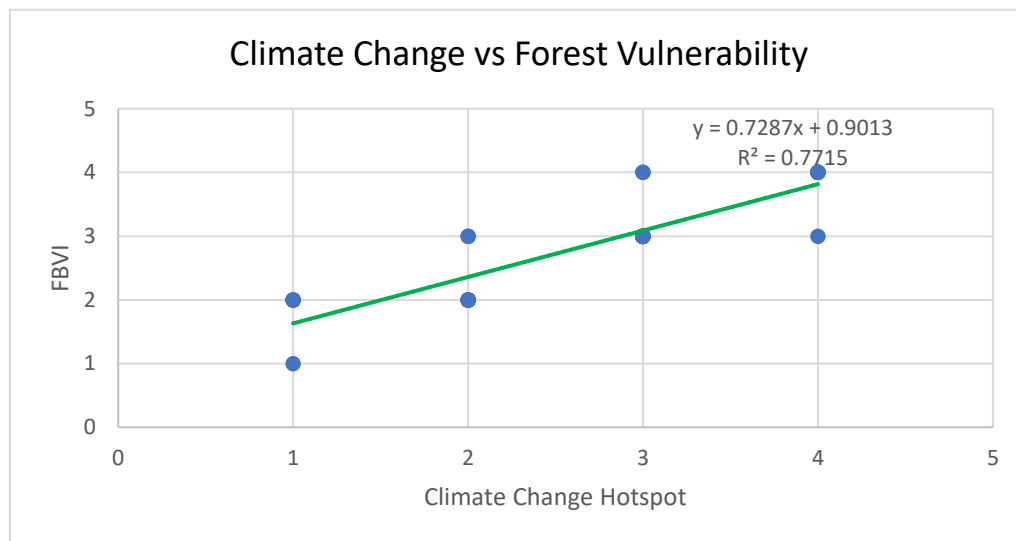


**Figure 3: Correlation between Climate Change Hotspot and FBVI**

5. A total of 46 grids that have been identified as very high and highly vulnerable grids towards climate change exposure also fall in very high and high vulnerability class for forest and biodiversity.

6. Trend analysis of Fire Point Intensity (FPI) over 22 years indicates that 6 districts in Assam very highly prone towards the fire incidents whereas 9 districts are highly prone towards fire events.

7. SPI trends analysis over 22 years indicates that 7 districts fall within very high drought prone zone.

8.  Analyzing the trend in the Forest Canopy Density (FCD) over 22 years, it has been observed that the total decrease in forest cover is 1,207 sq. km (3.93%). Furthermore, over the period of 22 years there has been a decrease of 3,188 sq. km. area under Very Dense Forest (VDF).

9.  LULC change detection analysis indicates that a drastic increase in cropland area of 7313 sq km (9.30%) has occurred during 2022 than that of 2000. Also, there's a considerable increase in settlement area of around 742 sq. km. (1%).

## 2.2  Vulnerability of Reserved Forest and Protected Areas

This section is an attempt to overlap the forest vulnerability with the boundaries of Reserved Forest (RF), Protected Areas (PA) and the Proposed Reserve Forests (PRF). Using the zonal statistics tool in ArcGIS platform FBVI has been extracted for each RFs and PAs of the state. Based on the majority of pixel, denoting specific class of vulnerability, each RF and PA have been categorized into different vulnerability zones as per the FBVI values.
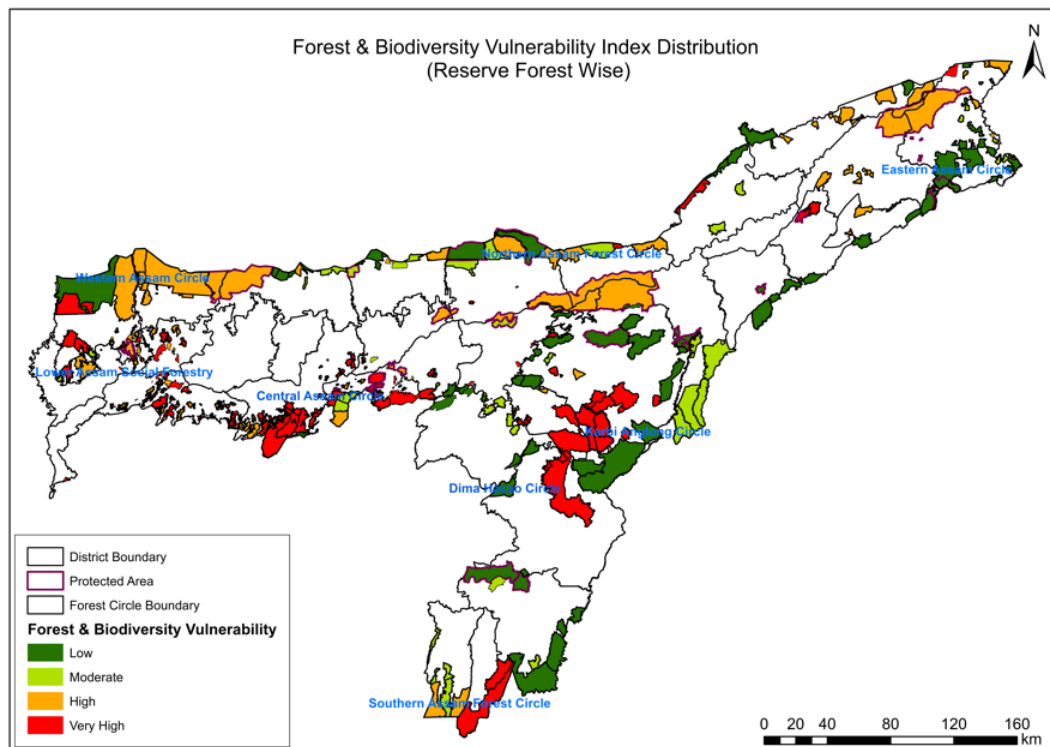


**Figure 4: FBVI distribution over RF of Assam**

The observation from the analysis is as below:

1.  There is a total of **151** (including 48 proposed RFs) RFs in entire state which come under Very High Forest & Biodiversity Vulnerability zone.

2.  In Assam, a total of **138** RFs (including 21 proposed RFs) falls under the High Forest & Biodiversity Vulnerable zone.

3. Whereas there are **61** RFs (including 10 proposed RFs) which have been categorised as moderate vulnerability & **87** RFs (including proposed RFs) as Low vulnerability (in terms of FBVI value).

4. Also, **3** protected area come under very highly vulnerable zone & **8** protected area as high vulnerable zone (in terms of FBVI).

5. As per the shapefile provided, total area under RF & protected area is **19429.30 sq. km.**

The categorization of different Reserved Forests and Protected Areas based on their vulnerability status is provided in Annexure 3.

## 2.3 Vulnerability of HCVA

The project uses High Conservation Value Areas (HCVA) for assessing the vulnerability of these areas based on Forest and Biodiversity Vulnerability Index (FBVI), and climate change hotspots. The process followed is as below:

**STEP 1:** Mapping of High Conservation Value Areas (HCVA) in Assam

**STEP 2:** Overlaying HCVA with Forest and Biodiversity Vulnerability Index (FBVI) map

**STEP 3:** Overlaying HCVA with climate change hotspots map

**STEP 4:** Correlating HCVA with FBVI and climate change hotspots maps
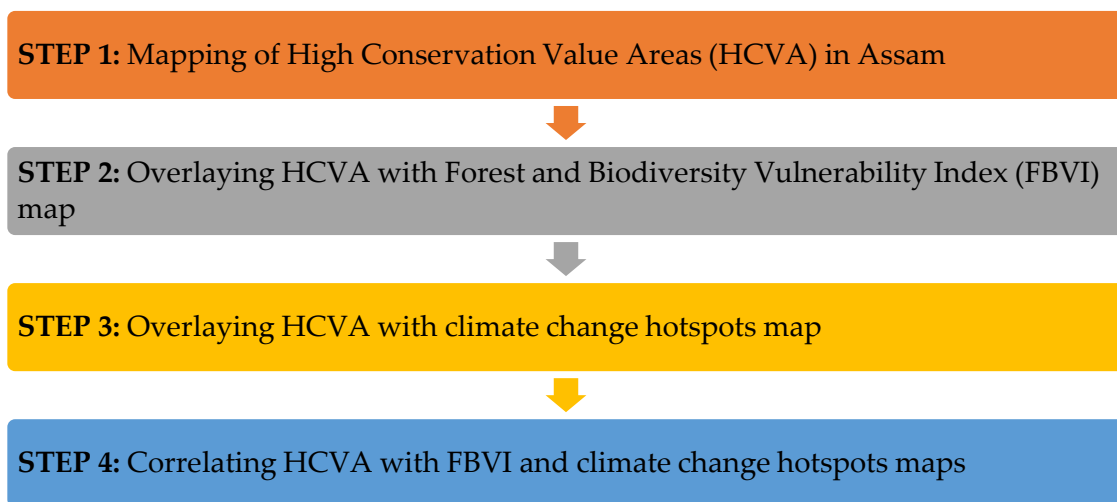
**Figure 5: Steps for correlating HCVA with FBVI and climate change hotspots**

**STEP 1: Mapping of High Conservation Value Areas (HCVA) in Assam**

As per Forest Stewardship Council "*From endemic species to sacred sites, all natural habitats – especially forests – inherit conservation values. Those biological, ecological, social or cultural values of outstanding significance are known as 'high conservation values,' or HCVs*". The HCV areas can be based on biodiversity, ecosystem, landscapes, ecosystem services, cultural identity, and basic human needs (CIFOR, 2007). Based on the above definitions we have mapped the following areas as HCVs in Assam:

- Biodiversity Heritage Sites
- Important Bird Areas (IBA)
- Key Biodiversity Areas (KBA)

- Ramsar Sites
- World Heritage Sites
- Sacred Groves
- Community Conserved Areas (CCAs)

**Data Sources**

The following data sources are used to map the HCVAs in Assam:

**Table 2: Data source for locating HCVA in Assam**

| S.No. | Name | Source |
|-------|------|--------|
| 1 | Biodiversity Heritage Sites | Assam State Biodiversity Board |
| 2 | Important Bird Areas (IBA) | https://datazone.birdlife.org/site/ibacriteria |
| 3 | Key Biodiversity Areas (KBA) | EIACP Programme Centre "Wildlife & Protected Areas Management" by Wildlife Institute of India |
| 4 | Ramsar Sites | Google Earth |
| 5 | World Heritage Sites | Wildlife Institute of India |
| 6 | Sacred Groves | CPREEC - EIACP Programme Centre, Resource Partner on Ecological Heritage and Sacred Sites of India by C.P.R Environment Education Centre |
| 7 | Community Conserved Areas (CCAs) | Sudipto Chatterjee, Sonali Ghosh, Jayanta Sarma, S.K Barik, B.K Tewari and Kulen Chandra Das, 2011 |

**STEP 2: Overlaying HCVA with Forest and Biodiversity Vulnerability Index (FBVI) map**

To assess the vulnerability status of HCVA, all these locations have been overlaid on the spatial distribution of FBVI layer across the state. The grid value of the FFV layer have been extracted for each HCV locations, which is further used for the zonation of HCV locations based on vulnerability of forest and biodiversity. The results indicates that 1 sacred grove, 2 Community Conserved Areas (CCA), 11 Important Bird Areas (IBA), 9 Key Biodiversity Areas (KBA) falls under very high vulnerability. Whereas, 1 sacred grove, 2 world heritage sites, 1 ramsar sites, 2 CCA, 25 IBA, and 19 KBA falls under highly vulnerable category. Detailed list is shown in Annexure 1.
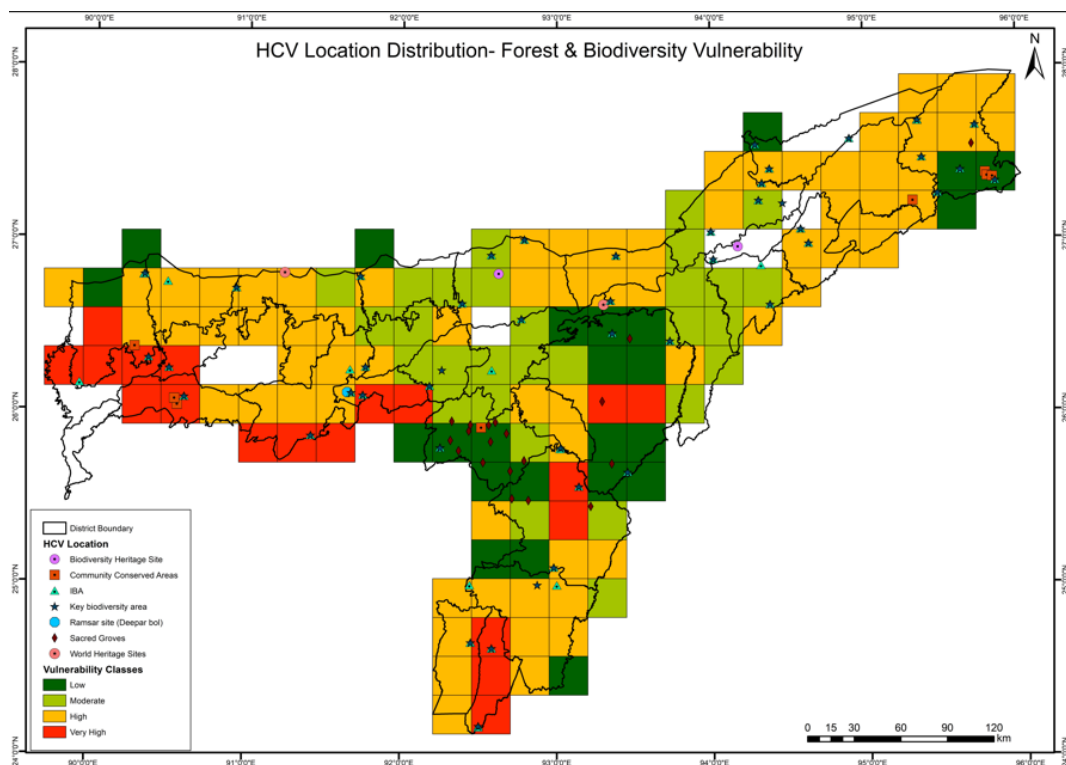
**Figure 6: Delineation of HCV Zone based on Forest & Biodiversity Vulnerability Index**

**STEP 3: Overlaying HCVA with climate change hotspots map**

To assess the vulnerability of HCVA, all these areas were overlapped over the climate change hotspots map as shown in figure below. The results indicates that 7 sacred grove, 2 Community Conserved Areas (CCA), 15 Important Bird Areas (IBA), 11 Key Biodiversity Areas (KBA) falls under very high climate change hotspot. Whereas, 11 sacred grove, 1 world heritage sites, 2 CCA, 13 IBA, 12 KBA, and 1 biodiversity heritage site falls under highly climate change hotspot category. Detailed list is shown in Annexure 2.
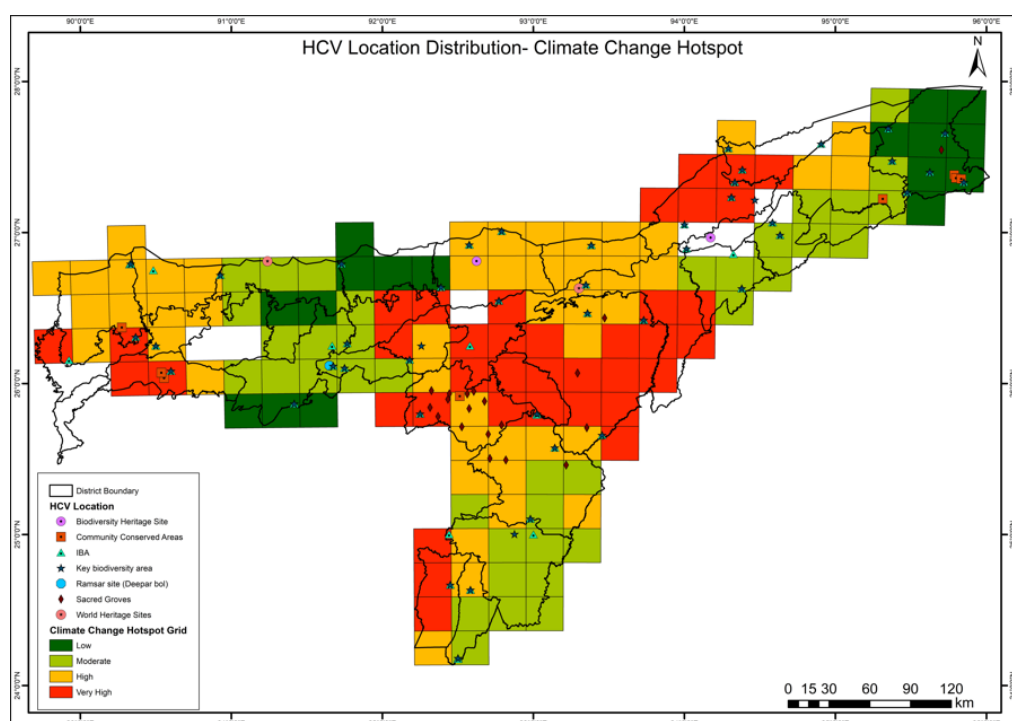
**Figure 7: Delineation of HCV Zone based on climate change hotspots**

## STEP 4: Correlating HCVA with FBVI and climate change hotspots maps

The correlation assessment has been done for HCVA locations using spatial distribution of FBVI and climate change hotspots layer. The HCVA locations categorized under very high, and highly vulnerable zones in terms of both Forest and Biodiversity and climate change vulnerability have been delineated as the zone of extreme priority. The areas falling under very high and high vulnerability are shown below:

**Table 3: HCV Location Correlation- FBVI layer & Climate Change Hotspot**

| Name | Type | Forest & Biodiversity Vulnerability Class | Climate Change Hotspot Class |
|---|---|---|---|
| Chinthong | Sacred Groves | Very Highly Vulnerable | Very High Climate Change Zone |

| Name | Type | Forest & Biodiversity Vulnerability Class | Climate Change Hotspot Class |
|---|---|---|---|
| Bodahapur | Community Conserved Areas | Very Highly Vulnerable | Very High Climate Change |
| Baldjana | Community Conserved Areas | Very Highly Vulnerable | Very High Climate Change |
| Boro Gendrabil | Community Conserved Areas | Highly Vulnerable | High Climate Change Zone |

| Name | Type | Forest & Biodiversity Vulnerability Class | Climate Change Hotspot Class |
|---|---|---|---|
| Chakrashila Complex | IBA | Very Highly Vulnerable | Very High Climate Change |
| Langting-Mupa Reserve Forest | IBA | Very Highly Vulnerable | High Climate Change Zone |
| Urpod Beel | IBA | Very Highly Vulnerable | Very High Climate Change |
| Barail Range forests | IBA | Highly Vulnerable | Very High Climate Change |
| Behali Reserve Forest | IBA | Highly Vulnerable | High Climate Change Zone |
| Bordoibam-Bilmukh Bird Sanctuary | IBA | Highly Vulnerable | Very High Climate Change |
| Bordoloni - Sampora | IBA | Highly Vulnerable | Very High Climate Change |
| Chirang Reserve Forest | IBA | Highly Vulnerable | High Climate Change Zone |
| Kaziranga National Park | IBA | Highly Vulnerable | High Climate Change Zone |
| Lumding Reserve Forest | IBA | Highly Vulnerable | Very High Climate Change |
| Manas National Park | IBA | Highly Vulnerable | High Climate Change Zone |
| Manas Reserve Forest | IBA | Highly Vulnerable | High Climate Change Zone |
| Marat Longri Wildlife Sanctuary | IBA | Highly Vulnerable | Very High Climate Change |
| Nameri National Park | IBA | Highly Vulnerable | High Climate Change Zone |
| Ripu Reserve Forest | IBA | Highly Vulnerable | High Climate Change Zone |
| Son Beel | IBA | Highly Vulnerable | Very High Climate Change |

| Name | Type | Forest & Biodiversity Vulnerability Class | Climate Change Hotspot Class |
|---|---|---|---|
| Bauwwa Beel | Key biodiversity area | Very Highly Vulnerable | High Climate Change Zone |
| Chakrashila Complex | Key biodiversity area | Very Highly Vulnerable | Very High Climate Change |
| Langting-Mupa Reserve Forest | Key biodiversity area | Very Highly Vulnerable | High Climate Change Zone |
| Tamaranga-Dalani-Bhairab Complex | Key biodiversity area | Very Highly Vulnerable | High Climate Change Zone |

| | | | | |
|---|---|---|---|---|
| Urpod Beel | Key biodiversity area | Very Highly Vulnerable | | Very High Climate Change |
| Behali Reserve Forest | Key biodiversity area | Highly Vulnerable | | High Climate Change Zone |
| Bordoloni - Sampora | Key biodiversity area | Highly Vulnerable | | Very High Climate Change |
| Kaziranga National Park | Key biodiversity area | Highly Vulnerable | | High Climate Change Zone |
| Lumding - Marat Longri | Key biodiversity area | Highly Vulnerable | | Very High Climate Change |
| Manas National Park | Key biodiversity area | Highly Vulnerable | | High Climate Change Zone |
| Nameri National Park | Key biodiversity area | Highly Vulnerable | | High Climate Change Zone |
| Ripu and Chirang Reserve Forests | Key biodiversity area | Highly Vulnerable | | High Climate Change Zone |
| Son Beel | Key biodiversity area | Highly Vulnerable | | Very High Climate Change |

The HCVA that come under very high vulnerability due to both FBVI and climate change hotspots are categorized as high priority regions. These HCVA are part of the districts namely Karbi Anglong, Goalpara, Bongaigaon, Kokrajhar, and Dhubri. The list of HCVA along with their presence in the respective districts are as follows:

**Table 4: Regions with very high FBVI and Climate change hotspot class**

| Region | Name | Type | Forest & Biodiversity Vulnerability Class | Climate Change Hotspot Class |
|---|---|---|---|---|
| Karbi Anglong | Chinthong | Sacred Groves | Very Highly Vulnerable | Very High Climate Change Zone |
| Goalpara | Bodahapur | Community Conserved Areas | Very Highly Vulnerable | Very High Climate Change |
| Bongaigaon | Baldjana | Community Conserved Areas | Very Highly Vulnerable | Very High Climate Change |
| Kokrajhar, Dhubri | Chakrashila Complex | IBA and Key biodiversity area | Very Highly Vulnerable | Very High Climate Change |
| Goalpara | Urpod Beel | IBA and Key biodiversity area | Very Highly Vulnerable | Very High Climate Change |

## 2.4 Drivers of Degradation and Deforestation

Scope-1 of the APFBCS Phase-II project included identification of drivers of deforestation and forest degradation. The study employed a four-way approach- Systematic review of literature, Socio-economic survey of 1380 forest fringe households, Stakeholder consultation and RS-GIS analysis to discern the drivers.

Land diversion due to development pressure, encroachment, resource extraction, natural hazards and illegal activities are the major drivers of forest degradation and deforestation in the state of Assam. This is also supplemented by RS-GIS findings, which shows that sizeable portions of reserved forest and protected area have been encroached upon and converted into croplands.

**Highlights of the systematic review of literature review:**

- The systematic review of literature suggests that resource extraction, encroachment (agriculture and settlement), illegal activities (timber extraction, poaching, hunting etc), development pressure and shifting cultivation are the prominent drivers of degradation and deforestation.

- Several underlying causes for forest degradation and deforestation haven been discerned in literature. Each of the drivers mentioned in the review can be attributed or linked to other direct or indirect contributing factors. For instance, some common factors cited in most of the literature are population growth, burgeoning industrialisation/urbanization and the subsequent demand and dependency on various resources- from land for expansion to extraction of numerous forest resources. In addition to dependency on the resources, literacy, or lack thereof, combined with poverty and lack of livelihood opportunities also drives unsustainable extraction of resources and increased cultivation of cash crops. Drivers such as encroachment, a major issue in the state has been attributed to political unrests, insurgencies and immigration and sometimes inefficient forest management.

- Furthermore, as inferred from the literature review, these drivers can be both natural and anthropogenic in nature, with the latter being the most common. The occurrence and impacts of various natural drivers, such as floods or increased precipitation, increased sedimentation and erosion, are often aggravated by many anthropogenic drivers such as encroachment, timber felling etc.; various anthropogenic activities are directly responsible for increased GHG emissions, leading to climate change and increased frequency of natural hazards.

The various interlinkages between each driver of deforestation and forest degradation are depicted in the figure below:
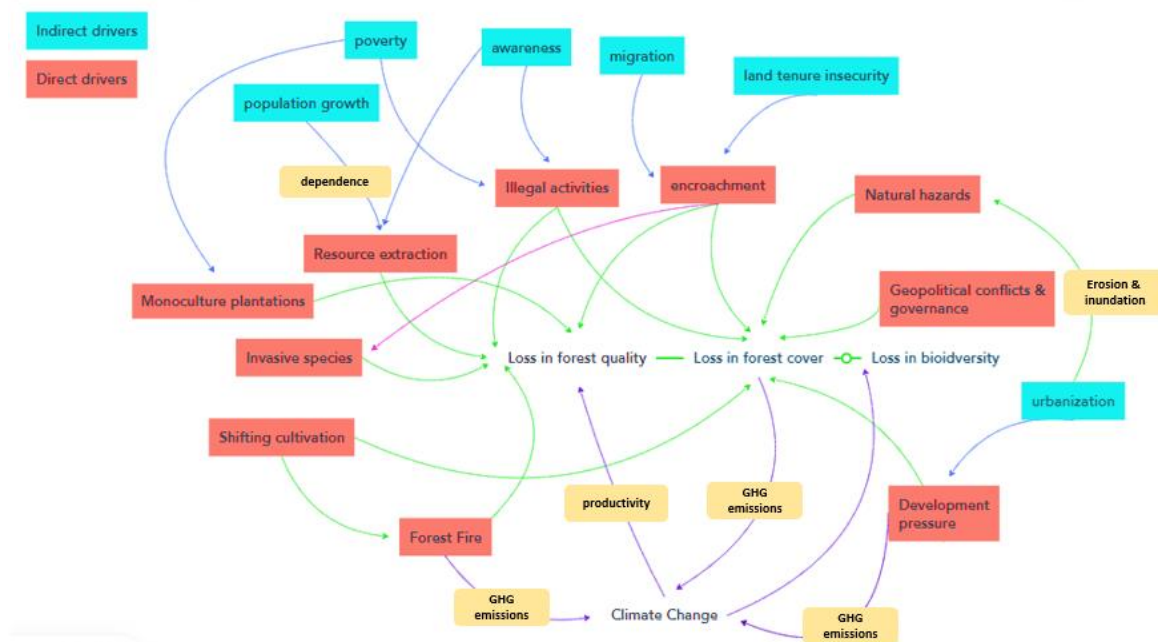
**Figure 8: Mind map showing interlinkages between various drivers**

**Highlights of the Socio-economic Survey:**

- The FFV lying closest to the forest area (up to 1 km) extract the maximum quantum of resources. This suggests that accessibility and proximity to a forest influences the quantity of resources extracted.

- Fuelwood is the major forest resource collected by the FFV.

- Household with no or small landholdings extract the maximum resources from the forest. This suggests that the size of landholding influences the forest resource dependency.

- Agriculture is the primary source of income for the sampled households. The number of households depending on forest resources as a source of income is small as compared to other sources of income. This suggests that a subsistence-based dependency on forest resources.

- The majority of the landless households or those with small landholdings (83%) are most dependent on forest resources despite driving their income from agricultural activities.

- Forests are the major source of resource extraction for fuelwood, grazing fodder and stall fodder.

- Availability of certain forest resources have decreased over the last few decades. The average distance to collect a forest resource has been noted to have increased. This, supplemented by the respondents' observations of their forest quality suggests that the forests are getting degraded.

- **Biomass Extraction Intensity (BEI)-** Biomass Extraction Intensity (BEI) of Forest Fringe Villages measures the collection intensity of forest products by forest-resource-dependent communities.

Communities depend on forests for a variety of products such as fuelwood, fodder, housing etc. Unsustainable use of forest products has resulted in large-scale forest degradation, depletion, and biodiversity loss, thereby adding to vulnerability. BEI captures the extraction pressure on forests and their vulnerability to deforestation, degradation, and biodiversity loss. It is quantified in terms of tonnes of forest produce per hectare per year (t/ha/yr).

The fringe villages of the recorded forests falling in the vicinity of the villages have maximum extraction pressure. The image below shows the spatial distribution of BEI categorised into 4 zones based on intensity of extraction quantified at district level: low (6–50), moderate (50–100), high (100–200), and very high (>200). The extraction intensity is directly proportional to the vulnerability of forest & biodiversity; therefore, a higher BEI denotes higher contribution towards vulnerability, while a low BEI depicts low vulnerability. In Assam, spatial extent of BEI indicates that total 9 districts fall on very high BEI zone (>200 t/ha/yr) whereas 7 districts experienced very low extraction pressure (< 50 t/ha/yr). The result indicates that Nalbari and Kamrup Metro shows very high extraction intensity, Tinsukia & Kokrajhar shows high extraction intensity, Karimganj and Morigaon shows moderate extraction intensity and Barpeta shows low extraction intensity.
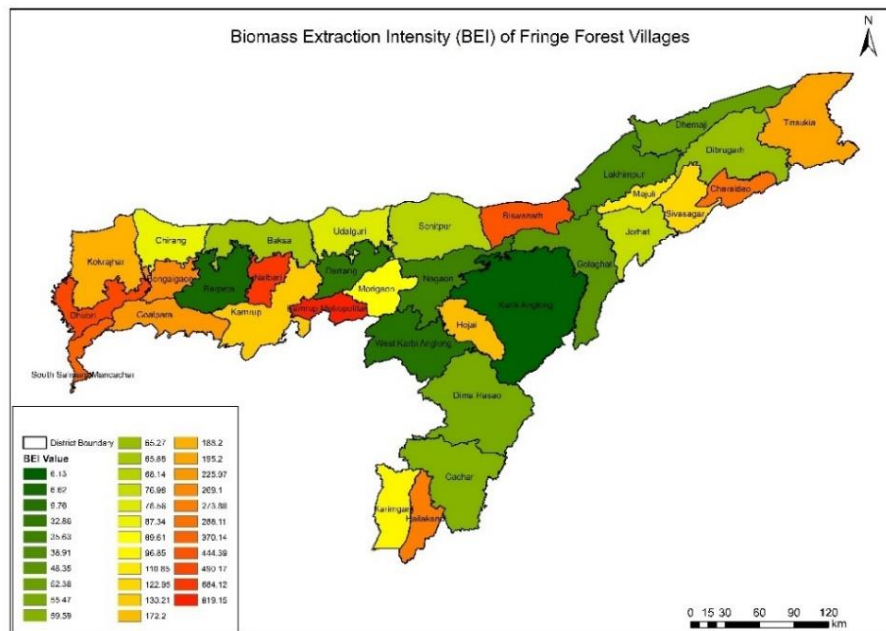


**Figure 9: Biomass Extraction Intensity (BEI)**

**Highlights of the RS-GIS Analysis:**

- Between 2000 to 2022, 2546 sq. km of forests have been converted into plantations, croplands, and settlement areas. The annual rate of land transition of forests to settlements, croplands and plantations are 1.04 sq. km/yr, 55.53 sq. km/yr, 59.17 sq. km/yr, respectively.
- A sizable portion of the Diroi Reserve Forest, Chirang Reserve Forest, and Sonai Rupai Wildlife Sanctuary have been converted into crop fields over the period of 22 years.
- The annual loss in forest carbon strock from 2000 to 2023 is 2.7 million tonnes of $CO_2$ eq/yr.
- The total loss in carbon stock in tons of carbon dioxide equivalent per hectare per year is 0.96 $tCO_2$ eq/hectare/year due to the conversion of forest land class into other land use classes specifically cropland and built-up over the period of analysis.
- FCD analysis suggests that a large area of Very Dense Forest (VDF) has been degraded over the span of 22 years. A total of 3188 sq. km of VDF has been degraded, and 170 sq. km of the Moderately Dense Forest (MDF) has been changed to other forest classes. Non-forest and open forest class has seen a growth of 2152 and 1263 sq. km respectively over 22 years.
- Fire Point Intensity (FPI) analysis over 22 years indicates that 6 districts in Assam are very highly prone towards fire incidents.
- Standard Precipitation Index (SPI) trends analysis over 22 years indicates that 7 districts fall within very high drought prone zones.
- The state has experienced earthquakes 45 times since 2000, as compared to 55 times in 50 years since 1950.
- Decadal variation of annual average precipitation indicates a decreasing trend in precipitation for the state of Assam. There is a decrease of 171.81 mm in average precipitation over the period of 60 years.
- Decadal variation of average air temperature indicates a gradually increasing trend. There is an increase of 0.3 ° in average air temperature over the period of 60 years. The trend is in further increasing trend during the present three years (2020-2022) which highlights an increase of 0.57 ° in average air temperature than that of during 1951-1960.
- The projection of the population for the year 2030 indicates that the population number in the RFA would reach over 2 million.
- Floods, being a recurrent hazard, inundate/submerges a substantial portion of several districts each time. It plays a pivotal role as a driver of forest degradation and biodiversity loss.

**Highlights of the Stakeholder Consultation:**

- The top 5 drivers based on percentage of number of responses from different stakeholders are development pressure, natural hazards, encroachment, increasing population pressure & urbanization, and illegal activities.
- There is general consensus among four different stakeholder groups- NGOs, Forest and allied department, Rural and livelihood development, other research institutes. Development pressure and encroachment were cited as drivers in all stakeholder groups.

**Consolidating analysis from SEA, stakeholder consultation, and systematic literature review**

1. Top 5 drivers based on systematic literature review, stakeholder consultation, and Socio-Economic Assessment are:

| Systematic Literature Review | Stakeholder Consultation | Socio-Economic Assessment |
|---|---|---|
| •Resource Extraction<br>•Encroachment<br>•Illegal activities<br>•Development pressure<br>•Shifting cultivation | •Development pressure<br>•Natural hazards<br>•Increasing population pressure & urbanization<br>•Encroachment<br>•Illegal activities | •Resource extraction<br>•Encroachment<br>•Natural hazards<br>•Anthropogenic forest fires<br>•Development pressure |

2. The results of systematic literature review and stakeholder consultation indicates that below mentioned districts were found common in both the analysis:

| Driver | Common Districts |
|---|---|
| Encroachment | Cachar, Kamrup, Kamrup Metro, Kokrajhar, Morigaon, Nagaon, and Sonitpur |
| Resource Extraction | Goalpara, Karbi Anglong, Sonitpur, Tinsukia |
| Illegal activities | Baksa, Chirang, Udalguri |
| Development pressure | Dibrugarh, Kamrup metro, Tinsukia |
| Geopolitical conflicts | Karbi Anglong |
| Shifting Cultivation | Karbi Anglong |
| Invasive species | Golaghat |

**Inferences:**

1. Based on the results from HCVA it can be observed that Karbi Anglong, Goalpara, Bongaigaon, Kokrajhar, and Dhubri are very highly vulnerable districts.

2. As per the common drivers from systematic literature review and stakeholder consultation it can be seen that following drivers are present in very highly vulnerable districts are:

   a. Karbi Anglong- Resource extraction, Geopolitical conflicts, and shifting cultivation.

   b. Kokrajhar- Encroachment

Thus, when implementing climate change mitigation strategy regions such as Karbi Anglong should prioritise strategy to counter drivers such as resource extraction, geopolitical conflicts, and shifting cultivation. Whereas Kokrajhar region should prioritise strategy to counter encroachment issue.

# 3. EXISTING MANAGEMENT PRACTICES IN ASSAM

Mitigation and adaptation are complementary approaches for reducing risks of climate change impacts over different timescales. Mitigation, in the near term and through the century, can substantially reduce climate change whereas adaptation can reduce the adverse effect of climate change. Assam has various interventions/ action points that helps in climate change mitigation and adaptation. These actions come along with a set of challenges along with it. This section describes various acts, policies, schemes catering to forest and biodiversity, response of Assam towards climate change and various challenges faced by different set of interventions.

## 3.1  Acts, Policies, Schemes Catering to Forest and Biodiversity of Assam

Assam has been known for its biodiversity and extensive forest resources; however, this rich heritage has been facing degradation due to various drivers that have been summarised in the previous chapter. Several conservation, management and policy initiatives have been taken up by the Government in response to the pressing challenge to conserve biodiversity and natural resources. The goal of forest conservation initiatives has been to balance the competing interests of utilizing forests for economic growth, maintaining ecological balance, and protecting the rights and livelihoods of those who depend on them. The state government of Assam has developed some of its own forest regulations in addition to the national ones, taking into consideration the need for forests in the area. The existing acts, policies and regulation of Assam in regard to forest and biodiversity have been mentioned in the figure below.



**STATE LEVEL**

- The Assam State Biodiversity Rules, 2010
- Assam Disaster Management Act, 2005
- Assam Forest Policy, 2004
- Assam Bamboo & Rattan Policy, 2003
- Assam Forest Protection Force Act, 1986
- The Assam Forest Regulation, 1891

**NATIONAL LEVEL**

- National Wetland Management Rules, 2017
- Biological Diversity Act, 2002
- Forest Conservation Act, 1980
- Environment Protection Act, 1986
- The National Forest Policy, 1988
- The Indian Forest Act, 1927
- The Indian Wildlife Protection Act, 1972
- Forest Rights Act, 2006

**Figure 10: Existing Acts, Policies and Regulation for forest and biodiversity of Assam**

The acts and policies lay the foundation for smooth jurisdiction of forest and biodiversity in Assam. Along with the existing regulations, various central and state initiatives are being implemented that cater to forest and biodiversity of the state. The major initiatives taken by the Central Government have been summarised in the table below.

**Table 5: Major initiatives by the Central Government for conservation of forest and Biodiversity**

| Major Initiatives by the Central Government | Description |
|---|---|
| **Compensatory Afforestation Fund Management and Planning Authority (CAMPA)** | The State CAMPA administers the amount received from the SCAF (State Compensatory Afforestation Fund) and utilizes the money collected for undertaking compensatory afforestation, assisted natural regeneration, conservation and protection of forests, infrastructure development, wildlife conservation and protection and other related activities. (State CAMPA, n.d.)<br><br>According to the 2023-24 report of the Departmentally Related Standing Committee on Development (A) Departments of the Assam Legislative Assembly, under SOPD (State Owned Priority Development) schemes, the department could spend Rs 338.87 crore against the allocation of Rs 528.33 crore in 2019-20, Rs 163.94 crore against the allocation of Rs 438.52 crore in 2020-21, and Rs 591 crore against the allocation of Rs 770.66 crore in 2021-22. The article also reports that the State Environment and Forest Department had to surrender funds amounting to Rs 164.02 crore under the CAMPA in 2020–21 for not being able to utilize them. (Sentinel, 2023) |
| **National Afforestation Programme (NAP)** | The overall objective of the National Afforestation Program (NAP) scheme is ecological restoration of degraded forests and to develop the forest resources with peoples' participation, with focus on improvement in livelihoods of the forest fringe communities, especially the poor. The major component of the scheme includes afforestation under Seven plantation models, maintenance of previous years plantations and Ancillary Activities like Soil and Moisture Conservation activities (SMC), fencing, overheads, Monitoring and Evaluation (M&E), micro-planning, awareness raising, Entry Point Activities (EPA) etc.<br><br>The fund sharing pattern of NAP between Centre and States Northeastern and hilly States is 90:10. Since inception of the NAP (2000-2002) an amount of Rs.3874.02 crores has been released till 2018-19 to various States and is being utilized for treatment/afforestation over 21 lakh hectare sanctioned area. (MoEF&CC, 2019)<br><br>In regard to Assam, Rs 2366.35 lakhs was allocated under NAP scheme for an area of 19,666 ha. Plantation was done through 550 JFMCs under 28 of FDAs in Assam which includes Artificial Regeneration, Natural Regeneration, Bamboo plantation and Medicinal & Aromatic plantation. (Social Forestry, n.d.) |

| Major Initiatives by the Central Government | Description |
|---|---|
| **Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA)** | The National Rural Employment Guarantee Act (NREGA) aims at enhancing the livelihood security of the people in rural areas by guaranteeing hundred days of wage employment in a financial year, to a rural household whose members volunteer to do unskilled manual work. In Assam, MGNREGA was introduced in the state in 2006-07 in 7 districts as the first phase. The coverage was extended to 6 more districts in the 2nd phase, that is in 2007-08 and since 2008-09 all districts are being covered under the program.<br><br>Plantation is one of the focus areas and Assam has achieved milestones in regard to the plantation done under MGNREGA. Dibrugarh District Administration has registered Nation Record under Limca Book of Record by planting 22,084 roadside saplings on either side of the 56.3 km road in 22 minutes on 7th July 2015. Similarly, Bongaigaon and Kokrajhar districts have been registered under Guinness Book of record for plantation under MGNREGA. (MGNREGA, n.d.) |
| **Green India Mission (GIM)** | The National Mission for Green India (GIM) is one of the eight Missions outlined under the National Action Plan on Climate Change (NAPCC) which aims at protecting; restoring and enhancing India's diminishing forest cover and responding to climate change by a combination of adaptation and mitigation measures. Activities under Green India Mission are implemented under the convergence with Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA), Compensatory Afforestation Fund Management and Planning Authority (CAMPA) and National Afforestation Program (NAP).<br><br>A High-Tech Nursery was established in the State with an amount of Rs. 10.00 Lakh and an area of 405 ha plantation was done through 9 NGOs with Rs. 33.14 lakh under the "Greening India Scheme" of Ministry of Environment & Forests, Government of India. (Social Forestry, n.d.) However, in a press release posted on 31st July, 2023 by Ministry of Environment, Forest and Climate Change, Assam has not been taken up under Green India Mission. (MoEF&CC, Green India Mission, 2023) |
| **National Mission for Sustaining the Himalayan Ecosystem (NMSHE)** | The NMSHE is part of India's National Action Plan on Climate Change (NAPCC) and aims to better understand the linkages between climate change and the Himalayan ecosystem for improved management of the fragile ecosystem. Among the 12 states in the Indian Himalayan Region (IHR), Assam is found to be the most vulnerable to the changing climate, according to the report "Climate vulnerability assessment for the Indian Himalayan Region using a common framework" published by Department of Science and Technology (DST) in 2018. (NMSHE, 2018) |

| Major Initiatives by the Central Government | Description |
|---|---|
| | Under the National Mission for Sustaining the Himalayan Ecosystem (NMSHE) implemented and coordinated by the Department of Science & Technology (DST), State Climate Change Cell has been established in the State of Assam which is mandated to study vulnerability and risk assessment at district level, institutional capacity building to attain the capability to handle climate change program, training programs for various stakeholders to work for minimizing the impact of climate change. (MoEF&CC, Impact of Climate Change in Assam, 2023) |
| **Trees Outside Forest (TOF) in India** | The Trees Outside Forests in India program was launched in September 2022 by Ministry of Environment, Forest, and Climate Change. The program will allocate up to $25 million U.S. dollars in seven states, Assam, Andhra Pradesh, Haryana, Odisha, Rajasthan, Tamil Nadu, and Uttar Pradesh, to rapidly expand tree coverage outside of traditional forests by 2.8 million hectares, contributing to India's Nationally Determined Contribution target of creating an additional "carbon sink" of 2.5 to 3 billion tons of carbon dioxide equivalent by 2030.<br><br>On October 18, 2022, the Government of Assam's Department of Environment and Forests and the U.S. Agency for International Development (USAID) announced the launch of the "Trees Outside Forests in India (TOFI)" program in Assam, which will bring together farmers, companies, and private institutions to rapidly expand tree coverage outside of traditional forests in the state. The new program will enhance carbon sequestration, support local communities, and strengthen the climate resilience of agriculture, thereby supporting global climate change mitigation and adaptation goals. (USAID, 2022) |
| **Integrated Development of Wildlife Habitats (IDWH)** | Under the scheme, "Integrated Development of Wildlife Habitats", the Government of India provides financial and technical assistance to the State/UT Governments for activities aimed at wildlife conservation. The scheme includes Protected Areas (National Parks, Wildlife Sanctuaries, Conservation reserves and Community Reserves), Protection of Wildlife outside Protected Areas and Recovery programs for saving critically endangered species and habitats. The activities supported under the scheme are Management planning and capacity building, Anti-poaching and infrastructure development, Restoration of habitats and Eco-development and community-oriented activities. Assam has been covered under scheme since 2007-08 wherein 275.827 lakhs fund was allocated to the state in 2017-18. |
| **Project Elephant** | Project Elephant (PE) was launched by the Government of India in the year 1991-92 with an objective to protect elephants, their habitat |

| Major Initiatives by the Central Government | Description |
|---|---|
| | and corridors, address issues of man-elephant conflict and welfare of domesticated elephants. The project led to the formation of five elephant reserves in Assam namely, Chirang - Ripu Elephant Reserve, Sonitpur Elephant Reserve, Dining Patkai Elephant Reserve ER, Kaziranga - Karbi Anglong Elephant Reserve and Dhansiri - Lungding Elephant Reserve. (Project Elephant, n.d.) |
| **Project Tiger** | Project Tiger was launched in 1973 by the Government of India as a pioneering initiative to conserve its national animal, the tiger. It provides central assistance to the States for tiger conservation in designated tiger reserves with an aim to reduce factors that lead to the depletion of tiger habitats and mitigate them by suitable management. The project led to formation of three tiger reserves in the state namely, Manas Tiger Reserve, Nameri Tiger Reserve and Kaziranga Tiger Reserve. (NTCA, n.d.) |
| **PMVDY (Pradhan Mantri Van-Dhan Yojana)** | Assam Plains Tribes Development Corporation Ltd. has been working as an implementing Agency in Assam since 2018 for the implementation of the Pradhan Mantri Van-Dhan Yojana in the state. This scheme aims at transforming the Minor Forest Produce of the Tribals into wealth so that they have a sustainable future ahead. In the state of Assam, the scheme has established its distinctive presence in 33 districts having 227 functional Van Dhan Vikas Kendra Clusters out of 471 sanctioned VDVKCs, comprising of 300 beneficiaries each. The total number of beneficiaries registered for the functional VDVKCs are 68,100 till date. (PMVDY, n.d.) |
| **Nagar Van Yojana (NVY)** | The scheme, Nagar Van Yojana (NVY) has been launched during the year 2020, for creation of Nagar Vans in urban areas, which promotes urban forestry by involving local communities, NGOs, educational institutions, local bodies, etc. Under NVY, so far, 385 projects have been sanctioned in the country including 3 projects in Assam with a fund release of 169.61 lakhs in 2021-22. (MoEF&CC, Nagar Van Yojana, n.d.) |
| **Environment Education Program (EEP)** | The Environment Education Division implements the 'Environment Education Programme (EEP)' - one of the components of the Central Sector Scheme - 'Environment Education, Awareness, Research and Skill Development (EEARSD)'. It intends to leverage on the key sectoral strength of Eco-clubs already formed under the National Green Corps programme, in addition to targeting Youth Clubs and other such clubs/ units/ groups formed under various programmes/ schemes of the Government. The EEP is being implemented from the year 2022 and has been approved for continuation till the year 2025-26. The Environment Education Programme aims to supplement the knowledge that the children and young generation gain from |

| Major Initiatives by the Central Government | Description |
|---|---|
| | classrooms with experience from nature and hands-on activities. (EEP, n.d.) |
| **Indian Forest & Wood Certification Scheme (IFWCS)** | The Indian Forest & Wood Certification Scheme has been launched by The Ministry of Environment, Forests and Climate Change. This national forest certification scheme offers voluntary third-party certification designed to promote sustainable forest management and agroforestry in the country. The scheme includes forest management certification, tree outside forest management certification, and chain of custody certification. It can provide market incentives to various entities that adhere to responsible forest management and agroforestry practices in their operations. |
| | The Forest Management certification is based on the Indian Forest Management Standard, consisting of 8 criteria, 69 indicators and 254 verifiers, which is an integral part of the National Working Plan Code 2023, launched earlier this year. A separate Trees Outside Forests Standard, is now introduced as a part of the newly launched Indian Forest & Wood Certification Scheme. (MoEFCC, 2023) |

Along with the schemes and programs initiated by the Central Government that have been conserving and enhancing the exiting forest and biodiversity of Assam, the Government of Assam has also taken few state - specific initiatives to further uplift the forests in Assam. The activities implemented include increased plantation, social forestry, disaster risk reduction, etc. The major initiatives taken by the State Government have been summarised in the table below.

**Table 6: Major initiatives by the State Government for conservation of forest and Biodiversity**

| Major Initiatives by the State | Description |
|---|---|
| **Assam Project on Forest and Biodiversity Conservation (APFBC)** | The **Assam Project on Forest and Biodiversity Conservation Society (APFBC Society)**, was created by the State Government of Assam as a Special Purpose Vehicle (SPV) registered under the Societies Registration Act, 1860. Society came in existence on 28 June 2012. The overall goals of the Society are to restore forest ecosystems, in collaboration with the forest dependent communities, to enhance their livelihoods and ensure conservation and sustainable use of biodiversity. (APFBCS, n.d.) |
| | The project has completed its phase I which included activities such as strengthening 140 existing JFMCs and EDCs and providing alternative livelihood training in 125 new JFMCs and EDCs. The project is currently in phase II wherein community engagement is one of the key interventions. The project aims to reduce their |

| Major Initiatives by the State | Description |
|---|---|
| | dependence on the forest by empowering them economically through livelihood training and connecting them to the market. It also aims to strengthen their ability to function independently, by creating/revising micro plans for all project communities, strengthening the JFMCs/EDCs and establishing social institutions (SHG, JLGs, etc.) that are self-sustainable. (APFBCS-PISA, n.d.) |
| **Social Forestry** | The Social Forestry Wing of the Forest Department has achieved remarkable success towards improvement of environment and elevation of socio-economic condition of the rural mass. Most of the unutilized Government wasteland has been identified and brought under Social Forestry Plantation with the objective of providing fuel wood, fodder, fruits, small timber for construction of huts and agricultural implements to the rural people. The up-to-date plantation raised under Social Forestry Schemes is approximately one lakh hectors. Under Extension Forestry, 32 recreation parks have been created. |
| | An area of 67.45 ha with 2,29,33,000 seedlings were raised with State Government fund of Rs. 183.04 lakh under SFG, TSP (Tribal Sub Plan) & SCCP (Scheduled Caste Sub Plan) schemes. Along with this, 20 lakh Agar and 10 lakh Maha Neem seedlings were raised in the nurseries in Assam. With an amount of Rs 171.66 lakh from the Ministry of New & Renewable Energy, Government of India, there was Fuel wood plantation (80 ha), Jatropha plantation (40 ha), distribution of improved chullah (668 no) and Bio-gas plant set up (43 no). Under the National Mission on Biofuel of Ministry of Rural Development, Government of India sanctioned Rs. 1.5 crore for raising 50 lakh Jatropha seedlings nursery through 17 FDAs (Forest development Agencies) in Assam. (Social Forestry, n.d.) |
| **Medicinal and Aromatic Plant Garden Scheme\*** | The Government of Assam, under Medicinal & Aromatic plant garden scheme sanctioned an amount of Rs. 1.00crore for taking up the scheme in 6 districts of Assam covering an area of 25 ha in Assam. (Social Forestry, n.d.) |
| **Cultivation of Medicinal Plants and cultivation of Cashewnut Scheme\*** | This scheme for cultivation of Medicinal plant is proposed for 1430 ha area at a total cost of Rs. 398,97,000 for three years period. Similarly scheme for cultivation of cashew nut is proposed for an area of 350 ha at a total cost of Rs. 447,97,700 for a ten-year period. This scheme is submitted to the Director Horticulture Guwahati and will be implemented through JFMC in Assam (Social Forestry, n.d.) |
| **Installation of Biogas Plant\*** | A proposal has been taken up for installation of Biogas plant in 550 JFMCs through the fund to be sanctioned by Ministry of Non-Conventional Energy Sources at the rate of Rs. 13,000.00 per plant. The subsidized rate fixed for the beneficiaries would be at the rate of Rs. 9,000.00 per plant. (Social Forestry, n.d.) |

| Major Initiatives by the State | Description |
|---|---|
| **Honeybee scheme*** | Setting up of Honeybee plant throughout the State is proposed to be implemented through 550 JFMCs at the rate of Rs. 16,000.00 per plant. A subsidized rate would be fixed for the beneficiaries at the rate of Rs. 800.00 per plant. The matter is take-up with the Director, Horticulture, Assam for sanctioning the required fund for implementation of the Scheme. (Social Forestry, n.d.) |
| **LPG Scheme*** | A proposal has been taken up for distribution of LPG connection with gas chullah in 550 JFMCs. The matter is taken up with the Manager (Marketing), I.O.C., Guwahati for taking necessary steps. (Social Forestry, n.d.) |
| **State Disaster Response Fund (SDRF)** | The Public Works Roads Department get some sanctions for repairing of Flood damaged roads & bridges under State Disaster Response Fund (SDRF). The activities include filling up of breaches and potholes, use of pipe for creating waterways, repair and stone pitching of embankments, repair of breached culverts, providing diversions to the damaged/ washed out portions of bridges to restore immediate connectivity, repair of approaches to bridges/embankments of bridges, repair of damaged railing bridges, repair of causeways to restore immediate connectivity, granular sub base, over damaged stretch of roads to restore traffic.  (SDRF, n.d.) |

**\*Proposed Scheme**

The schemes and programs described above are directly aiding in the conservation of forest and biodiversity of Assam, however there are few initiatives that indirectly protect forest through rural upliftment. The main focus of these schemes and programs includes livelihood generation, shifting to alternative sources of energy, skill enhancement, etc. that reduce the dependency of the local communities on forest for their daily sustenance. Few such initiatives have been summarised in the table below.

**Table 7: Major initiatives taken for rural upliftment in Assam**

| Initiatives for Rural Upliftment | Description |
|---|---|
| **Deen Dayal Antyodaya Yojana- National Rural Livelihoods Mission (DAY-NRLM)** | Assam State Rural Livelihoods Mission Society (ASRLMS) has been implementing the DAY-NRLM in the State since November 2011, with the objective of enhancing the social and economic empowerment of the rural poor in Assam. ASRLMS has undergone various phases of learning and has demonstrated significant successes to date in terms of the formation of quality Self Help Groups, their financial assistance and sustainability. The activities are executed with the help of Block Mission Management Units (BMMUs) which have been set up in 219 blocks. (ASRLM, n.d.) |

| Initiatives for Rural Upliftment | Description |
|---|---|
| **Pradhan Mantri Ujjwala Yojna (PMUY)** | Pradhan Mantri Ujjwala Yojana is a social welfare scheme which aims to provide LPG (Liquefied Petroleum Gas) connections to BPL households in the country. The scheme is aimed at replacing the unclean cooking fuels mostly used in the rural India with the clean and more efficient LPG. Ujjwala Yojana is aimed at providing 5 Crore LPG connections in BPL households across the country. The government has set a target of 5 Crore LPG connections to be distributed to the BPL households across the country under the scheme. (PMYU, n.d.)

The scheme has been launched by the Hon'ble Chief Minister, Assam on 13th May 2017 in the Dibrugarh District. In Assam, The Indian Oil Corporation Limited (IOCL) has been offering two 5 kg LPG cylinders as a refill package to PMUY beneficiaries, who are unable to afford the standard 14.2 kg cylinder. According to the number of ration card holders, Assam has about 56 lakh families below the poverty line (BPL). Of these, 44.14 lakh became the beneficiaries of PMUY entailing a free single-cylinder LPG connection. (Hindu, 2023) |
| **Mission Antyodaya** | Adopted in Union Budget 2017-18, Mission Antyodaya is a convergence and accountability framework aiming to bring optimum use and management of resources allocated by 26 Ministries / Department of the Government of India under various programs for the development of rural areas with Gram Panchayats as focal points of convergence efforts. In Assam, 5,000 clusters comprising of nearly 50,000 Gram Panchayats have been selected by the States purposively for implementing the framework. Mission Antyodaya encourages partnerships with network of professionals, institutions and enterprises to further accelerate the transformation of rural livelihoods. (Mission Antyodaya, n.d.) |

## 3.2 Assam's Response to Climate Change

Assam being one of the most vulnerable states to climate change, has established a **State Climate Cell.** The cell is responsible for formulating policies, action plans and prioritize research activities and actions in the subject of weather and climate. The Climate Cell is equipped with experts and networking facilities with various stakeholder departments, educational institutions, central government agencies, research laboratories, etc. The cell helps in formulating actions while implementing the National Action Plan on Climate Change formulated by Government of India.

The state, recognizing and considering the impacts of climate change, published its first **State Action Plan on Climate Change (SAPCC)** in line with the National Action Plan on Climate Change (NAPCC) in 2015. The SAPCC was further updated and revised for the period of 2021-2030 (ASAPCC 2.0) to be consistent with India's Nationally Determined Contributions (NDCs), Sustainable Development Goal (SDGs) and other national and international priorities. The ASAPCC 2.0 outlines the climate

mitigation and adaptation strategies for 9 vulnerable sectors (Agriculture, Forests, Water, Energy, Habitats, Disaster, Knowledge, Health and Transport).

Furthermore, Assam is the first north-eastern state that introduced the **Green Budget 2023-2024** to "identify, streamline and track efficiently the resources devoted to environmental sustainability and climate change" for the 9 vulnerable sectors identified in the ASAPCC 2.0. It identifies relevant government departments linked to these 9 vulnerable sectors, presents an overview of the budget allocation to relevant schemes and their expenditure based on their impact on climate change.   In addition to the above, Assam being one of the most disaster-prone states in India also has a **Disaster Management Plan** in place**.**

The present study is undertaken as a response to climate change by Assam Project on Forest and Biodiversity Conservation (APFBC) Society. The strategies suggested in the report are in line with the Assam's SAPCC and Green Budget document. The strategies further improve upon the activities that can be implemented by the forest department along with indicators that will greatly help in monitoring the status of the activity.

## 3.3   Current Implementation Challenges

The existing challenges and lacunas in the design and implementation of existing strategies were identified with the help of secondary literature and stakeholder consultation. A consultation was organized in Guwahati, Assam. It included stakeholders from different domains and organizations such as NGOs, state forest department, academic institutes, researchers, State Disaster Management Authority and government officials from different ministries such as labour, panchayat, tribal affairs, and culture. The purpose of the stakeholder consultation was to provide a platform for policymakers, government departments, and NGOs to collaborate and discuss about different challenges faced during the implementation of various climate change mitigation and adaptation strategies. The agenda and images of the stakeholder consultation is provided in Annexure 4.

The consultation helped to understand the effectiveness of interventions for different thematic areas such as enhancing green cover, forest protection and management, reducing dependency of forest fringe communities, training, capacity building, and awareness generation, disaster risk reduction, and biodiversity management.

The step-by-step approach for conducting the stakeholder consultation for understanding the role of drivers of deforestation and forest degradation is as follows:

1. **Explanation of project overview and current findings of the project –** The overall objectives of the stakeholder consultation and different activities planned were briefly explained along with the methodology adopted for implementation of the project. This was followed by the major finding of the vulnerability analysis to assess the impacts of climate change on forest and biodiversity of Assam.

2. **Group Activity:** In line with the objective of the workshop a group activity was conducted for the following:

   - Identification and understanding efficacy of ongoing climate change mitigation and adaptation strategies in Assam.
   - The challenges faced in implementation of the said activities.

All the stakeholders were divided into five groups. To maintain heterogeneity and ensure brainstorming among the members each group had a representative from different departments, organizations, and domain of work.

**Description of group activity-**

This task was a group activity. Every group was provided with an activity sheet consisting of 6 columns. The first column represented different thematic areas of several strategic actions undertaken for climate change mitigation and adaptation. In the next columns the stakeholders were required to list 5 best schemes implemented in the respective thematic area. The groups were also required to rate the effectiveness of the interventions in individual thematic areas on a scale of 1 to 5 (5 being most effective and 1 being least effective). Furthermore, the groups were asked about what's working well, what's not working well and give recommendations/ suggestions. The Activity sheet for the group activity is provided in Annexure 5.

The participants were also provided with a schemes reference sheet (Annexure 6) for ease of doing the activity.

Also, the participants were provided with a reference sheet for potential list of limitations that can be there while implementation of any climate change mitigation and adaptation scheme/ intervention/ strategy (Annexure 7).



**Figure 11: Group activity**

**Results of group activity-**

The ratings of the effectiveness of the thematic areas provided by all the groups during the group activity conducted in stakeholder consultation is provided below (1-least effective, 5-most effective).
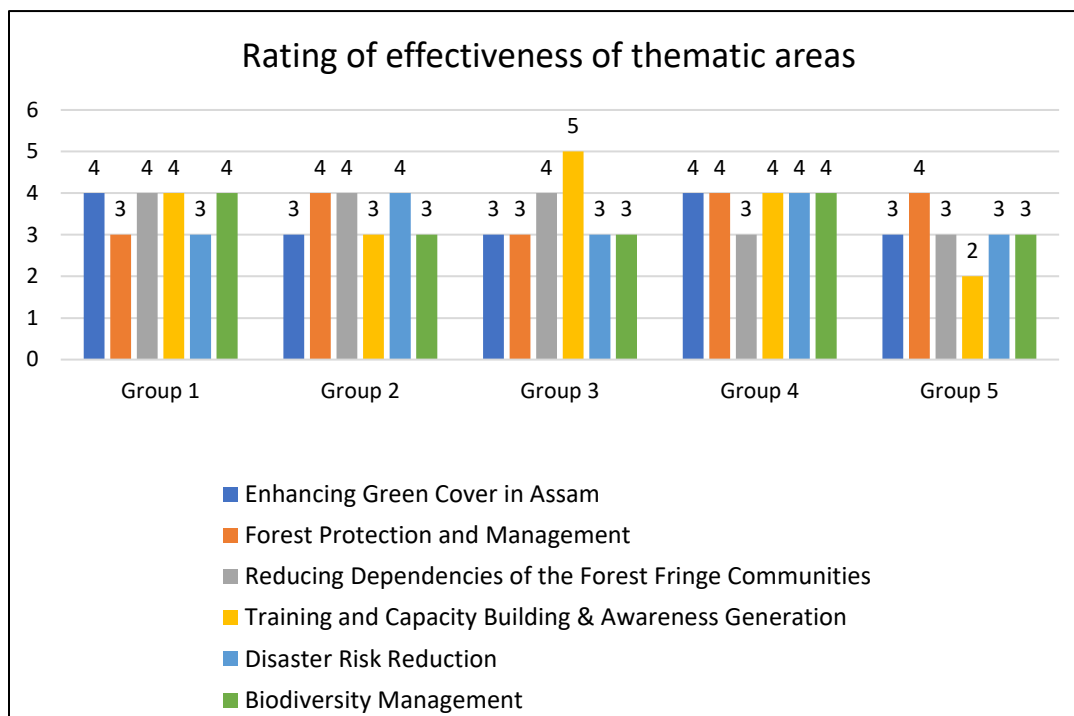
**Figure 12: Rating of effectiveness of thematic areas**

The compiled results from all groups for the group activity-2 performed to understand the efficacy of ongoing climate change mitigation and adaptation interventions in Assam-Strategic actions and their challenges is shown below:

**Table 8: Response provided by stakeholders during group activity:**

| Theme (Strategic Action) | What's not working well? | One Suggestion/ Recommendation |
|---|---|---|
| **Enhancing Green Cover in Assam** | *Proper exit plan to ensure program sustainability, Lack of proper MRV, Transparency, grievance redressal and feedback mechanism, Untimely fund release, Lack of funding, Lack of manpower, Geographical barriers, Urban forestry, Invasive species management, Lack of quality seedlings, non-appropriate selection of sites | *Strengthening Participatory approach, focus on community participation and (backbone of all schemes) productivity along with penetrative publicity awareness, Timely release of fund, Miyawaki forest concept-Japan, Community participation to be enhanced, Total ban of plastic, Frequent awareness programme for community on planting methodology, Indigenous planting should be encouraged |

| | | |
|---|---|---|
| **Forest Protection and Management** | Lack of enforcement/regulation, Resource availability (physical infrastructure/technology etc), Transparency, grievance redressal & feedback mechanism, Proper exit plan to sure programme sustainability, Human-Wildlife conflict management, Lacking active community participation | Proper implementation design (planning of interventions with extensive feasibility analysis-context & domain), Focus on community participation and (backbone of all schemes) productivity along with penetrative publicity awareness, Eviction of encroached forest lands and afforestation, SDMF scheme, Awareness and education, Training of JFMC and EDC groups, Special Insurance schemes, school cover |
| **Reducing Dependencies of the Forest Fringe Communities** | Lack of coordination between different implementing institutions, Inadequate market linkage, Lack of proper MRV, Transparency, grievance redressal and feedback mechanism Top-down approach, Lack of skill of community | Proper market linkage, focus on community participation and (backbone of all schemes) productivity along with penetrative publicity awareness, Agroforestry is the best option, Amrit Sarovar, Wetland management by community participation, Sericulture schemes, Consultations with business community |
| **Training and Capacity Building & Awareness Generation** | Lack of proper MRV, Lack of adequate human resource, Cultural barriers in adoption of interventions, People participation, Capacity gap, Transparency, grievance redressal and feedback mechanism | Transparency, grievance redressal and feedback mechanism, Focus on community participation and (backbone of all schemes) productivity along with penetrative publicity awareness, Regular training and capacity building for stakeholders(Monthly/quarterly/half-yearly), Awareness campaigns, Better selection of target groups, Compensation of benefits(monetary) to marginalized people, Lack of funding, Number of training programs with quality training/level of training, Developing knowledge pool, Documentation of indigenous training provided |
| **Disaster Risk Reduction** | Lack of funding, Data related issues (missing data/old data/data disparity/misinterpretation), Transparency, grievance redressal and feedback mechanism, Top-down approach, Lack of coordination between different departments, Geographical barriers, Departmental participation and putting annual budgetary allocation, Lack of awareness and management, Lack of manpower, Lack of good/technical | Capacity building of implementing agency, focus on community participation and (backbone of all schemes) productivity along with penetrative publicity awareness, Need for block level early warning system for detection of disasters, Need advocacy for more participation (CSO, Govt. officials, other stakeholders), Improving awareness in disaster management |

| | | |
|---|---|---|
| | proposal under SDMF, very new and less participation | |
| **Biodiversity Management** | Top-down approach, Resources availability (physical infrastructure/technology etc), Transparency, grievance redressal and feedback mechanism, Cultural barriers, Geographical and geopolitical barriers, Local biodiversity and management, Peoples participation, Low awareness level, Lack of community participation Over emphasize on specific site for plantation | Proper enforcement and/or regulation, focus on community participation and (backbone of all schemes) productivity along with penetrative publicity awareness, Nature based solutions for human-animal conflicts can be looked upon for feasibility and implementation, involve communities and share resources with BNC, Enhancing PBR model/engaging community participation, Honorary biodiversity warden, Strengthening interdepartmental coordination |
| **Others (presented by Group-1)** Climate adaptation Scheme | Fund constraints | Watershed management programme should be priority |

# 4. STRATEGIES

The impacts of climate change, exacerbated due to anthropogenic factors, are already visible on the forests and biodiversity of Assam. Combating climate change needs a combination of both mitigation and adaptation strategies; two sides of the same coin (FAO, n.d), with synergies and trade-offs between them. Forest ecosystems are unique in a way that they're an indispensable part of both mitigation and adaption strategies. By their role in sequestering and storing carbon, they help in reducing GHG emissions, through which they are important in mitigating climate change. On the other hand, they are essential for the livelihoods of forest dependent communities and other vulnerable sectors and communities, thereby are crucial for adapting to climate change (Bodegom et al., 2009)); the former concept is known as "adaptation for forests" while the latter is known as "forests for adaptation" (Locatelli et al., 2010)

Globally recognized mitigation and adaptation strategies in the forestry sector revolve around the principles of SFM and the larger goals of the UNFCCC, which involves protection of the carbon stock, reducing emissions from deforestation, conserving, managing and expanding forest storage sinks and substitution of fossil fuels (Brown et al., 1996; Candell and Raupach, 2008; Maness, 2009; Liu et al., 2010). Adaptation strategies in the forestry sector encompasses addressing the impacts of anthropogenic activities such as forest degradation, deforestation, loss if biodiversity, habitat fragmentation etc. It includes sustainable forest management practices that aim at reducing the vulnerabilities of forest ecosystems and the communities dependent on them (Ravindranath, 2007).

The climate change mitigation and adaptation strategies developed are an integrated approach to tackle climate change. To ensure an integrated approach to climate change the methodology has been developed following the below mentioned approach:

1. Identification of drivers of degradation, and climate risk perceptions in the state of Assam

    Three different exercises/ activities used are: (i) Socio-Economic Assessment (SEA); (ii) Systematic Literature review; (iii) Stakeholder consultation.

    The results from the above-mentioned exercises/ activities are used to identify and understand the relative importance and spread of various drivers of degradation present in the state of Assam. The results from these were compared and analysed together to identify the key or priority areas for different climate change adaptation and mitigation strategy.

2. Review of current actions, interventions, schemes, and or initiatives linked to climate change

    A secondary literature review is conducted to understand the ongoing schemes and current actions, interventions, and initiatives undertaken in Assam to combat climate change. The documents referred for the review includes Assam's SAPCC 2.0, Green Budget of Assam, IPCC reports, CIFOR criteria indicators, ITTO criteria indicators, national working plan code etc.

3. Identification of limiting factors

    Climate change strategies are best planned and achieved when there is an integration across all sectors and levels of government. With this view the stakeholder consultation followed a collaborative approach involving stakeholders working at different levels from various types

of organizations. This was done to get a holistic view on limitations of various actions, interventions, schemes, and or initiatives present in Assam.

4. Defining target themes

The document aims to seek win-win solutions wherever possible, however there are several guiding principles based on which the framework has been developed. This also underlines how the climate change planning actions are categorized under three strategies and four pillars supporting these strategies. The guiding principles are: (i) Recognizing the fundamental role of forest ecosystem in maintaining and enhancing resilience; (ii) Maximizing co-benefits; (iii) Integration with implementation planning; and (iv) Monitoring.

5. Identification and categorization of mitigation and adaptation measures

For interventions related to sustainability, and conservation of forest ecosystem adaptation measures focusses on protecting ecosystem as well as people from adverse effects of climate change. Thus, climate adaptation makes people and ecosystem less vulnerable. Whereas mitigation involves proactively planning to reduce loss of life by reducing the negative effects of climate change. Adaptation and mitigation are two sides of the same coin, and many sub-activities suggested under the three strategies achieves both mitigation and adaptation.

## 4.1 Strategies for Forest and Biodiversity

This section provides a comprehensive framework on climate mitigation and adaptation strategies for the forests and biodiversity of Assam, while drawing from globally adapted approaches and policies. The principles of Sustainable Forest Management (SFM), supplemented by the approaches note by the IPCC form the foundation of the strategies suggested in this section. SFM principles are recognised as a way of reducing the vulnerability of forest ecosystems and mitigating and adapting to climate change (Seppälä et al., 2009). The strategies have been broadly categorized into three categories:

Maintenance and enhancement of green cover and vitality of forest ecosystem

Maintain, conserve and enhance Biodiversity in forest ecosystems

Drive socio-economic development of Forest Dependent Communities (FDCs)
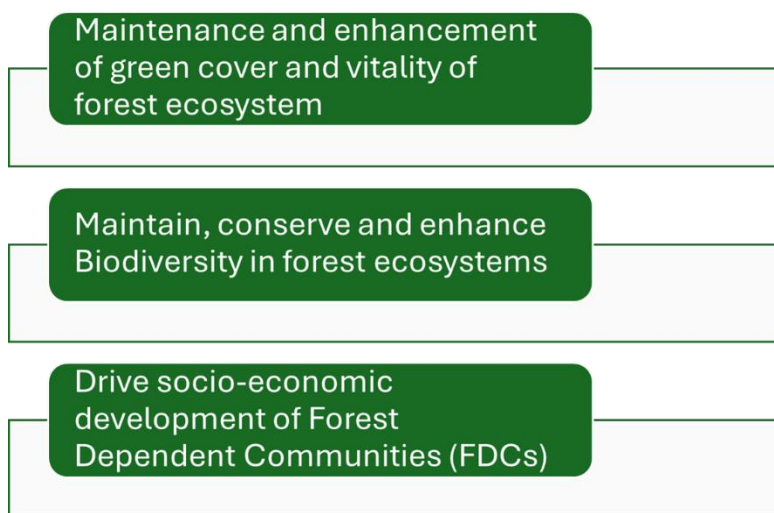
## Strategy 1: Maintain and enhance green cover and vitality of forest ecosystem

This strategy incorporates actions that aim at protecting, managing, and enhancing the carbon stock and storage potential of forest ecosystems. This includes protecting existing forests, avoiding deforestation, scientific forest management, forest certification, and restoration activities. There are already measures in place within the system (established protected areas, forest protection forces/committees, patrolling activities etc.) which may be further strengthened by restructuring/updating the existing management plans through involvement of all relevant stakeholders, taking stock of the vulnerability of the area, and making it consistent with India's NDC and other climate obligations. Incorporating carrying capacity assessments, through community engagement can aid in sustainable planning and management of various forest resources.

Several drivers of forest degradation and deforestation are prevalent in Assam. While deforestation is not avoidable in all circumstances due to needs of the developing economy, appropriate mitigation and adaptation approaches can help in minimizing the impacts of such activities. This may include compensatory afforestation and reforestation with native and ecologically appropriate species to maximize socio-economic gains (Locatelli et al., 2015b; Nunes et al., 2020). Ecosystem-based Approaches (EBAs) such as Reducing Emissions from Deforestation and Forest Degradation (REDD), and the role of conservation, sustainable forest management and enhancement of forest carbon stocks (REDD+), can also help in meeting the larger mitigation and adaptation goals.

The activities that help in enhancing and maintaining the green cover for forest ecosystem are:

a) **Forest Fire Management**

Management and control of forest fires are an integral part of sustainable forest management. Majority of the forest fires across the globe are anthropogenic in nature as a result of increasing population pressure and land use change practices (e.g. shifting cultivation). While deliberate forest fires (controlled burning) for the treatment of forest lands are important in the context of enhancing productivity and regeneration of certain species and establishing sustainable and long-term stable fire ecosystems, when uncontrolled, they can lead to loss in forest cover and wildlife. It thus becomes crucial to prepare and implement forest fire management as a core component of the working/management plan of the forest department. The major activities may include:

- Conducting fire risk mapping of the forest area to devise appropriate mitigation and control measures. Care should also be taken to identify and prioritize high conservation value areas and develop appropriate fire protection plans for the same.

- Preparation of the forest management plan should be done with engagement with the local communities in all aspects of fire control and management. The traditional knowledge of the communities should also be considered while managing forest fires. The awareness generation and capacity building programmes should not be limited to only the front-line staff but also involve the local communities. Communities should be equipped with necessary resources (early warning systems and equipment) to carry out forest fire prevention measures.

- Promote sustainable shifting cultivation practices (with longer cycles) or facilitate the transition of the same into more suitable alternatives such as agroforestry through various government or private interventions. This can have positive impacts both on the socio-

economic status of the communities and the ecology of the forest landscape (Mathur and Bhattacharya, 2022; Roy et al., 2015)

**b) Encroachment Management**

Forest encroachment for settlements and agriculture expansion is a major driver of degradation and deforestation in the state of Assam. It is important to have a well-planned system in place to manage this issue in a just manner. This includes:

- Identifying the extent/scale and nature of encroachment in the forest areas through a thorough survey of land holdings and mapping of the encroached area. Use of RS-GIS technology can aid in monitoring of the land use change in the forest area of the State and help in identifying the encroached area in a credible manner. This can be supplemented by conducting periodic socio-economic surveys (ground-truthing) to keep track of the changing population dynamics and land holdings in and around the forest boundaries. (Kaiser, 2024; Singh et al., 2013.

- Work in coordination with other government departments to identify the encroached area and households. There needs to be collective coordination with the district administration, police department, electricity and irrigation board etc. with a common intent to manage encroachment.

- Fast tracking of forest rights claims (Individual Forest Rights) can help in filtering out and identifying ineligible applicants and potential encroached area. These processes should be completed in a time-bound manner.

- Practice just/fair eviction management with appropriate compensation, wherever appropriate. For example, identify alternative land for resettlement/new settlements.

- Control further encroachment by strengthening forest protection and patrolling activities and conducting periodic socio-economic surveys to identify immigration in the forest area. Engagement of local community-forest institutions (JFMCs and EDCs) in the protect activities can also be a tool to identify and control encroachment in the area.

**c) Invasive Species Management**

Controlling and managing invasive species is another crucial component of sustainable forest management. When not controlled, it can have significant negative impact on forest ecosystems. Effective invasive species management can be centred on prevention, detection, control and restoration of affected areas. The key steps include:

- Mapping of the distribution, scale and affected area by invasive species. This may include an inventorization of the invasive species observed in the area and classification of the same based on degree of threat identified. Special care should be taken to include high conservation value areas in the mapping process.

- Identification of appropriate control and eradication measures with help of relevant stakeholders (e.g. local communities). Suitable safety measure should be undertaken to control the introduction or spread of such species while carrying out various forestry activities (e.g. sterilization of equipment, planting material to avoid contamination by potential propagators of the invasive species).

- Identify opportunities on possible utilization or value addition of the removed species. (e.g. use of *Lantana Camara* in making furniture).

**d) Strengthening of forest protection activities**

Forest protection strategies aim at prevention and control of degradation of forests and rely on various factors as elaborated below:

- Enforcement of forest protect laws through regular patrolling and frequent monitoring of the forest cover and boundaries. The laws and regulations related to forest protection should be enforced strictly with appropriate prosecution of the offenders. Awareness generation on the legal framework of forest protection can be beneficial in reducing forest related offences and enhancing conservation.

- Providing the front-line staff with the most up to date resources, surveillance technologies for patrolling, data management, intelligence gathering, and monitoring of the forest area. This should be supplemented by capacity building programs of the concerned staff.

- Engage and incentivize local communities in forest protection activities. Involving them in the forest patrolling and protection activities can strengthen forest conservation.

**e) Scientific Forest Management**

Practicing scientific management by applying appropriate silvicultural practices can enhance forest health and vitality, forest resource optimization leading to effective conservation. This can be strengthened by:

- Preparing and implementing silviculture plans/guidelines to ensure various forestry activities are being carried out as per scientifically accepted norms.

- Conducting periodic silviculture activities (enrichment planting, thinning, control of pests and invasive species etc.) to enhance the biodiversity of the forests. Care should be taken to customize the silvicultural practices to enhance the local biodiversity of the area and not place the existing biodiversity at risk.

- Conducting appropriate soil and moisture conservation activities through engagement with local communities and mapping of the same (e.g. contour trenches, gully plugging etc.),

- Conducting Assisted Natural Regeneration activities.

- Establishing high-tech nurseries and indigenous seed banks (Ensuring quality planting material).

- Conduct training and capacity building programs of the forestry staff and local communities on sustainable silvicultural practices.

**f) Restoration Activities**

Forest restoration can help in bridging connectivity between fragmented landscapes and conservation of biodiversity hotspots. It also helps regain the lost ecosystem services and helps communities and ecosystems to adapt to climate change (Locatelli et al., 2015a). Restoration efforts should be inclusive of both climate mitigation and adaptation objectives in order to amplify the

benefits and minimize trade-offs (Locatelli et al., 2015a). The following measures can be incorporated while restoring a forest landscape:

- Identify the scale and extent of degraded land within the forest boundaries using scientific methods along with primary and secondary sources and stakeholder consultations. Identification of the drivers of degradation or deforestation can also help in implementing the appropriate restoration measure.

- Restore the degraded lands by carrying out plantation/ compensatory afforestation, ANR and reforestation of ecologically suitable species. All efforts should be made to plant genetically diverse native species which can increase resilience to climate change (e.g. species tolerant to drought, pests or diseases) (Bond and Zaloumis, 2016).

- Integrate the forest landscape restoration (FLR) activities with the biodiversity conservation goals during the planning process through multi-stakeholder consultations. This is to ensure landscape continuity and sustained dispersal of plant and animal species. Participation from local communities in restoring the degraded areas through schemes/initiatives such as CAMPA, MGNREGA and TSP or SCSP etc. can contribute to the dual objectives of landscape restoration and income generation, thereby fulfilling both climate mitigation and adaption goals.

### g) Leverage nature-positive investments

Nature based solutions (NbS) has emerged as an important tool in both mitigating climate change whilst simultaneously benefiting both nature and society. NbS within the AFOLU (Agriculture, Forestry and Other Land Use) sector- including agroforestry and upfront plantations- provide cost-effective opportunities to meet the net zero targets. These entail a variety of activities, such as safeguarding existing ecosystems, restoring degraded landscapes, managing ecosystems sustainably, and re-establishing lost ecosystems. Similarly, carbon offset projects on improved energy efficiency (such as improved cook stoves, biogas etc) also help in shifting the dependency on forest resources to more sustainable options, thereby helping in mitigating climate change.

Public and private sector investment in such carbon offset projects can therefore help in meeting sustainable development goals in addition to mitigating climate change.

The primary step towards channelling such finance requires identification of eligible ecosystem-based approaches/PES schemes (AFOLU, Energy sector) that can be implemented in the state. This would include conducting feasibility studies for the eligible sectors and a mapping to stakeholders that can approached for implementing said projects. Multi-stakeholder workshops can help in disseminating information, risks and opportunities on such projects and attracting the right type of investments.

### h) Wood Certification

Certification of the wood forms the backbone for reducing the negative environmental impacts by promoting sustainable management of forest and Trees Outside Forests (TOF) in Assam. A certified wood can provide market incentives to plantation areas (including RFA, agroforestry, and TOF). Certified wood can be sold in the markets at premium prices as it signifies a green, and ethically sourced product. Certification of wood can also help in identification of source of wood thereby providing a means of pointing out illegally sourced wood.

Wood certification schemes should be promoted among all the relevant stakeholders such as forest departments/ forest divisions, exporters/ importers of wood-based products, wood-based industries, timber traders, saw millers, tree growers, and other end-users.

Currently three types of certifications are available:

- Forest Management Certification- for certification of Recorded Forest Areas (RFA) having an approved working plan/ working scheme in accordance with National Working Plan Code 2023.

- Tree Outside Forest Management Certificate- for certification of TOF areas having appropriate management plan/ working plan/ working scheme. Their management practices should comply with requirements of Indian Forest and Wood Certification Scheme (IFWCS) standard.

- Chain of custody certification- certification of unbroken path taken by products (such as timber and NTFP) from the forests, or TOF to the point where the product is sold with certification claim and/ or is converted into a finished product. Example providing chain of custody certification for plywood or furniture made from certified wood.

## Strategy 2: Maintain, conserve and enhance biodiversity in forest ecosystems

Climate change, forests, and biodiversity are intricately interlinked (Dale et al., 2000). This strategy includes activities that aims at promoting landscape connectivity and restoring degraded habitats, mitigating human-wildlife conflicts (HWC) and documentation of biodiversity. Infrastructure development is an important part of economic development. This is accompanied by a loss of biodiversity, in the form of habitat fragmentation and road kills. In order to mitigate the impacts of linear infrastructure development, wildlife crossings in the form of overpasses, underpasses and other similar structures can be constructed to ensure safe risk-free passage of wildlife. Such structures are known to be effective in reducing incidents of wildlife-vehicle collisions and have been adopted both globally and in India (Pörtner et al., 2015; Simmons et al., 2018; Settlele et al., 2015; Schmitz et al., 2015; Smith et al., 2016; Habib et al., 2020). Mitigation of HWC through preparing and implementing HWC action plans, through involvement of all relevant stakeholders in high priority areas can help in managing the same in a holistic manner.

Other approaches to protect biodiversity involves documentation and stock talking of the existing biodiversity of an area. This includes mechanisms such as People's Biodiversity Register (PBR) and species-specific management plans. These can aid in enhancing knowledge of different forest resources, their application and indicate the importance of their conservation. Furthermore, documentation of the flora and fauna of a region can help in establishing ecological and livelihoods baselines and highlight the avenues to maximise livelihood benefits (IUCN, 2021).

Thus, various activities have been suggested to mitigate the biodiversity loss in the state. There are four major activities further divided into various sub-activities to address the various challenges that threaten the biodiversity of the state. The four major activities are as mentioned below:

### a) Strengthening legal and administrative setup for sustainable utilisation and conservation of biodiversity

The adoption of Convention on Biological Diversity (CBD) in 1992 led Government of India to enact the Biological Diversity Act, 2002 for conservation of Biological Diversity, sustainable use of its components and fair and equitable sharing of the benefits arising out of the use of biological resources and knowledge. Further to this act, the National Biodiversity Authority (NBA) was established along with State Biodiversity Boards (SBBs) at state level and Biodiversity Management committees (BMCs) at local level to decentralize the implementation of the Act.

The Government of Assam constituted the "Assam Biodiversity Board" on 29th September 2010 along with State Biodiversity Rules to promote biodiversity conservation in the state. Till date, 2,549 BMCs have been constituted in the State covering all local bodies and Technical Support Groups (TSGs) have been established at district level to help the BMCs. Though the administration in the state has been carrying out the powers vested in it, there's more that we can do to further strengthen the already existing legal and administrative setup. The sub – activities suggested are as follows:

i. The targets, goals, the on–ground implementation of activities to achieve the set targets and the financial outlay of the activities should all be set out and well planned in the form of "State Biodiversity Strategy and action plan (SBSAP)". A financial plan for biodiversity remains a hurdle due to lack of resources and fund. In this context, BIOFIN (Biodiversity Finance Initiative) seeks to address the biodiversity finance challenge in a comprehensive manner with an objective to better incorporate economic value and financial benefits of biodiversity. It is implemented through a series of steps:

- Biodiversity Finance Policy and Institutional Review: This step includes the analysis of the policy and institutional context of biodiversity finance.

- Biodiversity Expenditure Review: This step uses detailed data on public and private funding to inform and promote improved biodiversity policies, financing and outcomes.

- Financial Needs Assessment: This is a comprehensive estimate of finance requirements for the achievement of national and sub-national biodiversity targets.

- Biodiversity Finance Plan: It is the drafting and adoption of a biodiversity finance plan to address four finance results viz. generate revenues, realign expenditures, deliver better, and avoid future expenditures.

ii. The conservation activities planned must follow a holistic approach and incorporate inputs from the departments such as agriculture, public works, horticulture as well as local communities which directly or directly depend on biodiversity. Additionally, while preparation of village micro plans and development plans, biodiversity should be streamlined as the local people heavily depend on various NTFPs, medicinal plants, etc.

iii. Due to the rich diversity of Assam, the intruders heavily exploit the biodiversity for monetary benefits. Thus, along with well laid plans for biodiversity conservation, Assam must also strengthen the plan for the protection of biodiversity from trafficking, poaching,

illegal trade, etc. Moreover, the masses must be made aware of the importance of biodiversity so that they don't get influenced by outside poachers and get involved in poaching activities. Technology should be made available for effective monitoring of poaching.

iv. It has become very important to put a price on biodiversity and generate finance for biodiversity conservation through access and benefit sharing mechanism. Assam has huge potential for ABS mechanism and the government must put efforts in maintaining a good database of tradable bio resources using online portal and ensure its adequate and wide publicity to attract market. The BMCs must contribute to identifying and maintaining the potential bio resources and gain benefits which can be further used in the conservation of biodiversity.

v. Strengthening of the Biodiversity Management Committees for the successful execution of the activities prioritized. While the BMCs are present at all the levels, i.e. Gaon Panchayat, Anchalik Panchayat, Zilla Parishad, Urban Local Bodies and Forest Range level in the 3 Autonomous Councils, the Technical Support Groups have been established only at district level. The Technical Support Groups are essential for monitoring the activities of BMCs and must be increased in number for better implementation of activities. The Biodiversity Management Committees should be trained to function digitally to save the time spent manually maintaining the registers and instead go for e-PBRs (electronic PBRs). Though a committee exists at the state level for monitoring and evaluation of quality of PBRs, given the huge number of BMCs in Assam, it is necessary to decentralize the monitoring of PBRs. However, an increase in the number of TSGs might serve the purpose as they can investigate the preparation and quality of PBRs at BMC level.

vi. Monoculture plantations adversely impact the native biodiversity of a region, and the state must discourage the industries that promote such plantations or suggest sustainable mono-plantation techniques that do not harm the biodiversity of the region.

**b) Strengthening the existing protected area network and the areas of conservation outside protected area**

The Protected Area Network in Assam occupies 3925-sq. km. area and constitutes about 5 % of the State's geographical area. The network includes 5 National Parks and 17 Wildlife sanctuaries as well as 3 proposed Wildlife Sanctuaries, 4 Tiger Reserves, 5 Elephant Reserves, 2 Biosphere Reserves and 2 World Natural Heritage Sites and they play very important role in in-situ conservation of biodiversity.

Assam is bestowed with such rich biodiversity within the protected areas and the following sub – activities must be prioritized to further strengthen its protection.

- The flagship species such as Rhinos, Elephants and Tigers already has specific conservation plans. Similarly, a detailed document must be prepared on the species (flora and fauna) categorized as threatened or on the verge of extinction for preparing conservation plans for them also.
- The conservation measures must follow a whole of government and whole of society approach where success requires political will and recognition at the highest level of government and relies on action and cooperation by all levels of government and by all actors of society. Thus, community-based conservation models must be developed

where the community protects the natural habitat in return of benefits for their daily sustenance.

- Mapping of biodiversity rich areas must be done as High Conservation Value Areas (HCVAs) which includes the Key Biodiversity Areas (KBAs), BHS (Biodiversity Heritage Sites), CCA (Community Conserved Areas), Sacred Grooves, etc. A broad level landscape approach must be taken for conservation of such areas.
- Since the quality of habitat has been lost due to continuous human intervention or invasive species, ecosystem restoration must be done by taking measures of control. For E.g., Manas and Kaziranga national parks have lush grasslands which serve as the prime habitat for rhinos and are invaded by various invasive species. Eradication of invasive species must be done to improve the quality of grasslands. Similarly, different ecosystems must be identified and restored to their best quality to support biodiversity.

### c) Human - Wildlife Conflict to Human - Wildlife Coexistence

Conflict between people and wildlife is dynamic. While completely stopping such conflict is not possible in most cases, a well-planned and integrated approach can reduce conflict, leading to coexistence. Moving from conflict to coexistence can be described as a continuum in which neither conflict nor coexistence is locked at a fixed point along the scale. Attitudes and behavior towards a species can change over time, across space, and in degree. Ideally, when a level of coexistence has been reached, ongoing negative interactions between people and wildlife become negligible.

The sub – activities suggested for moving from conflict to coexistence are as follows,

- In the past, species-specific programs have been initiated at the village level that have proven successful in mitigating the loss occurred due to Human – Wildlife Conflict. Thus, such a microsite–based approach must be taken while devising measures depending upon the socio – economic profile and geography of the area.
- Forest fragmentation in the past has resulted in isolated forest patches and thus the animals are frequently seen on railway tracks and highways leading to mortality. To overcome such a situation, the isolated fragments must be connected through wildlife crossings such as overpasses, underpasses, etc. for free ranging movement of animals and avoiding human – wildlife conflict.
- Various countries have used the SAFE (Safe person, Safe assets, Safe wildlife, Safe habitat, and Effective monitoring) approach to minimize the effect of Human – Wildlife Conflict. SAFE is a holistic and modern approach to an age-old challenge. It integrates the ancient tools of conflict to gradually increase the safety of people and their assets, and wildlife and their habitat, in an area over time. It focuses on Insurance Schemes and Payment for Compensation in the form of Private insurance policies, Disaster relief compensation or Conservation-focused HWC compensation or insurance schemes.
- Modern technology must be made accessible to the community as well as the department for effective implementation and monitoring of Human – Wildlife Conflicts. The activities can include identification of Human – wildlife Conflict Hotspots and keeping an all-time surveillance on the activities of the animals close to humans.

**d) Further research and review on Biodiversity**

Research is important to increase human knowledge, enrich science, generate progress, promote innovation, and share scientific findings with the concerned. The policy makers must make an informed decision to tackle the climate crisis and conservation issues. The best decision can only be taken if a vast number of resources are present as evidence to complement the policy, law or rule. Once the law and rules are positioned, it is necessary to consistently review the progress of the activities and measure the success of its implementation. The sub – activities suggested for research and review are as follows,

- The first and foremost step to enhance research is setting up dedicated centers for research on the subjects concerned. A knowledge resource center must be established to maintain a thorough database for the biodiversity of Assam, its use and benefits and the traditional ecological knowledge (TEK) associated with it. Subjects such as biodiversity conservation, wildlife studies, ecology and ethnobotany must be promoted, and students must be encouraged to choose it as a career option which in future would increase the resource and expertise on the subject for formulations of best suited policies.

- The effect of climate change can be observed easily in a few species that can act as an indicator of changing climate. These species and their behavioral change and pattern shift must be studied to have an early knowledge about climate change.

## Strategy 3: Drive socio-economic development of forest dependent communities

Forests, and biodiversity also play a vital role in supporting livelihood of the millions of people globally (Obeng et al., 2011). Forests provide a wide range of ecosystem services with approximately 800 million forest dependent communities residing in or around the tropical forests (Keenan, 2015). The effect of climate on forests, and biodiversity will result in decline in forest resources which would in turn reduce the ability of people to meet their basic needs such as water, food, and energy (IUFRO, 2009). This also results in deteriorating health and increased human wildlife conflict (IUFRO, 2009). Thus, enhancing livelihood opportunities for forest dependent communities and providing them with alternative sources of energy are some of the very important aspects to combat adverse effects of climate change.

Rural livelihoods, globally, is generally centred around three broad strategic areas livelihood diversification, migration and agricultural intensification (Barrett et al., 2001). In developing countries such as India, livelihood diversification remains an integral part among policy makers as its closely related to resilience of rural communities and their livelihood (Baffoe and Matsuda, 2017). Although a common characteristic of current strategies to reduce dependency of Forest Fringe Villages (FFV) on forest resources is promotion of alternative livelihood activities and community-based forest management, it is quite unclear how such measures have been embraced by the households. We explored the livelihood diversification using socio-economic survey, which revealed that only 0.51% of the surveyed households were engaged in the forest management activities while 0.30% were involved in tourism. It was also observed that 59% of the surveyed households had only single occupation for their income generation. Agriculture is identified as income generating occupation of

majority of households (36.63%) making them vulnerable to climate change by affecting the yield of the crops.

**Livelihood of households in FFV**

| Category | Percentage |
|---|---|
| Tourism | 0.30% |
| Forest Management Activities | 0.51% |
| Sale of forest resources | 2.29% |
| Small business | 8.56% |
| MGNREGA | 9.54% |
| Livestock | 12.55% |
| Private Labour | 29.63% |
| Agriculture | 36.63% |
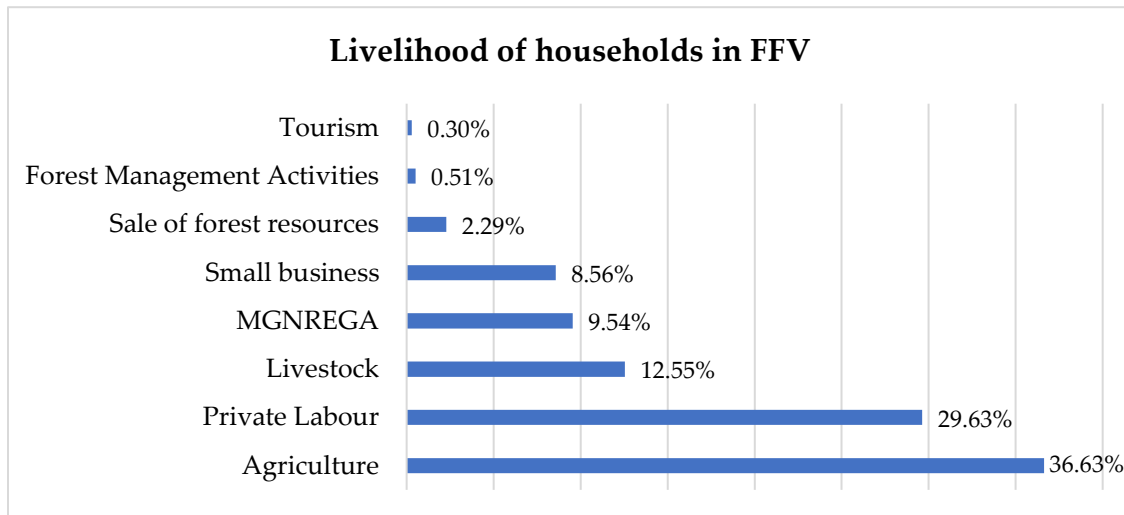
**Figure 13: Income generating livelihood of Forest Fringe Villages in Assam**

**Income diversification among households in FFV**

41% — Single Occupation
59% — Multiple Occupation
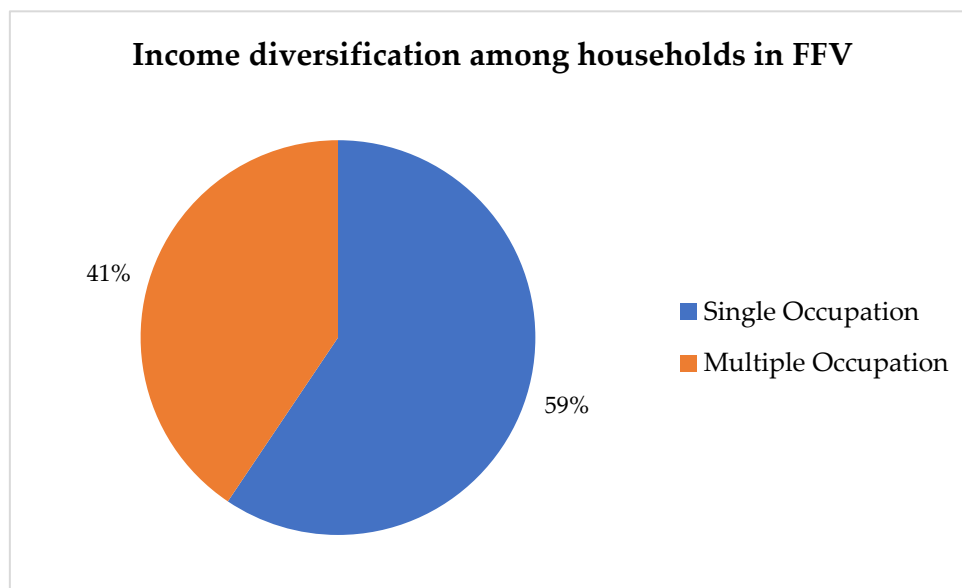
**Figure 14: Diversification of livelihood activities by households in FFV**

However, such trends indicating the livelihood diversification, even within the community, depends on various factors such as level of education, access to market, urbanization, capital, and various other characteristics (Ellis, 1999, 2000; Baffoe and Matsuda, 2018; Walelign and Jiao, 2017; Loison and Bignebat, 2018). The results from socio-economic survey revealed that 38.30% households with education below 10th had multiple occupation whereas 49.46% households with education above 10th had multiple occupation. Thereby, showcasing that higher level of education might help to increase the resilience of the FFV.
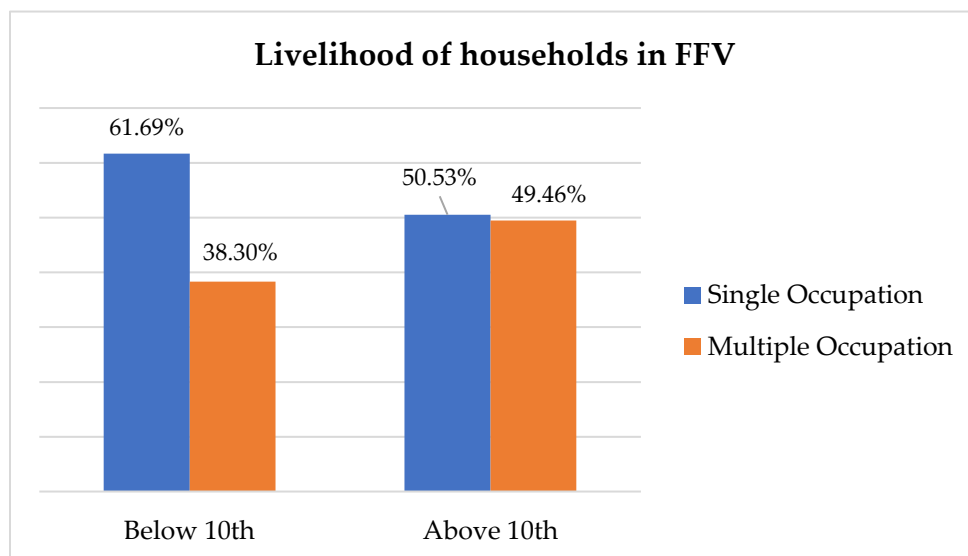


**Figure 15: Diversification of livelihood activities of FFV based on level of education**

Given the current climate change trends and vulnerability of FFVs, community-based forest management and providing alternative livelihood opportunities still remains an important tool form managing forest and biodiversity. The activities that can drive socio-economic development of forest dependent communities are as follows:

a) **Community Based Conservation Approach: Ensuring clearly defined forest tenure security and resource use rights of forest dependent communities**

Improving institutional arrangements, governance and decentralized management systems can assist in enhanced livelihood, and conservation for forest and biodiversity. Community-based Forest management is one such measure that creates a sense of ownership in the community for protection and conservation of the forests and also provides them equitable benefits.

- Awareness generation and hand holding support is fundamental in successful implementation of community-based forest conservation. This is crucial especially post-recognition of rights, by equipping the communities with the necessary resources so that the rights can be exercised wholly.
- It is important to scale up convergence of community forest management with activities such as generation of alternative livelihoods that will reduce the dependency of communities on forest.

- Conservation can only work when we recognize and build upon what community find important for them (Boedhihartono, 2017, Sheil et al., 2006). Thus, the social development schemes for forest-dependent communities should be tailored to meet their needs with a focus on skill and capacity building that acknowledges the existing cultural practices and incorporates the Traditional Ecological Knowledge (TEK). Ambiguity around benefit sharing systems and rights may hinder the sense of ownership leading different stakeholders to continue extracting forest resources for their short-term benefit.
- Finally, a collaborative approach needs to be adopted where government, private organizations (NGOs, CSOs, corporates, etc.) and communities take collective action by acting upon their defined roles.
- Regular monitoring of the interventions: The consideration should also be taken to monitor decision making and interventions by using a combination of both top-down and bottom-up approaches with the involvement of different sectors of organizations (line departments, civil society etc.).

### b) Promoting alternative income sources for forest dependent communities that lowers environment damage, provides equivalent benefits, and strengthen market linkages

Implementation of income diversification activities often faces challenges such as ensuring adoption rate by the communities, and an effective market linkage. For instance, the results from the SEA revealed that only 58% of the households use LPG and only 29.85% of the households refill their LPG. The skill development or capacity building or awareness generation programs had participation from 22.10% of the households. The percentage of households involved in forest management activities accounted for 12.39% only.

Based on the results observed from the SEA the action points and monitoring indicators are suggested in such a way that the effectiveness of the activity is depicted.

- Promote agroforestry & ensure plantations are carried out with ecologically sound species.
- Promote off-farm income generating activities such as NTFP-based enterprises, Eco-tourism etc.
- Support pilot projects to explore potential carbon finance & funds generated from it.
- Designing and implementing effective collaboration mechanisms between communities, forest department, and conservation organizations for value chain development (market linkages).
- Offer employment to forest dependent communities via various forestry activities: Various forestry activities conducted by the forest department such as plantation, Soil Moisture Conservation (SMC) can be done by involving local communities and thereby providing them with alternative income sources.
- Periodic review of Minimum Support Price (MSP)for Non-Timber Forest Produce (NTFPs) and their Geographical Indication (GI) tagging.

For this the role of Van Dhan Vikas Kendra (VDVKs) becomes very important. VDVKs should work on bridging knowledge gap, and adoption related problems by providing capacity building programs at larger scale.

To implement such programs over a large scale requires new and efficient financial approaches to support and/ or drive socio-economic development of the communities. This can be done by doing a feasibility analysis of potential activities that can be a part of a carbon finance project. First a pilot project can be deployed, and then similar activities can be taken up in other areas also. The project design should combine both a top-down and bottom-up approach where feedback from every stakeholder should be considered.

## c) Implement measures that reduce dependency on forest resources while recognizing traditional and cultural practices of the communities

Rural communities are very much dependent on the forest and forest resources. Forests provide multiple benefits in the form of food, medicines, building materials etc. They also provide numerous other benefits in the form of recreational activities, employment via tourism and resource sales. Thus, completely restricting or replacing the benefits provided by the forests is impractical. Considering this the provided strategy focuses on reducing the dependency on the forest resources while also respecting the customary rights and practices of the local communities.

Rural communities majorly depend on forest for fuelwood collection, grazing livestock, and NTFP collections (Jain and Sajjad, 2016). Measures can be taken up by the governments along with the communities to develop such reserves outside the forest areas.

- Forest department and NGOs/CSOs must take support from technical/ scientific organizations in integrating the local traditional with modern technologies to develop new improved fuel-efficient technologies. Current fuel-efficient technologies such as Improved Cookstoves (ICS), LPG, Solar equipment's etc. should be promoted. Emphasis must be given to enhancing their adoption rate and continuity of usage. A mechanism must be set up for ensuring regular monitoring to check its effective and sustained usage.
- Even though extraction of forest resources by the communities is allowed to some extent it should be complemented with various research studies to understand the carrying capacity of the area. This will indicate which species are getting degraded and measures can be taken to address problems related to it.
- To increase forest inventories, and subsequently enhance the biodiversity, better capacity building, training, and scaling up of the activity to a greater range is necessary. Apart from offering employment to local communities, recognizing their rights, and reducing dependency, it should be considered that such activities are put to good use. Communities should be aware and sensitized about such activities for conservation of forest and biodiversity. Community-based institutions such as Eco-Development Committees (EDCs), Joint Forest Management Committees (JFMCs), Biodiversity Management Committees (BMCs), Van Dhan Vikas Kendras (VDVK) etc. should be fully utilized for such tasks.

# Support Mechanism for Implementation of Strategies

The effective implementation of the aforementioned strategies is determined by the following four supporting mechanisms:

1. **Research:** Often national-level information on forest and biodiversity is inadequate for proper planning and thus additional surveys and research studies are needed for gap filling. Research is required for identification of issues and potential benefits that arises from it. This will be followed up by identification of suitable forest sites available for carrying out such activities. This is especially true for forestry activities as one needs to understand the baseline (i.e. the present trends, parameters, and conditions) before implementing the strategy and observing their impact. Research on enhancing forest productivity, genetic diversity (for commercial and non-commercial species), MSPs, and digital mapping of wildlife corridors and biodiversity rich areas can help to easily monitor the progress.

   For sustainable utilization for forest resources such as fuelwood, NTFPs, grazing, etc. site-specific studies related to carrying capacity of the area will be necessary for limiting the extraction potential of the area. The results derived from these studies can also be incorporated in the respective management plans for better understanding of all the stakeholders including decision makers. Such studies can either be done by the forest departments or can be a collaborative effort between the department and various technical and research institutions of the country.

2. **Resources:** Once we have the basic understanding of the problem statement and area of interest a resource mapping exercise can be undertaken. This will help in understanding all the requirements related to different resources such as proper infrastructure, sufficient human resources, finances, technology, and any other type of equipment/ machinery/ materials that may be necessary.

   a. Infrastructure: This might include establishment of nurseries for providing quality planting material, development of recreational areas for ecotourism, etc.

   b. Sufficient human resources: Number of personnels related to each activity having relevant knowledge for implementing, managing, and monitoring the activities.

   c. Finances: Investments are required for all the activities whether it is for carrying research studies, conducting training workshops, procuring other resources etc. Non-Governmental Organizations (NGOs) and other National and international organizations could play a vital role for funding the activities. Public-Private Partnerships (PPP), international private financing (e.g. foreign direct investment), international public financing (e.g. official development assistance), domestic private investment, blended and innovative financing (such as forest funds, carbon markets, Payment for Ecosystem Services (PES)) should be explored.

   d. Technology: Latest innovative technologies, equipment's, and approaches should be taken up for accurate, and effective implementation. Computer-based tools, and drone-based monitoring can be utilized for doing the same amount of work in less time.

   e. Other equipment's includes vehicle for forest protection and monitoring, binoculars, GPS, etc.

Resources also includes various data management software, electronic portals, GI tags etc. which can be used to store and update information. If the required resources for the implementation of the activity are not present, then it may be either procured externally or from other relevant departments. An integrated approach can also be implemented where different department or organizations specializing in certain areas collaborate.

3. **Training, capacity building, and awareness generation:** Experimentation, learning (including theoretical and practical knowledge), and dissemination of such information to *en masse*, all are important for implementation of any strategy. Ensuring that all the relevant stakeholders are aware about the project, its outcome, and are well equipped with necessary knowledge for successful implementation. The capacity of the personnels from all the stakeholders (including forest department, research institutions, private organizations, communities, and people involved) is the primary resource. It is essential that all stakeholders are well versed with the tasks and its goal. Without this noting can move forward.

   The capacities of NGOs, and environmental research institutions can be utilized for such workshops. Furthermore, certification and information manual can be provided to the participants, providing information about appropriate schemes, and identification of technical and financial support for carrying out such activities. There is also a need to train more ecologist and taxonomists, for maintaining and developing biodiversity database. Apart from this local preferences, needs, and traditional forest knowledges should be included in such database. Developing the capacity of officials and ground staff for conducting monitoring is for long-term. Available information should be used to review current practice and modify action points wherever necessary.

4. **Policy support:** There should be synergies between different strategies as well as policy for supporting such strategies. The formulation/ designing of policy should follow a mix of top-down and bottom-up approach (with multi-stakeholder engagement). The feedback from the bottom level stakeholders should be incorporated as per the requirements to make the policy more robust and transparent. The policy should also consider coordination and convergence between different departments, appropriate feedback and grievance redressal mechanisms and ensuring a proper exit plan for sustenance of the relevant programmes/ schemes. The policies should clearly indicate specific guidelines, rules, procedures, methods, forms, and administrative practices established to support the implementation of the strategies or actions.

**Restructuring of working/ management plan in consultation with multiple stakeholders**

The purpose of a management plan is to ensure that the activities that needs to be implemented by the stakeholders are documented. It provides us a guiding principle providing "how to" move towards achieving the greatest benefit by the management activities.

The management plan should be prepared encompassing all the strategies provided in the above section. Each region should have a separate management plan as the context, type of activity implemented etc, will be different. To understand the activity that needs to be implemented in the specific region a separated need assessment exercise should be conducted. A mix of bottom-up and top-down approach should be used while preparation of management plans, to ensure feedback from bottom level can be considered and documented. A management plan should be conforming to national and regional laws, plans, international commitments, and strategies related to forest and

biodiversity conservation in Assam. Areas of convergence and related schemes should be identified for efficient implementation of the activity.

In principle, a management plan, should encompass the biodiversity aspect as well and should be given due consideration in all stages of preparation. But in practice, site specific detailed information is either unavailable or insufficient. Thus, local biodiversity values are often overlooked in forest management strategies. To ensure that biodiversity conservation goals are included in local strategies, inputs from specialized institutions (such as NGOs, academia, BMC, etc) particular to biodiversity concerns should be taken into consideration. To formulate plans related to biodiversity there should be increased adoption of different biodiversity indices such as Shannon-weiner index, Simpson index, Berger-Parker index etc. The indices will present an understanding of population of different species in different ecosystem and places. This can be especially useful for preparing site specific strategies for countering problem related to invasive species in Assam.

A management plan should also provide insights on benefits arising out of the suggested activities and provide a robust benefit sharing mechanism. The process developed in the management plans can include both direct and indirect benefits of project activities. Project funding, functioning between different parties, and roles and responsibilities of all the stakeholders involved should also be well documented. After the implementation of the project activity the sustenance of the activity for the long term is also required. Thus, and appropriate exit strategy should also be developed.

To the fullest extent possible, multi-stakeholders (such as forest-dependent communities, local conservation agencies, and academic institutions) should be involved while formulating management plans, micro-action plans, and working plans. Practices adopted by local communities having Indigenous Traditional Knowledge (ITK) can be included in the management plan as such practices are intergenerational and tend to be more holistic, dynamic, and linked to experience on traditional lands. For example, autonomous councils in Assam should have their representation in preparation of management plans. Forest department should reflect on the process of conducting such consultations and act as a moderator for negotiating and integrating all the available suggestions based on scientific and local knowledge.

One of the most important aspects of forest and biodiversity conservation is to collect recent (up to date) information on the status of strategies. This puts focus on the Monitoring and Evaluation (M&E) data and adjusting strategies, activities, and their indicators as per the observed current trends. The changing behaviour of species, climatic conditions, norms, legal and administrative measures should be recorded and analysed. The management plan should be revised and customized periodically based on the present findings, trends, and modelling assumptions. Regular feedback and recommendations form the stakeholders should be adopted based on scalability and sustainability of the activity.

## Monitoring and Evaluation (M&E)

Although ecosystem is increasingly at threat due to climate change, but studies have shown us that if restored, protected, and/ or managed thy can help to effectively combat climate change. Ecosystem-Based Approach (EBA) is unique in a way that it considers both human well-being and biodiversity providing both mitigation and adaptation solutions (S. Naumann et al., 2011). But a clear understanding of what a successful mitigation and adaptation action looks like is very much required

(Moser et al., 2013). Any strategy or intervention or action point can be successful if the desired outcome is achieved. Which lay down the importance of role of monitoring and evaluation as a key component to drive progress. Often is the case that every action does not show us the effectiveness until decades later and objectives often change and/ or needs to be revised over the course of time but having goals and monitoring progress still remains key for a successful action. The monitoring and evaluation of an activity will help to pin-point the current status of the project, allocate resources appropriately, and meet deadlines.

Having a M&E plan and fulfilling the targets or objectives alone does not necessarily mean that the activity is successful. Periodic assessments and re-evaluating the objectives is also required. Based on the changing behaviour of species, changing climate, norms, legal and administrative measures the targets can be revised.
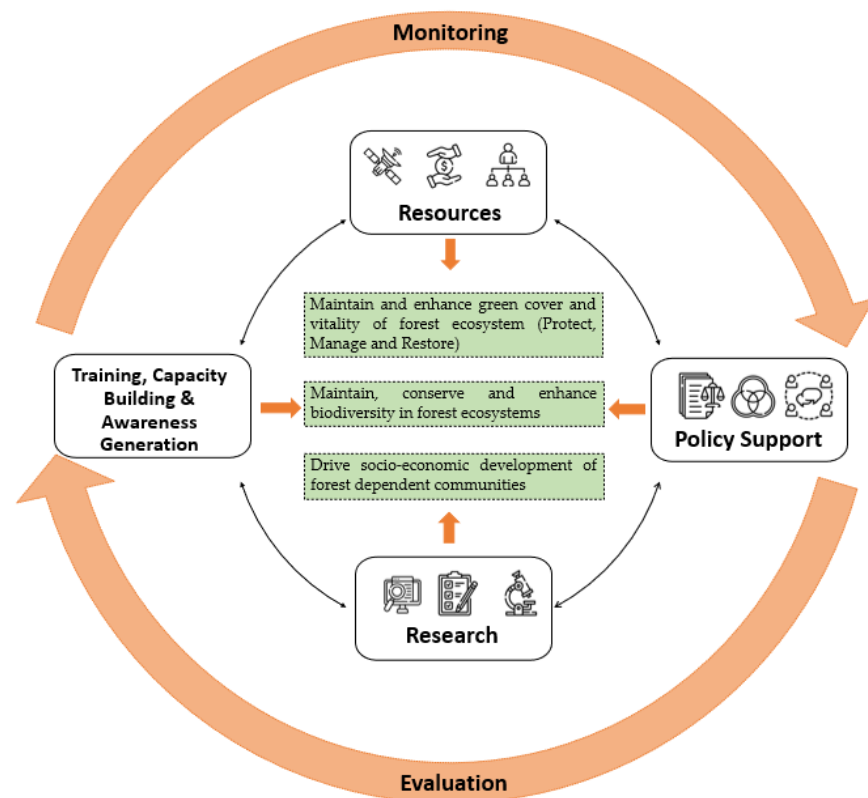


**Figure 16: Components of climate change mitigation and adaptation strategy**

# Summary of the Strategies

The strategies table below outlines different sub-activities under each strategy and classify them as adaptation, or mitigation, or both adaptation and mitigation. The number of sub-activities and their classification as mitigation and adaptation measures are:

- Mitigation – 20 sub-activities

- Adaptation- 16 sub-activities

- Mitigation as well as adaptation- 20 sub-activities

Out of all the sub-activities suggested some are already suggested in various other climate change strategy documents such as SAPCC 2.0, green budget etc. but these needs to be implemented and monitored effectively. While there are new sub-action points presented which includes 9 mitigation, 5 adaptation, and 2 mitigation and adaptation.

The detailed list of activities under each activity is shown in the Table 9.

The below shown colour coding of the strategies has been done for representing the priority of the activities:

Low Priority

Moderate Priority

High Priority

**Table 9: Strategies for climate change mitigation and adaptation**

| STRATEGY 1: Maintain and enhance green cover and vitality of forest ecosystem | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| S.No. | Activity | Sub-activities | Mitigation and Adaptation | Indicators | Outputs | Priority Districts | Convergence Schemes/ Initiatives | Responsible Agency |
| 1 | Prevention and control of forest fires | Strengthening the implementation of fire management plan for Assam and its integration as an essential component of the working/management plan. | Mitigation | 1. Area affected by forest fires (in ha)

2. No of forest fire cases

3. Training and capacity building programmes conducted for local communities

4. Area under shifting cultivation | Landscape continuity and protection of ecosystem services | Karbi Anglong, Karbi Anglong West, Dima Hasao, Cachar, Karimganj, Hailakandi | CAMPA, GIM | Assam Forest Department |
| | | Conduct fire risk mapping of the forest area to devise appropriate mitigation and control measures | Mitigation | | | | | |
| | | Increase the engagement of the local communities in all aspects of fire control and management | Mitigation and Adaptation | | | | | |
| | | Equip the communities with necessary resources (early warning systems and equipment) to carry out forest fire prevention measures | Mitigation | | | | | |
| | | Promote sustainable shifting cultivation practices (with longer cycles) or facilitate the transition into more suitable land use alternatives | Adaptation | | | | | |
| 2 | Encroachment Management | Identify the extent/scale and nature of encroachment in the forest areas through a thorough survey of land holdings and mapping of the encroached area | Mitigation | Area affected by encroachment | | Cachar, Kamrup, Kamrup Metro, Kokrajhar, Morigaon, Nagaon, and Sonitpur | | Assam Forest Department |
| | | Work in coordination with other government departments to identify the encroached area and households | Mitigation | | | | | |

| | | STRATEGY 1: Maintain and enhance green cover and vitality of forest ecosystem | | | | | | |
|---|---|---|---|---|---|---|---|---|
| S.No. | Activity | Sub-activities | Mitigation and Adaptation | Indicators | Outputs | Priority Districts | Convergence Schemes/ Initiatives | Responsible Agency |
| | | Fast track the Individual Forest Rights claims to filter out ineligible applicants | Mitigation | | | | | |
| | | Practice just/fair eviction management with appropriate compensation, wherever appropriate | Adaptation | | | | | |
| | | Control further encroachment by strengthening forest protection and patrolling activities and conducting periodic socio-economic surveys to identify immigration in the forest area | Adaptation | | | | | |
| 3 | Invasive species management | Conduct mapping of the distribution, scale and affected area by invasive species | Mitigation | Area infested by invasive weeds in forests | | Golaghat, Kokrajhar, Chirang, Udalguri | | Assam Forest Department |
| | | Identify appropriate control and eradication measures with help of relevant stakeholders (e.g. local communities) | Mitigation and Adaptation | | | | | |
| | | Identify opportunities on possible utilization or value addition of the removed species. (e.g. use of Lantana Camara in making furniture) | Adaptation | | | | | |
| 4 | Strengthening of forest protection activities | Ensure enforcement of forest protect laws through regular patrolling and frequent monitoring of the forest cover and boundaries | Mitigation | 1. Area protected from grazing

2. Incidences of pests and diseases | Improved Forest Management | All Assam | | Assam Forest Department |

| | | | STRATEGY 1: Maintain and enhance green cover and vitality of forest ecosystem | | | | | |
|---|---|---|---|---|---|---|---|---|
| S.No. | Activity | Sub-activities | Mitigation and Adaptation | Indicators | Outputs | Priority Districts | Convergence Schemes/ Initiatives | Responsible Agency |
| | | Facilitate adequate resources (modern technology, human and financial) for patrolling, data management, intelligence gathering, and surveillance of the forest area | Mitigation and Adaptation | 3. Incidences of forest related offences<br><br>4. Existence of policy and legal framework | | | | |
| | | Engage and employ local communities in forest protection activities | Adaptation | | | | | |
| 5 | Scientific Forest Management | Prepare and implement silviculture plans/guidelines to ensure various forestry activities are being carried out as per scientifically accepted norms | Mitigation | 1. Area treated under soil and water conservation measures<br><br>2. Duration of water flow in selected seasonal streams<br><br>3. Water bodies and wetlands in forest areas<br><br>4. Growing stock of wood<br><br>5. Increment in volume of identified species of wood | | All Assam | NAP, CAMPA, MGNREGA, GIM, TOFI, APFBC | Assam Forest Department, Assam Agroforestry Board, Panchayat and Rural Development |
| | | Conduct periodic silviculture activities (enrichment planting, thinning, control of pests and invasive species etc) | Mitigation | | | | | |
| | | Conduct appropriate soil and moisture conservation activities through engagement with local communities and mapping of the same (e.g. contour trenches, gully plugging etc.) | Mitigation | | | | | |
| | | Conduct Assisted Natural Regeneration activities | Mitigation and Adaptation | | | | | |

| STRATEGY 1: Maintain and enhance green cover and vitality of forest ecosystem | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| S.No. | Activity | Sub-activities | Mitigation and Adaptation | Indicators | Outputs | Priority Districts | Convergence Schemes/ Initiatives | Responsible Agency |
| | | Establish high-tech nurseries and indigenous seed banks (Ensuring quality planting material) | Mitigation | Efforts towards enhancement of forest productivity area under hi-tech plantations<br><br>Extent of seed production area and seed orchards | | | | |
| | | Conduct training and capacity building programs of the forestry staff and local communities on sustainable silvicultural practice and equip them with necessary equipment | Adaptation | | | | | |
| 6 | Restoration activities | Identify the scale and extent of degraded land within the forest boundaries using both primary and secondary sources, through stakeholder consultation | Mitigation | 1. Area under degradation<br>2. Area under plantation<br>3. Area under CAMPA plantation<br>4. Budgetary allocation for plantation schemes | | All Assam | NAP, CAMPA, MGNREGA, GIM, TOFI, APFBC, Tribal Sub Plan, Scheduled Cast Sub Plan, Integrated Wastelands Development Project (IWDP) Scheme, NMSA (SMAF), PMKSY | Assam Forest Department, Assam Agroforestry Board, Panchayat and Rural Development |
| | | Restore the degraded lands by carrying out plantation/ compensatory afforestation and reforestation of ecologically suitable species | Mitigation | | | | | |
| | | Integrate the forest landscape restoration (FLR) activities with the biodiversity conservation goals during the planning process through multi-stakeholder consultations | Mitigation | | | | | |

| | | | | STRATEGY 1: Maintain and enhance green cover and vitality of forest ecosystem | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| S.No. | Activity | Sub-activities | Mitigation and Adaptation | Indicators | Outputs | Priority Districts | Convergence Schemes/ Initiatives | Responsible Agency |
| 7 | Leverage nature-positive investments | Identification eligible ecosystem-based approaches/PES schemes (AFOLU, Energy sector) that can be implemented in the state | Mitigation and Adaptation | Feasibility studies for implementation of REDD/PES | | All Assam | APFBC, GIM | Assam Forest Department, Assam Agroforestry Board |
| 8 | Wood certification | Certification of wood from forest lands | Mitigation and Adaptation | 1. Area under certification (in ha) 2. Record keeping for certified and non-certified timber 3. Number of chains of custody certifications issued 4. Number of stakeholders seeking certification | Additional Financial Incentives | All Assam | Indian Forest and Wood certification Scheme | Assam Forest Department, Assam Agroforestry Board |
| | | Certification of woods from other lands | Mitigation and Adaptation | | | | | |
| | | Chain of custody certification for value addition of wood products | Adaptation | | | | | |

| STRATEGY 2: Maintain, Conserve and Enhance biodiversity in forest ecosystem | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| S.No. | Activity | Sub-activities | Mitigation and Adaptation | Indicators | Outputs | Priority Districts | Convergence Schemes/ Initiatives | Responsible Agency |
| 1 | **Strengthening legal and administrative setup** | Preparation of a comprehensive State Biodiversity Strategy and Action Plan involving all the social and economic sectors of the state to lay out a proper plan for biodiversity conservation. | Adaptation and Mitigation | 1. Records of ABS implemented and the benefit sharing realized<br><br>2. Documents published (Books, Reports, Research Papers, etc)<br><br>3. List of activities conducted by the State Biodiversity Board for sensitization<br><br>4. BMCs and TSGs Constituted in the state and PBR's documented<br><br>5. Feasibility studies taken for biodiversity credits | Sustainable utilisation and conservation of biodiversity | All Assam | | Assam State Biodiversity Board, Assam Forest Department, Panchayat and Rural Development, Assam Agroforestry Board |
| | | Development of cross - sector policies and mainstreaming of biodiversity in all relevant sectors | Adaptation and Mitigation | | | | | |
| | | Strengthening efforts related to poaching and a possible revision of the crime directive for types and levels of criminal sanctions. | Mitigation | | | | | |
| | | Assess the potential of Access and Benefit Sharing along with establishment of adequate supply chain. | Adaptation and Mitigation | | | | | |
| | | Increasing resources of Technical Support Group (TSGs) to support BMC | Adaptation and Mitigation | | | | | |
| | | Generating finance through trade of Biodiversity Credits in market must be explored and the potential must be assessed through feasibility studies. | Adaptation | | | | | |
| 2 | **Strengthening the existing protected area network and the areas of conservation** | Development of Species - Specific Conservation Plan for all species that are under threat and not just for the flagship species. | Adaptation and Mitigation | 1. Number of protected areas<br><br>2. Area of forests diverted under | Maintenance and protection of biodiversity in their natural habitat | All Assam | | Assam Forest Department, Assam State Biodiversity Board |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | STRATEGY 2: Maintain, Conserve and Enhance biodiversity in forest ecosystem | | | | | | | |
| S.No. | Activity | Sub-activities | Mitigation and Adaptation | Indicators | Outputs | Priority Districts | Convergence Schemes/ Initiatives | Responsible Agency |
| | outside protected area | Community based biodiversity conservation models must be developed for forest fringe communities | Adaptation and Mitigation | Forest Conservation Act 1980 (in ha)\n\n3. Number of plans prepared\n\n4. Number of wildlife corridors\n\n5. Area under different HCVAs (in ha)\n\n6. Number of HCVAs\n\n7. Gene banks created | | | | |
| | | Map & prioritize critical areas /HCVAs (such as KBAs, BHS, CCA, sacred grooves etc.) and adopting landscape approach towards their conservation | Mitigation | | | | | |
| | | Strict adherence to environmental laws around protected areas and HCVAs (High conservation value areas) | Mitigation | | | | | |
| | | Ecosystem restoration in protected areas by monitoring the health of the ecosystems | Mitigation | | | | | |
| 3 | Human - Wildlife Conflict to Human - Wildlife Coexistence | Site based planning approach and species-specific conflict management program in coordination with conflict vulnerable villages | Adaptation and Mitigation | 1. Number of HWC incidences reported\n\n2. Mortality rate\n\n3. Number of HWC action plans | Mitigating Human Wildlife conflict | All Assam | | Assam Forest Department, Assam State Biodiversity Board, Gram Panchayats |
| | | Identify high priority Wildlife-vehicle collisions areas for constructing ecologically sound wildlife crossings (overpasses, underpasses) | Adaptation and Mitigation | | | | | |
| | | Initiation of self - insurance schemes within the village to compensate for the economic | Adaptation and Mitigation | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | STRATEGY 2: Maintain, Conserve and Enhance biodiversity in forest ecosystem | | | | | | | |
| S.No. | Activity | Sub-activities | Mitigation and Adaptation | Indicators | Outputs | Priority Districts | Convergence Schemes/ Initiatives | Responsible Agency |
| | | loss due to human - wildlife conflict | | | | | | |
| | | Leveraging modern technology for patrolling, data management, intelligence gathering (identification of HWC hotspots), and surveillance of the Human - Wildlife Conflict | Adaptation and Mitigation | | | | | |
| 4 | **Further research and review on Biodiversity** | Establishment of Knowledge Resource Centre for Biodiversity along with development of subjects such as Biodiversity, Wildlife, Ethnobotany, etc in college and institutions of Assam | Adaptation | 1. Number of studies conducted<br><br>2. Periodicity of monitoring<br><br>3. Number of centres established | To create vast database, knowledge and resource for biodiversity which would help policymakers in taking appropriate steps for biodiversity conservation | All Assam | | Assam State Biodiversity Board, Rain Forest Research Institute, Other college and institutions |
| | | Periodically revisit the norms, criteria and needs of data for placing species in different schedules of the Wildlife (Protection) Act | Adaptation and Mitigation | | | | | |
| | | Ecological monitoring of critical habitats, changing behaviour of species and shift patterns due to climate change. | Adaptation | | | | | |

| STRATEGY 3: Drive socio-economic development of forest dependent communities | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| S.No. | Activity | Sub-activities | Mitigation and Adaptation | Indicators | Outputs | Priority Districts | Convergence Schemes/ Initiatives | Responsible Agency |
| 1 | Community Based Conservation Approach: Ensuring clearly defined forest tenure security and resource use rights of forest dependent communities | Recognition of Individual Forest Rights (IFR) and Community Forest Rights (CFR) under the FRA 2006 | Adaptation | Extent of rights recognized | Conservation of forests and biodiversity and enhanced livelihoods | All Assam | | Assam Forest Department |
| 2 | Promoting alternative income sources for forest dependent communities that lowers environment damage, provides equivalent benefits, and strengthen market linkages | Promote agroforestry and ensure plantations are carried out with ecologically sound species | Mitigation | 1. Number of NTFP based enterprises and VDVKs established<br><br>2. Net profit from established NTFP based enterprises, and VDVKs (in INR)<br><br>3. Number of capacity building and training programs conducted<br><br>4. Proportion of participants attended such | Enhanced livelihood | All Assam | NAP, APFBCS, MGNREGA, GIM, TOFI, PMVDY, ASRLM, DAY-NRLM, Antyodaya | Assam Forest Department, Panchayat and Rural Development, Gram Panchayats |
| | | Promote off-farm income generating activities such as NTFP-based enterprises, Eco-tourism etc. | Adaptation | | | | | |
| | | Support pilot projects to explore potential carbon finance and funds generated from it | Adaptation and Mitigation | | | | | |
| | | Designing and implement effective collaboration mechanism between communities, forest department, and conservation organizations for value chain development (market linkages) | Adaptation | | | | | |
| | | Offer employment to forest dependent communities via various forestry activities (e.g. | Adaptation | | | | | |

| STRATEGY 3: Drive socio-economic development of forest dependent communities | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| S.No. | Activity | Sub-activities | Mitigation and Adaptation | Indicators | Outputs | Priority Districts | Convergence Schemes/ Initiatives | Responsible Agency |
| | | through plantation, SMC activities etc.) | | capacity building and training programs | | | | |
| | | Periodic review of Minimum Support Price (MSP)for Non-Timber Forest Produce (NTFPs) and their Geographical Indication (GI) tagging | Adaptation | 5. Number of pilot projects/ programs implemented for understanding feasibility of carbon finance<br><br>6. Increase in the income of forest dependent communities (in INR per annum)<br><br>7. Number of NTFPs having MSPs<br><br>8. Number of job cards/person days generated through forestry activities<br><br>9. Ratio of daily wage to MSP | | | | |
| 3 | Implement measures that reduce dependency on forest resources while recognizing traditions | Providing limits for sustainable extraction of forest resources such as timber, fuelwood, fodder, NTFP etc. in management plans. | Adaptation and Mitigation | 1. Number of awareness generation programmes conducted | Conservation of forests and biodiversity | Goalpara, Karbi Anglong, Sonitpur, Tinsukia | APFBC, PMVDY, Antyodaya, LPG Scheme, Installation | Assam Forest Department |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| STRATEGY 3: Drive socio-economic development of forest dependent communities |
| S.No. | Activity | Sub-activities | Mitigation and Adaptation | Indicators | Outputs | Priority Districts | Convergence Schemes/ Initiatives | Responsible Agency |
| | of forest-dependent communities | Establish fuelwood, NTFP and fodder reserves outside forest areas. Also encourage and involve people and/ or communities for the same | Mitigation | 2. Proportion of participants attended awareness generation programmes<br><br>3. Extraction rate of forest resources (timber, fuelwood, fodder, NTFP) in tonnes/household/ year<br><br>4. Adoption rate of improved wood fuel efficient technologies (number/household) | | | of biogas plant | |
| | | Developing improved wood fuel efficient technologies via collaboration and facilitate access of these technologies to forest-dependent communities | Adaptation | | | | | |

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## 4.2   Best Practices

Some of the best practices followed in order to mitigate and/ or adapt to climate change are as follows:

| CASE STUDY 1 |
| --- |
| FIRELESS *JHUM* IN UKHRUL DISTRICT OF MIZORAM |

Increase in the concentration of CO2 in the atmosphere is one of major reasons for climate change. And shifting cultivation has been held liable for CO2 emissions, deforestation, and destruction of habitat (Singh, 2023). While there have been criticisms from governments and environmentalists alike, to either bring an end or replace it with settled form of agriculture the results are not very encouraging. The reasons for continued practice of *jhum* is cited by Leduc and Choudhury, 2012, are lack of viable technical options, limited market accessibility, and reach of support programs. As a compromise to reduce the emissions from burning increased regenerative fallow period is sought out as a solution.

It is generally true that burning is a necessary component of shifting cultivation (or *jhum*), some villages in the northern part of Ukhrul district of Manipur are practising "fireless shifting cultivation". This is also known as *yamkui*. This practice not only helps to remove the need of fire but also offers a cultivation period of approximately 4 or 5 years (Singh, 2023).
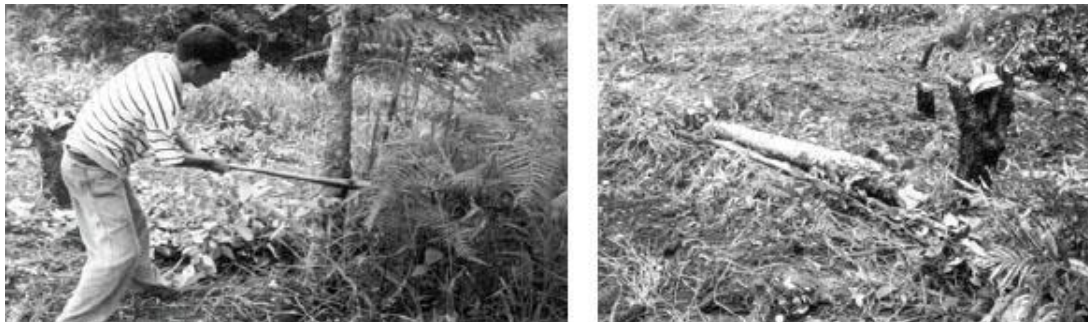


**Figure 17: Cutting trees (left) and laying trees on freshly made vegetative bunds**



**Figure 18: Plots ready for planting after formation of vegetative bunds**

The fireless shifting cultivation or *yamkui* is practiced by a farmers present in the village of Kalhang and a small proportion of farmers in the neighbouring villages (Luirishimphung, Nungbi Khullen, Nungbi Kajui, and Paorei). It lies at an altitude of 1823 to 1845 m above sea level having Latitude 24° to 25° 41' north and longitude 94° to 94° 47' east. The village has temperate climate having an annual rainfall between 1600 to 2100 mm and temperature ranging from 20° to 33° Celsius. Tangkhuls community reside in the area practising *jhum* for their sustenance.

The community in the village practice three forms of shifting cultivation:

1. Conventional shifting cultivation with 1 or 2 years of cropping having fallow period of 4 to 12 years (29.23% households are involved in this practice).

2. Conventional shifting cultivation with more than 2 years of cropping (typically 3 to 5 years) having fallow period of 9 to 15 years (62.4% households are involved in this practice).

3. Fireless shifting cultivation with more than 2 years of cropping having a fallow period of 4 or 5 years (8.37 % of the households are involved in this practice).

Although the fireless shifting cultivation is practiced by a small proportion of households in the total sample villages, but particularly in Kalhang village, 73.55 % of households practice fireless shifting cultivation. The factors considered by the villagers in adoption of fireless shifting cultivation are:

1. Terrain

2. Soil characteristics

3. Density of woody vegetation

4. Options available for households for income generation form agriculture

5. Family labour or human resources available

Fireless shifting cultivation or *Yamkui*, is favourable for areas having more grasses and shrubs along with very few trees. The dominant tree species in such areas was Alder (*Alnus nepalensis*) present in low density and scattered at distance in the area. The burning of such areas yields insufficient biomass which is also blown away by prevailing winds, rains and/ or downward slopes leaving soil incapable of providing sufficient yield. Farmers slash the vegetation from these areas, while the undergrowth i.e. shrubs, and herbs, are uprooted and the parts of plants from soil are removed. The slashed vegetation is piled along the contours as mulch, thereby allowing vegetative bunds to be formed along the contours. To strengthen the bunds logs from the tree trunks, and larger branches are laid along the contours of the area, while foliage, twigs, and smaller branches, are piled onto the bunds. The absence of fire allows survival of soil micro fauns, underground parts of shrubs, and microbes, providing nutrients for crops.The remaining logs are used for other household purposes such as fencing, fuelwood etc.

**Suggestion**

The above practice can be used for reducing the global greenhouse gas emissions in the state of Assam. It is recommended to first study the feasibility of the project and select a suitable area for the implementation of a pilot project. The pilot project will aid in better understanding of the practical requirements of the practice. This can be scaled up to other parts of Assam sharing similar characteristics wherever possible.

Rapid deforestation has been observed in the East Khasi hills of Meghalaya by the forest dependent communities. Due to excessive utilization of forest resources to cater to the increasing population, and economic development there has been substantial loss in carbon sequestration potential of he forests in the region. It was observed that in the Khasi hill district there was a loss or decrease of around 5.6 % forest cover from 2000 to 2005 (Plan Vivo, 2017). The drivers of degradation leading to deforestation and forest degradation are population growth, forest fires, unsustainable fuelwood extraction, charcoal making, stone quarrying, uncontrolled grazing, and agricultural expansion.

To reduce the rate of deforestation in the region and increase the carbon sequestration by the forests a REDD+ project was developed. It was initiated by Community Forestry International (CFI) with the help of Khasi Hills Autonomous District Council, Planet Action, Caring Friends, WeForest, the Waterloo Foundation, and Tamborine Trust. The project is implemented and managed by the indigenous communities of the region. The project not only offered increased carbon sequestration potential but also reduced the emissions by the communities, biodiversity conservation, and improved watershed management. Thereby providing additional benefits to the environmental values. The long-term goal of the project also includes a strategy to reduce poverty of rural communities, by providing them with alternative income generation options, training and capacity building of women to run microfinance institutions.

The project is located in the Umiam River Watershed present in the East Khasi Hills District of Meghalaya. The total area under the project is 27,139 hectares out of which 9,270 hectares of dense forests and 5,947 hectares of open forests in the year 2010.

The project includes activities that seeks to prevent the conversion and degradation of forest ecosystem. The activities are as follows:

1. Program management and institution building- Any REDD project includes component of building capacity of local communities for protection and conservation of forests. This is done by strengthening local institutions by providing them with financial support, coordination and collaboration, planning via formulation of management plans, implementation of activities, ensuring their continuation, and monitoring progress.

2. Advance closure- Mobilizing communities, restricting access and use of degraded forests, rootstock of coppicing species.

3. Assisted Natural Regeneration (ANR)- The restricted areas will be treated with ANR by weeding undesirable species, thinning, and multiple coppice shoot cutting.

4. Control forest fires- By establishing fire lines, creating awareness among community members, providing watch towers for effectively identifying and controlling forest fires quickly.

5. Sustainable fuelwood extraction- With the help of village councils    a plan for sustainable fuelwood extraction was formulated mentioning time, place, and permitted quantity of extraction.

6. Reducing fuelwood consumption – This was done by installing fuel efficient stives and procurement and distribution of LPG cook tops to at least 80% households as a target.

7. Livelihood activities- It involved development of SHGs for microfinance, bookkeeping, small enterprises, and GOI bank programs. SHGs were also involved in other activities such as sustainable farming program, distribution of LPG, and ecotourism strategy. Along with this piggery, poultry, and home-based nursery management was also implemented.



**Figure 19: Community Fireline creation (left) and tree plantation (right)**

**Suggestion**

REDD projects are a viable option for a degraded forest patch. Various interventions targeting reduction in the GHG emissions, reducing deforestation and forest degradation can be implemented in tandem for developing such projects. The most important aspects of such projects are identification of deforested areas, investing in project activities, involving communities for combating drivers, ensuring long term sustainability of the project and monitoring of project activities to ensure positive impacts.

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**CASE STUDY 3**

**COMMUNITY BASED ECO-RESTORATION IN THE WESTERN GHATS**

The Sholas- the tropical montane forests of the Western Ghats are considered to be one of the most biologically diverse ecosystems in the world. The region harbors various rare, threatened and endemic flora and fauna and is a notified ecologically sensitive area. Over the past few decades, these forests have faced tremendous anthropogenic pressures in the form of resource extraction, land use change, invasive species which has led to habitat degradation and loss of biodiversity. To address these issues, the India High Range Mountain Landscape Project was launched in 2014 by the Ministry of Environment, Forest and Climate Change, Government of Kerala and United Nations Development Programme with the support from the Global Environment Facility. The objective of the project is to conserve biodiversity in the mountain landscape of the Western Ghats by developing a multi-use management framework.

One of the project goals is eco-restoration of degraded landscapes in the landscape through community engagement in three districts of Kerala. These ecosystems were converted into

agricultural lands and timber plantations of commercial species such as Acacia and Eucalyptus, which turned invasive overtime (Joshi, 2022). These species, non-native to the area, naturalized and turned invasive in nature. Presence of other alien species in combination of other anthropogenic factors has harmed the ecology of the region, led to land degradation and a gradual loss of biodiversity.

The interventions of this project, therefore, included removal of exotic and invasive species, eco-restoration of degraded shola patches and degraded swamps, execution of species-specific plans through community engagement and capacity building. This included establishment of eco-development committees (EDC), training and capacity building, engagement of youth and carrying out the restoration of activities which generated livelihood opportunities (UNDP, 2021). The restoration activities included removal of the invasive species, plantation of native grasses, nursery establishment, transplantation of saplings and monitoring and evaluation of the activities. The progress and efficacy of these restoration activities were measured through establishment of monitoring plots. The landscape is gradually being restored, the availability of fodder has improved, springs have been revived and the famed native flowering plants like the the Neelakurinji (Strobilanthes kunthiana), have started growing on their own.

| CASE STUDY 4 |
| --- |
| RIGHTS AND REWARDS: COMMUNITY-BASED FOREST GOVERNANCE |

The states of Maharashtra and Odisha offer positive examples of example of how sustainable management of community forest resources (CFR) has translated socio-economic rewards for its forest dependent communities. Known for its bamboo forests, the gram sabha of Panchgaon (Chandrapur, Maharashtra) received its CFR rights (under the Forest Rights Act, 2006) in 2012, becoming the first village in the district to receive CFR rights. Since then, the gram sabha has been exercising their CFR rights to harvest and sell NTFPs such as bamboo which has substantially enhanced their livelihoods. The gram sabha has an inclusive community forest management plan in place, with rules and penalties in place to ensure sustainable harvesting of commercial forest resources such as bamboo. The gram sabha members have the technical skill and expertise of cutting bamboo by virtue of their work at the Forest Development Corporation of Maharashtra. They practice rotational harvesting of bamboo that ensures sustainable use of the resource. Without receiving any external funding support, the gram sabha has earned promising revenue from the sale of bamboo, over the years. Prior to the recognition of the CFR rights, wage labour was the primary source of income for village, where only half of the household's owned lands.

The profits generated from this community-based management of resource is channelized into community development, forest management, infrastructure development and value chain development of other forest resources. Besides creating employment for the villages, recognition of the CFR rights has empowered the communities towards financial independence and has led to a reduction of migrations (Agarwal, 2016; Agarwal and Saxena, 2018). Similarly, in the Vidharba region of Maharashtra, following the recognition of CFR rights, through the support of the civil society, the sale of Tendu leaves has significantly delivered economic benefits to the communities of various CFR gram sabhas (Sahu, 2020).

In the state of Odisha, women-led collectives have paved the way for economic empowerment. Post-recognition of CFR rights, tribal women collectives at Madhikol village (Kandhamal district), through facilitation by the civil society started exporting biodegradable plates made of Siali (Bauhinia vahlii). Their revenue model, which had eliminated middlemen, ensured significant socio-economic returns to the community (Agarwal and Saxena, 2018). In the Tendu rich areas of the Odisha, deregulation of the trade of tendu leaves have empowered and benefited communities by facilitating the trade of the same, on their own terms (Mishra, 2018).

These case studies offer insights on community-based forest management, supplemented by recognition of rights and the right support can enhance the livelihoods of forest dependent communities.

## WILDLIFE CROSSINGS: MITIGATING THE IMPACTS OF LINEAR INFRASTRUCTURES

Developmental pressures and construction of linear infrastructure such as roads has significant ecological impacts such as habitat fragmentation, loss of forests and significant wildlife mortality (Ree et al., 2015). Wildlife overpasses, overpasses, tunnels, Eco ducts and other similar structures are known to enable safe passage of wildlife by reducing the risk of collisions and road kills and mitigate the impacts of linear infrastructure (Mark, 2014; Smith et al., 2015). Several studies have monitored and documented the effectiveness of such structures (Simpson et al., 2016; Wang et al., 2017; Habib et al., 2020; Stewart et al., 2020). For instance, in India, the National Highway 44 (NH 44) passes through the Pench Tiger Reserve, which includes several animal underpasses. Habib et al., 2020 monitored animal movement in these underpasses over a period of 10 months in 2019 and found that 18 species of wild animals frequently used the same.

## INDIGENOUS EFFORT IN BANGLADESH HELPS REVERSE ENDANGERED FISH'S SLIDE TO EXTINCTION

In Bangladesh's Chittagong Hill Tracts (CHT), unchecked logging and quarrying threatened the survival of the Putitor mahseer fish (Tor putitora), an endangered species, by drying up springs crucial to its habitat. Climate change exacerbates the situation, intensifying dry seasons and further depleting water sources. Since 2016, a collaborative effort supported by USAID and the UNDP has been underway to reverse this decline. Indigenous communities are at the forefront of this initiative, working to curtail logging and quarrying activities

detrimental to the environment. Led by individuals like Lika Chakma, locals have become conservation volunteers under the CHT Watershed Co-Management Activity (CHTWCA). Their efforts focus on reviving threatened fish species, particularly the Putitor mahseer, through forest conservation and enforcement of regulations on fish catching.

Long-term efforts to address deforestation and resource overexploitation have yielded positive outcomes, with improved forest health leading to stabilized spring flows. Village Common Forests (VCFs) play a crucial role in preserving biodiversity-rich areas and safeguarding water sources. In addition to forest conservation, VCFs have implemented rules to protect fish populations, imposing fines for unauthorized fishing. By safeguarding headwaters within the common forest, communities promote sustainable fish breeding and population growth downstream.

Despite significant progress, Putitor mahseer remains under threat from overfishing, habitat loss, and climate change. Urgent conservation efforts, such as the CHTWCA, are crucial to prevent the species' extinction and preserve the ecological integrity of the region. The success of Indigenous-led conservation efforts in Bangladesh's Chittagong Hill Tracts demonstrates the importance of community engagement and sustainable practices in biodiversity conservation. By prioritizing local knowledge and participation, these initiatives offer hope for the protection of endangered species and the preservation of vital ecosystems in the face of mounting environmental challenges.

## CASE STUDY 7

## AGROECOLOGY SCHOOLS HELP COMMUNITIES RESTORE DEGRADED LAND IN GUATEMALA

Guatemala has witnessed the transformation of ancestral lands into intensive monoculture plantations, resulting in the destruction of native forests, loss of traditional practices, and adverse impacts on local health and the environment. Large-scale agriculture, coupled with the use of harmful chemical fertilizers, has exacerbated these challenges. A network comprising more than 40 Indigenous and local communities, along with farmer associations, has initiated agroecology schools across Guatemala to address these issues. These schools aim to promote the recovery of ancestral practices, educate communities on agroecology, and encourage the development of local economies. Through the "campesino a campesino" (from farmer to farmer) approach, these organizations empower communities to reclaim control over their livelihoods and environments.

Agroecology schools have played a pivotal role in empowering 33,000 families practicing organic farming techniques, who collectively protect 74,000 hectares (182,858 acres) of forest across Guatemala. By imparting knowledge on ecological principles such as soil conservation, seed storage, and natural pest control, these schools have enhanced autonomy, self-sufficiency, and health among

participants. María Isabel Aguilar, a small-scale farmer, exemplifies the transformative impact of agroecology schools. Equipped with ecological principles, she now produces organic crops using natural insecticides and fertilizers, leading to improved yields and environmental sustainability. Similarly, other farmers have learned techniques such as composting, seed selection, and rainwater harvesting, contributing to diversified and resilient farming systems.

Agroecology schools operate on the principle of co-learning, where farmers share knowledge and experiences to address local challenges. Facilitated by the Utz Che' Community Forestry Association, these schools prioritize participatory learning and knowledge exchange, empowering farmers to identify and implement solutions tailored to their contexts. The schools focus on activities that strengthen local economies and mitigate threats such as deforestation and monoculture expansion. The proliferation of agroecology schools across Guatemala signifies a grassroots movement towards ecological resilience and social empowerment. By reviving ancestral practices and nurturing community-led initiatives, these schools offer a promising pathway towards sustainable development, environmental conservation, and equitable livelihoods for Indigenous and local communities.

## CASE STUDY 8

## MAKING IT HAPPEN: NAMODAG, A SUCCESS STORY



In 2017, Vikash Ujjwal, a dedicated Forest Officer in Lohardaga, Jharkhand, identified significant challenges in forest management, including illicit felling and degradation. Determined to address these issues and empower local communities, Vikash initiated the Namodag ecotourism project. journey began with revitalizing defunct Joint Forest Management Committees (JFMCs) and engaging local communities in forest protection. Recognizing the need for sustainable livelihoods, he introduced various employment-generating activities, such as afforestation, soil conservation, and beekeeping, in collaboration with JFMC members. The concept of Namodag ecotourism emerged as a holistic approach to forest conservation and socio-economic development. JFMC members managed tourist activities, offering services like parking, trekking, and guiding. The project not only provided employment to locals but also promoted eco-friendly practices like using sal plates instead of plastic.

Since its inception, Namodag has attracted over 2.5 lakh tourists, generating significant revenue for the local community. The project led to an 80-90% reduction in illicit felling, rejuvenated forest density, and increased wildlife population. The Salgi JFMC received recognition as the best-performing committee in the division, showcasing the project's success. Namodag's success inspired other van samitis to replicate similar initiatives, aiming to create a comprehensive tourism circuit in the region.

Efforts to reduce forest fire risk include setting up a briquetting plant, offering green job opportunities, and improving the district's carbon footprint.

Vikash Ujjwal's vision, commitment, and collaborative approach transformed Namodag into a model of participatory governance and sustainable development. Through Namodag, communities not only safeguarded their forests but also found economic opportunities, demonstrating the power of grassroots initiatives in bringing positive change.

## CASE STUDY 9

## THAILAND TRIES NATURE-BASED WATER MANAGEMENT TO ADAPT TO CLIMATE CHANGE

Thailand, heavily reliant on irrigated crops like rice, faces increasing challenges from climate change-induced floods and droughts. To address these challenges sustainably, the country is shifting towards nature-based solutions for utilizing its abundant rivers, floodplains, and watershed forests. Researchers from five Thai universities evaluated two nature-based approaches to water management: recreating semi natural floodplains and constructing "living weirs" along watercourses. These projects, initiated within the past decade, involved collaboration between government departments, academics, and local communities.

The assessed initiatives demonstrated positive outcomes for disaster risk reduction, local communities, and ecosystems. The living weirs effectively regulated water flow, reducing flooding and enhancing water availability for irrigation and domestic use. Similarly, floodplain management schemes mitigated flood risks and supported agricultural production during dry seasons. To scale up nature-based solutions, consensus on their concept and design is crucial. Public participation, integration of local knowledge, and livelihood support are essential elements. Additionally, long-term monitoring, digital technology adoption, and equitable financing, including private sector investments, are necessary for successful implementation.

Thailand's shift towards nature-based water management represents a promising approach to climate adaptation. By incorporating ecosystem-based solutions, the country can enhance resilience, protect biodiversity, and improve the livelihoods of local communities. However, addressing existing challenges and ensuring inclusive participation are key to realizing the full potential of these initiatives.

## AI INNOVATION SAVES LIVES BY REDUCING HUMAN ANIMAL CONFLICT

In India, where rapid population growth and infrastructure development encroach upon wildlife habitats, human-animal conflict poses a significant challenge. Valiance Solutions, a Noida-based company, is addressing this issue with their AI-powered platform called Wildlife Eye. This innovative solution aims to mitigate conflicts between humans and wildlife, particularly in rural areas where such incidents are prevalent. Smart cameras installed on the periphery of villages detect approaching animals, and alerts are sent to forest officials and village response teams through a mobile app. The system also detects human violations in restricted areas during nighttime hours, ensuring the preservation of wildlife habitats.

The Tadoba Andhari Tiger Reserve, the first tiger reserve in India to adopt this AI-based virtual wall system, has seen significant success. Over 650 alerts have been relayed to officials in the past nine months, effectively averting potential conflicts. No incidents have been reported since the system's implementation, demonstrating its efficacy in safeguarding both humans and wildlife. Challenges such as lack of network infrastructure in rural areas were addressed through technical breakthroughs in Edge AI algorithms, reducing data transmission and consumption. Villager acceptance was gained through workshops and support from forest officials and village panchayats, highlighting the importance of community involvement in the success of such initiatives.

Wildlife Eye prioritizes local community benefits and aims to avert incidents to enhance overall safety and mitigate economic and emotional tolls associated with human-animal conflicts. The solution has garnered support from villagers, forest officials, and local authorities, providing a collaborative effort to protect lives and livelihoods. Valiance Solutions' Wildlife Eye represents a groundbreaking use of AI technology to address pressing environmental and social challenges. By applying innovative solutions like this, India can effectively reduce human-animal conflicts and promote coexistence between humans and wildlife, ensuring the protection of both lives and ecosystems.

## CASE STUDY 11

### NO FIREWOOD, NO LPG: HOW WE SAVED OUR VILLAGE'S FORESTS & BECAME CARBON-NEUTRAL

Nivaje, a village in Maharashtra's Sindhudurg district, has embarked on a remarkable journey towards becoming the state's first carbon-neutral village by the initiatives of NGO Bhagirath Gramvikas Pratishthan (BGP). Through sustainable measures such as biogas units, chemical-free farming, bamboo plantations, and more, Nivaje has significantly reduced its carbon footprint and transformed its ecological landscape. Nivaje, like many villages, was heavily dependent on forests for firewood, leading to deforestation and environmental degradation. However, with the intervention of BGP, the village embraced sustainable practices to mitigate its impact on the environment. The installation of biogas units in households became a pivotal solution, providing an alternative to burning fuelwood for cooking.

The introduction of biogas units in Nivaje revolutionized cooking practices, reducing reliance on fossil fuels and improving air quality in kitchens. Through loans provided by local banks and subsidies from the Zilla Parishad, villagers were empowered to set up biogas plants in their backyards, utilizing organic waste such as cattle manure and vegetable scraps to produce clean cooking gas. The adoption of biogas technology not only reduced greenhouse gas emissions but also mitigated deforestation by decreasing the demand for firewood. A single biogas plant in Nivaje replaced significant quantities of kerosene, firewood, and cattle dung cakes used for cooking, resulting in substantial reductions in emissions of harmful pollutants.

Collaborative efforts involving farmers, household members, local authorities, and financial institutions ensured the successful implementation and sustainability of the initiative. In addition to biogas adoption, Nivaje embarked on bamboo plantations and adopted chemical-free farming practices. Bamboo, known for its carbon sequestration capabilities, was planted in fields and backyards, contributing to carbon dioxide absorption and providing an additional source of income for villagers. The transition to sustainable agriculture, coupled with increased productivity through methods like the System of Rice Intensification (SRI), has boosted villagers' incomes and self-sufficiency. The sale of bamboo poles and agricultural produce has generated substantial revenue, transforming Nivaje from a village reliant on ration supplies to a self-sustaining community. With its remarkable environmental transformation, Nivaje is set to become a model green village and a potential destination for sustainable tourism.

## LESSON FOR THE WORLD: IFS OFFICER STOPS FOREST FIRES WHILE HELPING VILLAGERS EARN MORE

An Indian Forest Officer, Vikas Ujjwal in Jharkhand's Lohardaga district, devised an innovative solution to combat forest fires while simultaneously improving the livelihoods of villagers. By converting dry leaves into briquettes, an eco-friendly fuel source, the initiative not only prevented ecological disasters but also doubled the income of



hundreds of villagers. Recognizing the need for a proactive approach, he focused on mitigating the fuel component of the triangle by converting dry leaves into briquettes.In April 2019, Vikas installed a briquette-making machine in the Tisiya region, effectively transforming heaps of dry leaves into valuable eco-friendly fuelwood. Since then, the incidence of forest fires in the area has significantly reduced, leading to ecological restoration and wildlife preservation.

The briquette-making project not only prevented forest fires but also provided a lucrative source of income for villagers. By collecting and depositing dry leaves at the plant, villagers earned up to Rs 8,000 per week, doubling their previous incomes. This economic incentive encouraged villagers to participate actively in preventing forest fires. The conversion of dry leaves into briquettes not only reduced greenhouse gas emissions and forest degradation but also provided a sustainable alternative to traditional fuelwood. The sale of briquettes in local markets to tea shops, industries, and brick kilns replaced the need for wood from forests, further enhancing ecological preservation.

Encouraged by the success of the initiative, villagers expressed interest in expanding the project to other areas. Vikas plans to install more briquette-making plants in response to the enthusiastic response from locals, promoting economic prosperity and environmental sustainability in Lohardaga. Vikas Ujjwal's innovative approach to preventing forest fires while boosting villager income serves as a model for sustainable development and community empowerment. By addressing the root cause of forest fires and providing economic opportunities for villagers, the project demonstrates the potential for synergy between environmental conservation and socio-economic development.

## MANAS MAOZIGENDRI – A CASE STUDY FOR COMMUNITY BASED CONSERVATION

Manas Maozigendri Ecotourism Society (MMES) were a group of locals who without any outside help, began the difficult effort of saving the Manas woods on their own initiative.

The violent history of the Bodo movement served as the root for this organization. This was the dark period during which Manas was depleted of its resources. There was extensive deforestation as the southern boundary of Manas crosses the whole region controlled by Bodo. The law-and-order situation in and around Manas completely collapsed, and the inhabitants frequently sought refuge in the forest to avoid the atrocities committed by the police. Profiting from this anarchic state, few businessmen began organizing groups for the purpose of poaching and felling, and these organizations were granted free entry to the park. A few poaching parties periodically attacked the forest offices, destroying the majority of the park's protection camps. This grim situation compelled the forest guards to abandon almost all the protection camps. The situation was so perilous that UNESCO declared it as a world heritage site in danger.

A small group of Bodo teenagers from the Chapaguri Koklabari Anchalik Committee in the Koklabari district continued their crusade to conserve Manas despite the turbulent times. They carried out motivational efforts in specific locations where poaching and tree-cutting were prevalent, urging the local inhabitants to find alternative sources of income in order to abstain from these damaging practices. The committee members pleaded with their top leaders to negotiate a cease-fire with the Central and State governments while addressing the matter of preserving Manas National Park and turning it into a popular tourism attraction. This event marked the beginning of the transition of the Bodo mindset from terrorism to tourism.

In several of the periphery settlements, awareness programs opposing poaching and logging were first carried out. The Society's members personally visited to the homes of seasoned poachers and spoke with them, outlining the negative aspects of the occupation. Consequently, fifty poachers gave in to peer pressure and renounced their weapons in order to volunteer for the Society's conservation efforts.



**Figure 20: From Poachers to Protectors**

MMES has broadened the scope of its operations significantly over time. The conservation guards patrol the national park, which spans more than 300 square kilometers, from 11 protection camps throughout the year. Recognizing the role that the grasslands play in the ecology, the MMES manages the grasslands every year through controlled burning. They have been successful in stopping poaching and logging in the regions they monitor because of their persistent efforts. Both migratory bird numbers and wildlife populations have rebounded. In 2005, MMES's long-held goal of turning Manas into a popular travel destination was realized when the first foreign visitor lodged at their Jungle camp.

This excellent work done by the done by MMES in the Koklabari area encouraged six other NGOs with a similar model to start operating in other areas of Manas national Park. Visibility about their tremendous effort will play an important role in the long-term sustainability of their work.

## 4.3   Limitations of the study

While this study endeavours to provide valuable insights into vulnerability of forest and biodiversity in the state of Assam, and climate change mitigation and adaptation strategies, it is essential to acknowledge its inherent limitations. These constraints shape the scope and reliability of our findings and understanding them is crucial for interpreting the study's implications. This section mentions the boundaries, uncertainties, and potential areas for improvement within the study.

1. The study has potential limitations related to the presence of drivers of degradation in the state of Assam identified from Socio-Economic Assessment (SEA). They are therefore subject to the bias and the limited information available with the households. Therefore, an attempt has been made to validate the findings of SEA with the systematic literature of review, remote sensing analysis and stakeholder consultations.

2. Since, the study encompasses the entire state of Assam, the strategies presented operate at a broader level. However, for a region-specific approach, dedicated research tailored to the specific region is essential. Unfortunately, due to time constraints and resource limitations, such region-specific investigation was not within the scope of the current study. To effectively implement a micro-level or localized strategy, such as within a forest division or a protected area, a comprehensive field-level assessment is necessary. Such assessment would validate the region-specific drivers of degradation and assess the feasibility of appropriate mitigation and adaptation strategies. Additionally, engaging in multi-stakeholder consultations specific to the region would further enhance the effectiveness of these strategies. It is advisable to consult with regional implementation bodies or authorities to gauge the relevance and applicability of the proposed strategies based on the ground reality.

3. The findings of the report may be subject to limitations in accuracy due to a lack of recent or updated data for variables such as Biological Richness Index, Disturbance Index, etc. To address data availability limitations for such variables, a field-based assessments for the entire state should be conducted.

4. The remote sensing analysis has limitations with respect to identification of invasive species as 'vegetation'. Thus, a micro level (for example district wise analysis) approach with a subsequent ground truthing is the best possible method for dealing with such limitations.

5.  While the climate change adaptation and mitigation strategies, along with their associated monitoring parameters, are currently relevant, it is essential to recognize that their applicability may evolve over time. Regular updates to these strategies and monitoring parameters are necessary to align with changing ecological and socio-economic conditions in the future.

# 5. ANNEXURE

Annexure 1

Delineation of HCV Zone based on Forest & Biodiversity Vulnerability

| S.No. | Name | Type | Forest & Biodiversity Vulnerability Class |
|---|---|---|---|
| 1 | Chinthong | Sacred Groves | Very Highly Vulnerable |
| 2 | Bodahapur | Community Conserved Areas | Very Highly Vulnerable |
| 3 | Baldjana | Community Conserved Areas | Very Highly Vulnerable |
| 4 | Amchang Hills | IBA | Very Highly Vulnerable |
| 5 | Bauwwa Beel | IBA | Very Highly Vulnerable |
| 6 | Chakrashila Complex | IBA | Very Highly Vulnerable |
| 7 | Chandubi Lake and adjoining areas | IBA | Very Highly Vulnerable |
| 8 | Innerline (East) and Barak Reserve Forests | IBA | Very Highly Vulnerable |
| 9 | Innerline (West) and Katakhal Reserve Forests | IBA | Very Highly Vulnerable |
| 10 | Langting-Mupa Reserve Forest | IBA | Very Highly Vulnerable |
| 11 | Pabitora Wildlife Sanctuary | IBA | Very Highly Vulnerable |
| 12 | Sareswar Beel | IBA | Very Highly Vulnerable |
| 13 | Tamaranga-Dalani-Bhairab Complex | IBA | Very Highly Vulnerable |
| 14 | Urpod Beel | IBA | Very Highly Vulnerable |
| 15 | Amchang Hills | Key biodiversity area | Very Highly Vulnerable |
| 16 | Bauwwa Beel | Key biodiversity area | Very Highly Vulnerable |
| 17 | Chakrashila Complex | Key biodiversity area | Very Highly Vulnerable |
| 18 | Chandubi Lake and adjoining areas | Key biodiversity area | Very Highly Vulnerable |
| 19 | Innerline, Katakal and Barak Reserve Forests | Key biodiversity area | Very Highly Vulnerable |
| 20 | Langting-Mupa Reserve Forest | Key biodiversity area | Very Highly Vulnerable |
| 21 | Pabitora Wildlife Sanctuary | Key biodiversity area | Very Highly Vulnerable |
| 22 | Tamaranga-Dalani-Bhairab Complex | Key biodiversity area | Very Highly Vulnerable |

| | | | |
|---|---|---|---|
| 23 | Urpod Beel | Key biodiversity area | Very Highly Vulnerable |
| 24 | Borgaon | Sacred Groves | Highly Vulnerable |
| 25 | Kaziranga National Park | World Heritage Sites | Highly Vulnerable |
| 26 | Manas Bird Sanctuary | World Heritage Sites | Highly Vulnerable |
| 27 | Deepor Beel | Ramsar site (Deepar bol) | Highly Vulnerable |
| 28 | Nigam | Community Conserved Areas | Highly Vulnerable |
| 29 | Boro Gendrabil | Community Conserved Areas | Highly Vulnerable |
| 30 | Barail Range forests | IBA | Highly Vulnerable |
| 31 | Barail Wildlife Sanctuary | IBA | Highly Vulnerable |
| 32 | Barnadi Wildlife Sanctuary | IBA | Highly Vulnerable |
| 33 | Behali Reserve Forest | IBA | Highly Vulnerable |
| 34 | Bherjan-Borajan-Podumoni Wildlife Sanctuary | IBA | Highly Vulnerable |
| 35 | Bordoibam-Bilmukh Bird Sanctuary | IBA | Highly Vulnerable |
| 36 | Bordoloni - Sampora | IBA | Highly Vulnerable |
| 37 | Chirang Reserve Forest | IBA | Highly Vulnerable |
| 38 | Dadara-Pasariya-Singimari | IBA | Highly Vulnerable |
| 39 | Deepor Beel Bird Sanctuary | IBA | Highly Vulnerable |
| 40 | Dibru - Saikhowa Complex | IBA | Highly Vulnerable |
| 41 | Dum Duma, Dangori and Kumsong Reserve Forests | IBA | Highly Vulnerable |
| 42 | Jatinga | IBA | Highly Vulnerable |
| 43 | Jengdia Beel and Satgaon | IBA | Highly Vulnerable |
| 44 | Kaziranga National Park | IBA | Highly Vulnerable |
| 45 | Lumding Reserve Forest | IBA | Highly Vulnerable |
| 46 | Maguri and Motapung Beels | IBA | Highly Vulnerable |
| 47 | Manas National Park | IBA | Highly Vulnerable |
| 48 | Manas Reserve Forest | IBA | Highly Vulnerable |
| 49 | Marat Longri Wildlife Sanctuary | IBA | Highly Vulnerable |
| 50 | Nameri National Park | IBA | Highly Vulnerable |
| 51 | Ripu Reserve Forest | IBA | Highly Vulnerable |
| 52 | Sibsagar Tanks | IBA | Highly Vulnerable |
| 53 | Son Beel | IBA | Highly Vulnerable |
| 54 | Upper Dihing (West) Complex | IBA | Highly Vulnerable |

| | | | |
|---|---|---|---|
| 55 | Barail Range | Key biodiversity area | Highly Vulnerable |
| 56 | Barnadi Wildlife Sanctuary | Key biodiversity area | Highly Vulnerable |
| 57 | Behali Reserve Forest | Key biodiversity area | Highly Vulnerable |
| 58 | Bherjan-Borajan-Podumoni Wildlife Sanctuary | Key biodiversity area | Highly Vulnerable |
| 59 | Bordoibam-Bilmukh Bird Sanctuary | Key biodiversity area | Highly Vulnerable |
| 60 | Bordoloni - Sampora | Key biodiversity area | Highly Vulnerable |
| 61 | Dibru - Saikhowa Complex | Key biodiversity area | Highly Vulnerable |
| 62 | Deepor Beel Bird Sanctuary | Key biodiversity area | Highly Vulnerable |
| 63 | Dum Duma, Dangori and Kumsong Reserve Forests | Key biodiversity area | Highly Vulnerable |
| 64 | Jatinga | Key biodiversity area | Highly Vulnerable |
| 65 | Jengdia Beel and Satgaon | Key biodiversity area | Highly Vulnerable |
| 66 | Kaziranga National Park | Key biodiversity area | Highly Vulnerable |
| 67 | Lumding - Marat Longri | Key biodiversity area | Highly Vulnerable |
| 68 | Manas National Park | Key biodiversity area | Highly Vulnerable |
| 69 | Nameri National Park | Key biodiversity area | Highly Vulnerable |
| 70 | Ripu and Chirang Reserve Forests | Key biodiversity area | Highly Vulnerable |
| 71 | Sibsagar Tanks | Key biodiversity area | Highly Vulnerable |
| 72 | Son Beel | Key biodiversity area | Highly Vulnerable |
| 73 | Upper Dihing (West) Complex | Key biodiversity area | Highly Vulnerable |

Annexure 2

Delineation of HCV Zone based on Climate Change Hotspot

| S.No. | Name | Type | Climate Change Hotspot Class |
|---|---|---|---|
| 1 | Chinthong | Sacred Groves | Very High Climate Change Zone |
| 2 | Rumphum | Sacred Groves | Very High Climate Change |
| 3 | Ronghidi | Sacred Groves | Very High Climate Change |
| 4 | Tikka | Sacred Groves | Very High Climate Change |
| 5 | Umsowai | Sacred Groves | Very High Climate Change |
| 6 | Rongjangphomg | Sacred Groves | Very High Climate Change |
| 7 | Kungripi | Sacred Groves | Very High Climate Change |
| 8 | Bodahapur | Community Conserved Areas | Very High Climate Change |
| 9 | Baldjana | Community Conserved Areas | Very High Climate Change |
| 10 | Barail Wildlife Sanctuary | IBA | Very High Climate Change |
| 11 | Bordoibam-Bilmukh Bird Sanctuary | IBA | Very High Climate Change |
| 12 | Bordoloni - Sampora | IBA | Very High Climate Change |
| 13 | Chakrashila Complex | IBA | Very High Climate Change |
| 14 | Deobali Jalah | IBA | Very High Climate Change |
| 15 | Dhansiri Reserve Forest | IBA | Very High Climate Change |
| 16 | Garampani, Nambor and Doigrung | IBA | Very High Climate Change |
| 17 | Habang | IBA | Very High Climate Change |
| 18 | Kuarbari Dalani | IBA | Very High Climate Change |
| 19 | Laokhowa and Burhachapori Sanctuaries | IBA | Very High Climate Change |
| 20 | Lumding Reserve Forest | IBA | Very High Climate Change |
| 21 | Marat Longri Wildlife Sanctuary | IBA | Very High Climate Change |
| 22 | Sareswar Beel | IBA | Very High Climate Change |
| 23 | Son Beel | IBA | Very High Climate Change |
| 24 | Urpod Beel | IBA | Very High Climate Change |
| 25 | Bordoibam-Bilmukh Bird Sanctuary | Key biodiversity area | Very High Climate Change |
| 26 | Bordoloni - Sampora | Key biodiversity area | Very High Climate Change |
| 27 | Chakrashila Complex | Key biodiversity area | Very High Climate Change |
| 28 | Dhansiri Reserve Forest | Key biodiversity area | Very High Climate Change |

| | | | |
|---|---|---|---|
| 29 | Garampani, Nambor and Doigrung | Key biodiversity area | Very High Climate Change |
| 30 | Habang | Key biodiversity area | Very High Climate Change |
| 31 | Kuarbari Dalani | Key biodiversity area | Very High Climate Change |
| 32 | Laokhowa and Burhachapori Sanctuaries | Key biodiversity area | Very High Climate Change |
| 33 | Lumding - Marat Longri | Key biodiversity area | Very High Climate Change |
| 34 | Son Beel | Key biodiversity area | Very High Climate Change |
| 35 | Urpod Beel | Key biodiversity area | Very High Climate Change |
| 36 | Socheng | Sacred Groves | High Climate Change Zone |
| 37 | Langsomepi | Sacred Groves | High Climate Change Zone |
| 38 | Linchika | Sacred Groves | High Climate Change Zone |
| 39 | Rongcheck | Sacred Groves | High Climate Change Zone |
| 40 | Amri | Sacred Groves | High Climate Change Zone |
| 41 | Long-e-luboi | Sacred Groves | High Climate Change Zone |
| 42 | Tirkim | Sacred Groves | High Climate Change Zone |
| 43 | Jirkinding | Sacred Groves | High Climate Change Zone |
| 44 | Rongpongbong | Sacred Groves | High Climate Change Zone |
| 45 | Longmailaidikho | Sacred Groves | High Climate Change Zone |
| 46 | Damadidikho/Riaodikho | Sacred Groves-Damadidikho | High Climate Change Zone |
| 47 | Kaziranga National Park | World Heritage Sites | High Climate Change Zone |
| 48 | Kolbari Tokbi and Malong Kisir | Community Conserved Areas | High Climate Change Zone |
| 49 | Boro Gendrabil | Community Conserved Areas | High Climate Change Zone |
| 50 | Bauwwa Beel | IBA | High Climate Change Zone |
| 51 | Behali Reserve Forest | IBA | High Climate Change Zone |
| 52 | Chirang Reserve Forest | IBA | High Climate Change Zone |
| 53 | East and North Karbi Anglong Wildlife Sanctuaries | IBA | High Climate Change Zone |
| 54 | Kaziranga National Park | IBA | High Climate Change Zone |
| 55 | Langting-Mupa Reserve Forest | IBA | High Climate Change Zone |
| 56 | Manas National Park | IBA | High Climate Change Zone |
| 57 | Manas Reserve Forest | IBA | High Climate Change Zone |

| 58 | Nameri National Park | IBA | High Climate Change Zone |
|---|---|---|---|
| 59 | Ripu Reserve Forest | IBA | High Climate Change Zone |
| 60 | Sonai-Rupai Wildlife Sanctuary | IBA | High Climate Change Zone |
| 61 | Subansiri | IBA | High Climate Change Zone |
| 62 | Tamaranga-Dalani-Bhairab Complex | IBA | High Climate Change Zone |
| 63 | Bauwwa Beel | Key Biodiversity Area | High Climate Change Zone |
| 64 | Behali Reserve Forest | Key Biodiversity Area | High Climate Change Zone |
| 65 | Deobali Jalah, Sialmari, Haibargaon, Khutikatia (Nagaon) | Key Biodiversity Area | High Climate Change Zone |
| 66 | East and North Karbi Anglong Wildlife Sanctuaries | Key Biodiversity Area | High Climate Change Zone |
| 67 | Kaziranga National Park | Key Biodiversity Area | High Climate Change Zone |
| 68 | Langting-Mupa Reserve Forest | Key Biodiversity Area | High Climate Change Zone |
| 69 | Manas National Park | Key Biodiversity Area | High Climate Change Zone |
| 70 | Nameri National Park | Key Biodiversity Area | High Climate Change Zone |
| 71 | Ripu and Chirang Reserve Forests | Key Biodiversity Area | High Climate Change Zone |
| 72 | Sonai-Rupai Wildlife Sanctuary | Key Biodiversity Area | High Climate Change Zone |
| 73 | Subansiri | Key Biodiversity Area | High Climate Change Zone |
| 74 | Tamaranga-Dalani-Bhairab Complex | Key Biodiversity Area | High Climate Change Zone |
| 75 | Borjuli wild rice (Oryza rufipogon) Biodiversity Heritage Site | Biodiversity Heritage Site | High Climate Change Zone |

Annexure 3

RF with very high FBVI

| S.No. | Circle | RF_Name | Division | FBVI Status |
|---|---|---|---|---|
| | **RF with Very High Forest & Biodiversity Vulnerability** | | | |
| 1 | BTAD/Western Assam Circle | Shilkhikhata RF | Parbotjhora_RF | Very High |
| 2 | BTAD/Western Assam Circle | Katrigacha RF | Parbotjhora_RF | Very High |
| 3 | BTAD/Western Assam Circle | Phulkumari RF | Parbotjhora_RF | Very High |
| 4 | BTAD/Western Assam Circle | Guma RF | Parbotjhora_RF | Very High |
| 5 | BTAD/Western Assam Circle | Lalkura RF | Parbotjhora_RF | Very High |
| 6 | BTAD/Western Assam Circle | Mongoljhora RF | Parbotjhora_RF | Very High |
| 7 | BTAD/Western Assam Circle | Kachugaon | Kachugaon_RF | Very High |
| 8 | BTAD/Western Assam Circle | Phukagaon RF | Haltugaon_RF | Very High |
| 9 | BTAD/Western Assam Circle | | Baksa_RF | Very High |
| 10 | Lower Assam Social Forestry Circle | Bamungaon R F | Aie Valley_RF | Very High |
| 11 | Lower Assam Social Forestry Circle | Nakkati R F | Aie Valley_RF | Very High |
| 12 | Lower Assam Social Forestry Circle | Bahalpur R F | Aie Valley_RF | Very High |
| 13 | DHAC | Langting Mupa | DH_East_RF | Very High |
| 14 | Lower Assam Social Forestry Circle | DUDNATH HILL | Dhubri Division_RF | Very High |
| 15 | Lower Assam Social Forestry Circle | SARPAMARI | Dhubri Division_RF | Very High |
| 16 | Lower Assam Social Forestry Circle | CHANDARDINGA | Dhubri Division_RF | Very High |
| 17 | DHAC | Langting Mupa | Dimahasau_West_RF_Boundary | Very High |
| 18 | Central Assam Circle | Kachadal RF | Goalpara_RF | Very High |
| 19 | Central Assam Circle | Kahibari RF | Goalpara_RF | Very High |
| 20 | Central Assam Circle | Pancharatna RF | Goalpara_RF | Very High |
| 21 | Central Assam Circle | Phaphaga RF | Goalpara_RF | Very High |
| 22 | Central Assam Circle | Rendu RF | Goalpara_RF | Very High |
| 23 | Central Assam Circle | Rongpathar RF | Goalpara_RF | Very High |

| 24 | Central Assam Circle | Salpara RF | Goalpara_RF | Very High |
|----|----------------------|------------|-------------|-----------|
| 25 | Central Assam Circle | Zengrazangsa RF | Goalpara_RF | Very High |
| 26 | Central Assam Circle | Ajagar Hill RF | Goalpara_RF | Very High |
| 27 | Central Assam Circle | Ambuk RF | Goalpara_RF | Very High |
| 28 | Central Assam Circle | Aoimari RF | Goalpara_RF | Very High |
| 29 | Central Assam Circle | Athiabari RF | Goalpara_RF | Very High |
| 30 | Central Assam Circle | Bamundanga RF | Goalpara_RF | Very High |
| 31 | Central Assam Circle | Dakuwakata RF | Goalpara_RF | Very High |
| 32 | Central Assam Circle | Damra RF | Goalpara_RF | Very High |
| 33 | Central Assam Circle | Deosila RF | Goalpara_RF | Very High |
| 34 | Central Assam Circle | Dhanubhanga RF | Goalpara_RF | Very High |
| 35 | Central Assam Circle | Dipalchang RF | Goalpara_RF | Very High |
| 36 | Central Assam Circle | Dohikata RF | Goalpara_RF | Very High |
| 37 | Central Assam Circle | Geradubi RF | Goalpara_RF | Very High |
| 38 | Central Assam Circle | Chekuwari | Goalpara_RF | Very High |
| 39 | Central Assam Circle | Chekisim | Goalpara_RF | Very High |
| 40 | Central Assam Circle | Nakkati RF | Goalpara_RF | Very High |
| 41 | Central Assam Circle | Saikiabasha | Goalpara_RF | Very High |
| 42 | Southern Assam Circle | Inner Line(Hailakandi) | Hailakandi Division_RF | Very High |
| 43 | Southern Assam Circle | Katakhal | Hailakandi Division_RF | Very High |
| 44 | KAAC | | Hamren Division_RF | Very High |
| 45 | Central Assam Circle | Sursuria R F | Kamrup West Division_RF | Very High |
| 46 | Central Assam Circle | Khurkhuri R F | Kamrup West Division_RF | Very High |
| 47 | Central Assam Circle | Taraibari R F | Kamrup West Division_RF | Very High |
| 48 | Central Assam Circle | Garubaldha R F | Kamrup West Division_RF | Very High |
| 49 | Central Assam Circle | Ghoraputa R F | Kamrup West Division_RF | Very High |
| 50 | Central Assam Circle | Simla Hill R F | Kamrup West Division_RF | Very High |
| 51 | Central Assam Circle | Khatkhati Hill R F | Kamrup West Division_RF | Very High |
| 52 | Central Assam Circle | Moman R F | Kamrup West Division_RF | Very High |
| 53 | Central Assam Circle | Khaksi Sikrabura R F | Kamrup West Division_RF | Very High |

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|---|---|---|---|---|
| 54 | Central Assam Circle | Dumpara R F | Kamrup West Division_RF | Very High |
| 55 | Central Assam Circle | Mataikhar R F | Kamrup West Division_RF | Very High |
| 56 | Central Assam Circle | Bogaikhas R F | Kamrup West Division_RF | Very High |
| 57 | Central Assam Circle | Dimali R F | Kamrup West Division_RF | Very High |
| 58 | Central Assam Circle | Dhuniagaon R F | Kamrup West Division_RF | Very High |
| 59 | Central Assam Circle | Pantan R F | Kamrup West Division_RF | Very High |
| 60 | Central Assam Circle | Jharikhuri R F | Kamrup West Division_RF | Very High |
| 61 | Central Assam Circle | Gohain Gurung R F | Kamrup West Division_RF | Very High |
| 62 | Central Assam Circle | Melaghat R F | Kamrup West Division_RF | Very High |
| 63 | Central Assam Circle | Dudkhuri R F | Kamrup West Division_RF | Very High |
| 64 | Central Assam Circle | Kulsi R F | Kamrup West Division_RF | Very High |
| 65 | Central Assam Circle | Barduar R F | Kamrup West Division_RF | Very High |
| 66 | Central Assam Circle | Chhaygaon R F | Kamrup West Division_RF | Very High |
| 67 | Central Assam Circle | Luki R F | Kamrup West Division_RF | Very High |
| 68 | Central Assam Circle | Milmilia R F | Kamrup West Division_RF | Very High |
| 69 | Central Assam Circle | Kawasing RF | Kamrup_East_RF_ New | Very High |
| 70 | Central Assam Circle | Jarasal RF | Kamrup_East_RF_ New | Very High |
| 71 | Central Assam Circle | Rani RF | Kamrup_East_RF_ New | Very High |
| 72 | Central Assam Circle | Chamata RF | Kamrup_East_RF_ New | Very High |
| 73 | Central Assam Circle | Marokdola RF | Kamrup_East_RF_ New | Very High |
| 74 | Central Assam Circle | Gotanagar RF | Kamrup_East_RF_ New | Very High |
| 75 | Central Assam Circle | Apricola West RF | Kamrup_East_RF_ New | Very High |

| 76 | KAAC | Sildharampur Reserved Forest | Karbi_Anglong_Est_Division_RF_new | Very High |
|----|------|------|------|------|
| 77 | KAAC | Hidipi DCRF | Karbi_Anglong_Est_Division_RF_new | Very High |
| 78 | KAAC | Jamuna DCRF | Karbi_Anglong_Est_Division_RF_new | Very High |
| 79 | KAAC | Khonbamon Reserved Forest | Karbi_Anglong_Est_Division_RF_new | Very High |
| 80 | KAAC | Patardisa DCRF | Karbi_Anglong_Est_Division_RF_new | Very High |
| 81 | KAAC | Longlit DCRF | Karbi_Anglong_Est_Division_RF_new | Very High |
| 82 | KAAC | Langsoliet DCRF | Karbi_Anglong_West_Division_RF_new | Very High |
| 83 | KAAC | Matipung DCRF | Karbi_Anglong_West_Division_RF_new | Very High |
| 84 | KAAC | Meyungdisa DCRF | Karbi_Anglong_West_Division_RF_new | Very High |
| 85 | Northern Assam Circle | Ranga RF | Lakhimpur Division_RF | Very High |
| 86 | Northern Assam Circle | SUNAIKUCHI R.F | Nagaon Division_RF | Very High |
| 87 | Northern Assam Circle | TETELIA BAGHARA R.F | Nagaon Division_RF | Very High |
| 88 | Northern Assam Circle | SOUTH DIJU | Nagaon Division_RF | Very High |
| 89 | Northern Assam Circle | DHUADALANI RF | Nagaon Division_RF | Very High |
| 90 | Northern Assam Circle | Hawaipur R F | Nagaon South Division_RF | Very High |
| 91 | Northern Assam Circle | Lumding R F | Nagaon South Division_RF | Very High |
| 92 | Northern Assam Circle | Kaki R F | Nagaon South Division_RF | Very High |
| 93 | Northern Assam Circle | Hojai R F | Nagaon South Division_RF | Very High |

| 94 | Central Assam Circle | Agyathuri | North Kamrup Division_RF | Very High |
|-----|---------------------|-----------|-------------------------|-----------|
| 95 | Central Assam Circle | Sila | North Kamrup Division_RF | Very High |
| 96 | Central Assam Circle | Dirgheswari | North Kamrup Division_RF | Very High |
| 97 | Central Assam Circle | Gopeswar | North Kamrup Division_RF | Very High |
| 98 | Central Assam Circle | Natuanacha | North Kamrup Division_RF | Very High |
| 99 | Central Assam Circle | Manik Nagar | North Kamrup Division_RF | Very High |
| 100 | EAC | Panidihing R F | Sibsagar_RF_poly | Very High |
| 101 | Northern Assam Circle | Sengelijan | Sonitpur East RF | Very High |
| 102 | Northern Assam Circle | Bhomraguri RF | Sonitpur_West_RF | Very High |
| 103 | Northern Assam Circle | Singri Hills RF | Sonitpur_West_RF | Very High |

RF with high FBVI

| RF with High Forest & Biodiversity Vulnerability | | | | |
|------|------|---------|----------|-------------|
| S.No. | Circle | RF_Name | Division | FBVI Status |
| 1 | BTAD/Western Assam Circle | Tilapara RF | Parbotjhora_RF | High |
| 2 | BTAD/Western Assam Circle | Paroura RF | Parbotjhora_RF | High |
| 3 | BTAD/Western Assam Circle | Mahamaya RF | Parbotjhora_RF | High |
| 4 | BTAD/Western Assam Circle | Tipkai RF | Parbotjhora_RF | High |
| 5 | BTAD/Western Assam Circle | Shrigram RF | Parbotjhora_RF | High |
| 6 | BTAD/Western Assam Circle | Elasijhar | Kachugaon_RF | High |
| 7 | BTAD/Western Assam Circle | Nadangiri RF | Haltugaon_RF | High |
| 8 | BTAD/Western Assam Circle | Satbhendi RF | Haltugaon_RF | High |
| 9 | BTAD/Western Assam Circle | Bengtol RF | Haltugaon_RF | High |
| 10 | BTAD/Western Assam Circle | Chirang RF | Haltugaon_RF | High |
| 11 | BTAD/Western Assam Circle | Chirang RF | Haltugaon_RF | High |

| 12 | BTAD/Western Assam Circle | Manas RF | Haltugaon_RF | High |
|----|---------------------------|----------|--------------|------|
| 13 | BTAD/Western Assam Circle | Rowta RF | Dhansirir_RF | High |
| 14 | BTAD/Western Assam Circle | Kuklung | Chirang_RF | High |
| 15 | BTAD/Western Assam Circle | Teklai | Chirang_RF | High |
| 16 | BTAD/Western Assam Circle | Shishubari | Chirang_RF | High |
| 17 | BTAD/Western Assam Circle | Bengtol | Chirang_RF | High |
| 18 | BTAD/Western Assam Circle | Manas Pt 2 | Chirang_RF | High |
| 19 | BTAD/Western Assam Circle | Bhumeswar Hill | Chirang_RF | High |
| 20 | BTAD/Western Assam Circle | Digdari | Chirang_RF | High |
| 21 | BTAD/Western Assam Circle | Ranisundary | Chirang_RF | High |
| 22 | BTAD/Western Assam Circle | Lebra RF | Baksa_RF | High |
| 23 | BTAD/Western Assam Circle | Subankhata RF | Baksa_RF | High |
| 24 | Lower Assam Social Forestry Circle | Kakaijana R F | Aie Valley_RF | High |
| 25 | Lower Assam Social Forestry Circle | Rakhal Thakur R F | Aie Valley_RF | High |
| 26 | Lower Assam Social Forestry Circle | Areyarjhar R F | Aie Valley_RF | High |
| 27 | Southern Assam Circle | Katakhal Pt | Cachar Division_RF | High |
| 28 | Northern Assam Circle | Jia Dhal | Dhemaji Division RF | High |
| 29 | Northern Assam Circle | Sissi | Dhemaji Division RF | High |
| 30 | Northern Assam Circle | Simen | Dhemaji Division RF | High |
| 31 | Northern Assam Circle | Sengajan | Dhemaji Division RF | High |
| 32 | Northern Assam Circle | Archia Demow | Dhemaji Division RF | High |
| 33 | Northern Assam Circle | Zamzing | Dhemaji Division RF | High |
| 34 | Northern Assam Circle | Gali | Dhemaji Division RF | High |
| 35 | Northern Assam Circle | Kabu Chapori | Dhemaji Division RF | High |
| 36 | Lower Assam Social Forestry Circle | SHRIGRAM | Dhubri Division_RF | High |
| 37 | Lower Assam Social Forestry Circle | SAKATI | Dhubri Division_RF | High |
| 38 | EAC | Telpani R F | Dibrugarh Division_RF | High |

| 39 | EAC | Jokai R F | Dibrugarh Division_RF | High |
|----|-----|-----------|----------------------|------|
| 40 | EAC | Dihingmukh R F | Dibrugarh Division_RF | High |
| 41 | EAC | Namdang R F | Dibrugarh Division_RF | High |
| 42 | EAC | BOGAPANI RF | Digboi Division_RF | High |
| 43 | EAC | Kundil Kalia R F | Doom Dooma_Division_RF | High |
| 44 | EAC | Deopani R F | Doom Dooma_Division_RF | High |
| 45 | EAC | Kumsong R F | Doom Dooma_Division_RF | High |
| 46 | EAC | Sadiya Station R F (W.B.) | Doom Dooma_Division_RF | High |
| 47 | Central Assam Circle | Guriajhar RF | Goalpara_RF | High |
| 48 | Central Assam Circle | Kanyakuchi RF | Goalpara_RF | High |
| 49 | Central Assam Circle | Kheropara RF | Goalpara_RF | High |
| 50 | Central Assam Circle | Kothakuthi RF | Goalpara_RF | High |
| 51 | Central Assam Circle | Kumarkhali RF | Goalpara_RF | High |
| 52 | Central Assam Circle | Kuhiamari RF | Goalpara_RF | High |
| 53 | Central Assam Circle | Lankee RF | Goalpara_RF | High |
| 54 | Central Assam Circle | Matia RF | Goalpara_RF | High |
| 55 | Central Assam Circle | Mogho RF | Goalpara_RF | High |
| 56 | Central Assam Circle | Nalbari RF | Goalpara_RF | High |
| 57 | Central Assam Circle | Nolonga RF | Goalpara_RF | High |
| 58 | Central Assam Circle | Paikan RF | Goalpara_RF | High |
| 59 | Central Assam Circle | Rakhapara RF | Goalpara_RF | High |
| 60 | Central Assam Circle | Segunbahi RF | Goalpara_RF | High |
| 61 | Central Assam Circle | Shilabari RF | Goalpara_RF | High |
| 62 | Central Assam Circle | Uportola RF | Goalpara_RF | High |
| 63 | Central Assam Circle | Allibari RF | Goalpara_RF | High |
| 64 | Central Assam Circle | Bagmara RF | Goalpara_RF | High |
| 65 | Central Assam Circle | Bandermatha RF | Goalpara_RF | High |
| 66 | Central Assam Circle | Bordal RF | Goalpara_RF | High |
| 67 | Central Assam Circle | Borjhar RF | Goalpara_RF | High |
| 68 | Central Assam Circle | Budlung RF | Goalpara_RF | High |
| 69 | Central Assam Circle | Buraburi RF | Goalpara_RF | High |
| 70 | Central Assam Circle | Chitalmari RF | Goalpara_RF | High |
| 71 | Central Assam Circle | Dabli Hill RF | Goalpara_RF | High |
| 72 | Central Assam Circle | Dewlee RF | Goalpara_RF | High |
| 73 | Central Assam Circle | Dhamar RF | Goalpara_RF | High |
| 74 | Central Assam Circle | Dipkai RF | Goalpara_RF | High |
| 75 | Central Assam Circle | Dwarka RF | Goalpara_RF | High |
| 76 | Central Assam Circle | Ganbina RF | Goalpara_RF | High |
| 77 | Central Assam Circle | Gandabari RF | Goalpara_RF | High |
| 78 | Central Assam Circle | Ghagra Hill RF | Goalpara_RF | High |

| 79 | Central Assam Circle | Jaipur R F | Kamrup West Division_RF | High |
|---|---|---|---|---|
| 80 | Central Assam Circle | Baradobha R F | Kamrup West Division_RF | High |
| 81 | Central Assam Circle | Gizang R F | Kamrup West Division_RF | High |
| 82 | Central Assam Circle | Nampathar R F | Kamrup West Division_RF | High |
| 83 | Central Assam Circle | Barjuli R F | Kamrup West Division_RF | High |
| 84 | Central Assam Circle | Khatajuli R F | Kamrup West Division_RF | High |
| 85 | Central Assam Circle | Singra R F (Part 1) | Kamrup West Division_RF | High |
| 86 | Central Assam Circle | Mogakhal R F | Kamrup West Division_RF | High |
| 87 | Central Assam Circle | Singra R F (Part 2) | Kamrup West Division_RF | High |
| 88 | Central Assam Circle | Mahipara | Kamrup West Division_RF | High |
| 89 | Central Assam Circle | Maliyata RF | Kamrup_East_RF_New | High |
| 90 | Central Assam Circle | Motapahar RF | Kamrup_East_RF_New | High |
| 91 | Central Assam Circle | Sarnai Hill RF | Kamrup_East_RF_New | High |
| 92 | Central Assam Circle | Hengerabari RF | Kamrup_East_RF_New | High |
| 93 | Central Assam Circle | Jalukbari RF | Kamrup_East_RF_New | High |
| 94 | Central Assam Circle | Fatasil RF | Kamrup_East_RF_New | High |
| 95 | Central Assam Circle | South Kalapahar RF | Kamrup_East_RF_New | High |
| 96 | Central Assam Circle | Garbhanga RF (Addn) | Kamrup_East_RF_New | High |
| 97 | KAAC | Chelabor Reserved Forest | Karbi_Anglong_Est_Division_RF_new | High |
| 98 | KAAC | Englongkiri DCRF | Karbi_Anglong_West_Division_RF_new | High |
| 99 | KAAC | Tamulbari DCRF | Karbi_Anglong_West_Division_RF_new | High |
| 100 | Southern Assam Circle | Singla | Karimganj Division_RF | High |
| 101 | Southern Assam Circle | Langai | Karimganj Division_RF | High |
| 102 | Northern Assam Circle | KUKURAKOTA RF | Nagaon Division_RF | High |
| 103 | Northern Assam Circle | Jamuna Maudanga R F | Nagaon South Division_RF | High |
| 104 | Northern Assam Circle | Komrakata R F | Nagaon South Division_RF | High |
| 105 | Central Assam Circle | Sanpara | North Kamrup Division_RF | High |
| 106 | Central Assam Circle | Hajo | North Kamrup Division_RF | High |
| 107 | Central Assam Circle | Sildar | North Kamrup Division_RF | High |
| 108 | Central Assam Circle | Boramboi | North Kamrup Division_RF | High |
| 109 | Central Assam Circle | Gondhmoi | North Kamrup Division_RF | High |
| 110 | EAC | Diroi R F | Sibsagar_RF_poly | High |
| 111 | EAC | Sapekhati R F | Sibsagar_RF_poly | High |
| 112 | EAC | Solah R F | Sibsagar_RF_poly | High |
| 113 | Northern Assam Circle | Naduar RF | Sonitpur East RF | High |

| 114 | Northern Assam Circle | Biswanath RF | Sonitpur East RF | High |
| 115 | Northern Assam Circle | Gohpur RF | Sonitpur East RF | High |
| 116 | Northern Assam Circle | Senglimari RF | Sonitpur_West_RF | High |
| 117 | Northern Assam Circle | Balipara RF | Sonitpur_West_RF | High |

RF with moderate FBVI

| RF with Moderate Forest & Biodiversity Vulnerability | | | | |
|---|---|---|---|---|
| S.No. | Circle | RF_Name | Division | FBVI Status |
| 1 | BTAD/Western Assam Circle | Bamunijhora RF | Parbotjhora_RF | Moderate |
| 2 | BTAD/Western Assam Circle | Atharokotha RF | Parbotjhora_RF | Moderate |
| 3 | BTAD/Western Assam Circle | Rupsi RF | Parbotjhora_RF | Moderate |
| 4 | BTAD/Western Assam Circle | Dudumari RF | Parbotjhora_RF | Moderate |
| 5 | BTAD/Western Assam Circle | Bhelakopa RF | Parbotjhora_RF | Moderate |
| 6 | BTAD/Western Assam Circle | Baxamara RF | Haltugaon_RF | Moderate |
| 7 | BTAD/Western Assam Circle | Bhairabkunda RF | Dhansirir_RF | Moderate |
| 8 | BTAD/Western Assam Circle | Katribari | Chirang_RF | Moderate |
| 9 | BTAD/Western Assam Circle | Mora Padladiya RF | Baksa_RF | Moderate |
| 10 | BTAD/Western Assam Circle | Darranga RF | Baksa_RF | Moderate |
| 11 | Southern Assam Circle | Sonai | Cachar Division_RF | Moderate |
| 12 | EAC | DIGBOI RF EB | Digboi Division_RF | Moderate |
| 13 | EAC | KOTHA RF | Digboi Division_RF | Moderate |
| 14 | EAC | NAMPHAI RF | Digboi Division_RF | Moderate |
| 15 | EAC | Mechaki R F | Doom Dooma_Division_RF | Moderate |
| 16 | EAC | Philobari R F | Doom Dooma_Division_RF | Moderate |

| 17 | EAC | Dangori R F | Doom Dooma_Division_RF | Moderate |
|---|---|---|---|---|
| 18 | EAC | Duarmara R F | Doom Dooma_Division_RF | Moderate |
| 19 | EAC | Lokaipathar R F | Doom Dooma_Division_RF | Moderate |
| 20 | EAC | Diphu | Golaghat Division_RF | Moderate |
| 21 | EAC | South Nambar | Golaghat Division_RF | Moderate |
| 22 | EAC | Rengma | Golaghat Division_RF | Moderate |
| 23 | EAC | Doyang | Golaghat Division_RF | Moderate |
| 24 | EAC | north Nambor | Golaghat Division_RF | Moderate |
| 25 | KAAC | RONKHONG | Hamren Division_R F | Moderate |
| 26 | KAAC | KOLONGA DCRF | Hamren Division_R F | Moderate |
| 27 | Central Assam Circle | Teteliguri RF | Kamrup_East_RF_New | Moderate |
| 28 | Central Assam Circle | Garbhanga RF | Kamrup_East_RF_New | Moderate |
| 29 | KAAC | Jungthung Reserved Forest | Karbi_Anglong_Est_Division_RF_new | Moderate |
| 30 | Southern Assam Circle | Badshatila | Karimganj Division_RF | Moderate |
| 31 | Southern Assam Circle | Tilbhum Hills | Karimganj Division_RF | Moderate |
| 32 | Southern Assam Circle | Dohalia | Karimganj Division_RF | Moderate |
| 33 | Southern Assam Circle | Patheria | Karimganj Division_RF | Moderate |
| 34 | Northern Assam Circle | Pabha RF | Lakhimpur Division_RF | Moderate |
| 35 | Northern Assam Circle | Kadam RF | Lakhimpur Division_RF | Moderate |
| 36 | Northern Assam Circle | BARPANI R.F | Nagaon Division_RF | Moderate |
| 37 | Northern Assam Circle | LUTUMAI R.F | Nagaon Division_RF | Moderate |
| 38 | Northern Assam Circle | KILING R.F | Nagaon Division_RF | Moderate |
| 39 | Northern Assam Circle | BARBARI R.F | Nagaon Division_RF | Moderate |
| 40 | Northern Assam Circle | KAPHITALI | Nagaon Division_RF | Moderate |
| 41 | Northern Assam Circle | KAMAKHYA HILL R.F | Nagaon Division_RF | Moderate |

| S.No. | Circle | RF_Name | Division | FBVI Status |
|---|---|---|---|---|
| 42 | Northern Assam Circle | JOKOTA R.F | Nagaon Division_RF | Moderate |
| 43 | Central Assam Circle | Teteliguri PRF | North Kamrup Division_RF | Moderate |
| 44 | Central Assam Circle | Ganesh Hill PRF | North Kamrup Division_RF | Moderate |
| 45 | Central Assam Circle | Boman | North Kamrup Division_RF | Moderate |
| 46 | Central Assam Circle | Kurua | North Kamrup Division_RF | Moderate |
| 47 | Central Assam Circle | Kholihoi | North Kamrup Division_RF | Moderate |
| 48 | Central Assam Circle | Choulkhowa PRF | North Kamrup Division_RF | Moderate |
| 49 | Northern Assam Circle | Behali RF | Sonitpur East RF | Moderate |
| 50 | Northern Assam Circle | Charduar RF | Sonitpur_West_RF | Moderate |
| 51 | Northern Assam Circle | Charduar RF | Sonitpur_West_RF | Moderate |

RF with low FBVI

| RF with Low Forest & Biodiversity Vulnerability | | | | |
|---|---|---|---|---|
| S.No. | Circle | RF_Name | Division | FBVI Status |
| 1 | BTAD/Western Assam Circle | Ripu | Kachugaon_RF | Low |
| 2 | BTAD/Western Assam Circle | Newlee PRF | Dhansirir_RF | Low |
| 3 | BTAD/Western Assam Circle | Khalingduar RF Third Addn | Dhansirir_RF | Low |
| 4 | BTAD/Western Assam Circle | Khalingduar RF | Dhansirir_RF | Low |
| 5 | BTAD/Western Assam Circle | Darranga RF Addl | Baksa_RF | Low |
| 6 | BTAD/Western Assam Circle | Dihira PRF | Baksa_RF | Low |
| 7 | BTAD/Western Assam Circle | Batabari RF | Baksa_RF | Low |
| 8 | BTAD/Western Assam Circle | Daodhara RF | Baksa_RF | Low |
| 9 | BTAD/Western Assam Circle | Sukanjuli RF | Baksa_RF | Low |

| 10 | Southern Assam Circle | Inner Line(cachar) | Cachar Division_RF | Low |
|----|----------------------|---------------------|---------------------|-----|
| 11 | Southern Assam Circle | Barak | Cachar Division_RF | Low |
| 12 | Southern Assam Circle | Lower Jiri | Cachar Division_RF | Low |
| 13 | Southern Assam Circle | Upper Jiri | Cachar Division_RF | Low |
| 14 | Northern Assam Circle | Subansiri | Dhemaji Division RF | Low |
| 15 | Northern Assam Circle | Pobha | Dhemaji Division RF | Low |
| 16 | EAC | Joypur RF | Dibrugarh Division_RF | Low |
| 17 | EAC | DIRAK RF | Digboi Division_RF | Low |
| 18 | EAC | LEKHAPANI RF | Digboi Division_RF | Low |
| 19 | EAC | TIPANG RF | Digboi Division_RF | Low |
| 20 | EAC | TIRAP RF | Digboi Division_RF | Low |
| 21 | EAC | DIGBOI RF WB | Digboi Division_RF | Low |
| 22 | EAC | TINKOPANI RF | Digboi Division_RF | Low |
| 23 | EAC | UPPER DIHING RF WEST BLOCK | Digboi Division_RF | Low |
| 24 | EAC | UPPER DIHING RF EAST BLOCK | Digboi Division_RF | Low |
| 25 | DHAC | Krungming | Dimahasau_West_RF_Boundary | Low |
| 26 | DHAC | Barail | Dimahasau_West_RF_Boundary | Low |
| 27 | EAC | Kukuramara R F | Doom Dooma_Division_RF | Low |
| 28 | EAC | Hollogaon R F | Doom Dooma_Division_RF | Low |
| 29 | EAC | Hahkhati R F | Doom Dooma_Division_RF | Low |
| 30 | EAC | Hollonghabi R F | Doom Dooma_Division_RF | Low |
| 31 | EAC | Kakojan R F | Doom Dooma_Division_RF | Low |
| 32 | EAC | Tokouwani R F | Doom Dooma_Division_RF | Low |
| 33 | EAC | Nalani R F | Doom Dooma_Division_RF | Low |
| 34 | EAC | Tarani R F | Doom Dooma_Division_RF | Low |
| 35 | EAC | Burhi Dihing R F | Doom Dooma_Division_RF | Low |
| 36 | EAC | Dumduma R F | Doom Dooma_Division_RF | Low |
| 37 | EAC | Sadiya Station R F (N.B.) | Doom Dooma_Division_RF | Low |
| 38 | KAAC | AMRENG | Hamren Division_R F | Low |
| 39 | KAAC | JOKOTA | Hamren Division_R F | Low |
| 40 | KAAC | CHARCHIM DCRF | Hamren Division_R F | Low |
| 41 | EAC | Disai valley | Jorhat Division_ RF | Low |

| 42 | EAC | Disai | Jorhat Division_ RF | Low |
|---|---|---|---|---|
| 43 | EAC | Tiru Hills | Jorhat Division_ RF | Low |
| 44 | Central Assam Circle | Mayang Hill R F | Kamrup West Division_RF | Low |
| 45 | KAAC | Kaliyani Reserved Forest | Karbi_Anglong_Est_Division _RF_new | Low |
| 46 | KAAC | Nambar Reserved Forest | Karbi_Anglong_Est_Division _RF_new | Low |
| 47 | KAAC | Borjuri DCRF | Karbi_Anglong_Est_Division _RF_new | Low |
| 48 | KAAC | Hati Pahar DCRF | Karbi_Anglong_Est_Division _RF_new | Low |
| 49 | KAAC | Mahamaya DCRF | Karbi_Anglong_Est_Division _RF_new | Low |
| 50 | KAAC | Nambar Reserved Forest | Karbi_Anglong_Est_Division _RF_new | Low |
| 51 | KAAC | Daldali Reserved Forest | Karbi_Anglong_West_Divisi on_RF_new | Low |
| 52 | KAAC | Dhansiri Reserved Forest | Karbi_Anglong_West_Divisi on_RF_new | Low |
| 53 | KAAC | Kaki Reserved Forest | Karbi_Anglong_West_Divisi on_RF_new | Low |
| 54 | KAAC | Disama Reserved Forest | Karbi_Anglong_West_Divisi on_RF_new | Low |
| 55 | KAAC | Borlangfer DCRF | Karbi_Anglong_West_Divisi on_RF_new | Low |
| 56 | Northern Assam Circle | Kakoi RF | Lakhimpur Division_RF | Low |
| 57 | Northern Assam Circle | Dulang RF | Lakhimpur Division_RF | Low |
| 58 | Northern Assam Circle | KHOLAHAT R.F | Nagaon Division_RF | Low |
| 59 | Northern Assam Circle | BAMUNI R.F | Nagaon Division_RF | Low |
| 60 | Northern Assam Circle | SUANG R.F | Nagaon Division_RF | Low |
| 61 | Northern Assam Circle | NORTH DIJU R.F | Nagaon Division_RF | Low |
| 62 | Northern Assam Circle | BAGSER R.F | Nagaon Division_RF | Low |
| 63 | Northern Assam Circle | DABAKA  Part R.F | Nagaon Division_RF | Low |
| 64 | Northern Assam Circle | Doboka R F | Nagaon South Division_RF | Low |
| 65 | Protected Areas | Sonai Rupai WLS | Protected Areas of Assam | Low |

| 66 | Protected Areas | Nameri National Park | Protected Areas of Assam | Low |
|----|-----------------|----------------------|--------------------------|-----|
| 67 | Protected Areas | East Karbi Anglong WLS | Protected Areas of Assam | Low |
| 68 | Protected Areas | Hollongapar Gibbon WLS | Protected Areas of Assam | Low |
| 69 | Protected Areas | Dihing Patkai WLS | Protected Areas of Assam | Low |
| 70 | Protected Areas | Barail WLS | Protected Areas of Assam | Low |
| 71 | Protected Areas | Garampani WLS | Protected Areas of Assam | Low |
| 72 | Protected Areas | Nambor WLS | Protected Areas of Assam | Low |
| 73 | Protected Areas | Nambor Doigrung WLS | Protected Areas of Assam | Low |
| 74 | Protected Areas | Nambor Doigrung WLS | Protected Areas of Assam | Low |
| 75 | Protected Areas | Nambor Doigrung WLS | Protected Areas of Assam | Low |
| 76 | EAC | Geleki R F | Sibsagar_RF_poly | Low |
| 77 | EAC | Abhayapur R F | Sibsagar_RF_poly | Low |
| 78 | EAC | Dilli R F | Sibsagar_RF_poly | Low |
| 79 | Northern Assam Circle | Goroimari RF | Sonitpur_West_RF | Low |

PA with vulnerability FBVI classification

| Forest & Biodiversity Vulnerability Status in Protected Areas of Assam | | | |
|--------|-----------------|-----------------------------|-------------|
| S.No. | Type | Name | FBVI Status |
| 1 | Protected Areas | Panidihing WLS | Very High |
| 2 | Protected Areas | Marat Longri WLS | Very High |
| 3 | Protected Areas | Amchang WLS | Very High |
| 4 | Protected Areas | Pobitora WLS | High |
| 5 | Protected Areas | Orang National Park | High |
| 6 | Protected Areas | Burhachapori WLS | High |
| 7 | Protected Areas | Manas National Park | High |
| 8 | Protected Areas | Dibru Saikhowa NP | High |
| 9 | Protected Areas | Deepar Beel WLS | High |
| 10 | Protected Areas | Chakrasila WLS | High |
| 11 | Protected Areas | Kaziranga NP | High |
| 12 | Protected Areas | Laokhowa WLS | Moderate |
| 13 | Protected Areas | BHERJAN BORJAN PODUMONI WLS | Moderate |
| 14 | Protected Areas | Barnadi WLS | Moderate |
| 15 | Protected Areas | Sonai Rupai WLS | Low |
| 16 | Protected Areas | Nameri National Park | Low |
| 17 | Protected Areas | East Karbi Anglong WLS | Low |
| 18 | Protected Areas | Hollongapar Gibbon WLS | Low |
| 19 | Protected Areas | Dihing Patkai WLS | Low |
| 20 | Protected Areas | Barail WLS | Low |

| 21 | Protected Areas | Garampani WLS | Low |
|----|----------------|---------------|-----|
| 22 | Protected Areas | Nambor WLS | Low |
| 23 | Protected Areas | Nambor Doigrung WLS | Low |
| 24 | Protected Areas | Nambor Doigrung WLS | Low |
| 25 | Protected Areas | Nambor Doigrung WLS | Low |

Proposed RF with FBVI classification

| S.No. | Name | Division | District | FBVI status |
|-------|------|----------|----------|-------------|
| | | **Forest & Biodiversity Vulnerability Status of Proposed RF** | | |
| 1 | Magurmari | Kachugaon | Kokrajhar | High |
| 2 | Dolamara | KarbiAnglongEast | KarbiAnglongEast | Low |
| 3 | Kondoli | Nagaon | Nagaon | Very High |
| 4 | Kundrabil | Dhansiri | Udalguri | High |
| 5 | Alokjhari | Dhubri | Dhubri | Very High |
| 6 | Ambuk_addn | Goalpara | Goalpara | Very High |
| 7 | Amguri1 | Haltugaon | Kokrajhar | High |
| 8 | Amguri2 | Haltugaon | Kokrajhar | Moderate |
| 9 | Amguri | Goalpara | Goalpara | Very High |
| 10 | Amsolong | Hamren | KarbiAnglongWest | Low |
| 11 | Arang | Karimganj | Karimganj | Moderate |
| 12 | Bagulamari | Goalpara | Goalpara | High |
| 13 | Bakrakhuti | Goalpara | Goalpara | Very High |
| 14 | Bandarmatha | Goalpara | Goalpara | High |
| 15 | Bangaldoba | Haltugaon | Kokrajhar | High |
| 16 | Basundhari | Nagaon | Nagaon | Very High |
| 17 | BhairabHill | AieValley | Bongaigaon | Very High |
| 18 | Boha | Nagaon | Morigaon | Moderate |
| 19 | Bonsali | Dhubri | SouthSalmara | Very High |
| 20 | Borjuri | Nagaon | Nagaon | Very High |
| 21 | Borkona | Dhubri | SouthSalmara | Very High |
| 22 | Chakrapara | Goalpara | Goalpara | Very High |
| 23 | Charaibaha1 | KamrupWest | Kamrup(R) | High |
| 24 | Charaibaha2 | KamrupWest | Kamrup(R) | High |
| 25 | Chekowary_addn | Goalpara | Goalpara | Low |
| 26 | Chinanadi | Hamren | KarbiAnglongWest | Low |
| 27 | Chowlakhowa | NorthKamrup | Kamrup(R) | Moderate |
| 28 | Dabapara | Goalpara | Goalpara | Very High |
| 29 | Dairang | Goalpara | Goalpara | Very High |
| 30 | Darni | Goalpara | Goalpara | Very High |
| 31 | Deghdhowa | Goalpara | Goalpara | Very High |

| 32 | Deosali | Digboi | Dibrugarh | Moderate |
| 33 | DeosurHill | Nagaon | Nagaon | Low |
| 34 | Dewagiri | Goalpara | Goalpara | High |
| 35 | Dhansila | Nagaon | Nagaon | Very High |
| 36 | Dholpahar | Nagaon | Nagaon | Very High |
| 37 | Dibang | Doomdooma | Tinsukia | Very High |
| 38 | Dolongdoba | Goalpara | Goalpara | Very High |
| 39 | Duarmara_addn | Doomdooma | Tinsukia | High |
| 40 | EastApricola | KamrupEast | Kamrup(M) | Very High |
| 41 | Egarsati2 | Karimganj | Karimganj | Very High |
| 42 | Egarsati1 | Karimganj | Karimganj | Very High |
| 43 | GaneshHill | NorthKamrup | Kamrup(R) | Moderate |
| 44 | GaneshPahar | Goalpara | Goalpara | High |
| 45 | Garwani | KamrupEast | Kamrup(M) | Very High |
| 46 | Gathiapara | Goalpara | Goalpara | Very High |
| 47 | Gobardhan | Nagaon | Morigaon | High |
| 48 | Gudra | Goalpara | Goalpara | Very High |
| 49 | Hahara1 | KamrupEast | Kamrup(M) | Moderate |
| 50 | Hahara2 | KamrupEast | Kamrup(M) | Moderate |
| 51 | Hatimura | Nagaon | Nagaon | Moderate |
| 52 | Hatishila | Goalpara | Goalpara | Very High |
| 53 | Janjipara | Goalpara | Goalpara | Very High |
| 54 | Kachumari1 | Goalpara | Goalpara | Very High |
| 55 | Kalijani | Dhubri | Dhubri | Very High |
| 56 | KathalguriLalpahar | Nagaon | Nagaon | Very High |
| 57 | Khachibari | Goalpara | Goalpara | High |
| 58 | Khagarpur | AieValley | Bongaigaon | High |
| 59 | Khardang | Goalpara | Goalpara | Very High |
| 60 | Kharmauza | Goalpara | Goalpara | Very High |
| 61 | Khongkhal | Goalpara | Goalpara | Very High |
| 62 | Khoragaon | AieValley | Bongaigaon | Very High |
| 63 | Kolobari | AieValley | Bongaigaon | Very High |
| 64 | KumriKhutamari | Goalpara | Goalpara | Very High |
| 65 | Kurchapakhri | Goalpara | Goalpara | Very High |
| 66 | Lengteng | Nagaon | Nagaon | Low |
| 67 | Letkubari | Goalpara | Goalpara | Very High |
| 68 | Madhabpara | Nagaon | Nagaon | Low |
| 69 | Mahadev | AieValley | Bongaigaon | High |
| 70 | Mohangpathar | Doomdooma | Tinsukia | High |
| 71 | Nayekgaon1 | Haltugaon | Kokrajhar | Very High |
| 72 | Nayekgaon2 | Haltugaon | Kokrajhar | High |

| 73 | Nidanpur | Goalpara | Goalpara | High |
| 74 | Rakshini | Goalpara | Goalpara | Very High |
| 75 | Rongsai | Goalpara | Goalpara | Very High |
| 76 | Sagalkhuti | AieValley | Bongaigaon | Very High |
| 77 | Sakuranga | Nagaon | Nagaon | High |
| 78 | Salpar | Goalpara | Goalpara | Very High |
| 79 | Sarpani | Goalpara | Goalpara | High |
| 80 | Shalibhui1 | Dhubri | SouthSalmara | Very High |
| 81 | Shalibhui2 | Dhubri | SouthSalmara | Low |
| 82 | Tangaon | Dhubri | SouthSalmara | Very High |
| 83 | ThorkoNalbari | Goalpara | Goalpara | Very High |
| 84 | Tichimakli | Goalpara | Goalpara | High |
| 85 | Tokrabandha | Dhubri | Dhubri | Very High |
| 86 | TukraHill | Goalpara | Goalpara | Very High |
| 87 | Bhairabkunda | Dhansiri | Udalguri | Moderate |

Annexure 4

Agenda of Stakeholder consultation

**Agenda**

| Friday- 17th November 2023 | |
|---|---|
| 0930-1000 hrs. | **Registration** |
| 1000-1010 hrs. | **Welcome Address and Introduction to the Theme of the Project**<br>**Dr. J. V. Sharma** IFS Rtd, Senior Director, Land Resources Division, |
| 1010-1020 hrs. | **Special Remarks**<br>**Dr. Dipankar Saharia**, Senior Director, Administrative Services, TERI |
| 1020-1135 hrs. | **Inaugural Address**<br>**Mr Sandeep Kumar**, IFS, Project Director, Assam Project on Forest and Biodiversity Conservation Society |
| 1135-1145 hrs. | **Tea Break** |
| 1145-1215 hrs. | **Introduction to the Project and Purpose of the Workshop,**<br>**Vulnerability Assessment Findings**<br>**Mr. Aniruddh Soni**, Area Convenor and Associate Fellow, Centre for Biodiversity and Ecosystem Services, Land Resources Division, TERI<br>**Mr. Sayanta Ghosh**, Research Associate, TERI |
| 1215-1330 hrs. | **Drivers of Deforestation and Forest Degradation in Assam**<br>*Group Activity – Identification and review of the findings*<br>*Group Presentation and discussion by participants*<br>*Review of the findings by TERI* - **Ms Aabha Ballal**, and **Mr Sayanta Ghosh** Research Associate, TERI |
| 1330-1415 hrs. | **Lunch Break** |
| 1415-1510 hrs. | **Ongoing Climate Change Mitigation and Adaptation Interventions in Assam**<br>*Review of ongoing schemes –* **Mr Pranjul Chauhan**, Research Associate, TERI<br>*Group Activity – Discussion and Gap Analysis* |
| 1510-1520 hrs. | ***Open Discussion and Suggestions*** |
| 1520-1530 hrs. | **Concluding Remarks**<br>**Dr. J. V. Sharma** IFS Retd, Senior Director, Land Resources Division, TERI<br>**Mr Sandeep Kumar**, IFS, Project Director, Assam Project on Forest and Biodiversity Conservation Society |

Pictures from stakeholder consultations

Annexure 5

Sheet for Group Activity

Stakeholder Consultation on Devising Climate Change Mitigation and Adaptation Strategies for Forest and Biodiversity of Assam

### Session – 2

### Understanding the efficacy of ongoing Climate Change Mitigation and Adaptation Interventions in Assam – Gap Analysis and Recommendations

Activity: To be done by participants in groups

| Theme (Strategic Action) | Existing Schemes/ Programs | How would you rate them based on their effectiveness | What's working well? | What's not working well? Refer to the options provided in the reference sheet (section -3) | One Suggestion/ Recommendation |
|---|---|---|---|---|---|
| (A) | (B) | (C) | (D) | (E) | (F) |
| **Enhancing Green Cover in Assam**<br>• Plantations inside forest area<br>• Plantations for forest fringe communities (horticulture/ commercial)<br>• Avenue Plantations<br>• Agroforestry interventions<br>• Urban Forestry<br>• Silvicultural operations<br>• Management of invasive species | 1.<br>2.<br>3.<br>4.<br>5. | 1 2 3 4 5<br>5 being extremely effective<br>1 being least effective | | | |
| **Forest Protection and Management**<br>• Fire management<br>• Check on illicit felling, poaching, etc.<br>• Checking and reclamation of encroached lands<br>• Invasive species management<br>• Patrolling activities<br>• Scientific forest management<br>• Mitigating human-wildlife conflict | 1.<br>2.<br>3.<br>4.<br>5. | 1 2 3 4 5<br>5 being extremely effective<br>1 being least effective | | | |
| **Reducing Dependencies of the Forest Fringe Communities**<br>• Enhancing/ diversifying the livelihood of the forest-dependent communities<br>• Training and capacity building/ Awareness generation<br>• Strengthening/ Empowering local institutions like SHGs, JFMCs, EDCs, etc.<br>• Providing energy-efficient equipment<br>• Community-based eco-tourism efforts<br>• Strengthening market linkage and supply chain | 1.<br>2.<br>3.<br>4.<br>5. | 1 2 3 4 5<br>5 being extremely effective<br>1 being least effective | | | |

| Theme (Strategic Action) | Existing Schemes/ Programs | How would you rate them based on their effectiveness | What's working well? | What's not working well? Refer to the options provided in the reference sheet (section -3) | One Suggestion/ Recommendation |
|---|---|---|---|---|---|
| (A) | (B) | (C) | (D) | (E) | (F) |
| **Training and Capacity Building & Awareness Generation**<br>• Training of forest departments and communities on forest management, latest tools and technologies, trends (green credits, carbon credits, REDD, etc.), MRV system, Ecosystem services | 1.<br>2.<br>3.<br>4.<br>5. | 1 2 3 4 5<br>5 being extremely effective<br>1 being least effective | | | |
| **Disaster Risk Reduction**<br>• Mitigating disaster risk (floods, droughts, landslides, etc.)<br>• Strengthening the adaptive capacity of vulnerable communities | 1.<br>2.<br>3.<br>4.<br>5. | 1 2 3 4 5<br>5 being extremely effective<br>1 being least effective | | | |
| **Biodiversity Management**<br>• Specie specific management plans for biodiversity conservation<br>• Habitat restoration<br>• Efficient uses of biological resources<br>• Mitigating human-wildlife conflict<br>• Knowledge management and documentation (Indigenous traditional knowledge)<br>• Management of invasive species<br>• Access and benefit sharing | 1.<br>2.<br>3.<br>4.<br>5. | 1 2 3 4 5<br>5 being extremely effective<br>1 being least effective | | | |
| **Others** | 1.<br>2.<br>3.<br>4.<br>5. | 1 2 3 4 5<br>5 being extremely effective<br>1 being least effective | | | |

Annexure 6

Reference sheet

List of interventions/ schemes/ programmes

*To be filled in column B of group activity 2*

| S.No | Interventions/Schemes/Programmes |
|------|----------------------------------|
| 1 | Compensatory Afforestation Fund Management and Planning Authority (CAMPA) |
| 2 | Green India Mission (GIM) |
| 3 | APFBCS (The Assam Project on Forest and Biodiversity Conservation Society) |
| 4 | Nagar Van Yojna |
| 5 | Social Forestry Schemes |
| 6 | Protective afforestation scheme |
| 7 | Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) |
| 8 | PMVDY (Pradhan Mantri Van-Dhan Yojana) |
| 9 | Deen Dayal Antyodaya Yojana-National Rural Livelihoods Mission (DAY-NRLM) |
| 10 | Deen Dayal Upadhyaya Grameen Kaushalya Yojana (DDU-GKY) |
| 11 | Price Support Scheme |
| 12 | Barak Valley Flood Control Project |
| 13 | Brahmaputra Flood Control Project |
| 14 | Pradhan Mantri Ujjwala Yojna (PMYU) |
| 15 | Environment Education Program (EEP) |
| 16 | Rural Infrastructure Development Fund (RIDF) |
| 17 | State Disaster Response Fund (SDRF) |
| 30 | Mission Antyodaya |
| 31 | Pradhan Mantri Awaas Yojana - Gramin |
| 32 | State Priority Schemes- SCSP (Scheduled Caste Sub-plan) and TSP (Tribal Sub-plan) |
| 33 | National Social Assistance Program |
| 34 | Pradhan Mantri Gram Sadak Yojana |
| 35 | Northeastern States Road Investment Project (NESRIP) |
| 36 | Assam State Roads Project |
| 37 | Assam State Rural Livelihood Mission (ASRLM) |
| 38 | Saubhagya Scheme |
| 39 | Biogas Programme |
| 40 | Pradhan Mantri Jan Dhan Yojana (PMJDY) |
| 41 | Rashtriya Krishi Vikas Yojana (RKVY) |
| 42 | Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) |
| 43 | Others. Please specify_____ |

Annexure 7

Potential list of limitations/ barriers faced during implementation of any interventions/ schemes/ programmes

**Section 3: Limitations/ barriers**

*To be filled in column E of group activity 2*

| S.No. | Challenges |
|---|---|
| 1 | Lack of Funding |
| 2 | Poor Implementation Design (Planning of interventions without extensive feasibility analysis – context & domain) |
| 3 | Top-down approach (Lack of inputs from ground) |
| 4 | Lack of enforcement and/or regulation |
| 5 | Capacity gap (knowledge gap) of the implementing body |
| 6 | Lack of coordination between different implementing institutions |
| 7 | Lack of adequate human resource |
| 8 | Resources availability (Physical infrastructure/ technology, etc.) |
| 9 | Cultural barriers in adoption of interventions |
| 10 | Data related Issues (missing data/old data/ data disparity/ misinterpretation/) |
| 11 | Inadequate market linkage |
| 12 | Land unavailability and/or disputes |
| 13 | Geographical barriers (accessibility) |
| 14 | Geopolitical Issues (Local institutional laws/ administrative issues) |
| 15 | Lack of proper MRV (Monitoring, Reporting & Verification) mechanism |
| 16 | Transparency, Grievance redressal & feedback mechanism |
| 17 | Proper exit plan to ensure program sustainability |
| 18 | Corruption |
| 20 | Others (Please Specify) _____ |
| 21 | Others (Please Specify) _____ |
| 22 | Others (Please Specify) _____ |

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