

Devising Climate Change Mitigation and Adaptation Strategies for Forests and Biodiversity of Assam

Assam Project on Forest and Biodiversity Conservation (APFBCS)

Project Description

Assam, located in the northeastern region of India and part of a Global Biodiversity Hotspot, is home to rich biodiversity and vast forested landscapes. These forests are vital ecosystems that cover a significant portion of the state's area, providing numerous ecological, economic and social benefits. Subsequently, forests are essential to the livelihood of local communities, they serve as a wellspring of resources that contribute to their sustenance and economic well-being. Rising population drives the urbanization, expansion of agricultural activities, and increased dependence on forest resources, exacerbating the strain on these ecosystems, leading to deforestation and forest degradation which has become an area of critical concern. With an aim to reduce deforestation and forest degradation, and combat climate change the French development agency – Agence Française de Développement (AFD) is supporting Forest Department and State Government of Assam by co-funding “Assam Project on Forest and Biodiversity Conservation Phase II (APFBC Phase II)”. The aim of the project is to strengthen forest conservation, enhance biodiversity protection, and improve the livelihoods of forest-dependent communities. In this context, the project entrusted to TERI aims to assesses the vulnerability of Assam's forests and biodiversity, identifies key drivers of deforestation and forest degradation, proposes climate change mitigation and adaptation strategies, develops a Monitoring, Reporting, and Verification (MRV) system, and prepares a Forest Reference Emission Level (FREL)/ Forest Reference Level (FRL) for Assam.

Key Findings

1. Vulnerability assessment of forest and biodiversity of Assam

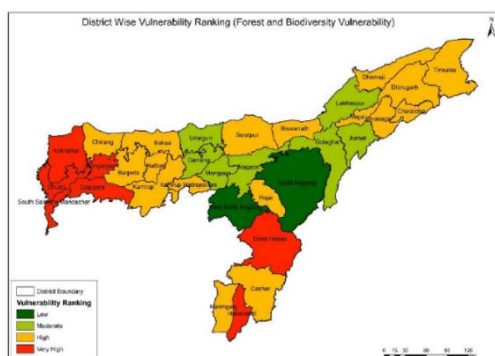


Figure 1: Forest and Biodiversity Vulnerability

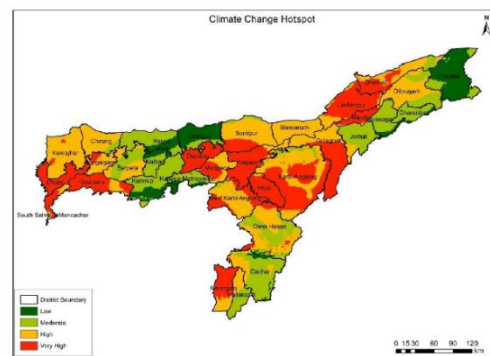


Figure 2: Climate Change hotspots

- ✓ Eight key indicators were used to develop the **Forest and Biodiversity Vulnerability Index (FBVI)**, including biological richness index, disturbance index, forest canopy density, fire intensity, slope degree, biomass extraction intensity, standardized precipitation index, and flood vulnerability index.
- ✓ **19 grids** are classified as **very highly vulnerable** including following districts **Kokrajhar, Bongaigaon, South Salmara Mancachar, Dhubri, Goalpara, Hailakandi, and Dima Hasao**
- ✓ **68 grids** fall into the **highly vulnerable** category including following districts **Dhemaji, Dibrugarh, Sivasagar, Kamrup, Baksa, and Karimganj.**

- ✓ There is a strong correlation ($R^2 = 0.77$) between climate change hotspots and forest vulnerability, indicating that areas experiencing extreme weather events are also witnessing accelerated biodiversity loss.
- ✓ 16 forested grids have experienced extreme rainfall variations exceeding 800 mm over the last 65 years.
- ✓ 18 grids have recorded temperature anomalies surpassing 2°C since 1958.
- ✓ 46 grids that overlap between high FBVI and climate change hotspots, emphasizing the urgent need for targeted intervention.

2. Identification of drivers of deforestation and forest degradation

The RS-GIS analysis conducted as part of this study reveals alarming trends in forest degradation and land-use change which are as follows:

- ✓ Between 2000 and 2022, approximately **2,546 sq. km of forests** have been converted into **plantations, croplands, and settlement areas**.
- ✓ The annual rate of transition from forests to **settlements, croplands, and plantations** stands at **1.04 sq. km, 55.53 sq. km, and 59.17 sq. km per year, respectively**.
- ✓ Notably, the **Diroi Reserve Forest, Chirang Reserve Forest, and Sonai Rupai Wildlife Sanctuary** have experienced substantial conversion into croplands, significantly reducing their ecological integrity.
- ✓ **Forest Canopy Density (FCD) analysis** suggests that **3,188 sq. km of Very Dense Forest (VDF)** has been degraded, while **170 sq. km of Moderately Dense Forest (MDF)** has transitioned into lower-density categories.
- ✓ Over the same period, **non-forest and open forest areas** expanded by **2,152 sq. km and 1,263 sq. km, respectively**, indicating widespread fragmentation and deforestation.

Systematic Literature Review	Stakeholder Consultation	Socio-Economic Assessment
<ul style="list-style-type: none"> • Resource Extraction • Encroachment • Illegal activities • Development pressure • Shifting cultivation 	<ul style="list-style-type: none"> • Development pressure • Natural hazards • Increasing population pressure & urbanization • Encroachment • Illegal activities 	<ul style="list-style-type: none"> • Resource extraction • Encroachment • Natural hazards • Anthropogenic forest fires • Development pressure

Figure 3: Top 5 drivers under different analytical approaches

3. Strategies for climate change mitigation and adaptation

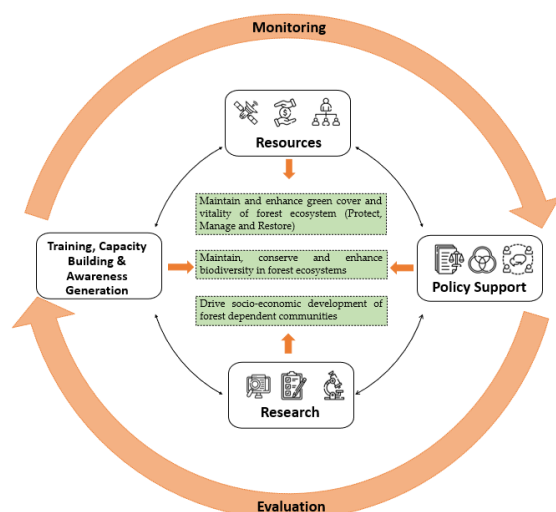


Figure 4: Mechanism for strategy implementation

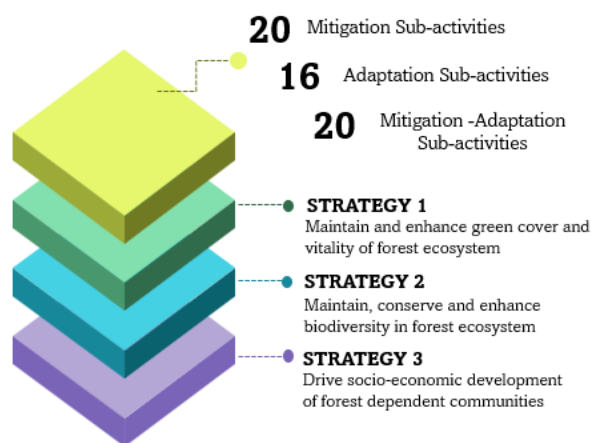


Figure 5: Strategies for climate change mitigation and adaptation

4. Development of Monitoring, Reporting, and Verification (MRV) system

Building on the vulnerability assessment, degradation analysis, and strategic recommendations for Assam’s forests, this study also introduces a **comprehensive Measurement, Reporting, and Verification (MRV) system** to track forest cover changes, greenhouse gas (GHG) emissions, and carbon sequestration efforts.

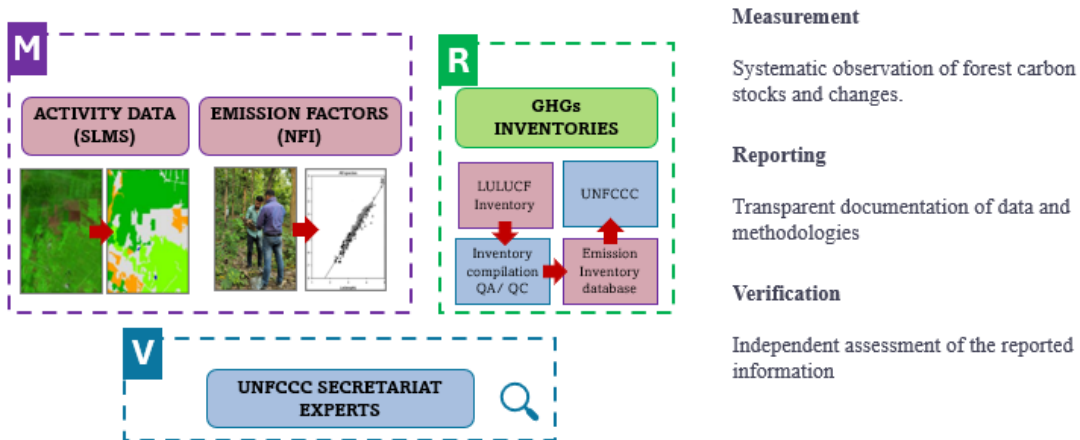


Figure 6: MRV System

For effective MRV implementation, the report underscores the need for **capacity building among forest management authorities, improved data collection methodologies, and community participation** in conservation efforts. Assam’s State Climate Change Cell is recommended to oversee MRV operations, ensuring periodic reporting in alignment with India’s National Forest Reference Emission Levels (FREL) and Biennial Update Reports (BURs) to the UNFCCC.

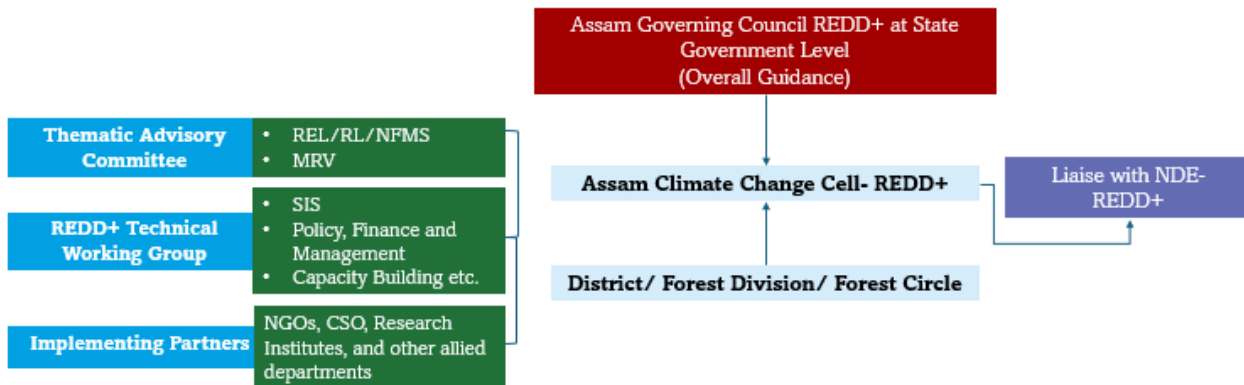


Figure 7: Institutional mechanism for implementation of REDD

5. Preparation of FREL/ FRL

As part of the broader strategy to assess, manage, and restore Assam’s forests, this study also establishes a **Forest Reference Emission Level (FREL)/ Forest Reference Level (FRL)** to serve as a benchmark for tracking carbon emissions and sequestration from forest ecosystems. FREL/FRL is a crucial component of Assam’s REDD+ framework, ensuring that conservation efforts are monitored effectively and that emissions reductions are quantified efficiently.

Forest Type	Area (in sq. km)
Tropical Wet Evergreen	2,105.76
Tropical Semi-Evergreen	12,756.77
Tropical Moist Deciduous	7,066.53
Trees Outside Forests/Plantations	6,305.06

Carbon Pool	Carbon Stock (in tC/ha)
Above Ground Biomass (AGB)	73.96
Below Ground Biomass (BGB)	20.37
Deadwood (DW)	0.26
Leaf Litter (LL)	0.78
Soil Organic Carbon (SOC)	88.76

Using **historical emission data from 2000, 2004, and 2008**, the study estimated Assam’s **annual emissions/ FREL as 8.42 million tCO₂ equivalent**, indicating a net carbon loss.

6. Financial instruments – ARR and REDD

With a robust reference baseline in place, Assam is now better positioned to measure, report, and verify emissions reductions, ensuring greater accountability, improved forest governance, and enhanced climate resilience. Moving forward, the study proposes two carbon finance models, i.e., ARR, and REDD.

The minimum duration of such projects will be 40 years (as per the requirements of the standard). A detailed baseline assessment to accurately estimate the amount of carbon credit generated from the two projects will be done after the MoU signing between the APFBCS, VNV, and TERI.

ARR	REDD
<ul style="list-style-type: none"> • Area of 12,000 ha • Credits approx. 2 lakhs in 5 years • Revenue: 25.8 cr. (AEFD: 65%, Investor: 35%) 	<ul style="list-style-type: none"> • Area of 96,000 ha • Credits approx. 3 lakhs in 5 years • Revenue: 51.6 cr. (AEFD: 65%, Investor: 35%)

Figure 8: Proposed carbon finance project