BAMBOO PLANTATIONS BY FARMERS AND COMMUNITY IN THE COUNTRY

Project title	Bamboo plantations by farmers and community in the country
Project ID	3570
Monitoring period	09-July-2019 to 16-December-2024
Crediting period	09-July-2019 to 08-July-2049
Original date of issue	26-June-2025
Most recent date of issue	20-November-2025
Version	1.3
VCS Standard Version	4.7
Prepared by	Infinite Environmental Solutions Limited

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1 PROJECT DETAILS

1.1 Summary Description of the Project

"Bamboo plantations by farmers and community in the country" project is a VCS AFOLU (Agriculture, Forestry, and Other Land Use) grouped project carried out by the Infinite Environmental Solutions Limited (Project Proponent) in Assam state of India. Primary aim of the project is carried out work towards community based sustainable implementation and management of Afforestation activity that involves carbon sequestration on degrading shrubland through bamboo plantation activity. Therefore, PP along with project implementor i.e., Holistic Life Transforming and Empowering Community (HLTEC) has collaborated with farmers to plant a Bamboo species (*Bambusa tulda*) in Assam for the first project activity instance (PAI-1). The agroforestry approach emphasizes on ecological restoration, carbon mitigation, socioeconomic empowerment of local people, as well as supports ecosystem conservation, rehabilitation, livelihood opportunities for rural communities etc.

Details of project Phases:

Phase	Plantation type	Scale up Capacity	Area planted (ha)	Number of farmers	Location	Project Start Date	Species
Project Activity Instance (PAI) -1	Agroforestry	4,500 (Grouped project)	834.33	462	Assam	09-July-2019	*Bambusa tulda*

The first project activity instance (PAI-1) is scattered in multiple small land parcels across Karbi Anglong district of Assam, India (Details are provided in section 1.13 of this documents). Project activity instance (PAI-1) started in July 2019 covering 834.33 hectares. The project is designed to continuously increase green cover within the project area. The project is a grouped project activity, and the Project Proponent (PP) intends to scale it up to 4,500 hectares across the other districts in Assam, state of India for future activity instances. The project intervention comprises of restoration of shrublands which are private lands of individual farmers through plantation of bamboo species. The main species planted by farmers under PAI-1 is *Bambusa tulda Roxb* (Bengal bamboo)[1]. The project capture and store carbon by planting Bengal bamboo on degrading shrublands, enhancing soil health, preventing deforestation, and engaging local communities in sustainable land use practices. These strategies contribute to carbon sequestration, reducing emissions, and promoting sustainable practices that contribute to GHG emission reductions or carbon dioxide removals. Before the implementation of the project

[1] https://wfoplantlist.org/taxon/wfo-0000853530-2024-12?page=1

activity, the land was degrading shrubland, and this degradation would persist even without the project activity. Before the adoption of bamboo plantation, the land was degrading shrub land.

For the PAI-1 estimates the total GHG emissions reductions and/or removals for crediting period for 30 years are 302,310 tCO_2e and annually 10,077 tCO_2e with capped LTA 270,010 tCO_2e. In the current monitoring period, the total GHG emissions removals by the project activity are 205,146 tCO_2e.

1.2 Audit History

Audit type	Period	Program	Validation/verification body name	Number of years
Validation/ verification	09-July-2019 -- 16-December-2024	VCS	CARBON CHECK (INDIA) PRIVATE LIMITED	5 years, 5 Month and 8 Days

1.3 Sectoral Scope and Project Type

Sectoral scope	14; Agriculture, Forestry, and Other Land Use (AFOLU)
AFOLU project category[2]	Afforestation, Reforestation, and Revegetation (ARR)
Project activity type	GHG emissions and/or removals through plantation activity

1.4 Project Eligibility

1.4.1 General eligibility

- Section 2.1.1 of the VCS standard 4.7 explains scope of the VCS program. “Bamboo plantations by farmers and community in the country” lead to sequestration/removal of CO_2 (which is one of the Kyoto protocols GHG) in different pools of carbon in the form of AGB, BGB, and SOC. Project activity is not excluded from the scope as per the table 1 given in the section 2.1.3 of the VCS standard 4.7.

- Project is listed on 20-July-2022 i.e., within three years of the project start date (in line with the section 3.8.2 of the VCS standard v4.7) and shall be validated before 08-July-2027 (As per 8 years deadline for ARR projects, given in the section 3.8.3 of the VCS standard v4.7). The opening meeting for the validation of this project activity with the validation/verification body was conducted on 25-March-2025 in Dokmoka, Karbi Anglong, Assam.

- The project uses CDM approved A/R Large-scale Methodology: Afforestation and reforestation of lands except wetlands Version 02.0[3] which is eligible under the scope of

[2] See Appendix 1 of the VCS Standard
[3] https://cdm.unfccc.int/UserManagement/FileStorage/THNRJC15IW4K89UBE6DFZYX23OVP0Q

the VCS program for ARR projects and follows the eligibility requirements as specified by this methodology. Under the applied methodology, project validation is authorized through 30-June-2025. As per the VCS Eligible ARR projects may include timber harvesting in their management plan. The project area shall not be cleared of native ecosystems within the 10-year period prior to the project start date.

The grouped project activity had not resulted in clearance or conversion of any native ecosystems, also this activity did not include any draining of native ecosystems or degradation of ecological functions.

1.4.2 AFOLU project eligibility.

The project is eligible under the scope of the VCS Program as the project includes AFOLU activities (project category ARR), which are supported by a methodology approved under the VCS Program.

- Program guide Version 4.4 [4]
- VCS Standard, Version 4.7[5]
- AFOLU Non-Permanence Risk Tool, v4.2[6]

The justification of eligibility of the project under the scope of the VCS Program is given in the table below:

Eligible conditions	Justification/description	Reference
1) Eligible ARR activities are those that increase carbon sequestration and/or reduce GHG emissions by establishing, increasing or restoring vegetative cover (forest or non-forest) through the planting, sowing or human-assisted natural regeneration of woody vegetation.	According to the list of eligible AFOLU Projects described in Appendix 1 of VCS Standard Version 4.7, the present activity falls under the Afforestation, Reforestation and Revegetation (ARR) category. The project's primary aim to increase the green cover through planting bamboo species, which leads to carbon sequestration in aboveground biomass, belowground biomass, and soil organic carbon.	Please refer section 1.12 of this document.
2) Eligible ARR projects may include timber harvesting in their management plan.	Harvesting is included in the management plan of the project.	Refer Section 1.12, which describes the project management plan.

[4] VCS-Program-Guide-v4.4.pdf (verra.org)
[5] https://verra.org/wp-content/uploads/2024/04/VCS-Standard-v4.7-FINAL-4.15.24.pdf
[6] AFOLU-Non-Permanence-Risk-Tool-v4.2-FINAL.pdf (verra.org)

3) The project area shall not be cleared of native ecosystems within the 10 years period prior to the project start date.	The project activity has not cleared any native ecosystem within the 10 years period prior to the project start date.	LULC map is given in section 1.14 of this document.

1.4.3 Transfer project eligibility

Not applicable, as the project is not being transferred from other GHG program. The project is only seeking registration under the VCS with project ID 3570.

1.5 Project Design

The project is a grouped activity and aims to do afforestation on degrading shrubland which are expected to remain degraded or continue to degrade further in the absence of the project activity. The grouped project activity complies with the requirements of section 3.6 in the VCS standard v4.7.

☐ Single location or installation

☐ Multiple locations or project activity instances (but not a grouped project)

☒ Grouped project

Grouped Project Design

The project consists of plantation of *Bambusa tulda* to established green cover in degrading shrublands, privately owned by farmers. Initially, PAI-1 of the project has been implemented in Karbi Anglong District, Assam. In future, grouped project activity (future PAI) may further exceed to other districts of Assam state, India. The project operates as a grouped initiative, commencing with PAI-1 covering 834.33 ha. The project has been designed with farmers for practicing bamboo planting on their private lands.

Project implementation is planned to be implemented in multiple instances; hence the project is a grouped project.

Description	Evaluation
A delineation of the geographic area(s) within which all project activity instances shall occur	As mentioned in Section 1.5, the initial PAI (PAI-1) is implemented in the state of Assam, and future PAIs will be implemented in other districts of Assam, state of India. Therefore, for the grouped project, the project boundary includes the entire Assam state. For any future instances of the project implemented in areas outside the initial PAIs, the baseline

	scenario and rationale for additionality will be the same as, or more conservative than, those established for the initial PAIs.
One or more determinations of the baseline for the project activity in accordance with the requirements of the methodology applied to the project	The PAI-1 implemented across Assam, has established its baseline scenario following the AR-ACM0003 methodology, considering the in degrading shrublands before intervention. The baseline determination ensures that, without the project, these lands would have remained in a degraded state with minimal carbon sequestration potential. For future instance of the project, the baseline scenario and rationale used will be same or at least as conservative as those determined based on the first PAI.
One or more demonstrations of additionality for the project activity in accordance with the requirements of the methodology applied to the project	The land parcel(s) must demonstrate the additionality explained in section 3.5 of this document. For future instance of the project, to demonstrate additionality will be same or at least as conservative as those determined based on the first PAI.
One or more sets of eligibility criteria for the inclusion of new project activity instances at subsequent verification events	In addition, with eligibility criteria mentioned in the section 1.4.2, land parcels included in the project activity: • Must be degrading shrubland • Must be in the geographical boundary of Assam, India. • Privately owned lands must have clear possession and accessible boundaries, distinct from government-declared protected areas.
A description of the central GHG information system and controls associated with the project and its monitoring	The operation division of PP oversees the governance of the GHG information system, controls, and monitoring associated with the project. Additionally, Project Implementer takes care of the Measurement, Reporting, and Verification (MRV) Team, along with the AFOLU expert and Agronomist, are tasked with the responsibilities outlined in section 6.3.

Eligibility criteria for New Project Instances (PAI):

Eligibility Criteria	Evaluation
1) Meet the applicability conditions set out in the methodology applied to the project.	Each land parcel considered for inclusion in the new Project Activity Instance must fulfil all the applicability conditions outlined in CDM AR-ACM0003 methodology.
2) Use the technologies or measures specified in the project description.	Each land parcel to be included in the new Project Activity Instance must engage in agroforestry practices. All the new instances will be under ARR category as described in section 1.12 project description and eligible as per Program standard 4.7 appendix 1A.1 as per Program standard 4.7 appendix 1A.1. The species of bamboo selected for future PAIs may vary depending on beneficiaries' requirements, local ecological conditions, soil types, and climate suitability considering diverse agroecological zones of Assam, India. However, this will not impact the baseline and additionality of the project.
3) Apply the technologies or measures in the same manner as specified in the project description.	For new instances, Project activity or the manner of project implementation will remain the same as specified in project description. The Project Activity Instances will have the same characteristics of the project activities as defined in section 1.12.
4) Are subject to the baseline scenario determined in the project description for the specified project activity and geographic area.	Each land parcel to be included in the new Project Activity Instance must adhere to the baseline scenario specified in the project description for the designated Project Activity and geographic area. The future project instances will have the same or at least as conservative baseline scenario and additionality demonstrations as described for the first PAI in sections 3.4 and 3.5 of this document.
5) Have characteristics with respect to additionality that are consistent with the initial phases for the specified project activity and geographic area.	For new instances, approach for considering baseline scenario and additionality will remain the same as validated in PAI-1.

6) The PAI will utilize the same baseline scenario as described in Section 3.4 or a baseline scenario appropriate to the specified methodology for the geographic area defined in Section 1.13.	The Baseline determination and additionality demonstration for all project activity instances in a project, including any new project activity instances included in the grouped project, shall be combined and have the same standards applied. To meet the minimum eligibility criteria, the project will define geographic areas within each instance using geodetic polygons, as outlined in VCS Standard v4.7, Section 3.6.10. The initial instance spans bamboo plantation activities across the Karbi District in the Indian state of Assam. In accordance with Section 3.6.13 of the VCS Standard v4.7, the baseline scenario for the geographic area of the PAI is determined using the approved methodology and any future PAIs proposed within the broader geographic boundary of the grouped project (i.e., Assam, India) will be included only if they maintain consistency with the baseline conditions and additionality rationale established for the initial PAI. Baseline scenario determination and additionality demonstration will be based on the initial project activities, ensuring eligibility for future instances as per VCS Standard v4.7, Section 3.6.16 (2) and (3). The analysis of common practices, regulations, and historical trends covers the entire geographic area, applying to both the initial and future instances.

Eligibility criteria for Inclusion of New Project Activity Instances:

Eligibility Criteria	Evaluation
Occur within one of the designated geographic areas specified in the project description	The Project Proponent confirms that the new project activity instances will be among the designated geographical areas as specified in the project description.
Conform with at least one complete set of eligibility criteria for the inclusion of new project activity instances. Partial conformance	The Project Proponent will ensure that the new project activity instances will comply with eligibility criteria mentioned in the section

with multiple sets of eligibility criteria is insufficient.	1.4.2, land parcels included in the project activity: • Must be degrading shrubland • Must be in the geographical boundary of Assam, India. • Privately owned lands must have clear possession and accessible boundaries, distinct from government-declared protected areas.
Be included in the monitoring report with sufficient technical, financial, geographic, and other relevant information to demonstrate conformance with the applicable set of eligibility criteria and enable evidence gathering by the validation/verification body	All the relevant details related to the project activity demonstrate conformance with the applicable set of eligibility criteria is provided under section 1.1, ,1.12 and 1.13 of Joint PDMR and section 1.2 of Non-Permanence Risk Report.
Have evidence of project ownership, in respect of each project activity instance, held by the project proponent from the respective start date of each project activity instance	Each new project activity instance will have evidence of project ownership in line with the eligibility criteria. For PA-1, Contractual Agreement between PP and Farmer evidences the project ownership held by project proponent from start date of each Project Activity instance.
Have a start date that is the same as or later than the grouped project start date	Instances that will be included in the project will have the start date on or after the project start date which is 09-July-2019.
Only be eligible for crediting from the later of start date of the project activity instance or the start of the verification period in which they were added to the grouped project, through to the end of the total project crediting period.	The new project activity instances added will be eligible for crediting from the later start date of the project activity instance or the start of the activity Each land parcel to be included in the new Project Activity instance will eligible for crediting from the later of start date of the verification period in which they were added to the grouped project, through to the end of the total project crediting period.
Not be or have been enrolled in another VCS project.	Each land parcel eligible for inclusion in the new project activity instance must not be enrolled in another VCS project. This requirement is guaranteed through a Contractual Agreement and a specific legal

	declaration by the land parcel owners/farmers.
Adhere to the clustering and capacity limit requirements for multiple project activity instances set out in 3.6.8 – 3.6.9	Project activity instances located within a 10-kilometer radius of another instance of the same project activity, managed by the same project proponent, must be considered part of a single project. Instances within this proximity cannot be distributed across multiple projects.
Addition of a new project proponent to the project	Where inclusion of a new project activity instance necessitates the addition of a new PP to the project, such instances shall be included in the grouped project description within two years of the project activity instance start date or, where the project activity is an AFOLU activity, within five years of the project activity instance start date. The procedure for adding new project proponents will be in line with VCS Registration and Issuance Process.

1.6 Project Proponent

Organization name	Infinite Environmental Solutions Limited (IESL)
Contact person	Jimmy Rajdeo Sah
Title	Chief Operating Officer
Address	Plot Number 128 FB, Ring Road, Sector F, Scheme Number 94, Indore, Madhya Pradesh, India-452016
Telephone	+91-7314050174
Email	Jimmy@infisolutions.org

1.7 Other Entities Involved in the Project

Organization name	Holistic Life Transforming and Empowering Community (HLTEC)
Role in the project	Project Implementor
Contact person	Joyhind Engleng
Title	Project Coordinator

Address	Jirjar, Aklam, Near Lorulangso, Dipphu, Karbi Anglong, Assam, India.
Telephone	+91-9577601508
Email	Joy.hind73@gmail.com

1.8 Ownership

The project proponent meets the ownership requirements of the VCS Program specifications as detailed in section 3.7 of the VCS Standard v4.7.

Land Ownership- Plantations are being established on private lands owned by the individual farmers. The legal titles for these land parcels are being held by the farmers and are documented through land certificate records. The project proponent is collecting and physically verifying ownership details in the form of land ownership certificates for all farmers.

Project Ownership- The project's plantations are established on private land owned by farmers. These farmers generate carbon credits through the plantation activity, which they transfer to the project proponent through a contractual agreement. Infinite Environmental Solutions Limited holds exclusive rights to the carbon credits generated from this project. In the initial PAI-1, 100% of the project area is under the project proponent's control. A contractual agreement has been signed between the project implementor and each participating farmer, allowing the project proponent to plan, implement, and monitor project activities throughout the crediting period.

FPIC Process- Project implementer has got an extensive experience in the agriculture and Agroforestry sector, along with its longstanding presence in the proposed project areas of Assam. The organization has built strong relationships with the farming community by collaborating closely with them. To consult and engage with the community, HLTEC employed participatory approaches, including community meetings, group discussions and one-on-one meetings with individual farmers. The initial community meetings were conducted to inform residents about the potential Verified Carbon Standard (VCS) project, assess their interest, and gather information about the communities and potential sites. During these consultations, HLTEC informed stakeholders about the impacts on their territories and resources to which they have customary access. This process addressed all stakeholders' queries, ensuring they had a clear understanding of resource ownership.

1.9 Project Start Date

Project start date	09-July-2019
Justification	The project activity has started its first plantation activity which consists of pit digging, and planting of seedlings, on 09-July-2019, marking the initiation of activities that led to the generation of GHG emission removals. Hence, the project has selected 09-July-2019 as

	the start date of the project activity. Sapling distribution records/ purchase bills from nursery are provided as a proof for the start date of the project activity.

1.10 Project Crediting Period

Crediting period	☐ Seven years, twice renewable ☐ Ten years, fixed ☒ Other (30 years which can be further renewed. AFOLU ARR projects may have crediting period from 20 years to 100 years)
Start and end date of first or fixed crediting period	09-July-2019 to 08-July-2049

1.11 Project Scale and Estimated GHG Emission Reductions or Removals

☒ < 300,000 tCO_2e/year (project)

☐ ≥ 300,000 tCO_2e/year (large project)

Calendar year of crediting period	Estimated GHG emission reductions or removals (tCO_2e)
09-July-2019 to 31-December-2019	15,727
01-January-2020 to 31-December-2020	39,104
01-January-2021 to 31-December-2021	47,815
01-January-2022 to 31-December-2022	49,998
01-January-2023 to 31-December-2023	50,332
01-January-2024 to 31-December-2024	47,233
01-January-2025 to 31-December-2025	30,232
01-January-2026 to 31-December-2026	10,085
01-January-2027 to 31-December-2027	2,784
01-January-2028 to 31-December-2028	995
01-January-2029 to 31-December-2029	731
01-January-2030 to 31-December-2030	731

01-January-2031 to 31-December-2031	731
01-January-2032 to 31-December-2032	731
01-January-2033 to 31-December-2033	731
01-January-2034 to 31-December-2034	731
01-January-2035 to 31-December-2035	731
01-January-2036 to 31-December-2036	731
01-January-2037 to 31-December-2037	731
01-January-2038 to 31-December-2038	731
01-January-2039 to 31-December-2039	498
01-January-2040 to 31-December-2040	156
01-January-2041 to 31-December-2041	33
01-January-2042 to 31-December-2042	4
01-January-2043 to 31-December-2043	0
01-January-2044 to 31-December-2044	0
01-January-2045 to 31-December-2045	0
01-January-2046 to 31-December-2046	0
01-January-2047 to 31-December-2047	0
01-January-2048 to 31-December-2048	0
01-January-2049 to 08-July-2049	0
Total estimated ERRs during the first or fixed crediting period	**302,310**
Total number of years	**30**
Average annual ERRs	**10,077**

1.12 Description of the Project Activity

The project is a grouped project where *B. tulda* will be planted by HLTEC by associating with local farmers at various locations across Assam. The project aims to improve the livelihoods of the farmers as well as reduce atmospheric carbon dioxide through plantation of bamboo.

From July-2019 to December-2022, the PAI-1 (834.33 ha) was implemented in Karbi Anglong District of Assam, and its targeted area of plantation will also increase in the near future i.e., 4,500 ha in the other districts in the Assam, state of India.

The main aim of project is to restore the degrading shrubland through reforestation and plantation activity. The project aims to convert shrubland into agroforestry land, the one which contribute towards forest restoration, climate change mitigation and will provide additional income to farmers through NTFPs. In the PAI-1, from July-2019 to December-2022, there were plantations of *B. tulda*. In case of Bengal bamboo, harvesting practice done only after the culm is mature, and each culm that are added each year by year, take 5 years to reach its maturity.

The below table consist of Bamboo plantation models and species for PAI-1:

S. N.	Common Name	Scientific Name	Harvesting/ non-harvesting	Spacing (meter)
1	Bengal bamboo	*Bambusa tulda*	Harvesting	There was no specific spacing was opted due to slopping and undulating area.

During the project's implementation phase, a uniform spacing approach was not followed for the bamboo saplings, as the site consists of sloping, rugged, and undulating terrain with varying gradients and elevations. Consequently, the farmer chose to vary the spacing between the saplings to better align with the site's topographical features[7]. Uniform spacing would have been impractical in undulating area, potentially leading to poor growth or instability, especially in steeper areas. By adjusting the spacing, the farmer can address soil and water conservation problem which helps to promote better plant establishment, optimizes resource use, and reduces environmental impact. Therefore, this approach is suitable for the successful execution and long-term sustainability of species.

Farmers are the major participants of this project activity who are trained to upgrade their knowledge to maintain the plantation and reduce the soil erosion in the area. The participants were informed about the need of project through the meetings and awareness programme and demonstrated with future impacts of climate change. Project activity changed the pre-project scenario from degrading shrubland to bamboo plantation activity. Subsistence farmers voluntarily chose to be a part of this activity. Due to lack of financial and technical support in the project area, project participants shifted their activity to agroforestry plantation.

Project has established procedures and guidelines to maintain a sustainable plantation that included plantation management plan, that covers all stages after the land is notified.

Organization Details

Infinite Environmental Solutions Limited

[7] Gupta, ATUL KUMAR. "National Bamboo Mission: A holistic scheme for development of bamboo sector in Tripura." *Indian Forester* 134.3 (2008): 305.

- The project proponent, Infinite Environment Solutions Limited, is responsible for the overall management and implementation of this grouped project, ensuring compliance with Verra's standards and effective coordination among all stakeholders involved. Infinite Environmental Solutions Limited collaborates with HLTEC, who engage local farmers and communities by providing training and resources necessary for the sustainable management of bamboo and agroforestry plantations.

- Farmers and communities voluntarily participate in the project, converting degrading shrubland into agroforestry systems, thereby enhancing their livelihoods through additional income from Non-Timber Forest Products (NTFPs).

- A detailed Plantation Management Plan has been established, outlining the sustainable management of the plantations, including site preparation, species selection, and maintenance practices.

- The project includes soil conservation measures aimed at reducing erosion and improving soil fertility, transforming degrading lands into productive agroforestry systems. Collaboration with local government bodies and conservation agencies ensures that the project aligns with regional environmental policies and contributes to climate change mitigation.

Holistic Life Transforming and Empowering Community (HLTEC)

- HLTEC is committed to assisting Infinite Environmental Solutions Limited and the Auditor Team with essential logistical support during the duration of DOE visits, consultant engagements, and monitoring operations. Furthermore, the organization will actively participate in obtaining appropriate support letters from relevant government agencies as needed, guaranteeing a smooth and effective execution of the project's objectives.

- The project implementor, HLTEC is integral to the execution of ground-level activities in Assam, collaborating directly with local farmers and communities to ensure the project's success.

- HLTEC manages the on-ground activities, including the planting of Bengal Bamboo ensuring that the project adheres to sustainable practices. The organization engages farmers through training sessions, providing them with the knowledge and skills necessary for maintaining the plantations and implementing soil conservation measures.

- Regular meetings and awareness programs are conducted by HLTEC to inform farmers and local communities about the project's benefits, including climate change mitigation and livelihood improvement. They offer ongoing technical support and guidance, helping farmers transition from traditional practices to sustainable agroforestry systems.

- HLTEC plays a key role in promoting the production of Non-Timber Forest Products (NTFPs), providing farmers with additional income streams while contributing to forest

restoration and biodiversity enhancement. These implementors also coordinate with local authorities and conservation bodies, ensuring that the project's activities align with regional environmental goals and policies.

Management Plan

- Planning- Site layout, Species selection and suitability, Environment assessments, and Stakeholder identification.
- Silviculture- Nursery, Land management, Marking & Pit preparation, and Planting.
- Forest protection- Fire control, Pest control, Disease control, and Training management

Planning- The project management plan has been developed to aim at continuity of policy action and controlling the plantation activity at the local level. Project management plan covers multiple activities of survey, assessment and revisions on basis of past results and present facts. Planning also includes actions for future in conformity with long term objectives. Planning activity has multiple provisions of control and maintenance of records (Such as: Number of farmers and contracts) and collection of facts. Planning conducted to implement the actives: Formulation, Draft and implementation of working plan. The species was selected based on the climatic suitability, rotation period and environment assessment.

The planning is divided in four areas, land mapping and planning, management of natural areas, conservation areas and management of commercial areas. For the first one, Micro Forestry assesses the terrain and examines the basic structure of soils and grass vegetation. Special consideration is given to important land planning issues such as land slope, water bodies, identification of any cultural sites, identification of riparian strips and sites for conservation protection, the existence of agricultural farms, condition of old logging roads, and wildlife habitats. Regarding natural areas, environmentally sensitive and conservation areas are identified during the planning phase of operations and designated as conservation zones which are protected to encourage natural regeneration. It is the company's policy to enable natural recovery and succession of conservation zones, and as such the primary management activity is to protect these areas, removing invasive exotics.

Silviculture-

- Bengal Bamboo: Bengal bamboo thrives in tropical and subtropical climates with moderate to high rainfall. It prefers well-drained, loamy, or sandy soils with a slightly acidic to neutral pH (5.5-7.0). Propagation is done through rhizomes or clumps; young plants are typically spaced 3-4 meters apart. For optimal growth, it needs full sunlight and should be shielded from strong winds to avoid damage.

The species can be suitable for a wide range of climatic conditions and soil types. The below table consist of Bamboo plantation models and species for Phase 1:

Sr. No.	Common Name	Scientific Name	Harvesting/non-harvesting
1	Bengal bamboo	*Bambusa tulda*	Harvesting

The various plantation activities include the following:

Nursery management: The established seedlings will be transported from the nursery to the beneficiary's land. The plant material will remain for the shortest possible time at the unloading site.

Planting target: For the project activity instance 1 company targeted plantation of bamboo in 834.33 ha land. This grouped project is planning to plant total 4,500 hectare over the period.

Land preparation: Land was prepared 8-10 days before the plantation and weeds were removed manually.

Plantation: Planting is done just before the rainy season for better survival of the plants and it is ensured that 90% survival rate is maintained. All the plants were brought from nursery to field for direct plantation. This activity is expected to be completed by the end of October of each planting year depending on the weather where possible. Soil is then placed around the roots, ensuring that the seedling remains in a vertical position and firmed down using the fingertips.

Mortality replacement: Plantation has maintained such that there should be survival of planted bamboos more than 90%. Project implementer has monitored the plantation at 3-5 months of gap after planting up to 3 years for the mortality replacement to maintain the requirements.

Thinning activity: According to the VCS Program Definition v4.5, the harvest of trees, or extraction of biomass that leads to a reduction of more than 20% in carbon stocks over a five-year period from starting, is considered thinning activity. For grouped projects, this 20% threshold applies to each individual project activity[8]. *B. tulda* biomass is removed through thinning activity, which involves the selective removal of overmature culms, specifically those aged five years from the clumps. The LTA has been calculated based on the thinning activity. These thinning practices encourage healthy growth and regeneration by reducing competition for nutrients and improving overall clump productivity. In the project scenario, selective thinning of *B. tulda* clumps will begin once the clumps reach over maturity, starting from the 5th year. *B. tulda* exhibit a growth pattern where clumps produce new bamboo shoots annually, which then develop into mature culms. These culms reach their full height and maximum biomass accumulation within a single growing season. As a result, thinning focuses on removing older, overmature culms from the 5th year onward, with the culms selected for thinning representing approximately 20% of the total biomass of the clumps. The ecological growth pattern of *B. tulda* ensures that thinning these culms stimulates ongoing growth, as the thinned culms are replaced in the following growing season. This cycle leads to the creation of a permanent bamboo forest with high carbon capture and storage. Consequently, the thinning activities result in no loss of biomass or associated carbon

[8] https://verra.org/wp-content/uploads/2023/08/VCS-Program-Guide-v4.4.pdf

stocks over the project period. This reflects the unique contribution of bamboo species to long-term, permanent carbon removals.

Weed Control: It is noted that common weeds grow faster than newly planted trees and unless the weeds are controlled effectively. Weeding will be performed manually or mechanically or by hand. No chemical weedicide would be applied on the field.

Fire control: Trainings are given to farmers and tools are provided to prevent the forest fires. Apart from training and tools, plantation area is planned accordingly to minimize the tree cover loss and reduce the spread of fires. One more step is also taken by maintaining the soil moisture to mitigate fires.

The grouped project is not located in a boundary that is covered by jurisdictional REDD+ program.

1.13 Project Location

The proposed Project Activity involves the plantation of the *B. tulda* in one District (Karbi Anglong) of Assam state, India on the multiple scattered lands privately owned by the farmers in PAI-1 with geographic co-ordinates the project boundary at 26.556606N to 25.822930N Latitude and 93.136785E to 93.278813E Longitude. A separate KML file containing the project location and set of geographic coordinates for PAI-1 is submitted. The project activity initially involves 834.33 ha in one district of Assam state. The state, District wise area are provided in below table. The coordinates of project activity area are as follows:

State	District	Area in ha	Geo co-ordinates
Assam	Karbi Anglong	834.33	26.276472N, 93.058570E
Grand Total		**834.33**	

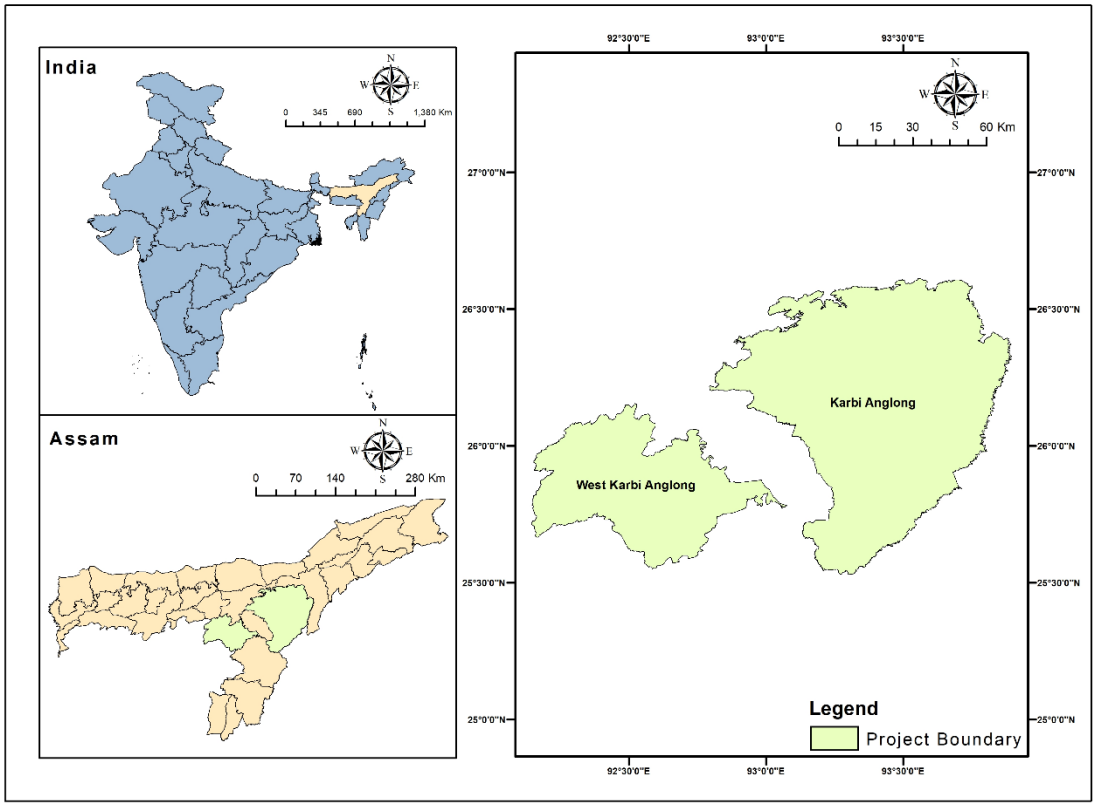


Figure 1: Project location map

1.14 Conditions Prior to Project Initiation

The land before the implementation of the project activity was degrading shrubland owned by farmers. Without the implementation of the project the land would continue to degrade further.

Ecosystem type and Climate: Initially, the project area is located in the state of Assam. The climate and type of ecosystem that are present in the project area under PAI- 1 are shown in the detailed table below:

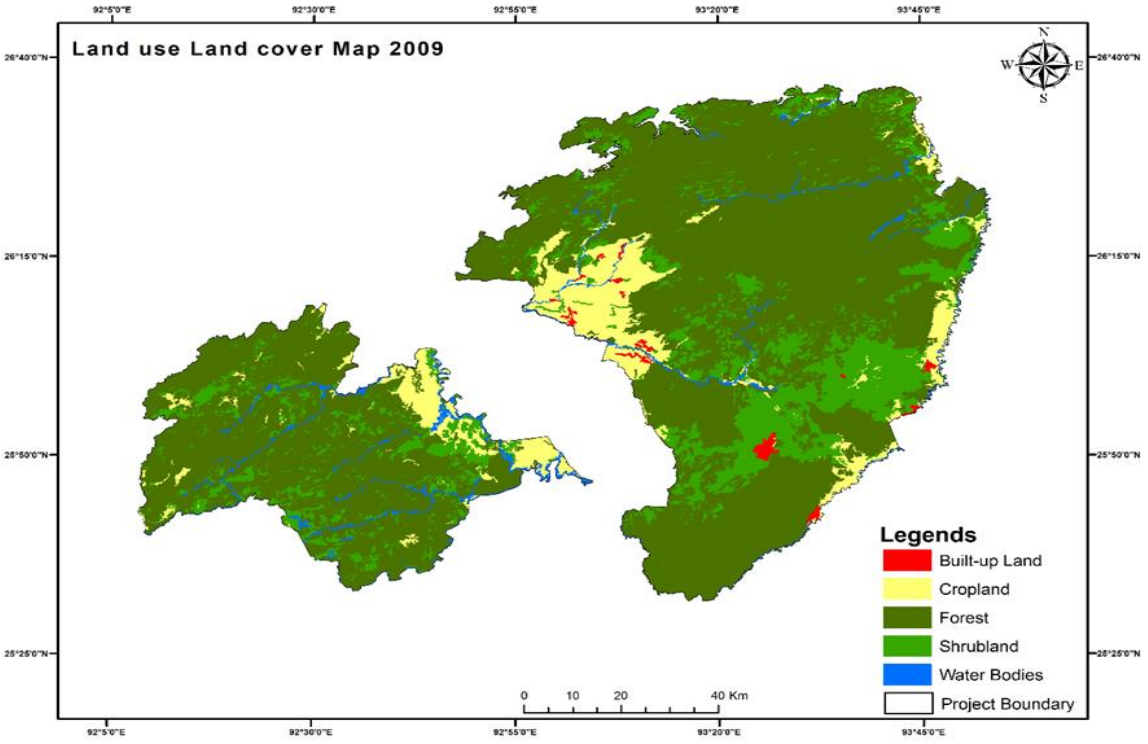
State	Ecosystem type
Assam	Major geographical region of the state enjoys the sub-tropical monsoon climate with average annual rainfall ranging to around 1500mm, with suitable sub-alpine climatic condition prevailing over hilly regions of the state. The average temperature varies across the State. The summer temperature varies between 25^{0}C and 35^{0}C while the winter temperature might reach up to 6^{0}C[9]. The climatic conditions have given rise to several forest types in the state, including Cachar semi-evergreen forest, East Himalayan moist mixed deciduous forest and Tropical wet evergreen forest[10].

[9] https://www.academia.edu/download/119648860/Ch_3_SSK_Climate_of_Assam.pdf
[10] https://fsi.nic.in/uploads/isfr2023/isfr_book_eng-vol-2_2023.pdf

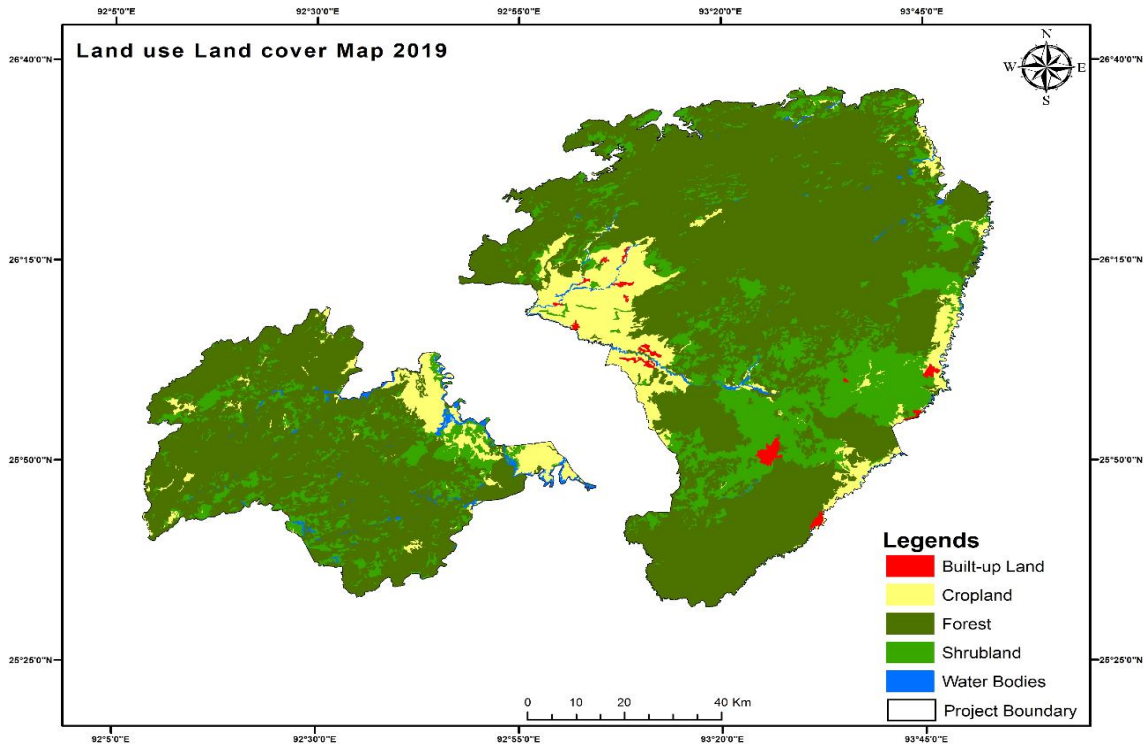
	The tree cover includes trees like *Dipterocarpus macrocarpus*, *Dipterocarpus terbinatus*, *Mesua ferrea*, *Michelia glabra*, *Palaquium polyanthum*, *Actinodaphne obovata*, *Bauhinia purpurea*, etc. Moist Deciduous Forests can further be described as Sal Forests and Mixed Deciduous Forests[11]. 14 species of cane, including endemics like *Plectomia assamica* and *Plectomia bractealis* grow in cane brakes in forests of Assam. Assam is home to a rich and diverse array of mammalian, avian, reptilian, amphibian, fish, molluscan, and insect species, including 193 mammalian species, 9 primate species, 950 bird species, 77 species of reptiles, 70 amphibians, 197 fish species, 39 freshwater molluscs, and 387 species of moths, contributing significantly to India's biodiversity.

Current and historical land-use: Prior to the project activity's implementation, the land in PAI-1 of the project area was a shrubland dominated by invasive species, contributing to land degradation. Without intervention, this degradation would have continued, exacerbating the existing environmental challenges. The baseline scenarios outlined in this document reflect an area with limited native vegetation and an overgrowth of invasive species, which hinder the natural restoration of the land. If no action were taken, the land would continue to degrade further. In response to this, the project aims to restore the land by introducing bamboo plantations, along with other appropriate measures. Overall, this initiative to rehabilitate and restore the degrading shrubland through the establishment of native bamboo plantations demonstrates a strategic and sustainable approach to improving land health and promoting better land management practices.

[11] https://environmentandforest.assam.gov.in/portlets/biodiversity-of-assam-0



Map: LULC map of the Assam Project boundary of 2009



Map: LULC map of the Assam Project boundary of 2019

Pedology and Hydrology:

Assam	**Pedology–** The state is endowed with a wide range of macro and microclimates, physiography, landforms, geology and vegetation that have an influence on the genesis of soil. Khadar and Hangar alluvial soils, along with red soils are dominantly present in the state. Inceptisols, Entisols and Ultisols are profoundly distributed across the state[12]. In certain parts of the state, Laterite soils are present. The Hill zone of this state including Karbi Anglong possess well drained deep soil which are characterized by sandy clay loamy texture[13]. **Hydrology-** The varied terrain of the state has led to different groundwater conditions. There has been an increase in the number of water bodies, indicating a higher likelihood of flooding and land being submerged. Rural communities depend heavily on groundwater for irrigation, drinking, and other needs. The available groundwater is of high quality, ranging from good to excellent for irrigation[14]. Also, most groundwater samples in the region are classified as good to excellent, making them safe for consumption. Aquifers are spatially distributed, however some of those present in the foothills of Naga hills have demonstrated Arsenic presence[15].

1.15 Compliance with Laws, Statutes and Other Regulatory Frameworks

There are no legally binding laws/ regulations enforcing or preventing the afforestation and reforestation activities in India. The afforestation /reforestation activities therefore are within the relevant, regional laws, statutes and regulatory frameworks.

India is a member of the UNFCCC (United Nations Framework Convention on Climate Change) and an active member of the ITTO (International Tropical Timber Organization). The Project complies with this regulatory framework, because in the AFOLU scope, Afforestation/Reforestation is one of several mechanisms by which GHG emissions are expected to be reduced.

The project is compliant with the entire applicable national and regional legal framework of the Government of India. The development of the project is based on guidelines included in environmental regulations and laws in force in the country. In addition, the project responds to

[12] https://www.researchgate.net/publication/338561125_Major_Soil_Types_and_Classification
[13] https://www.researchgate.net/profile/Rashmi-Baruah/publication/355200599_Characterization_classification_and_evaluation_of_soil_resources_of_a_farm_in_hill_zone_of_Assam/links/616793fa66e6b95f07c32595/Characterization-classification-and-evaluation-of-soil-resources-of-a-farm-in-hill-zone-of-Assam.pdf
[14] https://www.researchgate.net/profile/Smitakshi-Medhi/publication/384663594_Assessment_of_groundwater_quality_for_irrigation_purpose_in_aquifers_of_the_Upper_Brahmaputra_floodplains_of_Assam_India/links/67017deef599e0392fbc1a45/Assessment-of-groundwater-quality-for-irrigation-purpose-in-aquifers-of-the-Upper-Brahmaputra-floodplains-of-Assam-India.pdf
[15] https://www.sciencedirect.com/science/article/abs/pii/S2352801X24003230

the Government's desire to promote forest plantations and the development of *B. tulda* plantations.

National Government Laws

Indian Forest Act,1927[16]

The Government of India has the authority to regulate within any designated forest or wasteland, as follows:

- The fragmentation of land for cultivation refers to sites within the afforestation project activity that were previously barren and were expressly chosen for afforestation rather than agricultural cultivation.
- Deliberate setting fire to or clearance of vegetation did not occur or receive endorsement in the lands designated for the afforestation activity, which were barren prior to the project initiation.
- The imposition of tariffs on timber and other forest produce is relevant to the project since it involves the sustainable gathering of Non-Timber Forest Products (NTFPs), which is covered by the Forest Rights Act, which protects indigenous people's rights.
- The legislation governing the control of timber and other forest produce in transit is limited to occurrences involving the transfer of such commodities and, as such, does not apply to afforestation.

Project implementation and management do not violate any section of the policy.

National Forest Policy 1988[17]

Major objectives of the policy which are being enhanced by the project are:

- Increasing substantially the forest/tree cover in the country through massive afforestation and social forestry programs, especially on all denuded, degraded and unproductive lands.
- Meeting the requirements of fuelwood, fodder, minor forest produce and small timber of the rural and tribal populations.
- Creating a massive people's movement with the involvement of women, for achieving these objectives and to minimise pressure on existing forests.
- Minor forest produce provides sustenance to tribal population and to other communities residing in and around the forests. Such produce should be protected, improved and their production enhanced with due regard to generation of employment and income.

Project implementation and management do not violate any section of the policy.

[16] Rahate and Banait, "The Indian Forest Act, 1927."
[17] https://pib.gov.in/newsite/erelcontent.aspx?relid=57051

Forest Conservation Act-1980[18]

Under the FCA 1980, following sections are relevant to the project.

- Restriction on the de-reservation of forests or use of forest land for non-forest purpose. In the section 2.4 of FCA 1980 restricts any forest land or any portion thereof may be cleared of trees which havegrown naturally in that land or portion, for the purpose of using it for afforestation.

Project implementation and management do not violate the act.

Forest Right Act 2006[19]

Project implementation and management do not violate rights of indigenous peoples and objectives of FRA 2006.

Assam Government Laws

Assam bamboo & rattan policy, 2019[20]

- Enhancement of resources through promotion of bamboo and cane plantation in forest areas, wastelands as well as in private lands and through its sustainable and scientific harvesting.
- Improvement of productivity by use of improved planting stock and scientific management practices.
- Generating employment opportunity and livelihood security of the bamboo and cane dependents at all levels through assured supply of raw materials and establishment of appropriate institutions.

Project implementation and management do not violate any section of the policy.

Assam Forest Policy, 2004[21]

Major objectives of the policy which are being enhanced by the projectare:

- Maintenance of environmental stability through preservation and where necessary, restoration of ecological balance that has been adversely disturbed by serious depletion of forests in the state.
- Increasing the forest/tree cover in forest deficient areas of statelike chars, chapories permanently established along the course of the river Brahmaputra, through community afforestation and suitable agro-forestry and farm forestry models.

1) Creating a massive people's movement with special involvement of women for achieving the objectives and to minimize pressure on forests under the community-based conservation programme.

[18] Forest Conservation Act 1980 (nbaindia.org)
[19] Act.pdf
[20] https://industriescom.assam.gov.in/sites/default/files/swf_utility_folder/departments/industries_com_oid_4/portlet/level_2/assam_bamboo_and_cane_policy_2019.pdf
[21] https://asbb.gov.in/Downloads/Assam%20Forest%20Policy%202004.pdf

Project implementation and management do not violate the act. **Karbi Anglong Autonomous Council, 1951**[22]

Under the Karbi Anglong Autonomous Council, following section are relevant with respect to project:

Functions under the provisions of the Sixth Schedule, allowing legislative, executive, and financial powers and has jurisdiction over the Karbi Anglong and West Karbi Anglong districts.

This law gives power to people empowered to make laws on land, forest, agriculture, village administration, public health, and local customs.

This law works in coordination with the Assam state government but autonomy in specified areas such as agriculture or grazing or for residential or other non – agricultural purposes or for any other purpose likely to promote the interests of the inhabitants of any village or town.

Project implementation and management do not violate the act.

1.16 Double Counting and Participation under Other GHG Programs

1.16.1 No Double Issuance

Is the project receiving or seeking credit for reductions and removals from a project activity under another GHG program?

☐ Yes ☒ No

1.16.2 Registration in Other GHG Programs

Has the project registered under any other GHG programs?

☐ Yes ☒ No

1.16.3 Projects Rejected by Other GHG Programs

Has the project been rejected by any other GHG programs?

☐ Yes ☒ No

1.17 Double Claiming, Other Forms of Credit, and Scope 3 Emissions

1.17.1 No Double Claiming with Emissions Trading Programs or Binding Emission Limits

Are project reductions and removals or project activities also included in an emissions trading program or binding emission limit?

☐ Yes ☒ No

[22] https://karbianglong.gov.in/about-us/about-kaac-secratariat

1.17.2 No Double Claiming with Other Forms of Environmental Credit

Has the project activity sought, received, or is planning to receive credit from another GHG-related environmental credit system?

☐ Yes ☒ No.

1.17.3 Supply Chain (Scope 3) Emissions

Do the project activities specified in Section 1.12 affect the emissions footprint of any product(s) (goods or services) that are part of a supply chain?

☐ Yes ☒ No.

1.18 Sustainable Development Contributions

1.18.1 Sustainable Development Contributions Activity Description

The project aims to enhance the population's quality of life by promoting economic growth, creating jobs, reducing poverty and inequality, and eradicating hunger. It emphasizes sustainable use of natural resources, environmental conservation, climate change adaptation, and disaster risk management. Afforestation initiatives are being advanced to support these goals, reflecting a commitment to a resilient and sustainable future.

SDG	SDG GOALS
	The project reduces poverty by creating employment opportunities for women, youth, and marginalized communities, providing stable jobs and fair wages that enhance livelihoods and economic stability.
	The project facilitates the creation of alternative livelihoods by providing employment opportunities and food security, thereby addressing the nutritional needs of individuals in poverty engaged in project implementation and management.
	The project will provide employment to men, women, and youth, prioritizing local hires and aligning job opportunities. It ensures equitable distribution of work within the community and offers timely training to farmers to enhance plantation survival rates and productivity.
	The project activity will sequester tonnes of Carbon Dioxide (a major greenhouse gas) resulting in positive impacts on the environment. Improve soil health, thereby contributing to climate change mitigation and aligning with the objective of SDG 13, which focuses on climate action.

	Implementing sustainable land management practices enhances plantations' resilience to climate change. Planting bamboo will boosts farmers' incomes, enriches biodiversity, and prevents soil erosion, aligning with Sustainable Development Goal 15: Life on Land.

In addition to the aforementioned UNSDGs, the project activities also contribute to India's SDG targets[1] in the following ways:

Goal	Target of India	Project Activity Contribution
	Global SDG target 1.4 aims to ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property.	The project has signed agreements with farmers ensuring land ownership, control over resources, and a share of carbon credits from generated VCUs.
	Global SDG target 8.5 aims to achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities.	Project provides direct employment to local community at fair wages for plantation and management activities, supporting India's SDG goal of reducing poverty and ensuring decent work for all.
	This target corresponds to the global SDG target 13.1 which aims to strengthen resilience and adaptive capacity to climate-related hazards and natural disasters. The target has been set to 0 to imply that all States/UTs must be adequately prepared to ensure that no human life is lost due to extreme weather events.	This project supports India's SDG target 13.1 by enhancing resilience and adaptive capacity to climate-related hazards and natural disasters. By enhancing local ecosystems and promoting sustainable livelihoods to help communities withstand extreme weather events.
	National Afforestation and Eco-Development Board aims to achieve 33 percent of the geographical area in the country under forest and tree cover. Global SDG target 15.2 aims to promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally.	Project supports National Afforestation and Eco-Development Board's goal of 33% forest and tree cover by increasing green cover in targeted areas. It also contributes to SDG target 15.2 by promoting sustainable forest management, halting deforestation, and restoring degrading low productive lands, enhancing ecosystem health and environmental sustainability goals.

1.18.2 Sustainable Development Contributions Activity Monitoring

The project emphasizes sustainable development in forestry production, delivering measurable impacts across various domains. It aligns closely with specific Sustainable Development Goals (SDGs), reinforcing global sustainability efforts. Comprehensive monitoring mechanisms are in place to assess the project's contributions to sustainable development, with evaluations conducted systematically before each verification event.

Table 1: Sustainable Development Contributions

Row number	SDG target	SDG indicator	Net impact on SDG indicator	Current project contributions	Contributions over project lifetime
1)	1.1	1.1.1 Proportion of the population living below the international poverty line by sex, age, employment status and geographic location (urban/rural)	Implemented activities to decrease	PAI-1 of this project activity generating the seasonal employment of 1,397-man days including both men and women who perform manual tasks and earn an average of US$ 4.5 (more than of US$ 1.25) per day in this monitoring period.	Over the course of the project, plantation activities are projected to generate a cumulative total of 10,000 seasonal jobs. These opportunities offer individuals the chance to earn an average more than of US$ 1.25 per day throughout its life, boosting income prospects and fostering economic support for local communities.
2)	2.3	2.3.2 Average income of small-scale food producers, by sex and indigenous status	Implemented activities to increase	In the PAI-1, 462 farmers have been enrolled, encompassing nearly 2,100 individuals as part of farming families. They are anticipated to generate supplementary income from both carbon credits and secondary produce during the current monitoring period.	The entire Project Activity Instance is expected to include 3,500 farmers (with 15,500 individuals as members of farmer families), all of whom can generate additional income from carbon credits and produce in the project lifespan.
3)	8.5	8.5.1 Average hourly earnings of female and male employees, by occupation, age and	Implemented activities to increase	The project is benefiting 110 farmers and local communities (63 male and 47 female) by creating employment opportunities of 1,397 man-days	It is expected that over 2,000 farmers and local communities will get employment opportunities through the project activity in the project's lifespan.

		persons with disabilities		through its activities such as land preparation, planting, regular plantation maintenance, and project management during current monitoring period.	
4)	8.6	8.6.1 Proportion of youth (aged 15–24 years) not in education, employment or training	Implemented activities to decreased	The PAI-1 has provided SDG awareness training and Climate Change Awareness programs to 89 individuals and relevant stakeholders.	The entire Project Activity is expected to provide SDG awareness training and Climate Change Awareness programs to 1,000 individuals and relevant stakeholders.
5)	13.0	Tonnes of greenhouse gas emissions avoided or removed	Implemented activities to decreased	By plantation of 834.33 ha of land the PAI-1, project has successfully removed 205,146 tCO_2 of carbon dioxide from the atmosphere during the current monitoring period.	The project activity will sequester prevented the release of 302,310 tCO_2 (as per plantation activity in PAI-1) and over the entire Project Activity lifespan, the grouped project expected to sequester 1,780,839 tCO_2 through the plantation of 4,500 ha.
6)	15.1.	15.1.1 Forest area as a proportion of total land area	Implemented activities to increase	By plantation activity, the project has restored the 834.33 ha (in PAI-1) of degrading land and increased green cover and halt biodiversity loss in the project area.	Over the entire life of the project, 4,500 ha of degrading land will be restored by increasing green cover.

1.19 Additional Information Relevant to the Project

Leakage Management

This project aims to enhance vegetation cover on degraded or degrading shrubland, ensuring that plantation activities do not displace existing agricultural practices or grasslands. By economically empowering community groups in the project region, the initiative fosters sustainable livelihoods while simultaneously contributing to the reduction and removal of greenhouse gas (GHG) emissions, thereby supporting climate change mitigation efforts in the area. Since no agricultural activities are displaced and leakages are effectively non-existent, the overall leakage for the project is considered nil.

Commercially Sensitive Information

The public version of this Project Description and Monitoring Report contains all relevant information, with commercially sensitive details, such as benefit-sharing arrangements, excluded. Sensitive information that has been shared with the validator but withheld from the public includes land ownership documents, agreements between the project proponent (PP) and the farmer community, and agreements between the project implementor and the PP. These documents were made available to the audit team during the onsite visit.

Further Information

There is no additional information available for this project; therefore, it is not applicable.

2 SAFEGUARDS AND STAKEHOLDER ENGAGEMENT

2.1 Stakeholder Engagement and Consultation

2.1.1 Stakeholder Identification

Stakeholder Identification	The process of identifying stakeholders impacted by the project activity followed these steps: **a) Identification of the Project Area**: The Project Implementor, with over a decade of experience in agroforestry plantation and related activities in Assam, conducted a thorough evaluation to identify the optimal project area. This process included leveraging the PI's (Project Implementor) regional

	expertise, geographical knowledge, and climatic understanding. Ground assessments were carried out in collaboration with local experts and experienced farmers to ensure the selection of sites suitable for project implementation. **b) Stakeholder Identification**: To ensure an inclusive and comprehensive stakeholder identification process, the PI's adopted the following methodology: Initial Engagement: An introductory session was organized with local communities and smallholder farmers to present the project's goals, objectives, and potential benefits, particularly in improving soil organic carbon levels. Information about the consultation meeting was communicated through an invitation letter written in the local language, detailing the meeting's date, venue, agenda, and structure (including presentations and stakeholder feedback mechanisms). Stakeholder Consultation Meetings: During the meetings, stakeholders were encouraged to provide feedback on the project design and its expected impact on agroforestry practices and livelihoods. A designated stakeholder response team facilitated discussions, recorded feedback, and assessed attendees understanding of the meeting content to address any concerns effectively. Interested stakeholders, particularly farmers, were given the option to register their participation voluntarily through multiple channels, including phone calls, in-person visits to the offices of HLTEC or via voluntary representatives. c) List of Stakeholders Identified: The following groups of stakeholders were identified as integral to the project: Local Farming Communities: The primary beneficiaries who adopt plantation practices and benefit from farming practice. Daily Wage Laborers: Individuals who are involved in project activities, such as implementing soil enhancement measures, and benefit through job opportunities.
Legal or customary tenure/access rights	The project proponent (PP) holds sole ownership of the carbon rights generated under this project. This ownership is secured

through a legal framework established via agreements between the PP and PI, as well as between these entities and the participating farmers. The agreements stipulate the direct transfer of carbon rights to the PP in accordance with the contractual agreement terms and gradual legal transferred to the other entities and farmers, ensuring clarity and compliance with relevant land-use and carbon rights laws.

The farmlands involved in this project are privately owned, either by individual farmers or their families, who hold undisputed legal titles to the land. The project proponent has undertaken thorough due diligence during farmer onboarding to confirm that:

- The land is free from legal disputes: Land records and farmer declarations are verified to ensure there are no pending court cases or unresolved ownership conflicts.
- Customary or traditional rights are respected: In areas where customary tenure systems may apply, appropriate consultations were conducted with community leaders and stakeholders to confirm there are no conflicting claims or rights over the land.

Additionally, the project proponents proactively ensured the following:

- Verification of Land Ownership Documents: Legal ownership of all participating parcels was confirmed through the collection of land deeds, government records, or other legally valid documentation provided by farmers.
- Transparent Carbon Rights Agreement: The carbon rights transfer agreements explicitly outline the roles, responsibilities, and benefits for both the farmers and the project proponent. These agreements were explained in local languages to ensure complete understanding by all stakeholders.
- Conflict-Free Project Area: Ground verification and stakeholder consultations ensured that all project land parcels are free from disputes related to customary or legal land rights. This is documented as part of the project's due diligence process.

	By establishing a robust legal framework and ensuring the absence of tenure-related disputes, the project upholds the integrity of the carbon rights transfer process while respecting the rights of farmers and local communities.
Stakeholder diversity and changes over time	Social Diversity: The social diversity among stakeholders is shaped by a variety of factors, including the regional farming practices and socio-economic structures. Farming methods such as subsistence farming, extensive cereal cultivation, agroforestry, and mixed farming are deeply ingrained in the social fabric of the regions involved. Furthermore, external influences such as education, governance, political policies, and community development programs play a crucial role in defining social dynamics. The project primarily engages small to medium landholding farmers and local daily wage laborers as key stakeholders. This group is diverse in income levels, social status, and access to resources, which impacts their ability to adopt soil organic carbon improvement practices. Efforts are made to ensure inclusivity and equity, recognizing the diverse social needs and capabilities of stakeholders. Financial Diversity: Stakeholders exhibit a broad spectrum of economic statuses, influencing their involvement and participation in the project: 1. Small Landholding Farmers: These farmers often face financial constraints, limiting their access to inputs like organic fertilizers, improved seeds, and technical guidance. They represent a critical group requiring targeted support through subsidies, technical training, and financial incentives. 2. Medium-Sized Landholding Farmers: This group generally experiences stable incomes and has greater access to resources. They serve as early adopters and role models for sustainable practices that enhance soil organic carbon levels. 3. Daily Wage Laborers: Economic stability for this group depends on job availability and seasonal agroforestry activities. The project provides consistent employment opportunities, contributing to their financial resilience.

By addressing these financial disparities, the project ensures equitable access to benefits, fostering inclusive growth and participation among all stakeholder groups.

Cultural Diversity: The project spans the culturally diverse states of Assam, each with unique traditions, languages, and practices. The cultural differences among stakeholders have been acknowledged and celebrated as a strength rather than a barrier. Stakeholder engagement activities were conducted without bias towards caste, religion, or language, fostering an inclusive environment where people from varied cultural backgrounds collaboratively contributed to the project's success.

The implementation of the project has acted as a catalyst for fostering cultural exchange and understanding among stakeholders. Interactions during training sessions, community meetings, and on-field activities have allowed individuals to share their traditions and practices, enriching the collective cultural experience within the project area.

Promoting Positive Change: The project has contributed to strengthening social cohesion, economic stability, and cultural resilience by:

- Encouraging inclusive participation from all stakeholder groups.
- Providing equitable opportunities for financial and social upliftment.
- Respecting and incorporating diverse perspectives and traditions into project activities.

Changes Over Time: Over the project's duration, the stakeholder community has witnessed positive changes, including:

- Increased collaboration among farmers and laborers from different backgrounds, leading to a more cohesive and resilient community.
- Improved economic stability for smallholders and laborers through consistent project support and employment opportunities.

	• Greater appreciation and integration of cultural diversity, enhancing mutual respect and understanding within the community. Despite differences in social, financial, and cultural aspects, the project has successfully brought together stakeholders from varied backgrounds, fostering collaboration, knowledge exchange, and collective progress. This integration has significantly contributed to creating a vibrant and inclusive project community.
Expected changes in well-being	The project activities are designed to be environmentally sustainable, delivering a range of anticipated benefits to the surrounding ecosystem and communities. Key environmental improvements include biodiversity conservation through *B. tulda* plantations, enhancement of soil fertility, improved water retention capacity, and contributions to climate change mitigation and adaptation through increased carbon sequestration. Stakeholder consultations with individual farmers and local communities have underscored the importance of the project to their livelihoods and overall well-being. For the farming community, the project fosters an opportunity to adopt efficient and sustainable agroforestry practices, thereby potentially improving their economic resilience. The inclusion of local people in project activities promotes empowerment, ownership, and a sense of shared responsibility among stakeholders. Furthermore, the project's focus on sustainable land management practices is expected to improve ecosystem services like soil health and water quality. As a result, the project can lead to significant positive changes in the social and economic well-being of the community, including job creation and skill development. By integrating these aspects, the project not only advances environmental objectives but also strengthens social cohesion and economic stability within the project area.
Location of stakeholders	The primary focus of stakeholders, including NGOs, local farmer communities, local stakeholder farming communities that are situated in Assam.

Location of resources	The project strategically targets the district i.e. Karbi Anglong, district of Assam. These areas are characterized by a significant presence of small and marginal farming communities, who either own or customarily access land and resources within these regions. Engaging these stakeholders is pivotal to the project's success and long-term sustainability. The project employs a phased approach to engage local communities, ensuring that their traditional rights, practices, and resource needs are respected. This inclusivity fosters widespread participation among diverse groups, enabling the project to deliver benefits that extend beyond individual stakeholders. The project also places a strong emphasis on social inclusivity, involving key stakeholders like smallholder farmers, women, and marginalized groups. This approach not only promotes social and economic empowerment but also strengthens the connection between the project and the local communities, increasing their commitment to sustainable practices. Women, in particular, are recognized as vital contributors to the project's goals, playing a crucial role in promoting afforestation practices and resource management. This broad-based participation fosters collective responsibility among stakeholders, ensuring the project's benefits—enhanced livelihoods, improved ecosystem services, and strengthened community resilience have a long-lasting impact across the targeted regions.

2.1.2 Stakeholder Consultation and Ongoing Communication

Date of stakeholder consultation	Various stakeholder consultation meetings were conducted phase wise in different blocks between 2019-2022. Please see the above detailed table.

Sr.No.	Date	Place/Location
1	27-May-2019	Terang gaon, Rongkhang, Karbi Anglong
2	01-June-2019	Matikhola Timung Gaon, Samelangso, Karbi Anglong
3	04-June-2019	Terang Gaon, Rongkhang, Karbi Anglong

4	07-March-2020	Men taro, Samelangso, Karbi Anglong
5	18-June-2020	Men Taro, Samelangso, Karbi Anglong
6	12-May-2021	Matikhola Timung Gaon, Samelangso, Karbi Anglong
7	04-February-2022	Arsong Kanbor Horai, Rongkhang, Karbi Anglong
8	03-May-2022	Bhek Killing Gaon, Karbi Anglong

Stakeholder engagement process

The stakeholder engagement process was designed to be culturally sensitive and inclusive, ensuring the active participation of diverse community groups across the regions of Assam. Invitations for meetings were distributed through multiple culturally appropriate channels, including public notices prominently displayed at Gram Sabha offices and direct communication through village leaders. To accommodate linguistic diversity, invitations were issued in local languages (Assamese) and English. These announcements were made 8–10 days prior to the scheduled meetings, allowing sufficient time for stakeholders to prepare and attend.

The process involved multiple phases to ensure effective engagement and communication:

1. **Announcement and Initial Awareness Creation**: The project team worked closely with local leaders and social representatives to announce the project. Meetings with these representatives helped establish trust and provided a platform to disseminate information about the project's objectives, expected benefits, and participation processes. Emphasis was placed on making these sessions gender-sensitive, encouraging women and marginalized groups to attend and share their perspectives.
2. **Community Consultations and Group Discussions**: Village-level meetings were held to ensure broad participation from farmers and other stakeholders. These meetings used simple and accessible language to explain

	the environmental, social, and economic benefits of sustainable *B. tulda* cultivation. 3. **Individual Farmer Engagement and Feedback Collection**: The project team conducted small group discussions and one-on-one consultations with farmers to provide personalized guidance and address specific queries. Stakeholders were encouraged to share feedback on project plans, which was documented systematically. Key suggestions, such as preferred planting techniques and concerns about water usage, were incorporated into the project design. **Methods for Documenting Outcomes**: • Detailed minutes of all meetings were prepared, capturing stakeholder feedback, concerns, and suggestions. • Photographs and attendance records of participants were maintained for transparency and accountability. • Feedback forms were distributed to participants to document their perspectives on the project's objectives and approach. **Gender and Cultural Sensitivity**: Efforts were made to ensure gender sensitivity by providing a comfortable environment for women to participate and share their views. Additionally, cultural traditions and practices were respected by scheduling meetings at convenient times and choosing neutral, accessible venues. The ongoing communication strategy includes regular follow-up meetings, project updates, and the establishment of a local grievance redressal mechanism. These steps ensure transparency, continued stakeholder involvement, and trust-building throughout the project lifecycle.
Consultation outcome	The consultation process was characterized by active and inclusive participation from all stakeholder groups, ensuring that each voice was heard. Stakeholders were given a platform to express their views and concerns, leading to a collective and unanimous agreement to proceed with the project. During discussions, the project's design and

implementation were carefully examined, with stakeholders providing valuable insights and suggestions, which were considered for project optimization. Extensive discussions were held regarding the potential risks, costs, and benefits of the project. These included the environmental and social benefits such as improved plantation activities, carbon sequestration, and enhanced livelihoods, as well as potential risks like the possibility of adverse impacts on water usage and land management.

A detailed review of relevant laws and regulations pertaining to workers' rights in the host country was provided. This review ensured that the project adheres to national labor laws, especially concerning fair wages, working hours, and safety standards for workers involved in the plantation process. The project team ensured that these regulations were clearly communicated to all stakeholders to ensure full legal compliance and to address any concerns raised by stakeholders, particularly those related to worker rights and fair treatment.

In line with Free, Prior, and Informed Consent (FPIC) principles, all stakeholders were given sufficient information in a language and format understandable to them. The project clearly communicated the scope, objectives, and expected outcomes, ensuring stakeholders could make an informed decision about their participation. Stakeholders were encouraged to raise any concerns or objections, which were thoroughly discussed and addressed before proceeding with the project. This approach ensured that the stakeholders' consent was given freely and without coercion.

The VCS validation and verification process was also introduced during consultations, explaining how the project will undergo independent validation and verification. This process ensures transparency, accountability, and credibility of the project's activities and outcomes. Stakeholders were informed about how VCS certification would provide third-party validation of the project's environmental and social claims, which will further ensure the integrity of the project and its alignment with global standards.

	Overall, the consultation outcome was positive, with stakeholders demonstrating a clear and thorough understanding of the project's objectives, risks, costs, and benefits. The proactive communication approach fostered transparency and trust, ensuring that stakeholders were well-informed and comfortable with their involvement. As a result, the project is set to proceed with the active and committed participation of all stakeholders, ensuring that the project aligns with both environmental and social objectives.
Ongoing communication	The HLTEC have established comprehensive mechanisms for continuous stakeholder communication in the project. These include local representatives, a regional support office, and a volunteer network to ensure accessibility and prompt issue resolution. Regular updates are shared through meetings and direct contact, fostering inclusivity and enabling stakeholders to voice concerns and provide feedback. Communication is culturally sensitive, with materials in local languages and efforts to include underrepresented groups, particularly women. A transparent grievance redressal system ensures concerns are addressed efficiently. These mechanisms promote trust, collaboration, and stakeholder ownership of the project, facilitating the adoption of sustainable practices and ensuring its long-term success. By fostering engagement at all levels, the project strengthens relationships with the community and aligns activities with stakeholder needs and expectations.
Stakeholder input	The stakeholder consultation process reflected a strong sense of optimism and support for the project. Farmers and other participants appreciated the environmental benefits, increased productivity, and additional monetary advantages resulting from the project's implementation. Their feedback was thoroughly analyzed and incorporated into the project's planning and operational framework to ensure alignment with their expectations and the project goals. Key inputs and actions taken include: 1. **Regular Stakeholder Meetings**: Farmers suggested conducting regular consultations, which the project team agreed to integrate into the ongoing stakeholder

	engagement process to maintain transparency and open communication. 2. **Support for Field Activities**: Stakeholders offered to assist during DOE field visits and data collection, which has been incorporated into the field monitoring plan. 3. **Monitoring and Carbon Credit Sharing**: Farmers expressed their willingness to participate in carbon credit monitoring and sampling activities, and detailed discussions clarified the mechanisms for sharing benefits from carbon credits, ensuring mutual understanding and satisfaction. 4. **Consensus on Positive Impacts**: Stakeholders unanimously agreed that the project poses no negative impacts and recognized its potential to enhance area productivity and improve livelihoods in the region. The project team reviewed all inputs to determine updates to the design. While no substantial changes were deemed necessary due to alignment with stakeholder expectations, minor adjustments, such as scheduling regular consultations and enhancing communication about carbon credit sharing, were implemented. The process of actively incorporating stakeholder feedback reinforced transparency, inclusivity, and trust, laying the foundation for long-term collaboration and project success.

2.1.3 Free Prior and Informed Consent

Obtaining consent	The consent for implementing the project activities in Assam was obtained through an inclusive and transparent consultation process, adhering to the principles of Free, Prior, and Informed Consent (FPIC). The project team conducted phased consultations with local communities, including Indigenous Peoples (IPs), Local Communities (LCs), and customary rights holders, ensuring the process was culturally appropriate, inclusive, and sensitive to local traditions and norms. During initial consultations, stakeholders were provided with detailed information about the project objectives, activities, potential impacts, and benefits, including mechanisms for

	sharing carbon credits and other project-derived gains. The discussions were held in local languages to ensure clear communication and understanding. Participants were encouraged to express their views openly, and any concerns were addressed comprehensively. All agreements were formalized through written consents ensuring transparency and mutual agreement. Efforts were made to identify and engage all relevant rights holders, with additional focus on women, marginalized groups, and underrepresented stakeholders, to foster equitable participation. No unresolved conflicts or disputes were identified in the project areas during stakeholder engagement. Moreover, steps were taken to confirm that the project activities would neither exacerbate nor influence the outcomes of any pre-existing conflicts in surrounding regions. The project team has established an accessible grievance redressal mechanism to address any emerging issues, ensuring sustained collaboration and trust with stakeholders.
Outcome of FPIC	The Free, Prior, and Informed Consent (FPIC) process for the project in Assam resulted in a transparent and collaborative agreement with Indigenous Peoples (IPs), Local Communities (LCs), and customary rights holders. Stakeholders were provided with detailed project information, including objectives, anticipated environmental and social benefits, carbon credit mechanisms, and monitoring processes, prior to seeking consent. This ensured all participants had a clear understanding of the project's implications and benefits before entering into agreements. The FPIC process successfully led to formal agreements with all relevant stakeholders, where participants voluntarily endorsed the project. These agreements confirm that the project activities are fully supported and aligned with local communities' expectations and needs. The disclosed information emphasized that the project would not result in encroachment on land, involuntary relocation, or any form of physical or economic displacement. Furthermore, the project adhered to strict guidelines to ensure that no customary or legal rights were violated, and all concerns raised during the consultation process were

	addressed comprehensively. The participatory nature of the process fostered trust and established a strong foundation for long-term collaboration with stakeholders. By ensuring transparent communication and securing voluntary consent, the project guaranteeing ethical and sustainable implementation of activities while respecting local rights and traditions.

2.1.4 Grievance Redress Procedure

Development process	Identified the key stakeholder which is affected by the project. Assessment was conducted by all stakeholders for understanding the local context and their issues. Grievance redressal mechanism has been developed with the aim that farmers can reach out to the professionals related to any query/ suggestions regarding the on-ground implementation of the project. Management is aware that there may be times when employees/workers/farm members need to file an official complaint about unjust treatment, harassment, and/or health and safety concerns in the workplace. Thereafter, a grievance mechanism was established by PP, where all the grievance would be addressed by local NGO representative to resolve it at initial level. The mechanism has been developed in a such way that the views of all the stakeholders reach the higher management authorities. The group of farmers can address the complaint and any grievance in relation to the project. The grievance mechanism includes the following: Stakeholders can file grievances through many channels, including in-person, Grievance Register, phone, text message, email, or internet. The NGO team regularly checks the Grievance Register with each farmer. A collection of grievances is maintained as a database (Grievance register) in the PP's head office.
Grievance redress procedure	The Grievance Redress Mechanism (GRM) enables aggrieved stakeholders ("complainants") to express their concerns through various channels, as mentioned previously. Its primary goal is to provide an accessible, quick, and effective response

to concerned stakeholders, particularly vulnerable populations who may lack access to official legal systems.

It is essential that potentially impacted stakeholders understand the purpose of the GRM, the various options available for voicing their grievances, and where to obtain assistance and guidance on how to proceed. For this project activity, the grievance mechanism is designed to be straightforward, allowing every individual to raise complaints or address queries effectively. Farmers can discuss their concerns with a designated group member appointed in their village by the NGO.

Before filing an official grievance complaint, HLTEC management asks that all employees review the policy that directly impacts their complaint. For example, if an employee files a sexual harassment, discriminatory complaint, he/she must consult the owner. HLTEC management encourages employees to resolve minor disputes with the help of a mediate person may be workers representative. If the informal complaint is not fairly and constructively resolved within 10 days, employees/workers may file a formal grievance.

If the issue can be resolved at the village member level, they have the authority to address it directly. If the issue cannot be managed at this level, it will be escalated to HLTEC management, where it will be documented in the grievance register and addressed within 10 days. If queries about the carbon project remain unresolved, HLTEC will contact team Infinite for an immediate response.

Acknowledging Receipt: Staff members who receive grievances, whether at the project office or through NGOs, should notify complainants that their grievance has been received. This will be logged and reviewed for eligibility, with an initial organizational response generated if deemed eligible. Acknowledgment should typically be sent within 3 to 5 days of receipt, often in the formal letters.

Evaluating GRM Eligibility: This procedural step confirms that the issue presented is relevant to the project. Maintaining a low barrier to entry with a rapid turnaround is preferable, ensuring that concerns can be addressed without

unnecessary obstacles. Eligibility determination serves to initiate an initial examination and response.

Assigning Responsibility: Complaints are directed to the appropriate institution or individual. Given the involvement of multiple partners in project activities, clarity regarding roles and responsibilities for GRM implementation and response is crucial. The referral process will depend on the type of issue raised and its associated risk level.

Closing Out the Grievance: If the response is successful, GRM staff will document the satisfactory resolution in consultation with the complainant. In cases involving significant risks, impacts, or negative publicity, it may be appropriate to include written documentation from the complainant indicating satisfaction with the response.

If there is a grievance or question that cannot be resolved through discussion or by both the parties (PP and project Implementor), it will be referred to a neutral third party, such as agricultural experts, environmental consultants, or academics, for mediation. If mediation fails, the project has a choice between arbitration, national courts, or possibly a higher international body for dispute resolution.

Key Features of the Grievance Mechanism:

1. The grievance procedure, governing structure, and decision-makers must be transparent.
2. Accept and thoroughly investigate all Grievance Complaint Forms.
3. The GRM should address concerns quickly, effectively, and in a culturally appropriate manner, ensuring accessibility for all affected parties without cost or retaliation within 10 days, depending on the severity of each case.
4. The project proponent (PP) will inform impacted parties about the grievance process during community engagement initiatives and maintain a public record of grievance responses.
5. All grievances will be processed confidentially, independently, and without bias, and in a timely manner. PP will treat all parties fairly throughout the grievance process.
6. The project will accept and investigate all appeals, ensuring the implementation of the final decision.
7. PP will maintain accurate and comprehensive records of each grievance.

	8. Users of the grievance mechanism will not face retaliation, abuse, or discrimination. The PP employs trained personnel to conduct stakeholder engagement initiatives and may seek external expertise as needed.

Grievances received	Resolution and outcome
Not Applicable	All project activities are implemented on private or farmer-owned land. So, this indicate that the procedure is easily accessible to stakeholders for ongoing consultation.

2.1.5 Public Comments

Comments received	Actions taken
Project was open for public comment period from 15-August-2022 to 14-September-2022, the project did not receive comments during the public commenting period, or after the public comment period.	No action required as there are no comments received.

2.2 Risks to Stakeholders and the Environment

2.2.1 Management Experience

The project management and development teams consist of experienced professionals with over five years of expertise in AFOLU project design, carbon accounting, and reporting. Many have successfully managed projects through the validation, verification, and issuance of GHG credits under the VCS Program or other approved GHG programs. The management teams possess expertise and experience in implementing nature-based livelihood and carbon development projects. The project proponent has also partnered with the HLTEC to enhance project support and has developed a recruitment strategy to address identified gaps in expertise or resources. This collaborative, interactive approach ensures effective management, reduces risks, and promotes positive project outcomes.

2.2.2 Risk Assessment

	Risks identified[23]	Mitigation or preventative measure taken

[23] The identified risks and commensurate mitigation or preventative measure(s) for forced labor, child labor, and human trafficking, must be inclusive of staff and contracted workers employed by third parties

Natural and human-induced risks to stakeholders' wellbeing	No risk identified	Our project design includes strategies aimed at preventing potential negative impacts, backed by stringent protocols to ensure stakeholder safety and well-being throughout the project. The careful planning and implementation of our activities, which prioritize both environmental and social responsibility, reinforce this proactive approach. This effectively mitigates possible risks, thereby protecting the interests of all parties involved. The species planted in this project are native. Thus, they do not primarily possess any natural risk disrupting the environmental wellbeing of participants. Participants are always part of decision making and monitoring plans, thus a sense of connectedness and integrity is ensured, pointing towards workplace, financial and societal wellbeing as a whole.
Risks to stakeholder participation	No risk identified	The project proponent has assessed and not any natural and human-induced risks to local stakeholder's well-being, food security, land loss, loss of yields and climate change adaptation were identified. All the local stakeholders have been included in the local stakeholder consultations during the development of the carbon project and further, general training during project activity considers any potential risks. The project activities have been carefully developed in collaboration with the owners and beneficiaries. Their valuable input and perspectives have been taken into consideration during the planning process. All local stakeholders were consulted during the LSC meetings, and their concerns were addressed before they actively participated in the project. The

		project design includes measures to mitigate any foreseeable risks, ensuring that stakeholder safety and wellbeing are not compromised. As a result, stakeholders can engage with the project confidently, knowing that their health and safety are safeguarded.
Working conditions	No risk identified	Working conditions of the project involve safety measures, fair compensation, training and support. No risk involves for current project working conditions. PP having HR policies and Code of conduct against the working condition. Employees of this project activity have respectable working conditions, equitable payment, and equal possibilities for growth and learning in an environment where people are free to voice their concerns and demand for better terms.
Safety of women and girls	No risk identified	The project proponent confirms that no entity (project proponent or any other entity) involved in any form of discrimination or sexual harassment during current monitoring period as well PP have strict HR policies POSH and Anti-Harassment policies regarding safety of women and girls.
Safety of minority and marginalized groups, including children	No risk identified	Conducted awareness programs focusing on safety, health, and potential risks associated with the project, educate both adults and children about safety practices and potential hazards to minimize risks. Ensure that the rights and interests of minority groups, including children, are respected and protected throughout the project duration. This includes safeguarding against exploitation, ensuring fair compensation, and preserving their access to resources.

Pollutants (air, noise, discharges to water, generation of waste, and release of hazardous materials and chemical pesticides and fertilizers)	No risk identified	The project involves plantation only. There will be no harm in air, water nor generation of any kind of waste due to the implementation of project. The project proponent (PP) has implemented safeguards to protect the surrounding environment, including air and water quality, noise levels, and hazardous materials. Additionally, the PP complies with the laws and policies set forth by the Government of India.

2.3 Respect for Human Rights and Equity

2.3.1 Labor and Work

	Risks identified[24]	Mitigation or preventative measure(s) taken
Discrimination	No risk identified	Discrimination-related incident was not reported. The project proponent affirms that neither the project proponent nor any other entity engaged in project design or implementation has been implicated in any instances of discrimination, PP have strict HR policies regarding sexual harassment.
Sexual harassment	No risk identified	Sexual harassment -related incident was not reported. The project proponent affirms that neither the project proponent nor any other entity engaged in project design or implementation has been implicated in any instances of sexual harassment, PP have strict HR policies regarding sexual harassment.
Equal pay for equal work	No risk identified	The project proponent offers employment opportunities and promote fair and inclusive work environments for both men and women in Assam. We ensure equal pay for equal work and value, and currently have a team (implementation partners) of many individuals working on the ground across the project boundary.

[24] The identified risks and commensurate mitigation or preventative measure(s) for forced labor, child labor, and human trafficking, must be inclusive of staff and contracted workers employed by third parties.

Gender equity in labor and work	No risk identified	The project's sustainable practices are poised to bring about environmental enhancements and bolster the socio-economic well-being of the stakeholders. Consequently, a commitment to upholding gender equity and fair compensation for labor and work is inherent in the project's approach, with equal opportunities having been already provided or planned for in this regard.
Forced labor	No risk identified	PP does not promote or engage in forced labor within or outside of the project boundary and is committed to not using victims of these practices now or in the future. There are no such events/ activities in project which represent victims of forced labor.
Child labor	No risk identified	PP does not promote or engage in child labor within or outside of the project boundary and is committed to not using victims of these practices now or in the future. There are no such events/ activities in project which represent victims of child labor.
Human trafficking	No risk identified	PP does not promote or engage in human trafficking within or outside of the project boundary and is committed to not using victims of these practices now or in the future. There are no such events/ activities in project which represent victims of human trafficking.

2.3.2 Human Rights

The property and land use rights of local stakeholders have been upheld, and free, prior, and informed consent has been obtained from enrolled farmers through a Farmer's Agreement. Consequently, the project recognizes, respects, and promotes the protection of the rights of farming communities and customary rights holders, in alignment with applicable international human rights law.

Risks identified	Mitigation or preventative measure(s) taken
No risk identified	The property and land use rights of the local stakeholders have not been violated. The property and land use rights will remain intact, with the project ensuring that free, prior, and informed consent has been obtained from the enrolled farmers through the execution of farmer's agreement.

2.3.3 Indigenous Peoples and Cultural Heritage

There are no any IPs and LCs in the project area. All the farm owners involved in this project activity includes lands or territories duly owned or controlled by farm owners and are not undertaken by other parties.

Risks identified	Mitigation(s) or preventative measure taken
No risk identified	Project staff, partners, and stakeholders had received cultural sensitivity training to promote respect and knowledge of the customs, beliefs, and practices of the local community and also developed guidelines and protocols to ensure that project operations are conducting in a way that respects and doesn't impede cultural customs and sensitive locations.

2.3.4 Property Rights

The current ARR project has been implemented in the private farmland which has clear title rights of the local farmers from the local stakeholder community. The property rights and resources right go to landowner of plantation areas. The legal documents of land right are available with each farmer which justify the real ownership.

Risks identified	Mitigation or preventative measure(s) taken
No risk identified	The property and land use rights of local stakeholders have been fully respected, and free, prior, and informed consent has been obtained from enrolled farmers through a Farmer's Agreement.

2.3.5 Benefit Sharing

Process used to design the benefit sharing plan	The benefit-sharing mechanism (BSM) was described during a consultation meeting regarding carbon revenue and other benefits generated through the project's activities. As a result of the consultation, agreements were signed with all beneficiaries involved in the project.
Summary of the benefit sharing plan	The carbon agreement was signed between the individual farmer and project implementer (HLTEC), which includes a permanent binding contract, benefit sharing percentage, and land ownership. Furthermore, it confirms that carbon rights are transferred to PP and clearly explains how funds will be used and shared. The agreement ensures that revenue is allocated for plantation maintenance, necessary fees, and fair distribution among beneficiaries. Additionally, with a legally enforceable contract, beneficiaries fully understand their roles, commitments, and expected benefits.

Approval and dissemination of benefit sharing plan	A clear and transparent agreement has been established between the farmers and the project implementors, detailing the rights associated with carbon credit generation for the development of the carbon project. These agreements are presented to farming groups during community meetings to ensure that all terms are understood and accepted by the community. Project implementor staff will ensure that the agreement is readily accessible to the community upon request.
Benefit sharing during the monitoring period	The actual benefit sharing of the received carbon credit finance will be directly deposited into the bank accounts of the respected farmers. The fund distribution to the individual farmers will be determined by the extent of the plantation and the volume of carbon sequestration achieved by the project activity in the monitoring period. The benefit sharing mechanism agreement is a commercially sensitive document which is attached in Appendix –1. The channel progress is as follows: Project Proponent ⟶ Project Implementor ⟶ Farmers

2.4 Ecosystem Health

	Risks identified	Mitigation or preventative measure(s) taken
Impacts on biodiversity and ecosystems	No risk identified	The project is implemented on privately owned land (degrading shrubland) that is already experiencing degradation, limiting potential adverse impacts on local biodiversity and ecosystems. Furthermore, Bamboo plantations is expected to enhance the ecosystem by improving soil health and providing ground cover that can support local flora and fauna. Monitoring will be conducted to ensure that no adverse biodiversity impacts occur. Moreover, the project proponent has made efforts to avoid the introduction of invasive species, ensuring that all planting activities contribute to the preservation and enhancement of the local environment. By emphasizing the use of naturally adapted species, the project has

		supported the natural flora and fauna of Assam contributing to the resilience and sustainability of local ecosystems.
Soil degradation and soil erosion	No risk identified	The Bamboo planted in the project area will bind the soil, effectively preventing topsoil erosion. Farmers actively participate in bamboo planting, which enhances soil health and contributes to overall environmental improvement. This initiative not only restores ecosystem balance but also boosts soil fertility through the act of planting.
Water consumption and stress	No risk Identified	The species involved in the project do not contribute to water stress or depletion of soil moisture. However, *Bambusa tulda* has been shown to effectively bind soil due to its clump growth pattern, which promotes soil and water conservation[25]. Moreover, this species holds potential for the reclamation of saline soils and water[26]. The mobility of soil water is strongly linked to the performance of *B. tulda*[27].

2.4.1 Rare, Threatened, and Endangered species

Is the project located in or adjacent to habitats for rare, threatened, or endangered species?

☐ Yes ☒ No

2.4.2 Introduction of species

Species introduced	Classification	Justification for use	Adverse effects and mitigation
Bengal Bamboo (*Bambusa tulda* Roxb)	Native[28]	*Bambusa tulda* Roxb., also known as Bengal bamboo, belongs to Poaceae family. This is one of the most important bamboos in many parts of its range, especially India, Bangladesh and northern Thailand.	This species has no adverse effect so there is no need of any mitigation measure.

Existing invasive species	Mitigation measures to prevent the spread or continued existence of invasive species

[25] Indian Journal of Ecology (2023) 50(3): 799-801 DOI: https://doi.org/10.55362/IJE/2023/3972
[26] https://indianecologicalsociety.com/wp-content/themes/ecology/volume_pdfs/1686627678.pdf
[27] https://www.researchgate.net/profile/Aniket-Gaikwad-6/publication/358208993_Effect_of_different_bamboo_species_on_soil_properties_grown_on_Entisol_of_semi-arid_climate/links/640e1c1d315dfb4cce7254fc/Effect-of-different-bamboo-species-on-soil-properties-grown-on-Entisol-of-semi-arid-climate.pdf
[28] https://doi.org/10.1007/978-981-10-0569-5_3

Lantana camara	Uprooting or weeding

2.4.3 Ecosystem conversion

The project activity has not cleared the native ecosystems within last 10 years from its start date. PRA responses conclude that land parcels involved in the project activity were in the land use identified in the baseline which either shrubland or partially agriculture since more than last 10 years. LULC map has been uploaded with the project documents and can be used to cross check any conversion of native ecosystem.

	Risks identified	Mitigation or preventative measure(s) taken
Ecosystem conversion	No risk identified	Not Applicable

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

The CDM consolidated methodology AR-ACM0003: Afforestation and reforestation of lands except wetlands -Version 02.0 is applied in this project activity.

Type (methodology, tool or module).	Reference ID, if applicable	Title	Version
Methodology	AR-ACM0003	AR-ACM0003: Afforestation and reforestation of lands except wetlands[29]	2.0
Tool	AR-Tool 02	AR-TOOL02: Combined tool to identify the baseline scenario and demonstrate additionally in A/R CDM project activities[30]	01
Tool	AR-Tool 03	Calculation of the number of sample plots for measurements within A/R CDM project activities[31]	2.1.0
Tool	AR-Tool 08	Estimation of non-CO_2 greenhouse gas (GHG) emissions resulting from burning of biomass attributable to an A/R CDM project activity[32]	4.0

[29] https://cdm.unfccc.int/UserManagement/FileStorage/THNRJC15IW4K89UBE6DFZYX23OVP0Q
[30] https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-02-v1.pdf
[31] https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-03-v2.1.0.pdf
[32] https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-08-v4.0.0.pdf

Tool	AR-Tool 14	Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities[33]	4.2.0
Tool	AR-Tool 15	Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity[34]	2.0
Tool	AR-Tool 16	Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities[35]	1.1.0
Tool	AR-Tool 17	Demonstrating appropriateness of allometric equations for estimation of aboveground tree biomass in A/R CDM project activities	1.0
Tool	AR-Tool 19	Demonstration of eligibility of lands for A/R CDM project activities[36]	2.0
Tool	NA	VCS AFOLU Non-Permanence Risk Tool (Version 4.2)[37]	4.2

3.2 Applicability of Methodology

Methodology ID	Applicability condition	Justification of compliance
AR-ACM0003	This methodology is applicable under the following conditions: a) The land subject to the project activity does not fall in wetland category b) Soil disturbance attributable to the project activity does not cover more than 10 per cent of area in each of the following types of land, when	a) Wetlands are defined as lands that are covered or saturated by water for all or part of the year (e.g., peatland) and that does not fall into the forest land, crop land, grass land or settlements categories[38]. In the section 1.14, LULC map have been provided for the Project area which concludes that project area does not fall under wetland category. b) As per implementation plan, dimensions of pits have been fixed at 0.3 x 0.3 m.

[33] https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-14-v4.2.pdf
[34] cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-15-v2.0.pdf
[35] https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-16-v1.1.0.pdf
[36] https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-19-v1.pdf
[37] AFOLU-Non-Permanence-Risk-Tool-v4.2-FINAL.pdf (verra.org)
[38] https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/4_Volume4/19R_V4_Ch07_Wetlands.pdf

	these lands are included within the project boundary I. Land containing organic soils II. Land which, in the baseline, is subjected to land-use and management practices and receives inputs listed in appendices 1 and 2 to this methodology A project activity applying this methodology shall also comply with the applicability conditions of the tools contained within the methodology and applied by the project activity.	Plantation density remained less than 500 plants per hectare throughout the project area. Activity results total 0.3 x 0.3 m x 300 (maximum density of plant per hectare) = m^2 soil disturbance per hectare. It concludes that total soil disturbance occurred due to project activity is 0.27%. The project activity complies all the applicability condition of this methodology as well applied tool.
AR-CDM Tool 02	Forestation of the land within the proposed project boundary performed with or without being registered as the A/R CDM project activity shall not lead to violation of any applicable law even if the law is not enforced.	Refer section 1.14 herein, which enumerates that the project activity and first project activity instance is in compliance with all local laws and regulations and does not lead to violation of any applicable law, even if the law is not enforced. In fact, the project activity and first project activity instance being agroforestry system is promoted by various national and state policy as detailed in section 1.15 herein above.
	This tool is not applicable to small - scale afforestation and reforestation project activities.	The project activity is a grouped project activity and PAI-1 covers 834.33 hectare of area during 2019 to 2022. PP intends to scale up the project up to 4,500 ha area which will lead to annual GHGs removal more than 16,000 tons of CO_2, as per CDM methodology booklet large scale methodology applicable.[39]

[39] https://cdm.unfccc.int/methodologies/docum entation/meth_booklet.pdf

AR-CDM Tool 03	This tool has no internal applicability conditions.	Not applicable.
AR-CDM Tool 08	The tool is applicable to all occurrence of fire within the project boundary. Non-CO_2 GHG emissions resulting from any occurrence of fire within the project boundary shall be accounted for each incidence of fire which affects an area greater than the minimum threshold area reported by the host Party for the purpose of defining forest, provided that the accumulated area affected by such fires in a given year is ≥5% of the project area.	a) As detailed in section 5.2, the farmers participating in the Project Activity and the First Project Activity Instance not using biomass burning or fire for site or land preparation. b) As mentioned in section 5.2 herein, the Project Activity and First Project Activity Instance is not: I. Using fire for site preparation ii. Using fire to clear the land of harvest residue prior to replanting of the land iii. Subjected to fire risk, as detailed in Non-Permanence Risk Report
AR-CDM Tool 14	This tool has no internal applicability conditions.	Not applicable
AR-CDM Tool 15	This tool is not applicable if the displacement of agricultural activities is expected to cause, directly or indirectly, any drainage of wetlands or peat lands.	The Project Activity does not result in the displacement of any agricultural activity; therefore, this aspect is not applicable.
AR-CDM Tool 16	a. The areas of land to which this tool is applied: I. Do not fall into wetland category II. Do not contain organic soil as defined in "Annexure A:	a) I. Project lands are not wetlands or peatlands. II. The project area is characterized as degrading land. The type of soil in the project area are Alluvial, laterite, red, and peaty soil[40]. Such

[40] https://www.researchgate.net/profile/Gp-Obi-Reddy/publication/322222168_Degraded_and_Wastelands_of_India_Status_and_Spatial_Distribution/links/61988a3f3068c54fa504a9d3/Degraded-and-Wastelands-of-India-Status-and-Spatial-Distribution.pdf?origin=publication_detail&_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InB1YmxpY2F0aW9uIiwicGFnZSI6InB1YmxpY2F0aW9uRG93bmxvYWQiLCJwcmV2aW91c1BhZ2UiOiJwdWJsaWNhdGlvbiJ9fQ&_cf_chl_tk=2LxMqiSJ7aMcAATSs1508slR3nVE7w5eLlxaOB_xcvs-1737089805-1.0.1.1-q6xWwFhI8gt4RkqFWuq_U9nC9A_olYOSGjfG_xsa4e4

	glossary" of the IPCC GPG LULUCF 2003 III. Are not subject to any of the land management practices and application of inputs as listed in the Tables 1 and 2 b. The A/R CDM project activity meets the following conditions: I. Litter remains on site and is not removed in the A/R CDM project activity II. Soil disturbance attributable to the A/R CDM project activity, if any • In accordance with appropriate soil conservation practices, e.g., follows the land contours • Limited to soil disturbance for site preparation before planting and such disturbance is not repeated in less than twenty years.	lands under tropical conditions have less carbon compared to plantations and forest cover. III. The lands of Table 1 refer to shrubland in which soil disturbance is restricted. Project area does not classify as land listed in Table 1. The lands of Table 2 refer to grassland in which soil disturbance is restricted. There are no grasslands in the project area with the use of any inputs. Therefore, the project area does not classify as land listed in Table 2. b) I. Litter is not removed. II. Soil disturbances are limited to site preparation (digging of holes to plant seedlings). There is no soil disturbance after the project activity implementation.
AR-CDM Tool 17	A species-specific or group-of-species-specific allometric equation derived from trees growing in edapho-climatic conditions similar to those in the project area is considered appropriate, and hence can be used for ex post estimation of tree biomass, if at least one of the following conditions is satisfied: (a) The equation is used in the national forest inventory, or the national GHG inventory, of the host Party;	Since the edaphic-climatic conditions of the project region and Myanmar are similar (please refer the table provided in section 5.2 of this document), the developed equation is applicable. Furthermore, the equation was derived from harvesting (n) of more than 30 culms, and the model achieved an R^2 value of 0.975, significantly exceeding the required threshold of 0.85. Therefore, the developed allometric equation fully complies with condition (c) under this tool, ensuring its validity and applicability for estimating aboveground biomass in the project area.

	(b) The equation has been used in commercial forestry sector of the host Party for ten years or more; (c) The equation was derived from a data set of at least 30 sample trees, and the value of coefficient of determination (R^2) obtained was not less than 0.85.	
AR-CDM Tool 19	This tool has no internal applicability conditions	Not applicable
VCS Non-Permanence Risk Tool	Applicable on all AFOLU projects	Project is an AFOLU project.

3.3 Project Boundary

The carbon pool selected for accounting of carbon stock changes are shown in table below-

Carbon Pool	Whether selected	Justification/Explanation
Above-ground biomass	Yes	This is the major carbon pool subjected to project activity
Below- ground biomass	Yes	Carbon stock in this pool is expected to increased due to the implementation of the project activity
Dead wood, Litter and Soil organic carbon	No	Optional. Although expected to increase due to project activity, since it does not virtually exist in the pre-project situation, will not be accounted for.

Identify the relevant GHG sources, sinks and reservoirs for the project and baseline scenarios are listed table below-

Source		Gas	Included?	Justification/Explanation
Baseline	Above ground biomass	CO_2	Yes	As per the applied CDM methodology AR-ACM0003 v02, the most plausible baseline scenario of the project activity is considered to be the land-use prior to the implementation of the project, that is, degrading shrubland having low inherent potential to support living biomass. On these lands the carbon stocks in the living biomass pools of trees and non-tree vegetation under the baseline scenario are expected to be in steady state or declining. Hence, changes in the carbon stocks in the living biomass
		CH_4	No	
		N_2O	No	
		Other	No	
		CO_2	Yes	

Source		Gas	Included?	Justification/Explanation
	Below ground biomass	CH_4	No	pool of trees and non-tree vegetation in the absence of the project activity shall be assumed to be negligible and therefore sum of changes in carbon stocks in the baseline are considered to be zero.
		N_2O	No	
		Other	No	
	SOC	CO_2	Yes	Soil disturbance is less than 10% on a non-organic soil so baseline emissions can be conservatively ignored.
		CH_4	No	NA
		N_2O	No	NA
		Other	No	NA
Project	Above ground biomass	CO_2	Yes	This corresponds to the largest carbon reservoir subject to the project activity. Carbon storage in above-ground biomass is expected to increase as a result of the implementation of the project activity. Carbon sequestration in the form of Above ground biomass has been calculated using AR-CDM TOOL-14 "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities
		CH_4	No	GHG removals in the baseline project can be conservatively ignored
		N_2O	No	GHG removals in the baseline project can be conservatively ignored
		Other	No	GHG removals in the baseline project can be conservatively ignored
	Below ground biomass	CO_2	Yes	Carbon stock in this pool is expected to increase due to the implementation of the project activity. Carbon stock is calculated using AR-CDM TOOL-14 "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project

Source		Gas	Included?	Justification/Explanation
				activities" which suggest to use the root shoot ratio for the calculation of below ground biomass.
		CH_4	No	GHG removals in the baseline project can be conservatively ignored
		N_2O	No	GHG removals in the baseline project can be conservatively ignored
		Other	No	GHG removals in the baseline project can be conservatively ignored
	SOC	CO_2	Yes	Carbon stock in this pool is expected to increase due to the implementation of the project activity. Soil organic carbon increase in the project has been calculated using the default method given in AR-CDM TOOL-16 "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities"
		CH_4	No	GHG removals in the baseline project can be conservatively ignored
		N_2O	No	GHG removals in the baseline project can be conservatively ignored
		Other	No	GHG removals in the baseline project can be conservatively ignored

The Project Activity encompasses numerous small land parcels situated across Karbi Anglong, District of Assam in India, as outlined in section 1.12. In total, it spans 4,500 hectares of land and is anticipated to engage 3,500 farmers. The initial instance of the project activity pertains to 834.33 hectares of land parcels, engaging 462 farmers across one district. The KML file is provided separately.

As per the table 2, paragraph 10 of AR-ACM0003, CO_2 emissions due to burning of woody biomass are accounted as a change in carbon stock, however in this project activity there is no burning of woody biomass has taken place for the purpose of plantation activity, or as part of forest management.

Source	Gas	Included?	Justification/Explanation

Baseline	Burning of woody biomass	CO_2	No	There is no burning of woody biomass has taken place for the purpose of site preparation, or as part of plantation activity in this project activity.
		CH_4	No	Pre-existing vegetation is not slashed nor burned
		N_2O	No	Pre-existing vegetation is not slashed nor burned
		Other	No	NA
Project	Burning of woody biomass	CO_2	No	There is no burning of woody biomass involved for the plantation management in this project activity.
		CH_4	No	Biomass in the project scenario is not slashed nor burned in this project activity.
		N_2O	No	Biomass in the project scenario is not slashed nor burned in this project activity.
		Other	No	NA

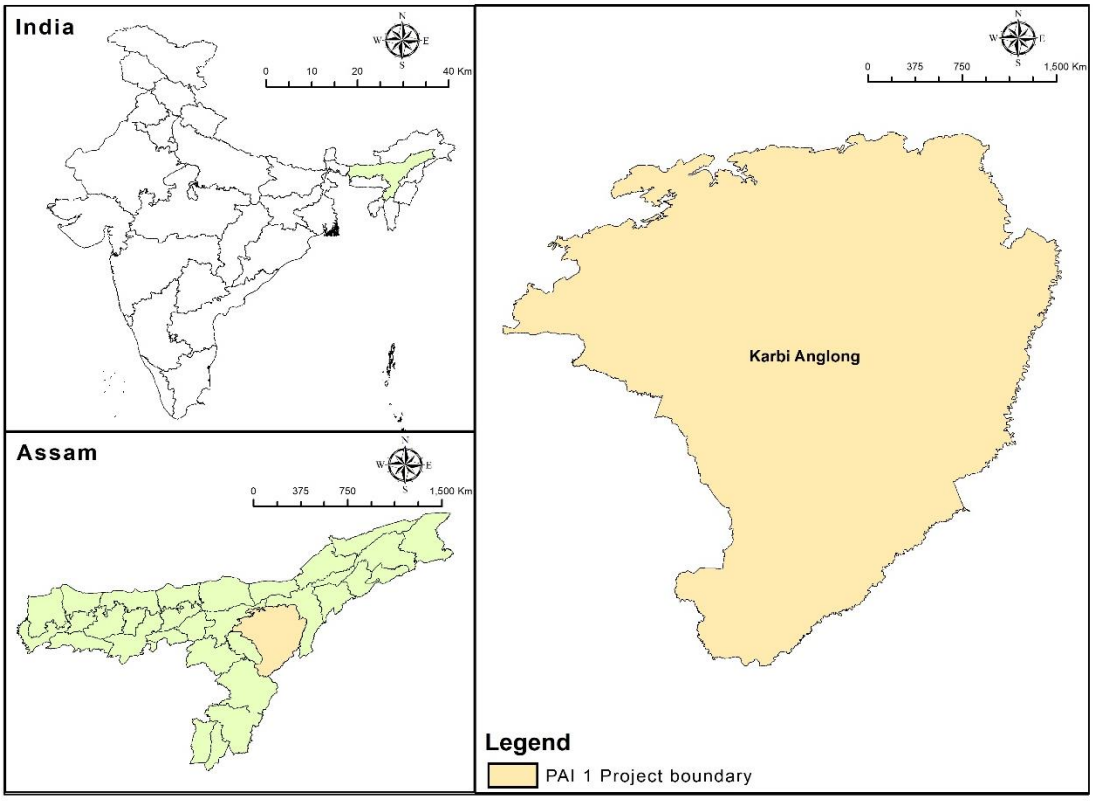


Figure 2: Project Location Map

3.4 Baseline Scenario

The A/R methodological tool 02, "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities, Version 01," was used to identify alternative scenarios and assess the project's additionality. The methodology detailing the steps involved in this process is described in Section 3.5. The methodology necessitates providing a rationale for considering the pre-project land use as the most probable baseline scenario for the large-scale A/R CDM project activity as per the baseline survey conducted (PRA).

PAI-1 covers one district, Karbi Anglong in Assam state within this boundary, as outlined in Section 3.3 of this document, while the geographical boundary of the grouped project encompasses the entire state Assam, India.

Based on the observations conducted in the baseline assessment, as outlined in the "Conditions prior to project initiation" section, it is evident that the project areas primarily consist of degrading shrubland and partial agricultural lands used for subsistence farming. In the absence of the project activity, the baseline scenario for the project area, is as follows:

1) Before the implementation of the project, the land parcel under the project activity consisted of one distinct land types: shrubland. The shrubland areas were dominated by invasive

species, such as *Lantana camara*[41], all of which have significant negative impacts on both the environment and biodiversity in the project area. These invasive species are known to outcompete native vegetation, degrade soil quality, reduce biodiversity, and disrupt ecosystem services, further exacerbating the land's degradation. In the areas of subsistence agriculture, land management practices were generally characterized by low productivity and limited sustainability, contributing to soil erosion and declining soil fertility. Without intervention, both the shrubland and subsistence agricultural areas would continue to deteriorate, exacerbating environmental challenges such as habitat loss, reduced soil health, and decreased agricultural yields.

2) Prior to project implementation, the land earmarked for the PAI-1 a degrading shrubland. The localized condition of Karbi Anglong induces primary crop production of Pineapple, Mango, Banana, Maize, turmeric, Ginger, Tapioca, black pepper, papaya and field crops like cotton, jute, Mesta. Karbi Anglong is historically a major producer of lac in the country, along with traditional framing of pigeon pea, *Cajanus cajan*[42].
3) Unpredictable rainfall and rising diurnal temperature fluctuations have disrupted conventional agricultural practices[43]. The erratic rainfall is directly connected to drought patterns all-over the state. Also, climate change induced soil erosion is also a vital concern in this region, leading to degradation in agricultural productivity. Additionally, topsoil erosion has also been identified as a consequence of fire incidents[44]. Soil degradation is the main issue driving the shift in land use patterns, particularly in agriculture[45].

The demonstration and identification of land degradation were carried out by following the steps outlined in the A/R methodological tool[46] "Tool for the identification of degraded or degrading lands for consideration in implementing CDM A/R project activities" which provides a systematic approach for identifying land degradation. With reference to the ar-am-tool-13-v1, i.e., "A reduction in plant cover or productivity due to overgrazing or other land management practices" outlined in sub section (iv) in section C for procedure III consist with the result of PRA survey. Based on the PRA survey, it is evident that the project areas primarily consist of degrading lands system[47]. It also indicates that degradation, primarily driven by the soil erosion, and biological degradation, manifested through a reduction in shrub biomass, are significant factors contributing to the ongoing shrubland degradation issues faced by the project area.

[41] https://www.researchgate.net/publication/330080139_Invasive_alien_species_of_India/link/5c2c3a33a6fdccfc7076ff53/download?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InB1YmxpY2F0aW9uIiwicGFnZSI6InB1YmxpY2F0aW9uIn19

[42] https://journalijecc.com/index.php/IJECC/article/view/1772

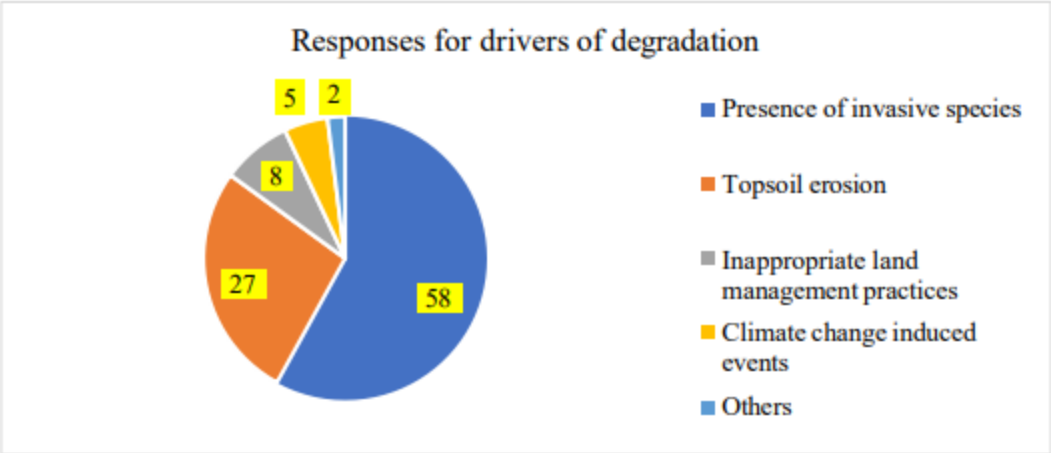
[43] Sarmah, A., & Gogoi, R. (2024). Combating climate change in Assam agriculture: A multi-strategic approach by NICRA. Trends and Innovations in Environmental Science.

[44] https://www.sciencedirect.com/science/article/pii/S2665972724000989

[45] https://www.sciencedirect.com/science/article/abs/pii/S2211464524000654

[46] Tool for the identification of degraded or degrading lands for consideration in implementing CDM A/R project activities (V...

[47] (PDF) Role of Agriculture in Economic Development of Assam, Upadhyaya, Tanka Prasad. "Role of Agriculture in Economic Development of Assam." Cognizance Journal of Multidisciplinary Studies 2.6 (2022): 10-2.



In the absence of the project activity, the baseline scenario for the project area, is as follows:

- The project areas are located on private lands. The land in Assam consists primarily of shrubland with no history of continuous farming practices.
- In the baseline scenario, there are no alternative land uses beyond shrubland in Assam, in the absence of the PP interventions. The lands within the project areas in Assam, though previously categorized as degrading shrubland, are owned by farmers and have shown no signs of farming activities in recent year.
- Prior to the project implementation, the vegetation cover observed within the project boundary of PAI 1 land parcel (Image attached in Annexure 1). Hence analysis was performed by using LULC classification, based on NDVI values, confirms that the area was predominantly covered by shrubland vegetation. This classification aligns with the NDVI thresholds established by the USGS[48] and is consistent with findings reported in regional scientific literature of Diphu District of Assam State[49]. Therefore, based on scientific evidence it is concluded that presence of shrub vegetation is present in the project area prior to project activities (refer to the table below).

Table: NDVI Classification Scheme

Features	NDVI Value classification	
	Assam Regional study	USGS
Waterbody	Below 0	-
Bare Soil, Rock, Sand and Cloud	0-0.2	0.1 or less
Shrub/Grassland	0.2-0.3	0.2 to 0.5
Sparse Vegetation	0.3-0.5	-
Dense and Healthy Vegetation	Above 0.5	0.6 to 0.9

[48] NDVI, the Foundation for Remote Sensing Phenology | U.S. Geological Survey

[49] Bora, K., Borah, N., Bose, S., Goswami, J., & Kashyap, P. J. (2025). NDVI-Based Geospatial Analysis of Forest Cover Alterations in Daldali Reserve Forest, Assam, India. *Asian Journal of Geographical Research*, *8*(1), 61-72.

- PP has done NDVI classification based on Landsat data (For 2009 and 2014) and Sentinel data (2019). And NDVI classification based on Sentinel and Landsat satellite data is important for accurate, consistent, and large-scale vegetation monitoring. Sentinel-2 and Landsat missions provide high-resolution, multi-spectral imagery that is particularly well-suited for NDVI calculations. Sentinel-2[50], with its 10-meter spatial resolution enables precise temporal and spatial analysis of vegetation dynamics. However, Landsat[51], with a longer historical with 30-meter resolution, offers invaluable long-term vegetation trend data. Therefore, combining both data enhances classification accuracy and allows to cross-validate results, providing a more robust understanding of vegetation cover and change over time[52]. As a result of Landsat and Sentinel-2 (Table Below) NDVI values from 2009, 2014, and 2019 consistently indicate the presence of shrub and sparse vegetation.

Table: NDVI Value Range PAI 1 KML Karbi Anglong (Assam)

Year	2009	2014	2019
NDVI Value	0.08-0.36	0.07-0.42	0.08-0.44

Furthermore, result of NDVI classification has been conducted in accordance with the thresholds outlined in Table 1 which demonstrate the NDVI values below 0.5 are considered indicative of sparse, degraded, or non-forest vegetation. This threshold is consistent with global NDVI classification with USGS and regional study classification as mentioned in above. Based on this classification, the PAI 1 land parcel does not demonstrate NDVI values characteristic of forested land. Instead, the data reveals a predominance of shrubland and bare soil over the years assessed. These NDVI-derived land cover patterns support the conclusion that, despite minor vegetation recovery over time, the area remains in shrub land and does not meet the NDVI criteria typically used to classify forest ecosystems.

These NDVI-derived land cover patterns support the conclusion that, despite minor vegetation recovery over time, the area remains in shrub land and does not meet the NDVI criteria typically used to classify forest ecosystems.

- The farming communities surrounding the small project land parcels in Assam predominantly cultivate cash crops[53] such as tea but continue to face challenges related to declining land productivity. These rural farmers rely heavily on agriculture and allied activities for their livelihoods yet have limited access to modern technology, external technical support, high-yielding crop or tree varieties, effective management and monitoring practices, and the use of organic fertilizers or compost. Consequently, issues such as production imbalances, water

[50] Zhu, Z., Wang, S., & Woodcock, C. E. (2019). Improvement and expansion of the Fmask algorithm: Cloud, cloud shadow, and snow detection for Landsats 4–7, 8, and Sentinel 2 images. *Remote Sensing of Environment*, 224, 129–148.
[51] Pettorelli, N., Vik, J. O., Mysterud, A., Gaillard, J. M., Tucker, C. J., & Stenseth, N. C. (2005). Using the satellite-derived NDVI to assess ecological responses to environmental change. *Trends in Ecology & Evolution*, 20(9), 503–510.
[52] Pettorelli, N., Vik, J. O., Mysterud, A., Gaillard, J. M., Tucker, C. J., & Stenseth, N. C. (2005). Using the satellite-derived NDVI to assess ecological responses to environmental change. *Trends in Ecology & Evolution*, 20(9), 503–510.
[53] Upadhyaya, Tanka Prasad. "Role of Agriculture in Economic Development of Assam." Cognizance Journal of Multidisciplinary Studies 2.6 (2022): 10-2.

scarcity, and inadequate year-round food and income security persist, emphasizing the need for a sustainable livelihood-enhancing intervention.

These factors lead to the conclusion that there is no reason to believe that the project areas will revert to forest areas without intervention. Acknowledging these circumstances, the project scenario prioritizes the establishment of large-scale planned plantations to support sustainable land restoration while enhancing the socioeconomic resilience of local communities.

3.5 Additionality

Additionality of the project has been analysed using AR-CDM tool "Combined tool to identify the baseline scenario and demonstrate additionally in A/R CDM project activities" (Version 01).

Project participants shall apply the following five steps:

STEP 0. Preliminary screening based on the starting date of the A/R project activity

STEP 1. Identification of alternative scenarios: alternative land use scenario has been analysed and justified with the help of PRA responses/secondary data (research reference) collected from the project area.

STEP 2. Barrier analysis: Barrier analysis has been justified with the help of PRA responses and secondary data (research reference) collected from the project area.

STEP 3. Investment analysis (if needed): Not applicable.

STEP 4. Common practice analysis: Similar type of project in the project area in respect of similar scale and nature has been identified for common practise analysis.

3.5.1 Regulatory Surplus

Is the project registered or seeking registration in an UNFCCC Annex 1 or Non-Annex 1 country?

☐ Annex 1 country ☒ Non-Annex 1 country

Are the project activities mandated by any law, statute, or other regulatory framework?

☐ Yes ☒ No

If the project is located inside a Non-Annex 1 country and the project activities are mandated by a law, statute, or other regulatory framework, are such laws, statutes, or regulatory frameworks systematically enforced?

☒ Yes ☐ No

As described in Section 1.15 of the PDMR, the project activities are not mandated under any existing laws, statutes, or regulatory frameworks, including any systematically enforced regulations applicable in UNFCCC Non-Annex 1 countries. This applies across the entire geographical boundary of the project (i.e., Assam state, India). While the project aligns with the

broader legal and policy framework promoting forest conservation and biodiversity protection, as outlined in Section 1.15, its specific interventions exceed current legal requirements. The project generates additional environmental benefits that are not mandated under any government program or policy, thereby demonstrating compliance with the regulatory surplus criterion.

3.5.2 Additionality Methods

The additionality of the project is demonstrated in accordance with the applied AR-CDM tool 02 "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities" version 01[54]. The assessment follows the systematic steps outlined in this tool:

This methodology ensures that the project's activities result in real, measurable, and verifiable emission reductions or removals that would not occur in the absence of the project.

STEP 0. Preliminary screening based on the starting date of the A/R project activity

The planting activity was conducted from 09-July-2019, which is before the registration date and after 31-December-1999. The first plantation date is 9-July-2019 and is considered as a project start date which was after 31-December-1999.

The incentive from the planned sale of CERs was seriously considered in the decision to proceed with the project activity.

Each land parcel is included in the PAI-1 of this Grouped Project Activity after collecting following evidence to confirm meeting all the applicability and eligibility criteria:

a) Provide evidence that the starting date of the A/R CDM project activity was after 31-December-1999,

- Last 10 years satellite images form the part of each farmer eligibility for inclusion in First Project Activity Instance.
- Project Activity and First Project Activity Instance Land Title/Rights document for each land parcel which categorizes the land use type and evidence of cropping activity before plantation.

b) Provide evidence that the incentive from the planned sale of CERs was seriously considered in the decision to proceed with the project activity. This evidence shall be based on documentation that was available to third parties at, or prior to, the start of the project activity.

- During the local stakeholder consultation process, generating carbon credits through the Verified Carbon Standard (VCS) using the Clean Development Mechanism (CDM) was highlighted as a key agenda. Farmers were briefed about the concept of carbon credits and their economic benefits. The Project Proponent (PP) has communicated extensively with

[54] https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-02-v1.pdf

stakeholders through one-to-one consultations, demonstrative presentations, leaflet distribution, and social media, emphasizing the economic advantages of carbon credits for participating farmers in the plantation project. Given this, carbon credits play a vital role in farmers' decision-making process, influencing them to integrate plantation activities into their traditional cropping framework to secure an additional sustainable revenue stream. The agreement between the PI and farmers outlines the process of carbon credit generation and the resulting revenue. Consequently, the potential income from the planned sale of Verified Carbon Units (VCUs) was a significant factor in the farmers' decision to proceed with the Project Activity.

STEP 1. Identification of alternative land use scenarios to the proposed A/R CDM project activity

Sub-step 1a. Identify credible alternative land use scenarios to the proposed project activity

The following alternatives to the project activity will be evaluated:

❖ Land Use Scenario A - Continuation of the pre-project land use

- The project activity, which encompasses numerous dispersed small land parcels owned privately by farmers, is expected to persist with the current or historical land under shrubland category.
- The land use scenario aligns with all mandatory laws and policies of both the state and central governments.

❖ Land Use Scenario B- Afforestation of the land within agroforestry system without being registered as the A/R CDM project activity

- Agroforestry represents a dynamic and ecologically based approach to natural resource management. This practice aims to enhance social, economic, and environmental benefits for land users across all levels[55].
- The current project area is suitable for cultivating bamboo, aligning with the objectives of the National Agroforestry Policy launched by the Ministry of Agriculture, Government of India in 2014[56]. This policy aims to increase tree cover to 33%, as outlined in the National Forest Policy of 1988, which currently stands at less than 25%.

The Forest Survey Report of 2023[57] has been released revealing a notable increase of 1445 sq km in the forest and tree cover of the country which includes 156 sq km increase in the forest cover and 1289 sq km increase in tree cover.

[55] https://www.researchgate.net/profile/Shuaibu/publication/273945390_Journal_of_Horticulture_and_Forestry_Agroforestry_practices_and_concepts_in_sustainable_land_use_systems_in_Nigeria/links/55109df50cf2a8dd79be7902/Journal-of-Horticulture-and-Forestry-Agroforestry-practices-and-concepts-in-sustainable-land-use-systems-in-Nigeria.pdf
[56] National Agroforestry Policy 2014.pdf (agricoop.nic.in)
[57] https://fsi.nic.in/forest-report-2023

❖ If applicable, forestation of at least a part of the land within the project boundary of the proposed A/R CDM project at a rate resulting from:

- Legal requirements;
- Extrapolation of observed forestation activities in the geographical area with similar socio-economic and ecological conditions to the proposed A/R CDM project activity occurring in a period since 31-December-1989 as selected by the PP.

The Project Area does not comprise any land designated for forestation due to legal obligations, and the rate of forestation activities in geographical areas with similar socioeconomic and ecological conditions to the proposed project activity is very low, almost negligible. Therefore, this scenario is not applicable.

Outcome of Sub-step 1a: Below is the list of credible alternative land use scenarios that would have occurred on the land within the project boundary of the A/R CDM project activity

- Land Use Scenario A - Continuation of the pre-project land use
- Land Use Scenario B- Afforestation of the land with in Agroforestry system without being registered as the A/R CDM project activity

Sub-step 1b. Consistency of credible alternative land use scenarios with enforced mandatory applicable laws and regulations

The identified alternatives fully comply with existing laws and regulations governing alternative land use scenarios. Consequently, they adhere to all applicable legal and regulatory requirements both presently and in the foreseeable future.

The following are the list of such laws:

1) The Indian Forest Act, 1927[58]
2) The Wildlife (Protection) Act, 1972
3) Water (Prevention and Control of Pollution) Act, 1974 with Rules[59]
4) Forest (Conservation) Act, 1980[60]
5) Environmental (Protection) Act, 1986[61]
6) Convention on Biological Diversity, 1992[62]
7) Noise Pollution (regulation and Control) Rules, 2000[63]
8) Forest Right Act 2006[64]

[58] Rahate and Banait, "The Indian Forest Act, 1927."
[59] indiacode.nic.in/indiacode/bitstream/123456789/19018/1/water_act_1974.pdf
[60] Forest Conservation Act 1980 (nbaindia.org)
[61] https://cpcb.nic.in/displaypdf.php?id=aG9tZS9lcGEvZXByb3RlY3RfYWN0XzE5ODYucGRm
[62] https://www.cbd.int/doc/legal/cbd-en.pdf
[63] https://www.corpseed.com/knowledge-centre/the-noise-pollution-regulation-and-control-rules-2000
[64] https://forestrights.nic.in/doc/Act.pdf

9) National Agroforestry Policy, 2014[65]

All the aforementioned policies have been carefully considered during the evaluation of alternatives to the Project Activity and First Project Activity Instance. The listed alternatives provided are fully compliant with applicable laws and regulations.

Identified Alternative Scenarios	Permitted/Not permitted
Land Use Scenario A - Continuation of the pre-project land use The project activity that involves multiple scattered small land parcels privately owned by farmers are most likely to continue with existing /historical land use is degrading land or degraded land under shrubland category.	Permitted
Land Use Scenario B- Afforestation of the land with in agroforestry system without being registered as the A/R CDM project activity.	Permitted

Outcome of Sub-step 1b: Here is the compilation of plausible alternative land use scenarios to the A/R CDM project activity, ensuring compliance with mandatory legislation and regulations. This assessment considers their enforcement within the region or country, as well as decisions by the Executive Board (EB) regarding national and/or sectoral policies and regulations.

- Land Use Scenario A - Continuation of the pre-project land use
- Land Use Scenario B- Afforestation of the land with in agroforestry system without being registered as the A/R CDM project activity

STEP 2. Barrier analysis

Sub-step 2a. Identification of barriers that would prevent the implementation of at least one alternative land use scenarios.

The proposed project activity and First Project Activity Instance (PAI-1) faces a number of technological, ecological condition and social barriers to its implementation described as below:

For 1st PAI: Barrier analysis matrix

Land use scenarios	Investment	Institutional	Technological	Local tradition	Prevailing practice	Ecological conditions	Social conditions
Continuation of the pre-project land use							

[65] National Agroforestry Policy 2014.pdf (agricoop.nic.in)

Afforestation of the land with in Agroforestry system without being registered as the A/R CDM project activity			X			X	X

Technological barrier:

Dearth of quality planting material: One of the primary challenges encountered by farmers in adopting new plantation (Agroforestry) practices is the scarcity of quality seedling material[66,67]. It's estimated that only approximately 10% of available planting material meets high-quality standards, leaving the majority lacking any guarantee of quality assurance. This issue primarily stems from inadequacies in the production, handling, distribution, as well as planting and supervision processes associated with high-quality planting material[68].

This barrier prevents the alternative land scenario B (Afforestation of the land with in Agroforestry system without being registered as the A/R CDM project activity).

Ecological condition

The land that was once used for farming is now under ecological stress, leading to a decline in agricultural output. As a result, local communities are seeking alternative sources of livelihood beyond agriculture. The entire region, especially Karbi Anglong, is experiencing increasingly warmer days and nights, coupled with dry spells[69] that are negatively impacting farming activities. Soil erosion[70], particularly from water-induced processes like sheet, gully, and rill erosion[71], presents a major challenge to the sustainability of agriculture.

The barrier is degrading the land directly correlating to the loss of pre-project agricultural success.

Social condition

Demographic pressure on the land: As the population continues to rise, landholdings are diminishing due to land fragmentation. Landless and marginal farmers now constitute over 80% of rural households, with agriculture proving insufficient to support them. The table below illustrates the operational land holdings per household for the year 2010-2011. Also, 2/3rd of Indian farmers are small and marginal land owned farmers[72].

States	No. of Operational Holdings	Average Area Per Operational Holding (ha)	Average Area Operated Per Holding (ha)

[66] https://mospi.gov.in/sites/default/files/publication_reports/Report_587m_0.pdf
[67]\https://www.researchgate.net/profile/Manoj-Sharma-38/publication/372100772_Journal_of_Krishi_Vigyan_12_1/links/64a421878de7ed28ba746634/Journal-of-Krishi-Vigyan-12-1.pdf#page=32
[68] https://www.phytojournal.com/archives/2017/vol6issue6S/PartV/SP-6-6-241.pdf
[69] https://link.springer.com/article/10.1007/s41324-020-00312-2
[70]https://www.researchgate.net/publication/365944380_Eastern_Himalayan_Division_A_Potential_Zone_to_be_Hub_of_Agriculture
[71] https://www.academia.edu/download/98844411/772-789.pdf
[72]https://des.assam.gov.in/sites/default/files/swf_utility_folder/departments/ecostat_medhassu_in_oid_3/menu/document/agri_census2010-11_phase1_0.pdf

Assam	2,720,223	2,999,070	1.10

The fragmentation and dispersal of land holdings, as commonly observed in many marginal and small farms across host country (India), hinder the efficient utilization of farm resources and the adoption of technology by farmers. Consequently, this poses a challenge to economic productivity. Furthermore, it impedes the diversification process, which is deemed essential for enhancing farmers' income. High population density and competing land uses create significant demographic pressure on land, which impedes the adoption of agroforestry projects. In the absence of carbon finance to cover costs and offer financial incentives, these projects encounter further difficulties and resistance, complicating the implementation of sustainable land management practices.

State	Size groups (in hectares)	Number of holdings	Percentage of concentration	Operated Area (in hectare)	Percentage of concentration
Assam	Marginal (Below 1.0)	1,831,115	67.32	774,797	25.84
	Small (1.0-2.0)	496,574	18.25	687,156	22.91
	Semi-Medium (2.0-4.0)	303,528	11.16	817,982	27.27
	Medium (4.0-10.0)	84,869	3.12	437,372	14.58
	Large (10.0 & above)	4,137	0.15	281,763	9.40
	All	2,720,223	100.00	2,999,070	100.00

Lack of skilled labour/or properly skilled labour force: The dominant barrier primarily preventing the adoption of alternative land use scenario B is the transition from traditional farming patterns to climate-smart agriculture, specifically the shift from conventional agriculture to agroforestry practices. This transition is predominantly hindered by two major constraints: firstly, the lack of knowledge about adaptive practices associated with Climate-Smart Agriculture (CSA); and secondly, the non-availability of skilled labor required for the effective adoption of CSA technologies. These challenges collectively impede the successful implementation of climate-resilient agricultural practices, thereby limiting the widespread adoption of agroforestry systems[73].

- Outcome of Step 2a: List of barriers that may prevent one or more land use scenarios identified in the Step 1b Technological barrier
- Social condition

Sub-step – 2b Elimination of land use scenarios that are prevented by the identified barriers

[73] Frontiers | Climate smart agriculture technologies adoption among small-scale farmers: a case study from Gujarat, India (frontiersin.org)

The following table shows the summary of barriers hindering land-use option scenarios:

Alternative Land Use Scenario	Barriers Limiting the Scenario
Land Use Scenario A - Continuation of the pre-project land use	-
Land Use Scenario B- Afforestation of the land with in Agroforestry system without being registered as the A/R CDM project activity	**Technological** ✓ Dearth of quality planting material Social condition **Ecological & Social condition** ✓ Demographic pressure on the land ✓ Lack of skilled labour/or properly skilled labour force

Outcome of Sub-step 2b: Land use scenario A – Continuation of Pre-Project Land Use, the only alternative scenario is not prevented by any barrier.

Sub-step 2c. Determination of baseline scenario

This sub step consists of applying the decision tree from the tool. As demonstrated above, land use scenarios that are not prevented by any barrier contains only one land use scenario (A) is considered as baseline scenario. As such step 3 of Investment Analysis is not needed. Therefore, according to the decision tree of sub step 2c of the combined tool, it is concluded that Land Use Scenario A, Continuation of pre project land use, is the baseline scenario and Step 4: "Common practice test" is the next step in the analysis.

STEP 4. Common practice analysis

Considering the host country i.e., India, plantation and agroforestry activities on degrading shrublands are not legally mandated. Their implementation is highly contingent on the availability of external funding and support mechanisms. Historically, government-backed initiatives have been limited in scope. At the farmer level, Farmers themselves face significant challenges such as limited cash flow, exposure to multiple risks, and lack of resources that prevent them from undertaking such activities independently.

Therefore, while the baseline scenario is fully aligned with applicable legal and regulatory requirements, the existence of such frameworks does not translate into large-scale action on the ground. Based on the scenario, in the absence of legal obligation and strong financial incentives, reforestation and agroforestry on degrading private lands cannot be regarded as common practice.

Adoption of agroforestry among small and marginal farmers in Assam remains limited due to a combination of factors, including low awareness and technical knowledge, financial constraints from upfront investment needs and limited credit access, and market challenges such as poor

value chains and low profitability of tree products, quality planting material, poor scientific management inputs, several legal barriers on cultivation, harvesting, transportation and selling, non-payment for ecosystems and environment services, and long gestation period. Additional barriers include lack of infrastructure and extension support, weak or fragmented policy and institutional backing. It is common cross India that farmers hardly get any support from any state and government policies in carrying out good and large-scale plantation. Socio-cultural preferences for conventional farming further reduce willingness to adopt long-term agroforestry practices, making uptake slow despite its potential benefits.

Now coming specific to the proposed project PAI-1 which is located in the state of Assam in India. The selected lands for the project are degrading and undergoing further deterioration.

Analysis of the extent to which forestation activity has diffused[74] in the geographical area of the proposed Project Activity Instance-1 is shown below:

State	Geographical Area (Sq. km)	2009[75]		2023[76]		Diffusion	
		Forest Cover (Sq.km)	Tree Cover (Sq.km)	Forest Cover (Sq.km)	Tree Cover (Sq.km)	Forest Cover Change in area with respect to 2009 (sq. km)	Tree Cover Change in area with respect to 2009 (sq. km)
Assam	78,438	27,692	1,590	28,313.55	2,101.46	+621.55	+511.46

The project area includes several similar forestation projects, in which some are listed below:

- Assam Bamboo & Cane Policy, 2019[77]
- National Bamboo Mission,[78]
- SBDA-Supported Activities (State Bamboo Development Agency)[79]
- Cluster-Based & Value-Chain Initiatives

In the state of Assam, various bamboo promotion programs have been initiated by both state and central governments. However, these initiatives face several limitations that restrict farmers from fully benefiting, prompting their willingness to participate in this project activity. Key constraints include limited project coverage (limitations in area eligibility), inadequate post-plantation support, shortage of skilled personnel and training[80], delays in fund disbursement, complicated eligibility criteria and documentation, insufficient monitoring and evaluation mechanisms, and the absence of integration with carbon financing opportunities.

[74] https://fsi.nic.in/forest-report-2023
[75] https://fsi.nic.in/sfr2009/assam.pdf
[76] isfr_book_eng-vol-1_2023.pdf
[77] The Assam Bamboo and Cane Policy 2019 | State Bamboo Development Agency, Assam | Government Of Assam, India
[78] National Bamboo Mission
[79] Home | State Bamboo Development Agency, Assam | Government Of Assam, India
[80] The story of National Bamboo Mission

In contrast, our project overcomes these challenges by offering inclusive support to farmers regardless of landholding size. It provides comprehensive training on plantation and maintenance practices, supplies saplings and technical assistance, and minimizes administrative burden requiring only a simple farmer agreement. Furthermore, the project ensures regular monitoring, evaluation, and direct financial benefits to farmers through carbon credit revenues.

In states like Assam, social forestry programs are actively underway, encompassing a range of plantation schemes intended to expand tree cover and promote sustainable land use. However, the spread of plantation initiatives under these policies has been limited.

Agroforestry plantation in the project area by HLTEC has been developed at a large scale in Karbi Anglong District of Assam, India with *Bambusa tulda* with 250 clump/ha density. As per publicly data available[81], there is no such extensive project being developed in Assam with this composition of species to boost the farmers income. Shifting from traditional cultivation practices to an agroforestry model within a carbon project framework offers a more sustainable, economically viable, and environmentally beneficial alternative. This model aligns with global priorities in climate change mitigation and sustainable agriculture, while providing farmers with diverse income opportunities. However, without the financial support and incentives from carbon investments, the project's lifespan would be significantly shortened, and implementing robust monitoring practices would be challenging. Consequently, such projects are rare in the absence of these critical supports. Hence, project activity is not a common practice.

Outcome of Step-4: Since, the Step-4 Common Practice Analysis is not satisfied. The proposed Project Activity and First Project Activity Instance being part of the Project Activity is not the baseline scenario and hence, it is additional.

The future project instances will have the same baseline scenario and additionality demonstrations in this document.

3.6 Methodology Deviations

There is no methodological deviation under this project activity. Hence, this section is not applicable.

4 IMPLEMENTATION STATUS

4.1 Implementation Status of the Project Activity

The project PAI-1 plantation began in 09-July-2019 and completed in December 2022, encompassing one district (Karbi Anglong) of Assam, India. The area planted under the PAI-1 are

[81] Verra Search Page

834.33 ha with 462 farmers. Year and species wise area planted under PAI-1 are mentioned in the table below:

Year	Species	Planted Area (ha)
2019	*Bambusa tulda*	540.48
2020	*Bambusa tulda*	223.17
2021	*Bambusa tulda*	59.95
2022	*Bambusa tulda*	10.73
Total		**834.33**

- In the upcoming planting season, dead seedlings had been replaced with healthy ones to keep the plantation's mortality rate below 10%.
- Necessary practices' including manual weeding, fire prevention etc. were adopted in project area to manage and foster the plant for productive and sustainable growth during the year.

Events Impacting GHG Emission Reductions or Removals and Monitoring

There is no loss of carbon stock during the current monitoring period which is from 09-July-2019 to 16-December-2024.

Project proponent of the project has adopted some measure to prevent and combat fires which includes:

- Ensuring the implementation of prevention measures through groups that monitor the absence of objects that would generate fires, the presence of personnel from outside of the village, etc.
- Regular weeding, opening of fire belts and having the necessary equipment for fire controlling.
- Although it is difficult to mitigate the impacts droughts but several adaptation measures have been taken place to avoid the damage on the plantations.
- Tree replacement: The tree plantation program contemplates planting additional trees to compensate for expected mortality.

Leakage and Non-Permanence Risk Management:

In case According to the VCS methodology, non-permanent carbon stocks are covered by buffer reserves of non-tradable carbon credits to address unforeseeable losses in carbon stocks. “AFOLU Non-Permanence Risk Tool, VCS Version 4.2”[82] is used for buffer calculation.

During the monitoring period, there were no changes to the project proponent, ownership, or key implementing entities. The project proponents continued to collaborate with local stakeholders, farmers, and technical experts to ensure successful project implementation and carbon credit

[82] AFOLU-Non-Permanence-Risk-Tool-v4.2-FINAL.pdf (verra.org)

eligibility. This is a new plantation project, and there are no previously implemented activities that will continue during the current monitoring period. In addition, there were no significant loss events occurred which caused loss of carbon stock during the monitoring period.

5 QUANTIFICATION OF ESTIMATED GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

To estimate the baseline emissions, the A/R Tool 14 "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities", version 04.2 was used. The section describes the calculation of area under different land-use scenarios using satellite images and a description from the Project Description document. At the project development stage information were collected regarding the land use of the project area using land use maps, satellite images and discussions with local communities. Major land use types in the baseline scenario were identified and stratified using the information. Based on this stratification, detailed field surveys were done to strengthen the stratification process.

Sentinel 2B satellite image for the year 2019, 2020, 2021 and 2022 was used to identifying land use types existed before the project started. This map was used along with the map of the project area provided by the project participant. The area was stratified in the shrub class as per the Forest Survey of India.

The baseline net GHG removals by sinks shall be calculated as follows (equation 1 of AR-ACM0003 methodology):

$$\Delta C_{BSL,t} = \Delta C_{TREE\_BSL,t} + \Delta C_{SHRUB\_BSL,t} + \Delta C_{DW\_BSL,t} + \Delta C_{LI\_BSL,t}$$

Where;

$C_{BSL,t}$ = Baseline net GHG removals by sinks in year t; t CO_2-e

$C_{TREE\_BSL,t}$ = Change in carbon stock in baseline tree biomass within the project boundary in year t, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"; t CO_2-e

$C_{SHRUB\_BSL,t}$ = Change in carbon stock in baseline shrub biomass within the project boundary, in year t, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"; t CO_2-e

$C_{DW\_BSL,t}$ = Change in carbon stock in baseline dead wood biomass within the project boundary, in year t, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"; t CO_2-e

$C_{LI\_BSL,t}$ = Change in carbon stock in baseline litter biomass within the project boundary, in year t, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"; t CO_2-e

The baseline emissions estimation is carried out using the A/R Methodological AR-TOOL 14 "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities Version 04.2"

Change in carbon stock in baseline tree ($C_{TREE\_BSL,t}$)

According to the AR-TOOL 14, carbon stock in trees in the baseline can be accounted as zero if all of the following conditions are met:

1) The Baseline trees are neither harvested, nor cleared, nor removed throughout the crediting period of the Project activity.

   The project is implemented on degrading shrubland, where the existing vegetation consists mainly of sparsely distributed shrubs with no presence of mature trees. For the project activity, as per the baseline land use scenario, it is confirmed that baseline trees are neither harvested, cleared, nor removed and will not clear throughout the crediting period.

2) The Baseline trees do not suffer mortality because of competition from trees planted in the project, or damage because of implementation of the Project activity, at any time during the crediting period of the project activity;

   As indicated above there are no pre-project trees in the Project Area.

3) The Baseline trees are not inventoried along with the project trees in monitoring of carbon stocks but their continued existence, consistent with the baseline scenario, is monitored throughout the crediting period of the project activity.

   As indicated above that the pre-project land use scenario is degrading shrubland, and there are no pre-project trees in the Project Area. Hence, the bamboo planted under this project activity will be inventoried during the monitoring of the carbon stocks.

Change in carbon stock in baseline shrub biomass ($C_{SHRUB\_BSL,t}$)

As stated above, the project land was classified as degrading shrubland prior to project implementation. Some shrubs were present in the baseline scenario; however, they were cleared during site preparation before the initiation of planting activities. The baseline emissions have been calculated by considering the shrubland condition in accordance with the requirements of Section 5.4 of the applied methodology.

As per the AR-Tool-14, the baseline shrub biomass has been calculated in accordance with the procedures outlined in Paragraphs 60 and 61 of the tool. The estimation was carried out for strata where the shrub crown cover exceeded 5%, using either default biomass value.

$$C_{SHRUB,t} = \frac{44}{12} \times CF_s \times (1 + R_s) \times \sum_i A_{SHRUB,i} \times b_{SHRUB,i}$$

$$b_{SHRUB,i} = BDR_{SF} \times b_{FOREST} \times CC_{SHRUB,i}$$

Where;

$C_{SHRUB,t}$ = Carbon stock in shrubs within the project boundary at a given point of time in year t; t CO_2-e

CF_S = Carbon fraction of shrub biomass; t C (t.d.m.)$^{-1}$

R_S = Carbon fraction of shrub biomass; t C (t.d.m.)$^{-1}$

$A_{SHRUB,I}$ =Area of shrub biomass estimation stratum i; ha

$B_{SHRUB,I}$ = Shrub biomass per hectare in shrub biomass estimation stratum i; t d.m. ha^{-1}

BDR_{SF} = Ratio of shrub biomass per hectare in land having a shrub crown cover of 1.0 (i.e., 100 per cent) and the default above-ground biomass content per hectare in forest in the region/country where the A/R CDM project activity is located; dimensionless

b_{FOREST} = Default above-ground biomass content in forest in the region/country where the A/R CDM project activity is located; t d.m. ha^{-1}

$CC_{SHRUB,I}$ = Crown cover of shrubs in shrub biomass estimation stratum i at the time of estimation, expressed as a fraction (e.g. 10 per cent crown cover implies = 0.10); dimensionless

The values used for the shrub biomass calculation are as follows:

Parameter/ Stratum	2019 B. tulda	2020 B. tulda	2021 B. tulda	2022 B. tulda
$CC_{SHRUB,I}$	0.115	0.118	0.119	0.125
b_{FOREST}	73	73	73	73
BDR_{SF}	0.1	0.1	0.1	0.1
$B_{SHRUB,I}$	0.84	0.86	0.87	0.91
$A_{SHRUB,i}$	540.48	223.17	59.95	10.73
R_S	0.4	0.4	0.4	0.4
CF_S	0.47	0.47	0.47	0.47
$C_{SHRUB,t}$	1098.58	462.38	126.03	23.62

As per the tool 14, the biomass may reach a steady state in which biomass growth becomes zero or insignificant, either because of biological maturity of trees or because the rate of

anthropogenic biomass extraction from the area is equal to the rate of biomass growth. Therefore, this parameter should be taken to be zero after the year in which tree biomass in the baseline reaches a steady state. The year in which tree biomass in the baseline reaches a steady-state is taken to be the 20th year from the start of the CDM project activity.

Change in carbon stock in baseline dead wood and Litter biomass ($C_{DW\_BSL,t}$ and $C_{LI\_BSL,t}$)

As stated above, since there are no trees present in the baseline scenario, the litter and deadwood biomass are considered to be negligible (nil).

Hence,

$$\Delta C_{BSL,t} = \Delta C_{SHRUB\_BSL,t}$$

5.2 Project Emissions

The actual net GHG removals by sinks are estimated using the equation 2 of the methodology AR ACM0003 (Version 02.0).

$$\Delta C_{ACTUAL,t} = \Delta C_{P,t} - GHG_{E,t}$$

Where;

$\Delta C_{ACTUAL,t}$ = Annual actual net GHG removals by sinks at time t; t CO_2-e yr^{-1}

$\Delta C_{P,t}$ = Change in carbon stocks in project, occurring in the selected carbon pools, at time t; t CO_2-e yr^{-1}

$GHG_{E,t}$ = Increase of non-CO_2 GHG emissions within the project boundary as a result of the implementation of the A/R project activity, in year t; t CO_2-e

The equation for the change in carbon stocks in the project, occurring in the selected carbon pools in year t, according to the "A/R equation of the methodology AR-ACM0003 (Version 02.0) sectorial scope 14" (equation 3 of AR-ACM0003 methodology).

As Change in the carbon stocks in project, occurring in the selected carbon pools in year t shall be calculated as follows:

$$\Delta C_{P,t} = \Delta C_{TREE\_PROJ,t} + \Delta C_{SHRUB\_PROJ,t} + \Delta C_{DW\_PROJ,t} + \Delta C_{LI\_PROJ,t} + \Delta SOC_{AL,t}$$

Where:

$\Delta C_{P,t}$ = Change in the carbon stocks in project, occurring in the selected carbon pools, in year t; t CO_2-e

$\Delta C_{TREE\_PROJ,t}$ = Change in carbon stock in tree biomass in project in year t, as estimated in the tool " Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"; t CO_2-e

$\Delta C_{SHRUB\_PROJ,t}$ = Change in carbon stock in shrub biomass in project in year t, as estimated in the tool " Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"; t CO_2-e

$\Delta C_{DW\_PROJ,t}$ = Change in carbon stock in dead wood in project in year t, as estimated in the tool " Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"; t CO_2-e

$\Delta C_{LI\_PROJ,t}$ = Change in carbon stock in litter in project in year t, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"; t CO_2-e

$\Delta SOC_{AL,t}$ = Change in carbon stock in SOC in project, in year t, in areas of land meeting the applicability conditions of the tool "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities", as estimated in the same tool; t CO_2-e

Estimation in the changes of carbon stock in tree biomass:

The change in carbons stock in tree biomass was estimated as per the requirements in the methodological tool AR-TOOL 14, "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities", Version 4.2. According to section 8.2 of this tool, this method is used for ex-ante estimation of the carbon stock in tree biomass. Under this method existing data is used in combination with tree growth models to predict the growth and development of trees over time.

Under the method applied (Difference of two independent stock estimations), the change in carbon stock in trees is estimated as the difference between two successive and independent carbon stock estimations.

The change in carbon stock in trees is estimated as follows:

$$\Delta \boldsymbol{C_{TREE}} = \boldsymbol{C_{TREE,t2}} - \boldsymbol{C_{TREE,t1}}$$

Where;

ΔC_{TREE} = Change in carbon stock in trees during the period between two points of time t_1 and t_2; t CO_2e

$C_{TREE,t1}$ = Carbon stock in trees as estimated at time t_1; t CO_2e

$C_{TREE,t2}$ = Carbon stock in trees as estimated at time t_2; t CO_2e

The carbon stock estimation uses the following equation:

$$\Delta \boldsymbol{C_{TREE}} = \frac{\boldsymbol{44}}{\boldsymbol{12}} \times \boldsymbol{CF_{TREE}} \times \Delta \boldsymbol{B_{TREE}}$$

$$\Delta \boldsymbol{B_{TREE}} = \boldsymbol{A} \times \Delta \boldsymbol{b_{TREE}}$$

$$\Delta b_{TREE} = \sum_{i=1}^{M} w_i \times \Delta b_{TREE,i}$$

Where;

C_{TREE} = Carbon stock in trees in the tree biomass estimation strata; t CO_2e

CF_{TREE} = Carbon fraction of tree biomass; t C (t d.m.)-1. A default value of 0.47 is used unless transparent and verifiable information can be provided to justify a different value.

B_{TREE} = Tree biomass in the tree biomass estimation strata; t d.m.

A = Sum of areas of the tree biomass estimation strata; ha

b_{TREE} = Mean tree biomass per hectare in the tree biomass estimationstrata; t d.m./ha

w_i = Ratio of the area of stratum *i* to the sum of areas of tree biomassestimation strata (i.e., $w_i = A_i/A$); dimensionless

$b_{TREE,I}$ = Mean tree biomass per hectare in stratum *i*; t d.m. ha^{-1}

To estimate the aboveground biomass (AGB) of the tree, the equation below is used. The allometric equation is in line with the requirements set out in tool 17. The justification for the equation used is provided in section 3.2 of this document-

Bambusa Tulda[83] = Y=0.307*DBH^2.174

D= Diameter at Breast Height (1.37 m) (meter)

Table: The edaphic-climatic comparison of project region[84]

S. N.	Parameter	Unit	Project region	Myanmar
1	Climate	Zone	Subtropics to Tropics	Subtropics to Tropics
2	Daytime maximum temperature	°C	30.50	32.90
3	Daily low temperature	°C	20.90	21.30
4	Humidity	%	75	74
5	Precipitation	mm	2,164	2,208
6	Hours of Sunshine	hours	1,971	2,482

[83] Puangchit, L., Hnin, S.M. and Sungkaew, S., 2019. Allometric equations for estimating the aboveground biomass of a 14-Year-old bamboo plantation at moeswe research station, Myanmar. Journal of Tropical Forest Research, 3(1), pp.1-19. https://www.bing.com/ck/a?!&&p=07c21af0487fa8692154afaf72f147348bd1156d391f329c62f050775eb6efd1JmltdHM9MTc1OTI3NjgwMA&ptn=3&ver=2&hsh=4&fclid=18478bda-6735-65d8-2601-9f9d6651643a&psq=Puangchit%2c+L.%2c+Hnin%2c+S.M.+and+Sungkaew%2c+S.%2c+2019.+Allometric+equations+for+estimating+the+aboveground+biomass+of+a+14-Year-old+bamboo+plantation+at+moeswe+research+station%2c+Myanmar.+Journal+of+Tropical+Forest+Research%2c+3(1)%2c+pp.1-19.&u=a1aHR0cHM6Ly9rdWtyLmxpYi5rdS5hYy50aC9rdWtyX2VzL2t1a3Ivc2VhcmNoX2RldGFpbC9kb3dsb2FkX2RpZ2l0YWxfZmlsZS8zOTUwMTgvMTMzMzkz

[84] https://www.worlddata.info/climate-comparison.php?r1=burma&r2=in-north-eastern

7	Soil	Unit less	The North Eastern region (NER) of India has the largest stretches of acid soils. It is estimated that approximately 91% soils are acidic, and nearly 65% soils are suffering from strong acidity (pH < 5.5) in NE India.	In Myanmar, approximately 30% of soil samples have a pH below 5.5, indicating acidity. This acidity is particularly prevalent in high rainfall areas, such as mountainous regions, where phosphorus fixation and potential toxicity from aluminum, manganese, and iron can occur.
8	Major Crop	Unit Less	Rice, Tea	Rice

Estimation in the changes of carbon stock in shrub biomass:

No shrubs were found during the project monitoring. Therefore, the estimations of changes in existing vegetation are only associated with the carbon stock in the tree biomass. Moreover, there is no planting of shrubs as a part of the project activities as therefore this parameter will be estimated as zero in both ex-ante and ex post calculations.

Hence,

$$\Delta C_{SHRUB\_PROJ,t} = 0$$

Estimation in the changes in carbon stock in dead wood and litter:

Although the project activity is anticipated to enhance both the deadwood and litter pools, they have not been included in the accounting. As these are optional carbon pools, their exclusion follows a conservative approach and thus they have not been estimated.

$$C_{DW,i,t} = C_{TREE,i,t} \times DF_{DW}$$

$$C_{DW,i,t} = 0$$

$$C_{LI,i,t} = C_{TREE,i,t} \times DF_{LI}$$

$$C_{LI,i,t} = 0$$

Estimation in the changes in carbon stock in soil organic carbon:

Soil organic carbon (SOC) stock estimations are conducted in accordance with the "Tool for the Change in Soil Organic Carbon stocks due to the Implementation of A/R CDM Project Activity." According to the tool's recommendations, it is assumed that the project activity will raise the SOC content of the lands from pre-project levels to those equivalents to the steady-state SOC content under native vegetation. This increase in SOC content is projected to occur at a constant rate over a 20-year period from the year of planting. The project meets the applicability conditions of this tool since:

- The areas of land to where the tool is applied do not fall into wetland category and are not subject to any of the land management practices and application of tool;
- Additionally, in this section details the type of land or category that the project plantations fall, with this it's also demonstrated that the project plantations don't fall in wetland category.
- Litter remains on site and is not removed, and soil disturbance is in accordance with appropriate conservation practices, limited to site preparation and not repeated within 20 years.

SOC at the beginning of the project ($SOC_{INITIAL,i}$) is estimated by multiplying the factors in Table by the reference SOC. As per the tool, a loss in SOC ($SOC_{LOSS,i}$) is applied in the case that soil disturbance occurs on more than 10 per cent of the land area, for the case of the project activity this is not the case, therefore $SOC_{LOSS,i}$ is zero. The following methodological formula is used for calculating the annual change in SOC stock.

$$dSOC_{i,t} = \frac{SOC_{REF,i} - (SOC_{INITIAL,i} - SOC_{LOSS.i})}{20\ years}$$

Where;

$dSOC_{i,t}$ = The rate of change in SOC stock in stratum i of the area of land, in year t; tC/ha/year

$SOC_{REF,i}$ = Reference SOC stock corresponding to the reference condition in native lands by climate region and soil types applicable to stratum i of the area of land; t C/ha

$SOC_{INITIAL,i}$ = SOC stock at the beginning of the A/R project activity in stratum i of the areas of land

$SOC_{LOSS,I}$ = Loss of SOC caused by soil disturbance attributable the A/R project activity, in stratum i of the areas of land; t C/ha

The values of $SOC_{REF,i}$,$f_{LU,i}$, $f_{MG,I}$ and $f_{In,I}$ are taken form the table 3 to 6 of Tool 16 (Tool for the Change in Soil Organic Carbon Stocks Due to the Implementation of A/R CDM Project Activity).

Parameter	Symbol	Value	Source (SOC estimation tool, V01.1.0)
Reference SOC (tC/ha)	$SOC_{REF,i}$	65	Table 3: HAC soils, Tropical moist
Land use factor	$f_{LU,i}$	0.82	Short-term cultivated (< 20 yrs) or set aside (< 5 years), Table 4
Management factor	$f_{MG,i}$	1.00	1. Full tillage, Table 4
Input factor	$f_{IN,i}$	1.00	2. Medium, Table 5

Initial SOC stock at the start of the project is estimated as follows:

$$SOC_{INITIAL,i} = SOC_{REF,i} \times f_{LU,i} \times f_{MG,i} \times f_{IN,i}$$

Where;

$SOC_{INITIAL,i}$ = SOC stock at the beginning of the A/R project activity in stratum i of the areas of land

$SOC_{REF,i}$ = Reference SOC stock corresponding to the reference condition in native lands (i.e. non-degraded, unimproved lands under native vegetation – normally forest) by climate region and soil types applicable to stratum i of the area of land; t C/ha

$f_{LU,i}$ = Relative stock change factor for baseline land-use in stratum i of the areas of land; dimensionless

$f_{MG,i}$ = Relative stock change factor for baseline management regime in stratum i of the areas of land; dimensionless

$f_{IN,i}$ = Relative stock change factor for baseline input regime (e.g. crop residue returns, manure) in stratum i of the areas of land; dimensionless

I = 1, 2, 3, … strata of areas of land; dimensionless

As per the tool 16, $dSOC_{i,t}$ is not considered more than 0.8 t C/ha/yea. The result of $dSOC_{i,t}$ is 0.8 t C/ha/year, therefore this is the value of the increase of the soil organic carbon.

Estimation of GHG emissions within the project boundary

Following the methodology and the "tool for non-CO_2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity (v04.0.0)" under $GHG_{E,t}$ only the non-CO_2 gases N_2O and NH_4 need to be quantified.

The Project Activity and First Project Activity Instance is not

I. Using fire for site preparation

II. Using fire to clear the land of harvest residue prior to replanting of the land

As mentioned before, the use of fire for site preparation and/or to clear the land of harvest residue prior to plantation activity is not part of the project activity and therefore non-CO_2 GHG emissions are considered as zero.

$$\boldsymbol{GHG_{E,t} = 0}$$

Hence, the following equation is used for the Project:

$$\boldsymbol{\Delta C_{ACTUAL,t} = \Delta C_{P,t}}$$

5.3 Leakage Emissions

According to the baseline survey, prior to the project implementation, the project area is degrading shrubland, there are no grazing activities, so leakage emission attributable to the displacement of grazing activities is accounted as zero.

As per Tool 15, leakage is estimated as follows:

$$LK_t = LK_{AGRIC,t}$$

Where;

LK_t = GHG emissions due to leakage, in year t; tCO_2-e

$LK_{AGRIC,t}$ = Leakage due to the displacement of agricultural activities in year t, as estimated in the tool "Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity"; tCO_2-e

The calculations for leakage are determined through Tool AR0015: Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity, leakage emission resulting from displacement of the activities is composed of decrease in carbon stock in the carbon pools of the land and change in soil organic carbon stock due to land-use change in the land.

$$LK_{AGRIC,t} = \frac{44}{12} \times (\Delta C_{BIOMASS,t} + \Delta SOC_{LUC,t})$$

$$\Delta C_{BIOMASS,t} = [1.1 \times b_{TREE} \times (1 + R_{TREE}) + b_{SHRUB} \times (1 + R_S)] \times CF \times A_{DISP,t}$$

$$\Delta SOC_{LUC,t} = SOC_{REF} \times (f_{LUP} \times f_{MGP} \times f_{INP} - f_{LUD} \times f_{MGD} \times f_{IND}) \times A_{DISP,t}$$

Where:

$LK_{AGRIC,t}$ = Leakage emission resulting from displacement of agricultural activities in year t; t CO_2e

$\Delta C_{BIOMASS,t}$ = Decrease in carbon stock in the carbon pools of the land receiving the activity displaced in year t; t d.m.

CF = Carbon fraction of woody biomass; dimensionless.

$A_{DISP,t}$ = Area of land from which agricultural activity is being displaced in year t; ha.

b_{TREE} = Mean above-ground tree biomass in land receiving the displaced activity; t d.m. ha^{-1}.

R_{TREE} = Root-shoot ratio for trees in the land receiving the displaced activity; dimensionless.

b_{SHRUB} = Mean above-ground shrub biomass in land receiving the displaced activity; t d.m. ha^{-1}.

RS = Root-shoot ratio for shrubs in the land receiving the displaced activity; dimensionless.

$\Delta SOC_{LUC,t}$ = Change in soil organic carbon (SOC) stock due to land-use change in the land receiving the displaced activity in year t; tC ha^{-1}.

SOC_{REF} = SOC stock corresponding to the reference condition in native lands by climate region and soil type applicable to the land receiving the displaced activity; t C ha^{-1}.

f_{LUP},f_{MGP}, f_{INP} = Relative SOC stock change factors for land-use, management practices, and inputs respectively, applicable to the receiving land before the displaced activity is received; dimensionless.

f_{LUD}, f_{MGD}, f_{IND} = Relative SOC stock change factors for land-use, management practices, and inputs respectively, applicable to the receiving land after the displaced activity has been received; dimensionless.

t = 1, 2, 3 …years elapsed since the start of the A/R CDM project activity.

As per Para 9 of section 6 in AR-Tool 15[85] "Displacement of an agricultural activity by itself does not result in leakage emission. Leakage emission occurs when the displacement leads to an increase in GHG emissions relative to the GHG emissions attributable to the activity as it exists within the project boundary". The land parcels under this project activity are degrading shrublands. Farmers involved in the project have defined area which is privately owned by them and it is completely under cultivation since generations. Also, increase in GHG emission occurring outside the project boundary attributable to the secondary effects of the A/R CDM project activity (e.g., changes in demand, supply or price of goods) are considered insignificant for the purpose of this tool and hence accounted as zero.

Additionally, the project is integrated with bamboo plantation in degrading shrubland, and no activities are displaced as per the PRA responses collected. As there is no displacement of agricultural activity within the project boundary as a result of the project activities, leakage emissions are considered to be zero for the life of the project. According to Paragraph 10 of Section 6 in Tool 15, leakage emissions resulting from the displacement of grazing activities are considered nil. In addition, the lands on which project implementation will occur are not and have not been grazing lands. Most of the project areas are degrading shrub land, grazing is not a common practice in the area. These lands have no prior history of grazing. Therefore, there is no displacement of agricultural activities as a result of project activities and leakage has been estimated to be zero.

5.4 Estimated GHG Emission Reductions and Carbon Dioxide Removals.

The ex-ante estimation of tree biomass in the first group of instances and the grouped was performed taking into account the initial studies of the project proponent.

[85] ar-am-tool-15-v2.0.pdf (unfccc.int)

The net anthropogenic GHG removals by sinks are calculated as follows, according to the "A/R Large-scale Consolidated Methodology - Afforestation and reforestation of lands except wetlands version 2.0, sectorial scope 14" (equation 5 of AR-ACM0003 methodology):

$$\Delta C_{AR-CDM,t} = \Delta C_{ACTUAL,t} - \Delta C_{BSL,t} - LK_t$$

Where;

$C_{AR\ CDM,t}$ = Net anthropogenic GHG removals by sinks, in year t; tCO_2-e

$C_{ACTUAL,t}$ = Actual net GHG removals by sinks, in year t; tCO_2-e

$C_{BSL,t}$ = Baseline net GHG removals by sinks, in year t; tCO_2-e

LK_t = GHG emissions due to leakage, in year t; tCO_2-e

Since emissions due to leakage were considered zero.

$LK_t = 0$

Net anthropogenic removals are expressed according to the formula:

$$\Delta C_{AR-CDM,t} = \Delta C_{ACTUAL,t} - \Delta C_{BSL,t}$$

Project proponent applied a discount reserve of 19% to cover the aspects related to the risk of non-permanence. The complete non-permanence risk analysis can be referred from the non-permanence risk report.

Based on data and parameters monitored detailed under section 6.2 below are the estimated net GHG emission removals for 834.33 ha of land parcels in First Project Activity Instance.

Calculation of Long-Term Average:

Long Term Average Calculations: for 1st PAI

The Long-Term Average (LTA) has been calculated by following the VCS Guidelines of Section 3.2.25 of VCS Program Standard v4.7 and AFOLU Guidance: Example for Calculating the Long-Term Average Carbon Stock for ARR Projects with Harvesting.[86]

$$LA = \frac{\sum_{t=0}^{n} PE_t - BE_t}{n}$$

Where;

LA = The long-term average GHG benefit

PE_t = The total to-date GHG emission reductions and removals generated in the project scenario (tCO_2e). Project scenario emission reductions and removals shall also consider project emissions of CO_2, N_2O, CH_4 and leakage.

[86] https://verra.org/wp-content/uploads/2018/03/VCS-Guidance-Harvesting-Examples_0.pdf

BE_t = The total to-date GHG emission reductions and removals projected for the baseline scenario (t CO_2-e)

t = year

n = Total number of years in the established time period; 30 years

As per VCS standard 4.7, para 7 under section 3.2.30 The number of buffer credits to withhold is based on the change in carbon stocks only (not the net GHG benefit), as such the buffer credits will be based on the long-term average change in carbon stock. The amount of buffer credit (19%) that need to be withheld is calculated using non-permanence risk assessment tool provided in Verra hub (19%) and multiplied with change in carbon stock.

Vintage period	Estimated baseline emissions (tCO_2e)	Estimated project emissions (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated buffer pool allocation (tCO_2e)	Estimated reduction VCUs (tCO_2e)	Estimated removal VCUs (tCO_2e)	Estimated total VCU issuance (tCO_2e)
09-July-2019 to 31-Dec-2019	530	16,256	0	3,089	0	15,727	12,638
01-Jan-2020 to 31-Dec-2020	1,322	40,426	0	7,681	0	39,104	31,423
01-Jan-2021 to 31-Dec-2021	1,622	49,437	0	9,393	0	47,815	38,422
01-Jan-2022 to 31-Dec-2022	1,698	51,696	0	9,822	0	49,998	40,176
01-Jan-2023 to 31-Dec-2023	1,711	52,043	0	9,888	0	50,332	40,444
01-Jan-2024 to 31-Dec-2024	1,711	48,944	0	9,299	0	47,233	37,934
01-Jan-2025 to 31-Dec-2025	1,711	31,942	0	6,069	0	30,232	24,163
01-Jan-2026 to 31-Dec-2026	1,711	11,796	0	2,241	0	10,085	7,844

01-Jan-2027 to 31-Dec-2027	1,711	4,495	0	854	0	2,784	1,930
01-Jan-2028 to 31-Dec-2028	1,711	2,706	0	514	0	995	481
01-Jan-2029 to 31-Dec-2029	1,711	2,442	0	464	0	731	267
01-Jan-2030 to 31-Dec-2030	1,711	2,442	0	464	0	731	267
01-Jan-2031 to 31-Dec-2031	1,711	2,442	0	464	0	731	267
01-Jan-2032 to 31-Dec-2032	1,711	2,442	0	464	0	731	267
01-Jan-2033 to 31-Dec-2033	1,711	2,442	0	464	0	731	267
01-Jan-2034 to 31-Dec-2034	1,711	2,442	0	464	0	731	267
01-Jan-2035 to 31-Dec-2035	1,711	2,442	0	464	0	731	267
01-Jan-2036 to 31-Dec-2036	1,711	2,442	0	464	0	731	267
01-Jan-2037 to 31-Dec-2037	1,711	2,442	0	464	0	731	267
01-Jan-2038 to 31-Dec-2038	1,711	2,442	0	464	0	731	267

01-Jan-2039 to 31-Dec-2039	1,181	1,679	0	319	0	498	179
01-Jan-2040 to 31-Dec-2040	389	545	0	104	0	156	52
01-Jan-2041 to 31-Dec-2041	89	122	0	23	0	33	10
01-Jan-2042 to 31-Dec-2042	12	16	0	3	0	4	1
01-Jan-2043 to 31-Dec-2043	0	0	0	0	0	0	0
01-Jan-2044 to 31-Dec-2044	0	0	0	0	0	0	0
01-Jan-2045 to 31-Dec-2045	0	0	0	0	0	0	0
01-Jan-2046 to 31-Dec-2046	0	0	0	0	0	0	0
01-Jan-2047 to 31-Dec-2047	0	0	0	0	0	0	0
01-Jan-2048 to 31-Dec-2048	0	0	0	0	0	0	0
01-Jan-2049 to 08-July-2048	0	0	0	0	0	0	0
Total	**34,212**	**336,523**	**0**	**63,939**	**0**	**302,310**	**238,371**

The Long-Term Average Value for Entire Project Area calculated for Each Stratum for 30 Years is 270,010 tCO_2e. The Long-Term Average for the 1st Project Activity Instance is estimated to reach in 6th year of the first crediting period.

6 MONITORING

6.1 Data and Parameters Available at Validation

Data / Parameter	Location of project area- Latitude and longitude
Data unit	Degree decimal
Description	GPS co-ordinates of the project boundary and sample plots
Source of data	GPS
Value applied:	As per Work Sheet, field data
Justification of choice of data or description of measurement methods and procedures applied	Direct measurement of latitude and longitude of a point within a project area using a GPS. Used to provide a simple location of a discrete project area.
Purpose of data	Calculation of project emissions
Comments	None

Data / Parameter	Total area of project
Data unit	Hectare
Description	Size of the area where the project activity has been implemented.
Source of data	Data is provided by Project proponent
Value applied:	834.33
Justification of choice of data or description of measurement methods and procedures applied	The eligible area for the project activity was determined by collecting multiple GPS location points of the land parcel. Using these points, individual land parcel KML files were then extracted with Google Earth.
Purpose of data	Calculation for both estimated and actual emission reductions/removals.

Comments	None

Data / Parameter	DBH
Data unit	centimeter
Description	Bamboo DBH is measured at 1.37 cm
Source of data	Form secondary data
Value applied:	<table><tr><th>Species</th><th>DBH (cm)</th><th>Reference</th></tr><tr><td>Bamboo</td><td>6.46</td><td>Carbon sequestration through bamboo plantation.pdf (egranth.ac.in)</td></tr></table>
Justification of choice of data or description of measurement methods and procedures applied	The parameter is required for the estimated of project for emission reductions/removals. This value is taken form the secondary data base.
Purpose of data	Calculation for both estimated and actual emission reductions/removals.
Comments	None

Data / Parameter	Allometric Equation
Data unit	Kg/clump
Description	Used for the calculation of AGB of clump
Source of data	Peer reviewed literature
Value applied:	*Bambusa Tulda*[87]=Y=0.307*DBH^2.174

[87] Puangchit, L., Hnin, S.M. and Sungkaew, S., 2019. Allometric equations for estimating the aboveground biomass of a 14-Year-old bamboo plantation at moeswe research station, Myanmar. Journal of Tropical Forest Research, 3(1), pp.1-19.

Justification of choice of data or description of measurement methods and procedures applied	The parameter is required for the estimated of project for emission reductions/removals. This value is taken form the secondary data base. Reference: Puangchit, L., Hnin, S.M. and Sungkaew, S., 2019. Allometric equations for estimating the aboveground biomass of a 14-Year-old bamboo plantation at moeswe research station, Myanmar. Journal of Tropical Forest Research, 3(1), pp.1-19.[88]
Purpose of data	Calculation for both estimated and actual emission reductions/removals.
Comments	None

Data / Parameter	Root-to-Shoot Ratio (R)
Data unit	Dimensionless (Ratio)
Description	Root-shoot ratio appropriate for biomass stock
Source of data	AR Tool 14- Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities
Value applied:	0.25
Justification of choice of data or description of measurement methods and procedures applied	The ratios of belowground to aboveground biomass (root-to-shoot ratio) is used to account for belowground biomass in living biomass estimations as it is not possible to estimate BGB through measurement for a living tree species as per the Tool 14 default value 0.25 are taken.
Purpose of Data	Calculation of project emission removals
Comments	None

[88] https://www.bing.com/ck/a?!&&p=07c21af0487fa8692154afaf72f147348bd1156d391f329c62f050775eb6efd1JmltdHM9MTc1OTI3NjgwMA&ptn=3&ver=2&hsh=4&fclid=18478bda-6735-65d8-2601-9f9d6651643a&psq=Puangchit%2c+L.%2c+Hnin%2c+S.M.+and+Sungkaew%2c+S.%2c+2019.+Allometric+equations+for+estimating+the+aboveground+biomass+of+a+14-Year-old+bamboo+plantation+at+moeswe+research+station%2c+Myanmar.+Journal+of+Tropical+Forest+Research%2c+3(1)%2c+pp.1-19.&u=a1aHR0cHM6Ly9rdWtyLmxpYi5rdS5hYy50aC9rdWtyX2VzL2t1a3lvc2VhcmNoX2RIdGFpbC9kb3dsb2FkX2RpZ2I0YWxfZmIsZS8zOTUwMTgvMTMzMzkz

Data / Parameter	Carbon Fraction (CF tree)
Data unit	tC/t.d.m
Description	Carbon fraction of tree biomass
Source of data	AR Tool 14- Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities
Value applied:	0.47
Justification of choice of data or description of measurement methods and procedures applied	According to the applied tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" IPCC default value of 0.47 is used
Purpose of Data	Calculation of project emissions
Comments	None

Data / Parameter	Conversion C to CO_2
Data unit	t CO_2/t C
Description	Factor applied to convert the tree carbon sequestered to tree CO_2e sequestered
Source of data	IPCC default value.
Value applied:	44/12=3.67
Justification of choice of data or description of measurement methods and procedures applied	IPCC default value.
Purpose of Data	Calculation of project emissions removal
Comments	None

Data / Parameter	Soil Organic Carbon (SOC)
Data unit	Tonnes C/ hectares
Description	Soil organic carbon (SOC) refers only to the carbon component of organic compounds.
Source of data	AR-Tool 16 applied for the SOC calculations and total area is multiplied with the dSOC value obtain from the tool spreadsheet.
Value applied:	dSOC value applied as 0.8 t/ha/yr
Justification of choice of data or description of measurement methods and procedures applied	This value is taken as per the AR-Tool 16. For calculating the value of the dSOC following factor are considered-

$SOC_{REF,i}$	$f_{LU,i}$	$f_{MG,i}$	$f_{IN,i}$	$SOC_{INITIAL,i}$	$SOC_{LOSS,i}$
65	0.82	1.00	1.00	31.20	0.00

Purpose of Data	Calculation of estimated emissions reductions/removals
Comments	None

Data / Parameter	Project clump
Data unit	Count of clump in numbers
Description	Total planted clump during PAI-1
Source of data	Please refer to the Master of farmer's detail.
Value applied:	208,582
Justification of choice of data or description of measurement methods and procedures applied	Data records for number of saplings planted were procured at the time of plantation activity.
Purpose of Data	Calculations of estimated emissions reductions/removals
Comments	None

Data / Parameter	W_i
Data unit	Dimensionless
Description	Relative weight of the area of stratum i, the area of the stratum i divided by the total project area.
Source of data	As per the Winrock's CDM A/R sample plot calculator spreadsheet tool
Value applied:	Summation of W_i is 1

Stratum Name	W_i
2019 B. tulda	0.65
2020 B. tulda	0.27
2021 B. tulda	0.07
2022 B. tulda	0.01

Justification of choice of data or description of measurement methods and procedures applied	Calculation of sample plots and project GHGs removal after allocating sample plots to each stratum.
Purpose of data	Calculation of project emissions
Comments	None

Data / Parameter	Permanent Sample Plot (PSP)
Data unit	Number
Description	Sample plots are chosen randomly from each stratum representing the plantation of respective stratum. Project Activity monitoring is based on the PSPs.
Source of data	Refer sample plot calculator excel sheet
Value applied:	40

Stratum Name	As per PSP calculator	PSPs taken
2019 B. tulda	29	30
2020 B. tulda	9	10
2021 B. tulda	1	2
2022 B. tulda	0	1

Justification of choice of data or description of measurement methods and procedures applied	PSPs has established on the basis of Wi and Std, dev. of each strata in PAI-1. Established PSPs based on A/R Methodological Tool 'Calculation of the number of sample plots for measurements within A/R CDM project activities' (Version 02.1.0). PSPs are selected form project area planted parcel by random point generated through Q GIS.
Purpose of data	Calculation of project emissions
Comments	As per PSP calculation the total no of PSP is 40 and project activity has taken 43 as a conservative approach.

6.2 Data and Parameters Monitored

Data / Parameter	DBH
Data unit	Centimeter (cm)
Description	Diameter at breast height
Source of data	Field measurements in Permanent Sample Plots (PSPs)
Description of measurement methods and procedures applied	DBH is measured at 1.37 m above ground Measurement of all the bamboo in the sample area of 25 x 25 m^2 grid in permanent sample plots.
Frequency of monitoring/recording	At the end of each monitoring period.
Value applied:	Please refer to the monitoring data sub sheet in Ex-post Emission Reduction sheet
Monitoring equipment	Measuring Tape
QA/QC procedures applied	Standard operating procedures are made to ensure the correct and validating data collection for each of the monitoring parameters
Purpose of data	Calculation of actual project emissions
Calculation method	Diameter is calculated using the formula Diameter= Girth/(π)
Comments	None

Data / Parameter	Ai
Data unit	Hectares (ha)
Description	Area of Stratum i
Source of data	Refer Excel sheet containing Latitude and Longitude of the Project Area using Geographical Information System (GIS)
Description of measurement methods and procedures applied	Strata area is selected and mapped in the software as .kml file
Frequency of monitoring/recording	During each verification
Value applied:	Project Stratification for first Project Activity instance is based on the year of plantation. Strata wise total area for the first Project Activity instance using GIS is given in below table:

Stratum Name	Area (Ha.)
2019 B. tulda	540.48
2020 B. tulda	223.17
2021 B. tulda	59.95
2022 B. tulda	10.73

Monitoring equipment	GPS instrument.
QA/QC procedures applied	Standard operating procedures are made to ensure the correct and validating data collection for each of the monitoring parameters
Purpose of data	Calculation of actual project emissions
Calculation method	N/A
Comments	None

Data / Parameter	Standard Deviation
Data unit	t/ha

Description	Assumed standard deviation of biomass stock in stratum i
Source of data	Assumed
Description of measurement methods and procedures applied	<table><tr><th>Stratum Name</th><th>Std. dev (t.d.m/ha)</th></tr><tr><td>2019 B. tulda</td><td>48.38</td></tr><tr><td>2020 B. tulda</td><td>40.06</td></tr><tr><td>2021 B. tulda</td><td>29.33</td></tr><tr><td>2022 B. tulda</td><td>12.1</td></tr></table>
Frequency of monitoring/recording	During each monitoring phase
Value applied:	As per calculation
Monitoring equipment	It is calculated for every stratum
QA/QC procedures applied	N/A
Purpose of data	Calculation of actual project emissions
Calculation method	N/A
Comments	None

Data / Parameter	Size of Each PSPs in the Stratum i ($A_{Plot\ i}$)
Data unit	Hectares (ha)
Description	An area of 25-meter x 25-meter size (measuring 0.0625ha) is measured and marked within each sample land parcel. The selection of 0.0625 ha PSP is based on the CDM manual[89] for "Measurements for Estimation of Carbon Stocks".
Source of data	Measured in the PSPs
Description of measurement methods and procedures applied	The area is measured with the help of using a measuring tape, measuring out 25 meters from each reference point in opposite directions to establish the four corners of the PSP.

[89] https://unfccc.int/resource/docs/publications/cdm_afforestation_field-manual_web.pdf

<table>
<tr><td>Frequency of monitoring/recording</td><td>During each verification</td></tr>
<tr><td>Value applied:</td><td><table>
<tr><th>Stratum Name</th><th>Number of permanent sample plot</th><th>Size of each PSPs (ha)</th></tr>
<tr><td>2019 B. tulda</td><td>30</td><td>0.0625</td></tr>
<tr><td>2020 B. tulda</td><td>10</td><td>0.0625</td></tr>
<tr><td>2021 B. tulda</td><td>2</td><td>0.0625</td></tr>
<tr><td>2022 B. tulda</td><td>1</td><td>0.0625</td></tr>
</table></td></tr>
<tr><td>Monitoring equipment</td><td>N/A</td></tr>
<tr><td>QA/QC procedures applied</td><td>Measurement, Verification and Reporting (MRV) personnel have been trained to measure the Sample Area of 0.0625 ha.

PP has designed MRV SOP for field measurement in line with Field Manual by CDM for ‘Measurement for Estimation of Carbon Stock’ (https://unfccc.int/resource/docs/publications/cdm_afforestation_fieldmanual_web.pdf)</td></tr>
<tr><td>Purpose of data</td><td>Calculation of actual project emissions</td></tr>
<tr><td>Calculation method</td><td>N/A</td></tr>
<tr><td>Comments</td><td>N/A</td></tr>
</table>

Data / Parameter	Land Title Records
Data unit	None
Description	Land ownership document of each individual farmers involved in First Project Activity instance.
Source of data	Land ownership document of each individual farmer in the form of land record
Description of measurement methods and procedures applied	The land title records are certified by government.
Frequency of monitoring/recording	During each verification
Value applied:	None

Monitoring equipment	Land title of document
QA/QC procedures applied	The PP employee checks the data
Purpose of data	For verification of land title ownership of Farmers involved in the First Project Activity instance.
Calculation method	None
Comments	None

Data / Parameter	Survival Rate
Data unit	% (percentage)
Description	The number of trees counted in each sample parcel initially after 3-5 months of planting and replantation is carried out immediately
Source of data	Field Measurement
Description of measurement methods and procedures applied	Initial survival checking after 3-5 months of planting. Final survival checking after 2 years of planting and subsequently at each monitoring event.
Frequency of monitoring/recording	At the end of each monitoring period
Value applied:	Please refer the Ex-post Emission Reduction Sheet
Monitoring equipment	N/A
QA/QC procedures applied	N/A
Purpose of data	Calculation of project emission
Calculation method	N/A
Comments	N/A

Data / Parameter	AGB_{tclum}
Data unit	t.d.m/ha
Description	AGB of species in sample plot of stratum at time t calculated using allometric equations.
Source of data	Allometric equations of each species were taken from peer reviewed publications.
Description of measurement methods and procedures applied	Allometric equation is used for calculate the AGB
Frequency of monitoring/recording	At the start of the project activity and every five years since the initial verification and certification of an A/R project activity.
Value applied:	Please Refer to the Ex-Post emission reduction sheet (Database sheet)
Monitoring equipment	N/A
QA/QC procedures applied	Standard operating procedures are made to ensure the correct and validating data collection for each of the monitoring parameters.
Purpose of data	Calculation of actual project emissions
Calculation method	Each tree species has defined equations to calculate AGB. DBH/ values are used as input to calculate AGB using the respective equations.
Comments	None

Data / Parameter	BGB_{tree}
Data unit	t.d.m/ha
Description	The root-shoot ratio used to determine the proportion of belowground biomass in relation to the aboveground biomass.

Source of data	Refer Ex-post Emission Reduction Sheet
Description of measurement methods and procedures applied	The ratios of belowground to aboveground biomass (root-to-shoot ratio) is used to account for belowground biomass in living biomass estimations as it is not possible to estimate BGB through measurement for a living tree species. So, as per the Tool 14 default value 0.25 is taken.
Frequency of monitoring/recording	During each verification
Value applied:	Refer Ex-post Emission Reduction Sheet
Monitoring equipment	NA
QA/QC procedures applied	NA
Purpose of data	Calculation of project emissions
Calculation method	BGB = 0.25 AGB (As per tool 14, IPCC default)
Comments	None

Data / Parameter	dSOC
Data unit	tC/ha/yr
Description	The rate of SOC changes within the project boundary under baseline conditions and project scenario
Source of data	Calculated as per the Tool-16
Description of measurement methods and procedures applied	Value of the calculation model “Tool for estimation of changes in soil organic carbon stocks due to the implementation of A/R CDM project activities”.
Frequency of monitoring/recording	At each verification period
Value applied:	0.8

Monitoring equipment	N/A
QA/QC procedures applied	Standard operating procedures are made to ensure the correct and validating data collection for each of the monitoring parameters
Purpose of data	Calculation of carbon stock density of soil organic carbon (SOC)
Calculation method	N/A
Comments	None

Data / Parameter	$A_{DISP,t}$
Data unit	Ha
Description	Area of land from which agricultural activity is being displaced in the current monitoring period
Source of data	N/A
Description of measurement methods and procedures applied	Standard operating procedures are made to ensure the correct and validating data collection for each of the monitoring parameters.
Frequency of monitoring/recording	At each verification period
Value applied:	0
Monitoring equipment	N/A
QA/QC procedures applied	N/A
Purpose of data	Calculation of actual project emissions
Calculation method	N/A
Comments	None

Data / Parameter	$A_{BURN,I,t}$
Data unit	ha
Description	The land area on fire had occurred and carbon loss in such area.
Source of data	Field measurement or remote sensing measurement
Description of measurement methods and procedures applied	The area shall be delineated either on the ground using GPS or from georeferenced remote sensing data
Frequency of monitoring/recording	At each verification period
Value applied:	0
Monitoring equipment	N/A
QA/QC procedures applied	N/A
Purpose of data	Calculation of actual project emissions
Calculation method	N/A
Comments	None

Data / Parameter	Buffer
Data unit	%
Description	The risk of carbon loss associated with the project activity has been mitigated and secured through the measures implemented by the project.
Source of data	N/A
Description of measurement methods and procedures applied	Calculated as per the VCS Non-Permanence Risk Tool 4.2

Frequency of monitoring/recording	At each verification period
Value applied:	19 %
Monitoring equipment	N/A
QA/QC procedures applied	N/A
Purpose of data	Calculation of actual project emissions
Calculation method	Buffer pool is calculated using the Verra hub portal where non-permanence risk assessment is performed.
Comments	None

6.3 Monitoring Plan

As per the requirements of VCS program, the project will describe the process and schedule for obtaining, recording, compiling and analyzing the monitored data and parameters set out in section 6.2 (data and parameters monitored) above. The following details should be included:

Roles and Responsibilities:

The management structure of the plantation project of respective project implementer and Infinite Environmental Solutions Limited is represented as follows:

Organization	Roles	Reporting	Designation
Infinite Solutions	Project plan; designing & execution Financial management; Budgeting; Project accounting; Checks & controls Project Monitoring & Reports Supervision of carbon credit project Addressing all legal procedures	Infinite Solutions Operation Director	Project Proponent (PP)
HLTEC	Project implementation General administration Coordination with the field staff Develop & maintain the MIS Intermittent Site visits	Infinite Solutions Operation Director	Project Implementer

Establishment of the project boundary

All land parcels subject to plantations under this project activity are delineated using GPS tracking function. For this, an extensive training is conducted and up-to-date GPS portable

devices are available (Garmin etrex). A step-wise guidance of this tracking procedure is provided in the SOPs Each planting plot, having assigned a unique ID, is tracked and the tracks are downloaded and recorded as Google Earth pro .kml file, as shape file and as Excel file. This allows for further processing of the tracks via GIS applications. The activities that allow for proper management and monitoring of the project areas are:

- Review of all project boundaries to assess potentially on-going afforestation activities, site by site.
- Geo-referencing (latitude and longitude) of each land parcel, which is part of the project.
- Periodic verification of at least 10% of recorded boundary tracks to ensure that the project boundaries correspond to the boundaries laid out
- There will be periodic verifications of the project area boundaries, during the crediting period. If the boundaries present changes within this period due to natural (pests, diseases, fire, etc.) or anthropogenic damages (harvests or deforestation), these areas will be located and their extent determined, making an assessment of the carbon loss. These areas will be treated as different strata from those initially established. The modified boundaries will be reported during the subsequent verification, the deforested lands will be excluded from the project and the VCUs issued for these areas will be deducted.
- Similarly, the areas where planting fails, or the use of the land changes, will be documented.
- Analysis of the field information obtained using a GIS system (ArcGIS), calculating the areas incorporated by tree stand model and year of planting, and those affected by disturbances will be carried out.

Stratification

Stratification of the areas will correspond to the guidelines established by methodology AR-ACM0003 “Afforestation and reforestation of lands except wetlands” Version (2.0). During the project, the number and boundaries of the strata defined ex-ante may change during the crediting period (ex-post). For this reason, strata will be monitored periodically. If a change in the number and area of the project strata occurs, the sampling framework will be adjusted accordingly through the following procedure for monitoring strata and the sampling framework. A stratification is proposed according as a function of the carbon sinks and disturbances identified, taking into account the following elements:

- The results of biomass accumulation
- Planting dates
- Unexpected disturbance occurring during the crediting period (e.g., fire, pest or disease outbreaks);
- Since this project activity instance 1 is rolled out over a 5 years period, planting different tree species groups, the database is updated periodically capturing the following information:

- Unexpected disturbances occurring during the crediting period (e.g., due to fire, pests or disease outbreaks), affecting differently different parts of an originally homogeneous stratum or stand;
- Forest management (cleaning, planting, re-replanting and harvesting, if any) may be implemented at different intensities, dates and spatial locations than mentioned in the PDMR
- Two different strata may be similar enough to allow their merging into one stratum.

The stratification identification procedure and the final stratification for this monitoring period are described below:

Identification of pre-stratification scenario: Infinite environmental solutions limited monitoring team identified possible stratification variables apart from planting years such as species planted, plantation model, climatic zone (as per project inventory database).

Sampling design, sampling size and random sample point selection

The sampling design is first of all driven by the precision requirements as outlined in the methodology. The targeted precision level for biomass estimation shall be ± 10% of the mean at a 90% confidence level. The survey sample size is determined by the variability of biomass within the samples and the precision level required in the methodology (90/10 precision level). The tool "Calculation of the number of sample plots for measurements within A/R CDM project activities" (Version 02.1.0)"[90] as well as the Sampling Calculator (Walker et al. 2007)[91] is used to estimate the number of permanent sample plots needed (project total as well as number of plots per stratum i) for monitoring changes in carbon pools at a desired precision level and to determine the plot locations. Based on this, Ex ante as well as standard deviation assumed by the expert was to determine variability of carbon stocks of trees and to determine the required sample size. It was agreed to fix the sample size at an uncertainty level of 10% and to apply the discounting procedure presented in Appendix 2 of the A/R Methodological tool 'estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities' (Version 4.2). The sample plot selection and location equally follow the guidance of the "Calculation of the number of sample plots for measurements within A/R CDM project activities" (Version 02.1.0) selecting a stratified random sampling procedure with a Square (25m * 25m) sample plot design. The random selection of planting plots for the sampling was done proportionally to the size of the plots. The different steps of this process are outlined below, for a full description it is referred to the Infinite Environmental Solutions Limited SOPs provided in the supporting documentation. The location of the center point of the 25m * 25m permanent sample square is determined randomly using an automatic ArcGIS function.

- **Pilot Inventory:** Plantation plots for each preliminary stratum were randomly selected. Calculation of biomass (In major carbon pool) per hectare and variability applying the AR

[90] https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-03-v2.1.0.pdf
[91] Winrock International » Winrock Sample Plot Calculator Spreadsheet Tool

methodology tool 'estimation of carbon stock and change in carbon stocks of the trees and shrubs in A/R CDM project activity'. inputs of win-rock model are given below:

Sr. No.	Stratum Name	Area (Ha.)	Mean AGB (t.d.m/ha)	Std. Dev. (t.d.m/ha)
1	2019 B. tulda	540.48	138.22	48.38
2	2020 B. tulda	223.17	133.52	40.06
3	2021 B. tulda	59.95	83.79	29.33
4	2022 B. tulda	10.73	34.56	12.10

Determination of sample size for this monitoring period:

Due to high variability of carbon and very low carbon densities during this early stage of the project, sample size is determined for a 10% uncertainty. The following minimum number of sample plots is required for the eight strata:

S. N.	Stratum Name	Area (Ha.)	Mean AGB (t.d.m/ha)	Std. Dev. (t.d.m/ha)	Nos. of PSP calculated	Nos. of PSP taken
1	2019 B. tulda	540.48	138.22	48.38	29	30
2	2020 B. tulda	223.17	133.52	46.73	9	10
3	2021 B. tulda	59.95	83.79	29.33	1	2
4	2022 B. tulda	10.73	34.56	12.10	0	1

- **Random planting plot selection and permanent sample point allocation:** Using the project database, the respective number of plots was randomly selected proportionally to size of the planting plots (see SOP 'PILOT INVENTORY & SAMPLING'). The center point of the square measurement point is randomly selected within these planting plots.

- **Permanent sample point design:** Following "Measurements for Estimation of Carbon Stocks in Afforestation and Reforestation Project Activities under the Clean Development Mechanism A Field Manual"[92], a sample plot size should be determined in a way to measure around 20 trees per plot. Based on the avg. tree density (250 trees per ha) in this project, each square should cover an area of approx. 625 m^2, i.e., with dimensions 25m*25m (conservatively)

- The pilot plots can be integrated into the total sample size since both the stratified random plot selection procedures as well as the parameters collected from the permanent sample circles are identical to the subsequent sampling. The Excel file with all plots randomly selected including a shape file with the exact circle point locations is attached as supporting information.

[92] cdm_afforestation_field-manual_web.pdf (unfccc.int)

Data collection, recording and analysis:

Data parameters	Data generation	Recording	Storage	Responsible persons
Area of plantation	The data will be generated through tracking of prerecorded way points with GPS	The way points will be recorded in KML format	The data will be stored centrally in electronic format	The data will be collected by PP team project officers
Area of sampling	The area sampled will be calculated with the help of applicable tool for sampling. The area will be updated annually	The area to be sampled is recorded by consultant	The data is stored centrally in electronic format	The data will be calculated by Project Manager
DBH	These parameters are calculated for three clumps[93] randomly in the designated sample plots which are permanent for the crediting period of the project. The measurement is taken annually for all the three clumps in the sample plots.	The records will be maintained by consultant	The data will be stored centrally in electronic format	Infinite Environmental Solutions Limited will carry out monitoring of plots for Collar Diameter.
Survival of trees	The survival of plantations will be noted visually for the first three years after the plantation.	The records will be maintained by consultant	The data will be stored centrally in electronic format and appropriate action in case of more than expected mortality	Infinite environmental Solutions limited
Area affected by Natural Disaster	Any plantation area affected by natural disasters and consequent loss of	The records will be maintained by PP	The data will be stored centrally in electronic format	Infinite Environmental Solutions Limited (PP)

[93] Kaushal, R., S. Islam, Salil Tewari, J. M. S. Tomar, S. Thapliyal, M. Madhu, T. L. Trinh, Tarun Singh, Avnindra Singh, and J. Durai. "An allometric model-based approach for estimating biomass in seven Indian bamboo species in western Himalayan foothills, India." Scientific Reports 12, no. 1 (2022): 7527. (An allometric model-based approach for estimating biomass in seven Indian bamboo species in western Himalayan foothills, India | Scientific Reports)

	carbon stock will be noted & calculated.			

A detailed description of the field data collection procedures can be found in the SOP. The field measurement procedure has been standardized from the early beginning of this project and the main steps are summarized as follows:

Field work safety: This includes equipment checking, calibration of measurement equipment; organization of field teams; and general office preparations prior to field work.

Field measurement planning: This step is to train new members of the survey teams or to update all team members to record parameters (such as tree measurement record etc.). A standard itinerary has been developed for this.

Orientation and training of standard field procedures: This includes standard rules on navigation and locating of sample point locations, and to fix and establish the square point center.

Navigating to and between sample points in the field: Standard activities according to a given workflow include three levels of data collection; (1) Plantation plot parameters; (2) Measurement plot specific parameters and (3) Tree specific parameters.

Sample point measurement activities: Standard activities according to a given workflow include three levels of data collection; (1) Plantation plot parameters; (2) Measurement plot specific parameters and (3) Tree specific parameters.

Field data transfer, verification and project carbon inventory database: The plot-wise data are entered into a standard database Excel template which uses excel based features to ensure/ verify the correct entry of data (conditional formatting to identify outliers/ wrong entries, provision of drop-down lists to avoid spelling errors, etc.). The survey team-wise data are then compiled in the total project carbon database.

Sample point layout

Square shape permanent sample plots are established which are easy to locate, and its boundary can be established with less effort. Considering the planting density in this project the size of the measurement circle is defined to capture at least 15-20 trees per plot. The formula used to calculate this is shown below.

$$A_{min} = 10{,}000 \times n_{min} \div ne$$

$$m^2 = m^2/ha \times trees \div trees/ha$$

Where, A_{min} = minimum circle area size in m^2

n_{min} = number of minimum trees required to measure within one measurement circle (at least 20)

ne = number of trees per ha planted which are expected to reach maturity stage

The table below summarizes the status information of the 8 project strata and the assessment of square shape.

Parameters collected and measured in the field

Diameter at Breast Height (DBH): DBH for each sampled clump has been calculated from the girth values measured in the field near the culm (at 1.37m). Tailors tape has been used for the girth measurement

$$Diameter = Girth / 3.14$$

Procedures for internal auditing and QA/QC

As stated in the IPCC GPG for LULUCF (page 4.111) monitoring requires provisions for quality assurance (QA) and quality control (QC) to be implemented via a QA/QC plan. The plan will be part of project documentation and cover procedures as described below for:

- Collecting reliable field measurements;
- Verifying methods used to collect field data;
- Verifying data entry and analysis techniques; and
- Data maintenance and archiving. Especially this point is important, as time scales of project activities are much longer than technological improvements of electronic data archiving.

Procedures to ensure reliable field measurements

Collecting reliable field measurement data is an important step in the quality assurance plan. Those responsible for the measurement work are trained in all aspects of the field data collection and data analyses. It is good practice to develop Standard Operating Procedures (SOPs) for each step of the field measurements, which should be adhered to at all times. These SOPs describe in detail all steps to be taken of the field measurements and contain provisions for documentation for verification purposes so that future field personnel can check past results and repeat the measurements in a consistent fashion. To ensure the collection and maintenance of reliable field data:

- Field-team members are fully aware of all procedures and the importance of collecting data as accurately as possible;
- Field teams install test plots if needed in the field and measure all pertinent components using the SOPs to estimate measurement errors;
- The document lists all names of the field team and the project leader will certify that the team is trained; and new staff is adequately trained.

Procedures to verify field data collection

To verify that plots have been installed and the measurements taken correctly, it is good practice to remeasure independently every 10 plots and to compare the measurements. The following quality targets are achieved for the re-measurements, compared to the original measurements:

- Missed or extra trees- no error within the plot
- Tree species or groups- no error

At the end of the field work independently 10-20% of the plots are checked. Field data collected at this stage is compared with the original data. Any errors found are corrected and recorded. Any errors discovered are expressed as a percentage of all plots that have been re-checked to provide an estimate of the measurement error.

Reliable carbon estimates require proper entry of data into the data analyses spreadsheets. Possible errors in this process are minimized if the entry of field data is cross-checked and, where necessary, internal tests incorporated into the spreadsheets to ensure that the data entries are realistic. Communication between all personnel involved in measuring and analyzing data is used to resolve any apparent anomalies before the final analysis of the monitoring data is completed. If there are any problems with the monitoring plot data that cannot be resolved, the plot is not used in the analysis.

Data maintenance and storage

Because of the relatively long-term nature of these project activities, data archiving (maintenance and storage) will be an important component of the work. Data archiving should take several forms and copies of all data should be provided to each project participant. Copies (electronic and/or paper) of all field data, data analyses, and models; estimates of the changes in carbon stocks and corresponding calculations and models used; any GIS products; and copies of the measuring and monitoring reports should all be stored in a dedicated and safe place, preferably offsite. Given the time frame over which the project activity will take place and the pace of production of updated versions of software and new hardware for storing data, it is recommended that the electronic copies of the data and report be updated periodically or converted to a format that could be accessed by any future software application.

7 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

7.1 Data and Parameters Monitored

Data / Parameter	Total area of project
Data unit	Hectare

Description	Total area of small land parcels in which project is implemented
Value applied:	834.33
Comments	None

Data / Parameter	DBH
Data unit	cm
Description	Diameter of the Cum at the breast height (1.37m). DBH values are collected for each sample plot prior to the verification.
Value applied:	Please referee the Ex-post Calculation sheet
Comments	None

Data / Parameter	t
Data unit	Year
Description	Time period elapsed between two successive estimations of carbon stock
Value applied:	Stratum: t (years) 2019 B. tulda: 5.44 2020 B. tulda: 4.96 2021 B. tulda: 3.96 2022 B. tulda: 2.96
Comments	None

Data / Parameter	A_i
Data unit	Hectares (ha)
Description	Area of Stratum i

Value applied:	Project Stratification for first Project Activity instance is based on the year of plantation. Strata wise total area for the first Project Activity instance using GIS is given in below table: **Stratum Name** / **Area (ha)** 2019 B. tulda: 540.48 2020 B. tulda: 223.17 2021 B. tulda: 59.95 2022 B. tulda: 10.73
Comments	None

Data / Parameter	Size of Each PSPs in the Stratum i ($A_{Plot,i}$)
Data unit	Hectares (ha)
Description	An area of 25-meter x 25-meter size (measuring 0.0625 ha) is measured and marked within each sample land parcel. The selection of 0.0625 ha PSP is based on the CDM manual[94] for "Measurements for Estimation of Carbon Stocks".
Value applied:	**Stratum Name** / **Number of permanent sample plot** / **Size of each PSPs (ha)** 2019 B. tulda: 30: 0.0625 2020 B. tulda: 10: 0.0625 2021 B. tulda: 2: 0.0625 2022 B. tulda: 1: 0.0625
Comments	None

Data / Parameter	AGB_{tree}
Data unit	t.d.m/ha
Description	AGB of culm in sample plot of stratum at time t calculated using allometric equations.
Value applied:	Please refer to the Ex-post Emission Reduction Sheet.

[94] 0 https://unfccc.int/resource/docs/publications/cdm_afforestation_field-manual_web.pdf

Comments	None

Data / Parameter	BGB_{tree}
Data unit	t.d.m/ha
Description	The root-shoot ratio used to determine the proportion of belowground biomass in relation to the aboveground biomass.
Value applied:	Refer Ex-post Emission Reduction Sheet
Comments	None

Data / Parameter	$A_{Burn,i,t}$
Data unit	Hectare
Description	Area burnt in stratum i Area burnt under the particular stratum under the current monitoring period. Area burnt is recorded at the time of each monitoring.
Value applied:	**Stratum** / **$A_{Burn,i,t}$** 2019 B. tulda / 0 2020 B. tulda / 0 2021 B. tulda / 0 2022 B. tulda / 0
Comments	None

7.2 Baseline Emissions

The baseline net GHG removals by sinks shall be calculated as follows (equation 1 of AR-ACM0003 methodology):

$$\Delta C_{BSL,t} = \Delta C_{TREE\_BSL,t} + \Delta C_{SHRUB\_BSL,t} + \Delta C_{DW\_BSL,t} + \Delta C_{LI\_BSL,t}$$

Where;

$C_{BSL,t}$ = Baseline net GHG removals by sinks in year t; t CO_2-e

$C_{TREE\_BSL,t}$ = Change in carbon stock in baseline tree biomass within the project boundary in year t, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"; t CO_2-e

$C_{SHRUB\_BSL,t}$ = Change in carbon stock in baseline shrub biomass within the project boundary, in year t, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"; t CO_2-e

$C_{DW\_BSL,t}$ = Change in carbon stock in baseline dead wood biomass within the project boundary, in year t, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"; t CO_2-e

$C_{LI\_BSL,t}$ = Change in carbon stock in baseline litter biomass within the project boundary, in year t, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"; t CO_2-e

The baseline emissions estimation is carried out using the A/R Methodological AR-TOOL 14 "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities Version 04.2"

Change in carbon stock in baseline tree ($C_{TREE\_BSL,t}$)

According to the AR-TOOL 14, carbon stock in trees in the baseline can be accounted as zero if all of the following conditions are met:

1) The Baseline trees are neither harvested, nor cleared, nor removed throughout the crediting period of the Project activity.

   For the project activity, it is confirmed that baseline trees are neither harvested, cleared, nor removed and will not clear throughout the crediting period. This is primarily because the project is implemented on degrading shrubland, where the existing vegetation consists mainly of sparsely distributed shrubs with no presence of mature trees.

2) The Baseline trees do not suffer mortality because of competition from trees planted in the project, or damage because of implementation of the Project activity, at any time during the crediting period of the project activity;

   As indicated above there are no pre-project trees in the Project Area.

3) The Baseline trees are not inventoried along with the project trees in monitoring of carbon stocks but their continued existence, consistent with the baseline scenario, is monitored throughout the crediting period of the Project activity.

   As indicated above there are no pre-project trees in the Project Area.

Change in carbon stock in baseline shrub biomass ($C_{SHRUB\_BSL,t}$)

As stated above, the project land was classified as degrading shrubland prior to project implementation. Some shrubs were present in the baseline scenario; however, they were cleared

during site preparation before the initiation of planting activities. The baseline emissions have been calculated by considering the shrubland condition in accordance with the requirements of Section 5.4 of the applied methodology.

As per the AR-Tool-14, the baseline shrub biomass has been calculated in accordance with the procedures outlined in Paragraph 60 and 61 of the tool. The estimation was carried out for strata where the shrub crown cover exceeded 5%, using either default biomass value.

$$C_{SHRUB,t} = \frac{44}{12} \times CF_s \times (1 + R_s) \times \sum_i A_{SHRUB,i} \times b_{SHRUB,i}$$

$$b_{SHRUB,i} = BDR_{SF} \times b_{FOREST} \times CC_{SHRUB,i}$$

Where;

$C_{SHRUB,t}$ = Carbon stock in shrubs within the project boundary at a given point of time in year t; t CO_2-e

CF_S = Carbon fraction of shrub biomass; t C (t.d.m.)$^{-1}$

R_S = Carbon fraction of shrub biomass; t C (t.d.m.)$^{-1}$

$A_{SHRUB,I}$ =Area of shrub biomass estimation stratum i; ha

$B_{SHRUB,I}$ = Shrub biomass per hectare in shrub biomass estimation stratum i; t d.m. ha^{-1}

BDR_{SF} = Ratio of shrub biomass per hectare in land having a shrub crown cover of 1.0 (i.e., 100 per cent) and the default above-ground biomass content per hectare in forest in the region/country where the A/R CDM project activity is located; dimensionless

b_{FOREST} = Default above-ground biomass content in forest in the region/country where the A/R CDM project activity is located; t d.m. ha^{-1}

$CC_{SHRUB,I}$ = Crown cover of shrubs in shrub biomass estimation stratum i at the time of estimation, expressed as a fraction (e.g. 10 per cent crown cover implies = 0.10); dimensionless

The values used for the shrub biomass calculation are as follows:

Parameter/ Stratum	2019 B. tulda	2020 B. tulda	2021 B. tulda	2022 B. tulda
$CC_{SHRUB,I}$	0.115	0.118	0.119	0.125
b_{FOREST}	73	73	73	73
BDR_{SF}	0.1	0.1	0.1	0.1
$B_{SHRUB,I}$	0.84	0.86	0.87	0.91
$A_{SHRUB,i}$	540.48	223.17	59.95	10.73
R_S	0.4	0.4	0.4	0.4
CF_S	0.47	0.47	0.47	0.47
$C_{SHRUB,t}$	1098.58	462.38	126.03	23.62

As per the tool 14, the biomass may reach a steady state in which biomass growth becomes zero or insignificant, either because of biological maturity of trees or because the rate of anthropogenic biomass extraction from the area is equal to the rate of biomass growth. Therefore, this parameter should be taken to be zero after the year in which tree biomass in the baseline reaches a steady state. The year in which tree biomass in the baseline reaches a steady-state is taken to be the 20th year from the start of the CDM project activity.

Change in carbon stock in baseline dead wood and Litter biomass ($C_{DW\_BSL,t}$ and $C_{LI\_BSL,t}$)

As stated above, since there are no trees present in the baseline scenario, the litter and deadwood biomass are considered to be negligible (nil).

Hence,

$$\Delta C_{BSL,t} = \Delta C_{SHRUB\_BSL,t}$$

7.3 Project Emissions

According to the methodology AR-ACM0003 is stated that if biomass distribution over the project area is not homogeneous, stratification should be carried out to improve the precision of biomass estimation (please refer the section 6.3).

The actual net GHG removals by sinks shall be calculated as follows (equation 2 in Methodology):

$$\Delta C_{ACTUAL,t} = \Delta C_{P,t} - GHG_{E,t}$$

Where;

$\Delta C_{ACTUAL,t}$ = Annual actual net GHG removals by sinks at time t; t CO_2-e yr^{-1}

$\Delta C_{P,t}$ = Change in carbon stocks in project, occurring in the selected carbon pools, at time t; t CO_2-e yr^{-1}

$GHG_{E,t}$ = Increase of non-CO_2 GHG emissions within the project boundary as a result of the implementation of the A/R project activity, in year t, as estimated in the tool "Estimation of non-CO_2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity"; t CO_2-e

Change in the carbon stocks in project, occurring in the selected carbon pools in year t shall be calculated as follows (equation 3):

$$\Delta C_{P,t} = \Delta C_{TREE-PROJ,t} + \Delta C_{SHRUB-PROJ,t} + \Delta C_{DW-PROJ,t} + \Delta C_{LI-PROJ,t} + \Delta SOC_{AL,t}$$

Where:

$\Delta C_{P,t}$ = Change in the carbon stocks in project, occurring in the selected carbon pools, in year t; t CO_2-e

$\Delta C_{TREE\_PROJ,t}$ = Change in carbon stock in tree biomass in project in year t, as estimated in the tool " Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"; t CO_2-e

$\Delta C_{SHRUB\_PROJ,t}$ = Change in carbon stock in shrub biomass in project in year t, as estimated in the tool " Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"; t CO_2-e

$\Delta C_{DW\_PROJ,t}$ = Change in carbon stock in dead wood in project in year t, as estimated in the tool " Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"; t CO_2-e

$\Delta C_{LI\_PROJ,t}$ = Change in carbon stock in litter in project in year t, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"; t CO_2-e

$\Delta SOC_{AL,t}$ = Change in carbon stock in SOC in project, in year t, in areas of land meeting the applicability conditions of the tool "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities", as estimated in the same tool; t CO_2-e

Estimation in the changes of carbon stock in tree biomass:

The change in carbon stock in tree biomass in project in year t is estimated based on the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities", AR-TOOL14.

The parameters used to determine the biomass of the forest species in the project are Carbon Fraction (CF), Root-to-shoot-ratio (R), and Diameter at breast height (DBH), Collar Girth, Height of tree, DBH, Collar girth and height was measured in the field. CF and R used default values proposed by IPCC.

The plot biomass value (i.e., per-hectare tree biomass at the centre of the plot) is estimated as follows (all time-dependent variables relate to the time of measurement):

Mean tree biomass per hectare in a stratum and the associated variance are estimated as follows: (equation 16 and 17 of tool 14)

$$\boldsymbol{b_{TREE,i}} = \frac{\sum_{p=1}^{n_i} \boldsymbol{b_{TREE,p,i}}}{\boldsymbol{n_i}}$$

$$\boldsymbol{s_i^2} = \frac{\boldsymbol{n_i} \times \sum_{p=1}^{n_i} \boldsymbol{b_{TREE,p,i}^2} - \left(\sum_{p=1}^{n_i} \boldsymbol{b_{TREE,p,i}}\right)^2}{\boldsymbol{n_i} \times (\boldsymbol{n_i} - \mathbf{1})}$$

Where;

b_{TREEi} = Mean change in tree biomass per hectare in stratum i; t d.m. ha^{-1}

$b_{TREEp,I}$ = Change in tree biomass per hectare in plot p in stratum i; t d.m. ha^{-1}

S^2_i = Variance of mean change in tree biomass per hectare in stratum i; (t d.m./ha)^2

n_i = Number of sample plots, in stratum i, in which tree biomass was re-measured

Mean carbon stock in trees within the tree biomass estimation strata and the associated uncertainty are estimated as follow: (equation 12 to 15 of tool 14)

Estimation in the changes of carbon stock in shrub biomass:

The change in carbon stock in shrub biomass in project in year t is estimated based on the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities", AR-TOOL14. Shrub plantation is not included in the project activity. Therefore, the biomass or change in the biomass of shrubs is considered as zero.

$$\Delta C_{SHRUB\_PROJ,t} = 0$$

Estimation in the changes of carbon stock in deadwood and litter biomass:

Although the project activity is anticipated to enhance both the deadwood and litter pools, they have not been included in the accounting. As these are optional carbon pools, their exclusion follows a conservative approach and thus they have not been estimated.

$$C_{DW,i,t} = 0$$

$$C_{LI,i,t} = 0$$

Estimation in the changes in soil organic carbon (SOC):

Estimations of soil organic carbon (SOC) stocks were done accordance to the "Tool for the change in soil organic carbon stocks due to the implementation of A/R CDM project activity". As suggested by the tool, it is assumed that the implementation of the project activity increases the SOC content of the lands from the pre-project level to the level that is equal to the steady-state of SOC content under native vegetation. The increase in SOC content in the project scenario takes place at a constant rate over a period of 20 years from the year of planting.

SOC at the beginning of the project ($SOC_{INITIAL,i}$) is estimated by multiplying the factors in Table by the reference SOC. As per the tool, a loss in SOC ($SOC_{LOSS,i}$) is applied in the case that soil disturbance occurs on more than 10 per cent of the land area, for the case of the project activity this is not the case, therefore $SOC_{LOSS,i}$ is zero. The following methodological formula is used for calculating the annual change in SOC stock.

$$dSOC_{i,t} = \frac{SOC_{REF,i} - (SOC_{INITIAL,i} - SOC_{LOSS.i}}{20\ years}$$

Where;

$dSOC_{i,t}$ = The rate of change in SOC stock in stratum i of the area of land, in year t; t C/ha/year

$SOC_{REF,i}$ = Reference SOC stock corresponding to the reference condition in native lands by climate region and soil types applicable to stratum i of the area of land; t C/ha

$SOC_{INITIAL,i}$ = SOC stock at the beginning of the A/R project activity in stratum i of the areas of land

$SOC_{LOSS,I}$ = Loss of SOC caused by soil disturbance attributable the A/R project activity, in stratum i of the areas of land; t C/ha

The values of $SOC_{REF,i}$,$f_{LU,i}$, $f_{MG,I}$ and $f_{In,I}$ are taken form the table 3 to 6 of Tool 16 (Tool for the Change in Soil Organic Carbon Stocks Due to the Implementation of A/R CDM Project Activity).

Parameter	Symbol	Value	Source (SOC estimation tool, V01.1.0)
Reference SOC (tC/ha)	$SOC_{REF,i}$	65	Table 3: HAC soils, Tropical moist
Land use factor	$f_{LU,i}$	0.82	Short-term cultivated (< 20 yrs) or set aside (< 5 years), Table 4
Management factor	$f_{MG,i}$	1.00	1. Full tillage, Table 4
Input factor	$f_{IN,i}$	1.00	2. Medium, Table 5

Initial SOC stock at the start of the project is estimated as follows:

$$SOC_{INITIAL,i} = SOC_{REF,i} \times f_{LU,i} \times f_{MG,i} \times f_{IN,i}$$

Where;

$SOC_{INITIAL,i}$ = SOC stock at the beginning of the A/R project activity in stratum i of the areas of land

$SOC_{REF,i}$ = Reference SOC stock corresponding to the reference condition in native lands (i.e. non-degraded, unimproved lands under native vegetation – normally forest) by climate region and soil types applicable to stratum i of the area of land; t C/ha

$f_{LU,i}$ = Relative stock change factor for baseline land-use in stratum i of the areas of land; dimensionless

$f_{MG,i}$ = Relative stock change factor for baseline management regime in stratum i of the areas of land; dimensionless

$f_{IN,i}$ = Relative stock change factor for baseline input regime (e.g. crop residue returns, manure) in stratum i of the areas of land; dimensionless

I = 1, 2, 3, … strata of areas of land; dimensionless

As per the tool 16, $dSOC_{i,t}$ is not considered more than 0.8 t C/ha/yea. The result of $dSOC_{i,t}$ is 0.8 t C/ha/year, therefore this is the value of the increase of the soil organic carbon.

Estimation of GHG emissions within the project boundary

The increase in GHG emissions as a result of the implementation of the proposed A/R CDM project activity within the project boundary can be estimated as:

$$GHG_E = \sum_{t=1}^{t^*} GHG_{E,t}$$

Where;

GHG_E = Increase in GHG emissions as a result of the implementation of the proposed A/R CDM project activity within the project boundary; t CO_2-e

$GHG_{E,t}$ = Increase in non-CO_2 emissions due to burning of biomass of existing woody vegetation as part of site preparation in year t, as estimated in the tool "Estimation of non-CO_2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity"; tCO_2e

t = 1, 2, 3, … t* years elapsed since the start of the A/R CDM project activity

Initially, the project activity or PAI did not involve any burning activity. Therefore, emissions from burning are considered nil.

7.4 Leakage Emissions

Leakage is estimated using the A/R CDM tool-15 "Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity" v2.0.

Baseline scenario of the land involved in the project is either degrading shrubland or agricultural land. Leakage associated with the agricultural activity can be estimated using below equation:

$$LK_{AGRIC,t} = \frac{44}{12} * \Delta C_{BIOMASS,t} + \Delta SOC_{LUC,t} = 0$$

$$\Delta C_{BIOMASS,t} = [1.1 * b_{tree} * (1 + R_{tree}) + b_{SHRUB} * (1 + R_s) * CF * A_{DISP,t}$$

$$\Delta SOC_{LUC,t} = SOC_{REF} * (f_{LUP} * f_{MGP} * f_{INP} - f_{LUD} * f_{MGD} * f_{IND}) * A_{DISP,t}$$

Where:

$LK_{AGRIC,t}$ = Leakage emission resulting from displacement of agricultural activities in year t; t CO_2e

$\Delta C_{BIOMASS,t}$ = Decrease in carbon stock in the carbon pools of the land receiving the activity displaced in year t; t d.m.

CF = Carbon fraction of woody biomass; dimensionless.

$A_{DISP,t}$ = Area of land from which agricultural activity is being displaced in year t; ha.

b_{TREE} = Mean above-ground tree biomass in land receiving the displaced activity; t d.m. ha^{-1}.

R_{TREE} = Root-shoot ratio for trees in the land receiving the displaced activity; dimensionless.

b_{SHRUB} = Mean above-ground shrub biomass in land receiving the displaced activity; t d.m. ha^{-1}.

RS = Root-shoot ratio for shrubs in the land receiving the displaced activity; dimensionless.

$\Delta SOC_{LUC,t}$ = Change in soil organic carbon (SOC) stock due to land-use change in the land receiving the displaced activity in year t; tC ha^{-1}.

SOC_{REF} = SOC stock corresponding to the reference condition in native lands by climate region and soil type applicable to the land receiving the displaced activity; t C ha^{-1}.

f_{LUP},f_{MGP}, f_{INP} = Relative SOC stock change factors for land-use, management practices, and inputs respectively, applicable to the receiving land before the displaced activity is received; dimensionless.

f_{LUD}, f_{MGD}, f_{IND} = Relative SOC stock change factors for land-use, management practices, and inputs respectively, applicable to the receiving land after the displaced activity has been received; dimensionless.

t = 1, 2, 3 ...years elapsed since the start of the A/R CDM project activity.

The land under this project activity is degrading shrubland. Farmers involved in the project have defined area of land. It is a trend to practise the subsistence agriculture over the complete land parcel owned by them. When a farmer is involved in the project and afforest/reforest a part of land owned by them, he/she cannot displace that agriculture outside the land parcel owned by them. So, there is no chance of displacement of agriculture activity outside the project area where agriculture was not being practised. According to Paragraph 10 of Section 6 in Tool 15, leakage emissions resulting from the displacement of grazing activities are considered nil. As stated above, the farmers involved in the project manage privately owned land that had continuously cultivated for generations. There was no grazing activity on this land prior to the project's implementation.

$$\boldsymbol{LK_t = 0}$$

7.5 GHG Emission Reductions and Carbon Dioxide Removals

State the non-permanence risk rating (%)	19	
Has the non-permanence risk report been attached as either an appendix or a separate document?	☒ Yes	☐ No

For ARR and IFM projects with harvesting, state, in tCO_2e the Long-term Average (LTA).	562,816
Has the LTA been updated based on monitored data, if applicable?	☒ Yes ☐ No
State, in tCO_2e, the expected total GHG benefit to date	205,146
If a loss occurred (including a loss event or reversal), state the amount of tCO_2e lost:	No Loss occurred. Hence, not applicable.

Vintage Period	Baseline emissions (tCO_2e)	Project emissions (tCO_2e)	Leakage emissions (tCO_2e)	Buffer pool allocation (tCO_2e)	Reductions VCUs (tCO_2e)	Removals VCUs (tCO_2e)	Total VCU issuance (tCO_2e)
09-Jul-2019 to 31-Dec-2019	688	18,849	0	3,451	0	18,162	14,711
01-Jan-2020 to 31-Dec-2020	1,430	39,198	0	7,176	0	37,768	30,592
01-Jan-2021 to 31-Dec-2021	1,426	39,091	0	7,156	0	37,665	30,508
01-Jan-2022 to 31-Dec-2022	1,426	39,091	0	7,156	0	37,665	30,508
01-Jan-2023 to 31-Dec-2023	1,426	39,091	0	7,156	0	37,665	30,508
01-Jan-2024 to 16-Dec-2024	1,371	37,592	0	6,882	0	36,220	29,338
Total	**7,768**	**212,913**	**0**	**38,978**	**0**	**205,146**	**166,165**

Vintage period	Ex-ante estimated reductions/ removals	Achieved reductions/ removals	Percent difference	Explanation for the difference
09-Jul-2019 to 31-Dec-2019	15,727	18,162	-17.41	The percent difference in total achieved reduction/ removal and Ex post estimated reduction/ removals is due to following reason: First, the actual emission reduction achieved might be more or less similar compared to the estimate demission reduction due to less difference in plantation density.
01-Jan-2020 to 31-Dec-2020	39,104	37,768		
01-Jan-2021 to 31-Dec-2021	47,815	37,665		
01-Jan-2022 to 31-Dec-2022	49,998	37,665		
01-Jan-2023 to 31-Dec-2023	50,332	37,665		
01-Jan-2024 to 16-Dec-2024	45,422	36,220		
Total	**248,398**	**205,146**		

APPENDIX 1: COMMERCIALLY SENSITIVE INFORMATION

Section	Information	Justification
1.8	Land ownership documents	As this is the private information of the stakeholder which may be violate the privacy right of the stakeholder, therefore, it is excluded from public version of the documents.
1.8	Agreements between Project developer and farmer community	
1.12	Agreements between the Project developer and Project Proponent	
2.3.5	Benefit sharing	

APPENDIX 2: DETAILS OF FARMER IN PAI-1

List of Assam farmer

Name of Farmer	Landsat NDVI Value		Sentinel-2 NDVI Value
	2009	2014	2019
Tingkrong Hense	0.13-0.19	0.19-0.27	0.23-0.34
Harmir Taropi	0.19-0.24	0.16-0.28	0.14-0.37
Asha Ronghangpi	0.15-0.17	0.17-0.20	0.24-0.27
Jonaki Phangchopi	0.16-0.20	0.15-0.29	0.17-0.32
Bishnu Tokbi	0.19-0.21	0.24-0.28	0.21-0.35
Komola Hensepi	0.20-0.26	0.26-0.3	0.23-0.34
Babu Rongpher	0.16-0.20	0.22-0.32	0.19-0.34
Bason Ronghangpi	0.21-0.23	0.30-0.32	0.26-0.33
Rajen rongpi	0.17-0.19	0.17-0.18	0.24-0.38
Basapi teronpi	0.18-0.21	0.19-0.19	0.27-0.37
Sim eh rongpi pi	0.15-0.18	0.15-0.21	0.26-0.42
Lolita Beypi	0.23-0.26	0.30-0.39	0.24-0.37
Golapsing Hense	0.16-0.21	0.20-0.27	0.22-0.31
Kave Ingtipi	0.19-0.23	0.21-0.34	0.19-0.35
Reshma Teronpi	0.10-0.19	0.16-0.30	0.26-0.36
Sunita Teronpi	0.10-0.19	0.27-0.35	0.24-0.36
Dibising kramsa	0.17-0.22	0.20-0.29	0.17-0.37
Sonita teronpi	0.17-0.23	0.24-0.32	0.18-0.31
Rangsina Taro	0.27-0.30	0.27-0.28	0.28-0.33
Hewali rongpharpi	0.21-0.23	0.22-0.29	0.25-0.33
Ranjiy Taro	0.15-0.23	0.27-0.35	0.21-0.37
Rup rongphar	0.16-0.20	0.26-0.29	0.26-0.33
Longki kro	0.13-0.16	0.22-0.26	0.17-0.33
Porson Singnar	0.26-0.28	0.25-0.29	0.26-0.34
Kasang teronpi	0.14-0.21	0.19-0.32	0.23-0.34
Khorsing kro	0.17-0.23	0.20-0.29	0.22-0.36
Kansing rongphar	0.16-0.22	0.25-0.32	0.10-0.31
Rupson Rongpi	0.12-0.28	0.25-0.36	0.24-0.39
Robinson Rongpi	0.16-0.22	0.21-0.29	0.24-0.35
Mongalsing Rongpi	0.19-0.27	0.19-0.31	0.26-0.39
Kadom ronghangpi	0.18-0.25	0.25-0.34	0.25-0.33
Sangmir teronpi	0.15-0.22	0.18-0.33	0.27-0.38
Hewali singnarpi	0.18-0.25	0.24-0.32	0.27-0.37

Kasang teronpi	0.13-0.27	0.23-0.32	0.30-0.38
Boron rongphar	0.16-0.26	0.22-0.31	0.24-0.33
Kave Rongpipi	0.16-0.21	0.25-0.34	0.23-0.32
Malong Rongpi	0.17-0.22	0.23-0.31	0.19-0.34
Gita terangpi	0.16-0.21	0.18-0.27	0.22-0.29
Eliban Teronpi	0.15-0.19	0.20-0.29	0.25-0.33
Longbi teron	0.16-0.21	0.21-0.28	0.19-0.30
Basonti kropi	0.14-0.20	0.20-0.29	0.17-0.27
Longbi teron	0.13-0.20	0.17-0.25	0.17-0.35
Sem rongpi	0.15-0.37	0.23-0.38	0.20-0.27
Hunmili singarpi	0.18-0.36	0.27-0.33	0.22-0.27
Sima Kropi	0.19-0.28	0.24-0.35	0.22-0.40
Manon Rongpipi	0.19-0.28	0.27-0.31	0.27-0.41
Manon rongpipi	0.15-0.28	0.26-0.34	0.24-0.39
Pradip Ronghang	0.20-0.23	0.30-0.35	0.21-0.30
Babu Ingti	0.18-0.27	0.28-0.36	0.25-0.36
Pradip Ronghang	0.20-0.27	0.18-0.35	0.11-0.38
Jiten Terang	0.20-0.26	0.23-0.32	0.27-0.38
Mili Hensepi	0.20-0.23	0.24-0.28	0.23-0.34
Kasang Singnarpi	0.22-0.26	0.32-0.36	0.20-0.35
Shukursing Ronghang	0.23-0.27	0.27-0.36	0.26-0.37
Hunmili Killingpi	0.18-0.23	0.27-0.34	0.21-0.34
Thang teron	0.19-0.24	0.24-0.35	0.22-0.34
Kache Teronpi	0.19-0.23	0.21-0.28	0.21-0.33
Khorsing Terang	0.17-0.25	0.23-0.34	0.15-0.39
Jonaki Kropi	0.15-0.23	0.20-0.33	0.17-0.38
Anjuli Rongpipi	0.15-0.22	0.21-0.32	0.19-0.32
Junaki kropi	0.22-0.28	0.24-0.32	0.14-0.20
Dara Sing Terang	0.13-0.18	0.22-0.28	0.20-0.28
Bura sing ke Ap	0.16-0.22	0.24-0.33	0.17-0.32
Shirika Terangpi	0.15-0.23	0.22-0.29	0.19-0.29
Anima Teronpi	0.18-0.24	0.26-0.30	0.21-0.35
Monika Teronpi	0.17-0.23	0.21-0.33	0.23-0.31
Pataropi Tokbipi	0.18-0.22	0.23-0.29	0.25-0.34
Har sing kro	0.08-0.36	0.07-0.42	0.08-0.44
Amrit Rongphar	0.21-0.28	0.25-0.34	0.25-0.37
Mohan Rongphar	0.20-0.27	0.23-0.27	0.27-0.38
Moses Singnar	0.16-0.18	0.22-0.28	0.22-0.30
Sermoni Tokbipi	0.16-0.18	0.24-0.31	0.22-0.32
Amrit Timung	0.17-0.20	0.27-0.31	0.22-0.30
Sunti Ingtipi	0.17-0.20	0.27-0.31	0.22-0.30

Kache Ingtipi	0.17-0.21	0.26-0.30	0.23-0.32
Ka Timungpi	0.11-0.18	0.15-0.32	0.23-0.34
Bajong Ingti	0.14-0.21	0.24-0.34	0.21-0.33
Kungri Ronghangpi	0.18-0.22	0.27-0.32	0.24-0.32
Kuri Teronpi	0.15-0.23	0.21-0.32	0.20-0.37
Hongbari Timungpi	0.16-0.20	0.24-0.30	0.21-0.28
Juri Rongpipi	0.16-0.18	0.24-0.26	0.21-0.31
Hongbari Rongpipi	0.12-0.18	0.21-0.30	0.23-0.33
Babu Timung	0.13-0.24	0.21-0.33	0.14-0.35
Muniram Rongpi	0.18-0.22	0.23-0.36	0.27-0.36
Mensing Rongpi	0.17-0.26	0.20-0.27	0.15-0.32
Dhansing Timung	0.20-0.27	0.23-0.34	0.18-0.43
Jemson Rongpi	0.15-0.23	0.27-0.38	0.30-0.38
Longki Kro	0.19-0.26	0.21-0.36	0.16-0.39
Burasing Teron	0.18-0.29	0.21-0.34	0.20-0.38
Sarsing Ingti	0.16-0.22	0.23-0.32	0.16-0.35
Kajir Ke Appi	0.16-0.19	0.21-0.26	0.21-0.36
Roshmi Teronpi	0.15-0.20	0.24-0.33	0.22-0.32
Tanzing Timung	0.19-0.26	0.24-0.32	0.27-0.37
Sarsing Rongpi	0.17-0.21	0.22-0.31	0.22-0.30
Kapi Ingtipi	0.15-0.20	0.22-0.30	0.24-0.32
Longsing Timung	0.16-0.20	0.24-0.34	0.24-0.31
Mongal Rongpi	0.17-0.22	0.25-0.31	0.22-0.32
Rustom Tmung	0.18-0.23	0.23-0.31	0.23-0.35
Sarlinja Tokbi	0.25-0.33	0.19-0.35	0.21-0.37
Dhorom Sing Timung	0.19-0.24	0.25-0.37	0.24-0.35
Fudang Singnarapi	0.14-0.24	0.28-0.35	0.28-0.37
Kare Singnarpi	0.14-0.21	0.22-0.38	0.26-0.36
Kare Timungpi	0.11-0.24	0.24-0.37	0.27-0.36
Jiten Terang	0.16-0.22	0.19-0.37	0.29-0.39
Kangbura Rongpi	0.16-0.21	0.26-0.38	0.14-0.40
Moina Milikpi	0.19-0.22	0.26-0.33	0.31-0.42
Rupson Terang	0.14-0.24	0.30-0.34	0.24-0.37
Babu Tokbi	0.17-0.23	0.25-0.29	0.23-0.34
Langkung Teron	0.16-0.24	0.22-0.38	0.14-0.38
Babusing Ronghang	0.15-0.26	0.26-0.39	0.22-0.39
Maina Timungpi	0.22-0.33	0.13-0.33	0.20-0.34
Ram Teron	0.25-0.36	0.32-0.37	0.13-0.40
Chondro sing Timung	0.18-0.23	0.22-0.29	0.22-0.32
Basapi Hansepi	0.24-0.31	0.20-0.33	0.18-0.34
Adison Teron	0.25-0.31	0.30-0.39	0.15-0.35

Poron Teron	0.18-0.28	0.20-0.40	0.20-0.34
Kam Sing Teron	0.22-0.32	0.33-0.39	0.15-0.37
Dewan Sing Milik	0.20-0.24	0.19-0.34	0.18-0.36
Bikrom Terang	0.16-0.25	0.24-0.34	0.12-0.32
Jonaki Taropi	0.18-0.28	0.22-0.34	0.15-0.36
Joy Rongpi	0.18-0.27	0.28-0.36	0.23-0.35
Rupsing Timung	0.15-0.18	0.23-0.29	0.20-0.32
Jirsong kro	0.28-0.32	0.29-0.38	0.10-0.33
Ajit Timung	0.18-0.24	0.29-0.38	0.23-0.44
Sima Rongpipi	0.13-0.21	0.25-0.35	0.22-0.35
Bidyaram terang	0.14-0.26	0.20-0.30	0.15-0.36
Bidyaram terang	0.17-0.23	0.16-0.32	0.19-0.36
Kadom Rongpipi	0.17-0.24	0.20-0.24	0.27-0.35
Serlina Teronpi	0.16-0.22	0.26-0.28	0.22-0.34
Moniram Bey	0.14-0.24	0.21-0.27	0.20-0.33
Arjun Hense	0.19-0.24	0.20-0.31	0.26-0.33
Tingkrong Hense	0.18-0.23	0.27-0.36	0.26-0.33
Jonaki Phangchopi	0.19-0.21	0.27-0.32	0.17-0.34
Bishnu Tokbi	0.19-0.23	0.22-0.32	0.19-0.34
Babu Rongpher	0.17-0.23	0.20-0.27	0.25-0.36
Rajib Ronghang	0.13-0.19	0.22-0.33	0.22-0.37
Junali kropi	0.16-0.23	0.19-0.28	0.24-0.34
Bikromsing Ronghang	0.20-0.22	0.27-0.35	0.24-0.36
Lirbon Timungpi	0.18-0.20	0.18-0.31	0.24-0.32
Monia Beypi	0.19-0.24	0.21-0.28	0.24-0.34
Anjuli Tokbipi	0.18-0.28	0.27-0.30	0.23-0.39
Roshmi Tokbipi	0.16-0.25	0.14-0.36	0.24-0.36
Renuka kropi	0.17-0.22	0.23-0.36	0.27-0.39
Hemari timung	0.15-0.23	0.18-0.28	0.18-0.33
Sarbura engti	0.18-0.23	0.28-0.33	0.21-0.36
Soron teron	0.16-0.19	0.16-0.27	0.24-0.35
Mongolsing Engti	0.13-0.21	0.21-0.32	0.26-0.37
Phudang teronpi	0.12-0.20	0.21-0.30	0.28-0.34
Sonjoy ronghang	0.13-0.22	0.17-0.28	0.25-0.37
Bidya ronghang	0.19-0.24	0.22-0.29	0.29-0.37
Sar sing teron	0.16-0.21	0.23-0.28	0.24-0.35
Bharoti rongpipi	0.19-0.22	0.16-0.27	0.23-0.33
Bina kropi	0.18-0.22	0.18-0.32	0.18-0.35
Arun singner	0.16-0.26	0.27-0.31	0.24-0.38
Songjita beypi	0.20-0.22	0.26-0.33	0.27-0.34
Kangbura terang	0.11-0.25	0.21-0.34	0.27-0.37

Dhoram teron	0.17-0.21	0.17-0.29	0.23-0.35
Roben Phangcho	0.16-0.27	0.21-0.26	0.28-0.39
Sarsing Ingti	0.22-0.24	0.25-0.33	0.25-0.31
Amphu Beypi	0.17-0.21	0.29-0.34	0.18-0.33
Amor Ronghang	0.21-0.26	0.24-0.31	0.31-0.39
Bason Ronghangpi	0.22-0.25	0.29-0.35	0.19-0.36
Khonsing Engti	0.22-0.25	0.29-0.35	0.19-0.36
Kare Ronghangpi	0.18-0.26	0.27-0.35	0.25-0.37
Rekha Hensepi	0.19-0.27	0.24-0.38	0.24-0.41
Kamalsing Teron	0.17-0.27	0.27-0.33	0.25-0.37
Khelan Bey	0.18-0.23	0.27-0.33	0.26-0.39
Sarim Bey	0.16-0.19	0.26-0.32	0.25-0.31
Kache engtipi	0.20-0.26	0.29-0.35	0.19-0.36
Darson rongpi	0.20-0.23	0.25-0.31	0.23-0.33
Rupsing rongpi	0.17-0.23	0.23-0.32	0.23-0.37
Ronjan rongpi	0.17-0.26	0.22-0.33	0.22-0.35
Bidya sing rongpi	0.19-0.23	0.28-0.34	0.25-0.40
Na terngpi	0.20-0.24	0.30-0.33	0.29-0.35
Prem terang	0.11-0.22	0.25-0.33	0.19-0.32
Mirjalin terangpi	0.19-0.23	0.30-0.35	0.26-0.36
Rajen rongpi	0.19-0.24	0.26-0.38	0.28-0.35
Arun singner	0.16-0.24	0.24-0.31	0.20-0.36
Hemari terang	0.20-0.25	0.23-0.36	0.25-0.39
Longki lekthe	0.21-0.27	0.26-0.38	0.19-0.36
Serlin hansepi	0.17-0.21	0.22-0.28	0.24-0.32
Jun terangpi	0.18-0.25	0.19-0.30	0.25-0.32
Mila Terangpi	0.19-0.22	0.26-0.35	0.19-0.33
Basapi teronpi	0.21-0.24	0.29-0.35	0.25-0.40
Maina terangpi	0.23-0.26	0.35-0.37	0.16-0.35
Sim eh rongpi pi	0.14-0.16	0.18-0.26	0.27-0.33
Lolita Beypi	0.21-0.26	0.31-0.38	0.27-0.40
Golapsing Hense	0.17-0.23	0.21-0.32	0.25-0.32
Kave Ingtipi	0.13-0.24	0.29-0.35	0.28-0.37
Sar im terang	0.11-0.22	0.25-0.34	0.15-0.36
Dibising kramsa	0.10-0.25	0.18-0.33	0.26-0.36
Sunita Teronpi	0.15-0.23	0.23-0.32	0.22-0.38
Dibising kramsa	0.18-0.23	0.25-0.30	0.15-0.33
Sonita teronpi	0.17-0.22	0.26-0.33	0.24-0.31
Rasing Tokbi	0.17-0.22	0.26-0.30	0.24-0.39
Rostom Tokbi	0.18-0.23	0.20-0.36	0.20-0.36
Mantri Teron	0.20-0.24	0.22-0.29	0.27-0.34

Ruplan Teronpi	0.17-0.24	0.28-0.38	0.25-0.37
Rangsina taro	0.17-0.21	0.24-0.29	0.25-0.33
Hewali rongpharpi	0.13-0.20	0.30-0.38	0.21-0.38
Rangsina kro	0.22-0.25	0.25-0.28	0.30-0.40
Ranjiy taro	0.17-0.24	0.32-0.37	0.24-0.33
Rup rongphar	0.14-0.21	0.25-0.33	0.22-0.36
Mohon sing engti	0.16-0.24	0.25-0.33	0.24-0.35
Merina teronpi	0.21-0.24	0.19-0.27	0.25-0.36
Joysing Ronghang	0.18-0.24	0.28-0.35	0.25-0.36
Jemina taropi	0.18-0.25	0.20-0.31	0.26-0.35
Ronjit taro	0.16-0.28	0.22-0.30	0.22-0.33
Jyoti beypi	0.18-0.24	0.27-0.30	0.23-0.39
Kasang teronpi	0.19-0.29	0.23-0.39	0.27-0.38
Khorsing kro	0.21-0.30	0.27-0.38	0.21-0.41
Bina phangchopi	0.18-0.25	0.28-0.38	0.18-0.37
Kansing rongphar	0.15-0.21	0.28-0.33	0.16-0.43
Kareng rongpipi	0.19-0.31	0.29-0.41	0.21-0.43
Gobin ronghang	0.20-0.25	0.23-0.37	0.13.0.41
Rubika ronghangpi	0.19-0.31	0.22-0.37	0.12-0.36
Biren teron	0.15-0.26	0.18-0.35	0.22-0.35
Dorsing bey	0.18-0.25	0.20-0.38	0.15-0.35
Sika ronghangpi	0.14-0.23	0.20-0.36	0.21-0.37
Thomas bey	0.19-0.29	0.34-0.39	0.28-0.38
Babu bey	0.16-0.28	0.18-0.31	0.11-0.35
Meili beypi	0.13-0.28	0.21-0.28	0.24-0.42
Juna teron	0.11-0.25	0.24-0.34	0.22-0.37
Babu hanse	0.18-0.28	0.18-.0.37	0.09-0.34
Simon Ronghang	0.17-0.24	0.21-0.33	0.16-0.35
Joysing Ronghang	0.12-0.25	0.18-0.36	0.16-0.37
Babu tokbi	0.14-0.25	0.24-0.34	0.11-0.34
Jirjar Ronghang	0.16-0.26	0.22-0.31	0.14-0.34
Velina Beypi	0.19-0.24	0.25-0.31	0.24-0.35
Dhaniram Terang	0.14-0.23	0.18-0.32	0.17-0.35
Amphu Tokbipi	0.12-0.27	0.24-0.36	0.13-.0.33
Na Beypi	0.08-0.24	0.07-0.31	0.08-0.32
Babusing Terang	0.18-0.26	0.22-0.35	0.26-0.35
Phulun singnar	0.22-0.29	0.25-0.34	0.23-0.38
Rupson Rongpi	0.17-0.26	0.22-0.29	0.21-0.35
Robinson Rongpi	0.18-0.26	0.23-0.34	0.18-0.36
Rupsing engti	0.16-0.25	0.18-0.40	0.11-0.36
Komal sing kro	0.17-0.27	0.26-0.38	0.22-0.35

Bimol sing kro	0.15-0.27	0.19-0.33	0.20-0.36
Kadom ronghangpi	0.17-0.27	0.24-0.35	0.17-.0.40
Joysing kro	0.22-0.24	0.28-.0.36	0.18-0.33
Sangmir teronpi	0.16-0.24	0.24-0.32	0.21-0.36
Hewali singnarpi	0.17-0.30	0.21-0.37	0.25-0.36
Jaysing engti	0.19-0.29	0.19-0.36	0.20-0.36
Harsing engti	0.21-0.30	0.28-0.37	0.25-0.35
Boron rongphar	0.19-0.29	0.26-0.39	0.12-0.38
Alton engti	0.15-0.23	0.28-0.37	0.22-0.39
Dilip rongphar	0.10-0.20	0.11-0.28	0.12-0.29
Kadom rongpipi	0.17-0.26	0.19-0.33	0.20-0.36
Mina Phangchopi	0.19-0.25	0.23-0.34	0.12-0.34
Mili Ronghangpi	0.16-0.28	0.21-0.37	0.15-0.34
Modon phangcho	0.15-0.25	0.22-0.36	0.25-0.35
Werson Rongpher	0.13-0.21	0.30-0.38	0.26-0.35
Jekson Rongphar	0.19-0.28	0.18-0.36	0.23-0.37
Babu Rongpi	0.19-0.28	0.21-0.33	0.23-0.36
Rustam tokbi	0.10-0.25	0.23-0.33	0.14-0.35
Andrew taro	0.14-0.25	0.25-0.31	0.16-0.34
Jonali engtipi	0.19-0.27	0.20-0.36	0.20-0.32
Junali engtipi	0.15-0.23	0.25-0.34	0.21-0.37
Romila beypi	0.16-0.26	0.24-0.30	0.22-0.36
Robika kropi	0.17-0.24	0.23-0.30	0.21-0.37
Kajor terangpi	0.15-0.24	0.23-0.30	0.19-0.32
Chai ronghang	0.14-0.20	0.25-0.35	0.16-0.33
Dhonsing ronghang	0.17-0.24	0.26-0.36	0.19-0.34
Rajib taro	0.18-0.24	0.25-0.31	0.19-0.35
Joysing kro	0.16-0.24	0.26-0.32	0.25-0.37
Babuso kiling	0.20-0.23	0.25-0.34	0.22-0.35
Bidya sing ronghang	0.15-0.24	0.21-0.36	0.20-0.37
Dimi teronpi	0.18-0.27	0.26-0.32	0.21-0.35
Kache Rongpharpi	0.18-0.23	0.24-0.30	0.17-0.36
Rajen kro	0.13-0.27	0.21-0.35	0.14-0.37
Dilip Rongphar	0.19-0.23	0.26-0.35	0.23-0.32
Man kro	0.16-0.25	0.18-0.33	0.22-0.35
Jari taro	0.10-0.24	0.25-0.35	0.19-0.36
Sonjoy taro	0.14-0.26	0.27-0.34	0.19-0.35
Mohen Teron	0.17-0.23	0.23-0.33	0.21-0.34
Rajiv Teron	0.14-0.21	0.14-0.28	0.17-0.36
Sing Teron	0.12-0.20	0.18-0.32	0.17-0.33
Amphu Rongpipi	0.16-0.22	0.23-0.34	0.21-0.30

Daising Timung	0.14-0.24	0.19-0.37	0.15-0.38
Sabitri Tokbipi	0.15-0.22	0.19-0.30	0.21-0.31
Sarsing Terang	0.14-.0.23	0.21-0.31	0.21-0.37
Eliban Teronpi	0.17-0.23	0.17-0.29	0.19-0.32
Longbi teron	0.11-0.23	0.23-0.33	0.18-0.33
Kave kropi	0.15-0.28	0.22-0.34	0.15-0.38
Basonti kropi	0.15-0.23	0.20-0.31	0.14-0.39
Longbi teron	0.15-0.23	0.20-0.31	0.14-0.39
Sem rongpi	0.15-0.29	0.22-0.34	0.18-0.38
Hunmili singarpi	0.20-0.26	0.26-0.39	0.17-0.37
Pali kropi	0.11-0.25	0.20-0.40	0.13-0.35
Babusing Rongphar	0.20-0.24	0.38-0.41	0.20-0.39
Sima kropi	0.20-0.24	0.38-0.41	0.20-0.39
Rejina kropi	0.16-0.26	0.26-0.37	0.25-0.36
Manon rongpipi	0.16-0.28	0.22-0.39	0.21-0.38
Manon rongpipi	0.16-0.27	0.19-0.37	0.20-0.38
Prodip Ronghang	0.17-0.27	0.24-0.38	0.25-0.40
Jiten Terang	0.22-0.26	0.24-0.35	0.23-0.35
Mili Hensepi	0.22-0.26	0.24-0.35	0.23-0.35
Kasang Singnarpi	0.16-0.27	0.24-0.36	0.16-0.36
Hunmili Killingpi	0.21-0.31	0.25-0.39	0.27-0.39
Robinson Rongpi	0.15-0.20	0.20-0.36	0.18-0.36
Kache teronpi	0.17-0.21	0.23-0.32	0.24-0.36
Jonaki kropi	0.19-0.26	0.20-0.34	0.15-0.33
Junaki kropi	0.21-0.24	0.26-0.30	0.20-0.34
Dara sing terang	0.15-0.22	0.22-0.33	0.26-0.36
Bura sing ke Ap	0.17-0.23	0.23-0.29	0.17-0.25
Shirika terangpi	0.12-0.23	0.26-0.35	0.19-0.37
Reena terangpi	0.13-0.21	0.18-0.33	0.22-0.32
Anima teronpi	0.18-0.25	0.26-0.35	0.22-0.35
Rajen kro	0.11-0.20	0.21-0.33	0.13-0.33
Monika teronpi	0.16-0.29	0.22-0.32	0.16-0.39
Pataropi tokbipi	0.17-0.25	0.27-0.34	0.13-0.34
Patarapi tokbipi	0.11-0.25	0.18-0.35	0.18-0.31
Anima teronpi	0.13-0.24	0.22-0.35	0.24-0.35
Monika teronpi	0.12-0.22	0.24-0.35	0.21-0.35
Manai engtipi	0.15-0.25	0.21-0.34	0.19-0.33
Anjana teronpi	0.11-0.25	0.25-0.32	0.17-0.33
Har sing kro	0.13-0.26	0.22-0.32	0.19-0.35
Rojoni timungpi	0.14-0.24	0.21-0.32	0.14-0.31
Rojoni timungpi	.014-0.22	0.17-0.29	0.15-0.32

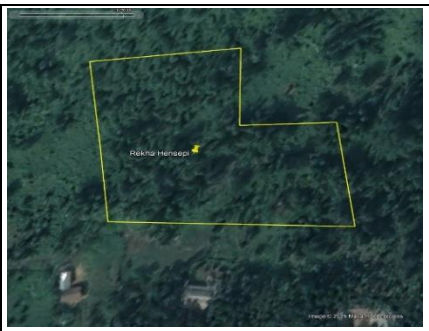
Longkiram Tokbi	0.20-0.24	0.24-0.34	0.22-0.35
Dhoniram Lekthe	0.13-0.20	0.25-0.32	0.23-0.29
Bina lekthepi	0.15-0.24	0.24-0.30	0.12-0.32
Moses singnar	0.17-0.24	0.14-0.37	0.18-0.34
Khorsing Terang	0.15-0.23	0.38-0.45	0.18-0.35
Long sing singar	0.14-0.22	0.26-0.32	0.25-0.33
Kabon kropi	0.20-0.26	0.23-0.32	0.27-0.33
Bidyasing singnar	0.18-0.27	0.10-0.34	0.15-0.37
Monalisha teronpi	0.18-0.24	0.21-0.35	0.20-0.36
Babu Rongpi	0.20-0.27	0.25-0.36	0.21-0.38
Hari taro	0.16-0.30	0.21-0.39	0.25-0.40
Babu Rongpi	0.20-0.32	0.22-0.36	0.24-0.40
Sika Ingtipi	0.15-0.31	0.22-0.34	0.18-0.41
Joysing Taro	0.18-0.29	0.28-0.35	0.18-0.42
Birensing phangcho	0.12-0.31	0.30-0.41	0.25-0.43
Basa Engtipi	0.12-0.28	0.21-0.39	0.14-0.39
Rupkasen Ronghang	0.21-0.28	0.29-0.37	0.19-0.40
Sermoni Tokbipi	0.17-0.31	0.24-0.36	0.16-0.41
Amrit Timung	0.15-0.21	0.22-0.31	0.22-0.35
Kathe Ingtipi	0.10-0.18	0.25-0.31	0.23-0.35
Sunti Ingtipi	0.16-0.22	0.26-0.34	0.14-0.33
Kache Ingtipi	0.16-0.23	0.24-0.34	0.21-0.35
Ka Timungpi	0.10-0.20	0.23-0.31	0.24-0.32
Kungri Ronghangpi	0.14-0.24	0.22-0.36	0.17-0.39
Kuri Teronpi	0.18-0.21	0.26-0.34	0.23-0.33
Sangwai Teronpi	0.17-0.22	0.22-0.31	0.20-0.33
Men sing ronghang	0.17-0.23	0.25-0.30	0.24-0.31
Rupson tokbi	0.22-0.29	0.29-0.38	0.16-0.36
Promoti teronpi	0.27-0.34	0.20-0.41	0.18-0.42
Kave engtipi	0.17-0.26	0.27-0.39	0.22-0.36
Rukasen ronghang	0.20-0.32	0.26-0.38	0.28-0.39
Muniram Rongpi	0.16-0.27	0.26-0.36	0.13-0.35
Mensing Rongpi	0.19-0.22	0.18-0.32	0.14-0.33
Rohila Rongpipi	0.21-0.26	0.24-0.35	0.17-0.40
Jiten Terang	0.19-0.25	0.26-0.33	0.19-0.34
Jemson Rongpi	0.16-0.27	0.21-0.37	0.11-0.36
Mongolsing millik	0.09-0.18	0.24-0.39	0.26-0.34
Diring Rongpi	0.20-0.28	0.28-0.35	0.13-0.34
Sing Rongpi	0.11-0.28	0.29-0.40	0.26-0.34
Longki Kro	0.15-0.24	0.20-0.32	0.15-0.31
Burasing Teron	0.09-0.19	0.23-0.40	0.20-0.36

Kajir Ke Appi	0.16-0.19	0.26-0.29	0.20-0.28
Roshmi Teronpi	0.13-0.16	0.28-0.30	0.23-0.29
Tanzing Timung	0.18-0.21	0.24-0.29	0.23-0.30
Sarsing Rongpi	0.18-0.21	0.26-0.32	0.23-0.29
Kapi Ingtipi	0.19-0.21	0.25-0.31	0.23-0.29
Longsing Timung	0.13-0.21	0.26-0.30	0.23-0.33
Rustom Tmung	0.16-0.21	0.24-0.30	0.21-0.30
Mena tokbipi	0.20-0.31	0.25-0.38	0.26-0.39
Kave tokbipi	0.15-0.28	0.24-0.34	0.26-0.35
Har sing kro	0.15-0.28	0.22-0.37	0.10-0.36
Sarlinja tokbi	0.17-0.28	0.25-0.37	0.17-0.37
Mena tokbipi	0.19-0.29	0.32-0.41	0.28-0.39
Kanja bey	0.27-0.33	0.21-0.38	0.12-0.37
Kanja bey	0.27-0.33	0.21-0.38	0.12-0.37
Babu ronghang	0.20-0.32	0.30-0.40	0.24-0.41
Babu ronghang	0.20-0.31	0.29-0.36	0.14-0.38
Birsing tokbi	0.24-0.3	0.29-0.35	0.23-0.36
Sima beypi	0.25-0.32	0.28-0.39	0.25-0.41
Sokursing tokbi	0.17-0.26	0.23-0.36	0.16-0.33
Sarkangthir tokbi	0.21-0.30	0.24-0.34	0.25-0.34
Rupsing Rongchehon	0.25-0.31	0.18-0.34	0.17-0.38
Menuka tokbipi	0.21-0.24	0.30-0.33	0.22-0.34
Phir Ingtipi	0.18-0.26	0.18-0.35	0.09-0.34
Kare Timungpi	0.18-0.24	0.18-0.32	0.22-0.34
Moina milikpi	0.16-0.22	0.15-0.23	0.17-0.31
Rupson Terang	0.18-0.23	0.28-0.35	0.18-0.32
Kensing ronghang	0.17-0.25	0.28-0.37	0.24-0.39
Birsing engti	0.17-0.28	0.30-0.37	0.27-0.35
Kadom ranghangpi	0.20-0.27	0.26-0.34	0.20-0.39
Kache ronghangi	0.18-0.25	0.25-0.37	0.24-0.37
Kareng tokbipi	0.16-0.26	0.24-0.34	0.25-0.35
Longdili terang	0.23-0.30	0.32-0.39	0.30-0.39
Sonjit Ronghang	0.19-0.29	0.24-0.34	0.25-0.36
Arjit terang	0.13-0.27	0.21-0.39	0.25-0.36
Mongal sing terang	0.18-0.27	0.21-0.35	0.14-0.33
Babusing Rongphar	0.21-0.29	0.28-0.39	0.28-0.39
There Rongpipi	0.22-0.27	0.30-0.37	0.22-0.34
Joy sing Ronghang	0.15-0.28	0.30-0.34	0.21-0.35
Rupjily singnarpi	0.19-0.28	0.22-0.36	0.18-0.37
Moja sing terang	0.15-0.20	0.23-0.37	0.14-0.31
Moja sing terang	0.20-0.26	0.27-0.38	0.20-0.34

Mamoni tokbipi	0.19-0.26	0.21-0.32	0.19-0.37
Sarklimson engti	0.17-0.30	0.26-0.34	0.10-0.38
Paniram ronghang	0.20-0.28	0.20-0.28	0.19-0.39
Sarklimson engti	0.15-0.27	0.16-0.37	0.12-0.37
Mamoni tokbipi	0.15-0.26	0.14-0.32	0.21-0.35
Biren Engti	0.14-0.22	0.28-0.38	0.25-0.40
Sang et Ronghangpi	0.18-0.26	0.32-0.36	0.23-0.35
Kareng killingpi	0.20-0.27	0.26-0.36	0.16-0.35
Babu Tokbi	0.19-0.22	0.24-0.33	0.23-0.30
Kache Engtipi	017-0.23	0.18-0.29	0.19-0.35
Roshmiri Kropi	0.17-0.20	0.23-0.27	0.19-0.33
Sonti beypi	0.18-0.27	0.24-0.28	0.26-0.35
Bina ronghangpi	0.16-0.27	0.17-0.37	0.29-0.36
Dolai sing terang	0.21-0.26	0.25-0.37	0.23-0.35
Kathe tokbipi	0.16-0.29	0.25-0.34	0.10-0.33
Babu bey	0.13-0.21	0.24-0.33	0.18-0.33
Sarsing terang	0.15-0.25	0.27-0.36	0.11-0.38
Moromi tokbipi	0.25-0.29	0.30-0.37	0.26-0.39
Jemsing engti	0.21-0.27	0.26-0.35	0.09-0.35
Jemsing engti	0.17-0.25	0.20-0.33	0.12-0.36
Ruptalin beypi	0.22-0.30	0.21-0.35	0.12-0.36
Sem Ronghang	0.20-0.27	0.26-0.35	0.11-0.30
Sona sing Ronghang	0.12-0.23	0.25-0.33	0.29-0.39
Mon sing Ronghang	0.19-0.23	0.23-0.33	0.14-0.32
Bhanti kropi	0.13-0.27	0.26-0.39	0.10-0.36
Bhanti kropi	0.24-0.30	0.31-0.39	0.31-0.42
Kareng phangchopi	0.21-0.28	0.27-0.38	0.13-0.35
Basapi teronpi	0.19-0.26	0.30-0.36	0.23-0.35
Babu Ronghang	0.13-0.28	0.23-0.37	0.11-0.37
Langkung Teron	0.21-0.27	0.29-0.36	0.20-0.34
Maina Timungpi	0.27-0.33	0.31-0.35	0.20-0.37
Adit Teron	0.19-0.30	0.32-0.39	0.26-0.34
Ram Teron	0.20-0.31	0.33-0.37	0.26-0.35
Chondro sing timung	0.15-0.22	0.25-0.33	0.20-0.35
Adison Teron	0.24-0.35	0.26-0.37	0.11-0.38
Poron Teron	0.18-0.30	0.34-0.39	0.29-0.35
Kam sing Teron	0.14-0.31	0.27-0.40	0.20-0.36
Bikrom Terang	0.18-0.23	0.20-0.31	0.22-0.35
Hukur killing	0.17-0.28	0.30-0.36	0.22-0.34
Rupjili beypi	0.22-0.32	0.31-0.39	0.29-0.40
Sonjoy taro	0.13-0.18	0.22-0.29	0.12-0.31

Rupjili beypi	0.15-0.24	0.23-0.32	0.27-0.41
Kasang terangpi	0.20-0.28	0.25-0.32	0.29-0.37
Jonaki Taropi	0.18-0.27	0.24-0.38	0.17-0.37
Joy Rongpi	0.24-0.29	0.25-0.30	0.21-0.37
Hussain Rongpi	0.22-0.27	0.33-0.39	0.22-0.39
Semson Engti	0.21-0.28	0.34-0.40	0.15-0.37
Binut teron	0.17-0.23	0.23-0.30	0.26-0.35
Kare kropi	0.15-0.20	0.21-0.26	0.23-0.36
Bidyaram terang	0.19-0.24	0.24-0.28	0.19-0.32
Nali teronpi	0.11-0.22	0.18-0.29	0.23-0.34
Sika Engtipi	0.16-0.20	0.18-0.25	0.18-0.32
Kajir lekthepi	0.13-0.20	0.16-0.28	0.23-0.34
Dhon Rongpi	0.17-0.20	0.19-0.25	0.28-0.35
Mina teronpi	0.17-0.20	0.19-0.31	0.26-0.31
Babu bey	0.14-0.17	0.18-0.25	0.22-0.32
Rina kropi	0.15-0.25	0.20-0.28	0.19-0.33
Phudang Kropi	0.17-0.25	0.18-0.31	0.26-0.35
Jonali kropi	0.21-0.23	0.24-0.28	0.21-0.30
Kadom Rongpipi	0.17-0.25	0.25-0.35	0.28-0.35

APPENDIX 3: GOOGLE EARTH PICTURE OF SOME FARMER IN MULTIPLE YEAR FOR PAI-1

		
a).2013	b).2018	c).2022
Multiple farmers plot shown in Figures (a) and (b) for the years 2013 and 2018 respectively, initially falls under the shrub-type vegetation category based on NDVI classification. Following the implementation of the project, vegetation cover changes, transitioning to dense vegetation. This change is illustrated in Figures (c) corresponding to the year 2022 respectively.		
		
a).2014	b).2018	c).2022
Rekha Hensepi plot shown in Figures (a) and (b) for the years 2014 and 2018 respectively, initially falls under the shrub-type vegetation category based on NDVI classification. Following the implementation of the project, vegetation cover changes, transitioning to dense vegetation. This change is illustrated in Figures (c) corresponding to the year 2022 respectively.		

		
a).2014	b).2018	c).2023
Longki Lekthe plot shown in Figures (a) and (b) for the years 2014 and 2018 respectively, initially falls under the shrub-type vegetation category based on NDVI classification. Following the implementation of the project, vegetation cover changes, transitioning to dense vegetation. This change is illustrated in Figures (c) corresponding to the year 2023 respectively.		
		
a).2014	b).2018	c).2022
Dare sing terang plot shown in Figures (a) and (b) for the years 2014 and 2018 respectively, initially falls under the shrub-type vegetation category based on NDVI classification. Following the implementation of the project, vegetation cover changes, transitioning to dense vegetation. This change is illustrated in Figures (c) corresponding to the year 2022 respectively.		
		
a).2014	b).2018	c).2022
Multiple farmers plot shown in Figures (a) and (b) for the years 2014 and 2018 respectively, initially falls under the shrub-type vegetation category based on NDVI classification. Following the implementation of the project, vegetation cover changes, transitioning to dense vegetation. This change is illustrated in Figures (c) corresponding to the year 2022 respectively.		

		
a).2014	b).2018	c).2022
Multiple farmers plot shown in Figures (a) and (b) for the years 2014 and 2018 respectively, initially falls under the shrub-type vegetation category based on NDVI classification. Following the implementation of the project, vegetation cover changes, transitioning to dense vegetation. This change is illustrated in Figures (c) corresponding to the year 2022 respectively.		
		
a).2014	b).2018	c).2022
Rajib Ronghang plot shown in Figures (a) and (b) for the years 2014 and 2018 respectively, initially falls under the shrub-type vegetation category based on NDVI classification. Following the implementation of the project, vegetation cover changes, transitioning to dense vegetation. This change is illustrated in Figures (c) corresponding to the year 2022 respectively.		