IMPROVING LIVELIHOODS THROUGH AGROFORESTRY PLANTATIONS IN INDIA

Document Prepared by Infinite Solutions

Project Title	Improving livelihoods through Agroforestry Plantations in India
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1 PROJECT DETAILS

1.1 Summary Description of the Project

This project aims for the sustainable implementation and management of Afforestation activity that involves carbon sequestration on degraded lands through agroforestry plantation activities with species plantations in the multiple districts of India. The project includes multiple land parcels (continue and scattered). The project has been undertaken to plant agroforestry species on the land which was severly degraded in the baseline and continues to be degraded. Before the project activity, the project area was facing threat due to severe soil erosion from slash and burn rotations. The project tends to combat land degradation and emphasize the role of project in the UN sustainable development and land restoration agenda.

Local farmers are project implementers, an individual those creates significant scalable implementations that create current and meet future expectations of the sustainable development goals by increasing forest cover. The farmers have strong background of working in field and plantations and displays highly impactful and eco-friendly cultivation activities in past years. The individuals involved in the project have as an objective to achieve a group carbon certification of its forest plantations for expected a total project zone of 4000 ha with 2000 hectare of initial plantations carried out. The Project Proponent have technical and administrative support for the project implementation and is responsible for all key activities needed to issue and sell carbon offsets from trees afforestation and reforestation.

The project activity is community and tries to transform a degraded land into a forest cover, by maintaining the sustainable land management practices. The project proponent has been initiated to initiate a sustainable income for participating farmers.

The project activity is expected to reduce atmospheric CO2 by sequestration and storing in the form of biomass. The project is expected to be functional and remove CO2 from the atmosphere for 80 years of its lifetime with 30 years of renewable period. The Project activities are carried out and monitored according to the approved project methodology AR-ACM0003 for the first crediting period of 30 years. The project aims to remove an estimated 39,445 tCO2e annually and 11,83,343 tCO2e during the first crediting period.

1.2 Sectoral Scope and Project Type

The project activity is grouped. The sectoral scope of this project is, Agriculture, Forestry, and Other Land Use (AFOLU), according to section 3.2 of the VCS standard. Ver 4.2[1]. Within the AFOLU type, the category of the project is Afforestation, Reforestation, and Revegetation (ARR)[2].

1.3 Project Eligibility

The project area has no green cover in the baseline and is identified as a low productive degraded land was selected plantation and eligible for ARR activities.

The project complies with all rules and requirements stated in the following documents. ARR program has not cleared any native forest within the 10 years of the project start date and trees have been planted on the deserted wasteland to increase the forest cover of the area and are in compliance with section 3.2 of the AFOLU specific matters of VCS standard Ver_4.3. The project is eligible for ARR activities and increases carbon sequestration by establishing vegetative cover on a less productive degraded land. The project includes multiple species such as agroforestry and other fast-growing species as well as shrubs

- Verified Carbon Standard (VCS) Program guide Version 4.1.
- Verified Carbon Standard (VCS) Standard, Version 4.3.
- VCS Methodology Requirements, v4.1.
- AFOLU Non-Permanence Risk Tool, Ver,4.0

According to the list of eligible AFOLU projects described in Appendix 1 of VCS Standard Version 4.3, the present project activity falls under the "Afforestation, Reforestation and Revegetation" (ARR) category. The project aims at increasing the vegetation cover through the plantation. The justification of eligibility of the project under the scope of the VCS Program is given in the table below.

Table 1: Eligibility conditions for Afforestation, Reforestation and Revegetation (ARR) and description under VCS

Eligibility conditions	Justification/Description
a) 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,	The project activity involves the plantation of trees on non-forest land (degraded and low productive land) which will increase the carbon sequestration of the land much higher than in the baseline conditions

[1] https://verra.org/project/vcs-program/projects-and-jnr-programs/vcs-sectoral-scopes/

[2] https://verra.org/wp-content/uploads/2022/02/VCS-Standard_v4.2.pdf

sowing or human-assisted natural regeneration of woody vegetation.	
b) Eligible ARR projects may include timber harvesting in their management plan.	Not Applicable.
c) The project area shall not be cleared of native ecosystems within 10 years before the project start date.	The project activity has not cleared the native ecosystems. Instead, it will plant agroforestry trees which are suitable for fruit and fodder production and highly adaptive to the native ecosystems of the project area. There was no vegetation in the baseline as the project area is degraded land and not identifies are not suitable for or survival of agroforestry trees without any plantation, management activity [3]. Local stakeholder consultation- Local stakeholder consultation was conducted to identify the baseline scenario and impact of land-use conversion to forestation activity. It is identified that the project activity has no forest or any vegetation in the baseline and is identified as desert land.

1.4 Project Design

The project is grouped activity and aims to afforestation the deserted wastelands, which are expected to remain degraded or to continue to degrade further in the absence of this project activity. The grouped project activity complies with the requirements of section Grouped projects 3.5 of the VCS standard Ver.4.3.

☐ The project includes a single location or installation only

☐ The project includes multiple locations or project activity instances, but is not being developed as a grouped project

☒ The project is a grouped project

[3] https://www.frontiersin.org/articles/10.3389/fpls.2018.01696/full

In all other cases, indicate whether the project has been designed to include a single location or installation only, multiple locations or project activity instances, but is not being developed as a grouped project, or as a grouped project.

Eligibility Criteria

For grouped projects, additional information relevant to the design of the grouped project (e.g., the eligibility criteria for the inclusion of new project activity instances) are described in the table below:

Eligibility conditions	Justification/Description
a) 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.	The project activity involves the plantation of trees on non-forest land (degraded and low productive land) which will increase the carbon sequestration of the land much higher than in the baseline conditions
b) Eligible ARR projects may include timber harvesting in their management plan.	Not Applicable.
c) The project area shall not be cleared of native ecosystems within 10 years before the project start date.	The project activity has not cleared the native ecosystems. Instead, it will plant agroforestry trees which are suitable for fruit and fodder production and highly adaptive to the native ecosystems of the project area. There was no vegetation in the baseline as the project area is degraded land and not identifies are not suitable for or survival of agroforestry trees without any plantation, management activity [4]. Local stakeholder consultation- Local stakeholder consultation was conducted to identify the baseline scenario and impact of land-use conversion to forestation activity. It is identified that the project activity has no forest or any vegetation in the baseline and is identified as desert land.

[4] https://www.frontiersin.org/articles/10.3389/fpls.2018.01696/full

Eligibility criteria for the new grouped project are discussed below. New project activity instances shall:

Eligibility conditions	Justification/Description
Occur within one of the designated geographic areas specified in the project description.	The new project instances will be within the geographical boundary several states of India.. All the areas are part of the project boundaries and have similarities in geography, meteorology and are identified as deserted land[5].
Comply with at least one complete set of eligibility criteria for the inclusion of new project activity instances. Partial compliance with multiple sets of eligibility criteria is insufficient.	The addition of new project instances will be done based on compliance with at least one complete set of eligibility criteria.
Be included in the monitoring report with sufficient technical, financial, geographic and other relevant information to demonstrate compliance with the applicable set of eligibility criteria and enable sampling by the validation/verification body	The applicable set of eligibility criteria is mentioned in the relevant section and will follow the same approach for new instances as well, please refer to the monitoring section of this PD.
Be validated at the time of verification against the applicable set of eligibility criteria.	The validation and verification will be done at the same time against the applicable set of eligibility criteria. The DOE is a third-party auditor and is eligible to validate and verify the project.
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 (i.e., the date upon which the project activity instance began reducing or removing GHG emissions)	The evidence of project ownership will be held by IESLLP and will remain same during the inclusion of new project instances.
Have a start date that is the same as or later than the grouped project start date	The project start date will be the same as the grouped project start date. The start date of

[5] https://www.worldatlas.com/articles/where-does-the-arabian-desert-lie.html

	the project is when the soil preparation for plantation has begun and is in line with section 3.7 of the project standard version. 4.3.
Be eligible for credit from the start date of the instance through to the end of the project crediting period (only). Note that where a new project activity instance starts in a previous verification period, no credit may be claimed for GHG emission reductions or removals generated during a previous verification period	The project instances later added will have to be credited from the start date of the instance through the end of the project crediting period (only).

1.5 Project Proponent

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Organization name	Infinite Environmental Solutions LLP
Contact person	Jimmy Rajdeo Sah
Title	Mr.
Address	215, Milinda Manor, Second Floor, RNT Marg, South Tukoganj, Indore Madhya Pradesh, 452001, India
Telephone	+91-7314050174
Email	Jimmy@infisolutions.org

1.6 Other Entities Involved in the Project

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Organization name	Infinite solutions
Role in the project	Carbon consultant
Contact person	Jimmy Rajdeo Sah
Title	Mr.
Address	215, Milinda Manor, Second Floor, RNT Marg, South Tukoganj, Indore Madhya Pradesh, 452001, India

Telephone	+91-7314050174
Email	Jimmy@infisolutions.org

1.7 Ownership

The project proponent Infinite Environmental Solutions LLP is the owner of the project. The project proponent has full and uncontested legal rights over the project activity by getting into agreement with individual farmers/land owners who are the legal owners of the land. Another entity is Infinite Solutions which acts as the carbon developer. The land has been owned by locals and the land documents will be available in case of individual landowners at the time of validation and verification to DOE.

The landowners agree to the plantation on their land, their upkeep for proper growth and maintaining survival rate. IESLLP acts as the project proponent on behalf of all the individual farmers/communities.

1.8 Project Start Date

The project start date is **20/06/2019**, the afforestation activities including land preparation and planting started on **20/06/2019**, hence it is identified as the start date for project activity.

1.9 Project Crediting Period

For the current grouped project, the crediting period will be of 30 years. The period starts on **20/06/2019** and ends on 19/06/2048. The project crediting period is 30 years and renewable.

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

The estimated annual GHG emission reductions/removals of the project are:

☐ <20,000 tCO_2e/year

☒ 20,000 – 100,000 tCO_2e/year

☐ 100,001 – 1,000,000 tCO_2e/year

☐ >1,000,000 tCO_2e/year

Project Scale	
Project	✓
Large project	

Year	Estimated GHG emission reductions or removals (tCO_2e)
2019	4199
2020	7031
2021	10284
2022	16310
2023	19205
2024	22099
2025	24994
2026	27888
2027	30783
2028	33678
2029	36572
2030	39467
2031	42361
2032	45256
2033	48151
2034	51045
2035	53940
2036	56835
2037	59729
2038	61556
2039	59104
2040	58461
2041	56058
2042	51179
2043	49789

2044	47684
2045	45579
2046	43474
2047	41369
2048	39263
Total estimated ERs	11483343
Total number of crediting years	40
Average annual ERs	39445

1.11 Description of the Project Activity

The project will achieve greenhouse gas (GHG) emissions reductions through afforestation (ARR) approach on a degraded land. The project activity is implemented on lands that are currently degraded and under pressure, which are not expected to convert to a non-degraded state without anthropogenic influences and financial support from project proponent. Considering the activities, that have occurred within these lands, and there will be no carbon stocks generation without the project implementation. The plantations activity associated with the project activities will help to restore and protect these deserted areas. The project activities will achieve GHG removals with the plantation through the selected carbon pools (aboveground biomass, belowground biomass and Litter), thus contributing to the mitigation of climate change. Moreover, the project creates new employment opportunities and strives to protect worker safety and rights while maintaining a good relationship with local stakeholders which is a social co-benefit parameter of its implementation. The project also executes training related to the forest management of the planting area. The Plantations will be conducted at multiple land parcels of state of Madhya Pradesh.

Management- Information management, GIS, Budgeting.

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

Management system- The project activity consists of the plantation that will increase the vegetation cover of the project site. The Afforestation activity will get employment for local people from yearly operational and maintenance of the plants.

Remote sensing is used to have a synoptic view of a larger area and to achieve faster as well as more accurate data interpretation. The company uses multiple online platforms to share information for better support and reduce the risk of data loss. GPS was used to mark the attributes (Latitude and longitude) for location identification and better accuracy of the plantation location.

Planning- A working plan has been developed to aim at the continuity of policy action and control the plantation activity at the local level. The working plan covered multiple activities of survey, assessment and revisions on basis of past results and present facts. Planning also includes actions for the future in conformity with long term objectives. Planning activity has multiple provisions of maintenance of records and collection of facts. Planning conducted to implement the activities: formulation, draft, and implementation of the working plan. Species were selected based on climatic suitability and environmental assessment.

Agroforestry - Species were selected for plantation in this project activity. The project participation is growing high-quality trees with the help of the farmers. Additionally, these species planted are suitable for a wide range of climatic conditions and soil types. Apart from exiting plantation, the projects activity is planning to plant more trees in the future. The proponent is establishing the forest by maintaining the growth, composition, health, and quality of forests, which will help the country to achieve its global 2030 UN agenda.

The silviculture activities include the following.

- **Planting target**- Project has planted almost 4000 hectare of trees and is planning to plant almost additional 2000 hectare of the area.
- **Land preparation** – Land was prepared for plantation before one month of plantation and natural manure was applied. The land was prepared with the locally available dung and FYM.
- **Plantation**- Planting is done during the season with leas temperature for better survival. All the saplings were brought from nursery to field for direct plantation.
- **Forest protection**- Forest protection includes natural resilience as well as an anthropogenic resilience system. Natural resilience is the capacity of the biological system to maintain its structure and patterns of behaviour concerning external disturbances, thus resilience is the ability of a forest ecosystem to withstand such prospective disturbing forces.

Fire control - Training is given and tools are provided to prevent forest fires. Apart from training and tools, the plantation area is planned accordingly to minimize forest loss and reduce the spread of forest fires.

Pest and disease control – Organic pesticides and natural methods are used to control pests in the plantation area. The company actively employs a range of preventative and control methods to combat pests and diseases. It aims to maintain a diversity of planting stock, to ensure that the

genetic base of the plantation is wide and varied. It has a dedicated research and development department that trials new commercial species for deployment, continuously evaluates its planted material and engages with leading research institutions. The company aims to avoid exposing trees to extreme temperature or abnormally high or low levels of water or fertiliser, to eliminate wherever possible unhygienic conditions and weeds, and to replace dead or dying plants regularly.

1.12 Project Location

The project is planning to include the plantation in the entire country. The plantations have already been carried out in the state of Madhya Pradesh. The project has been initially initiated with Dhar district by planting agroforestry trees on the degraded land. The coordinates for the location of Dhar 22° 36' 4.6512" N, 75° 18' 8.8812" E

1.13 Conditions Prior to Project Initiation

The land before the implementation of the project activity was degraded. There were very few plantations in the form of patches. Without the implementation of the project the land would continue to degrade:

- **Ecosystem type:** The project area has tropical ecosystem.
- **Current and historical land-use:** Land in the baseline was degraded and will continue to be degraded in the baseline.
- **Has the land been cleared of native ecosystems within 10 years of the project start date?**

☐ Yes ☒ No

Climate –

MP comes under the hot Torrid Zone and probably that's why the state observes tropical type of climate. Though weather varies from region to region, it's warm in most of the places. Like any other part of India, Chhattisgarh enjoys three seasons, summers, winters, and monsoons. During summers (April-June), the temperature sometimes goes up to 45°C (max) whilst the sun shines brightly over heads.

Pedology –

MP region lies in the area of 'Red and Yellow Soils' according to the All-India Scheme of Soil Classification. Laterite, Black, Red Sandy and Red Loamy soils are some other types of soil types found in Chhattisgarh.

Because of the topographical variations, the soil types are diverse in the state. The soils are usually shallow and young in the upper part of the landscape with less developed features and are usually highly eroded.

Hydrology –

Major water bearing formations are weathered, jointed & fractured rocks of Proterozoic age where ground water occurs under water table conditions. Water bearing fractures generally occur within 100 m depth. The semi-consolidated formations (Gondwanas) are another water bearing formations with weathered sandstone and limestone forming good aquifers. The unconsolidated sediments including alluvium and laterite are also water-yielding medium.

Eco–system –

MP State, lying in the Vindhyan hill regions and Deccan plateau in central India, has over 44% of its land area under forests and is rich in biodiversity. 7.8 million indigenous and tribal communities eke out their livelihood from these forests and biological resources.

1.14 Compliance with Laws, Statutes and Other 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

the Government's desire to promote forest plantations and the development of agricultural economic activities.

1.15 Participation under Other GHG Programs

1.15.1 Projects Registered (or seeking registration) under Other GHG Program(s)

The project has not been registered under any other GHG programs and is not seeking registration under any other GHG programs.

1.15.2 Projects Rejected by Other GHG Programs

The project has not participated in any other programs and has therefore not been rejected by any of them.

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

Does the project reduce GHG emissions from activities that are included in an emissions trading program or any other mechanism that includes GHG allowance trading?

☐ Yes ☒ No

There is no other form of environmental credits included in the project framework or currently ongoing in the project area. The project has not participated in any other program of environmental crediting for GHG emission removals. The project does not intend to generate any other kind of environmental crediting for GHG emission removals.

1.16.2 Other Forms of Environmental Credit

Has the project sought or received another form of GHG-related credit, including renewable energy certificates?

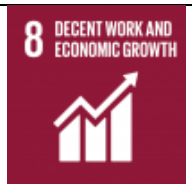
☐ Yes ☒ No

1.17 Sustainable Development Contributions

1.17.1 Sustainable Development Contributions Activity Description

Description of Sustainable development goals.

SDG	SDG GOALS

	The project helps the communities to sustain on the forest produce that is generated from the plantation. The Community are allowed to consume non-timber-based products from these forests.
	The project activity will provide employment to many people including men, women, and young people.
	The project activity will sequester tonnes of Carbon Dioxide (a major greenhouse gas) resulting in positive impacts on the environment.
	Improved management of land as a result of adoption of good practices –thereby increasing the adaptive capacity of the plantation to climate change impacts.

1.17.2 Sustainable Development Contributions Activity Monitoring

Table 1: Sustainable Development Contributions

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
1)	1.4.2	Proportion of total adult population with secure tenure rights to land, with legally recognized documentation and who perceive their rights to land as secure, by sex and by type of tenure	Implemented activities to increase	The project will lead to various communities getting access to the plantation activities for non-timber related valued products.	It is expected that tribal areas in the village communities would be beneficiaries. The actual number shall be available at a later stage.
2)	8.3.1	Proportion of informal employment in non-agriculture employment, by sex	Implemented activities to increase	The project will lead to various communities getting access to the plantation activities for non-timber related valued products.	It is expected that tribal areas in the village communities would be beneficiaries. The actual number shall be available at a later stage.
3)	13.0	Tonnes of greenhouse gas emissions avoided or removed	Implemented activities to increase	By plantation of 4000 ha, this project will prevent the release of 39,445 tonnes of carbon into the atmosphere annually.	Prevented the release of 11,83,343 tC02 of carbon dioxide into the atmosphere over its lifetime of 30 years

	15.1.1	Forest area as a proportion of total land area	Implemented activities to increase	The project will promote sustainable use of terrestrial ecosystems, combat desertification, and halt and reverse land degradation and halt biodiversity loss by plantation of 4000 ha.	In total lifetime of the project, it will promote sustainable use of terrestrial ecosystems, combat desertification, and halt and reverse land degradation and halt biodiversity loss by plantation of 4000 ha.

1.18 Additional Information Relevant to the Project

Leakage Management

There is no displacement of agriculture activities and leakages are considered to be nil. As a result, the overall leakage for the project is nil.

Commercially Sensitive Information

No commercially sensitive information has been excluded from the public version of the project description.

Further Information

Not Applicable

2 SAFEGUARDS

2.1 No Net Harm

This project is designed to have a positive impact on the environment by improving the local ecological conditions of the environment and thus, plantation can reverse the harmful effects on the soil. The project is designed to improve environmental services and socio-economic values. The aim of the project is to achieve better soil fertility, and biodiversity conservation. The project design causes no negative socio-economic impacts to the local community. Therefore, this project will produce positive impacts only.

2.2 Local Stakeholder Consultation

The local stakeholder consultation meeting was organized at multiple locations for initially at Dhar district. Invitation for the meeting was communicated at the gram panchayats as well as circulated with local NGOs. The aim of the meeting held, was to inform local stakeholders (Farmers) about the project and give them an opportunity to discuss and provide feedback on the project. The overall goal was to improve the project design based on stakeholders' comments and suggestions and increase the local awareness and involvement of local people in the project. The meetings were attended by a total of many villagers/local NGO's and officials including both male and female

Stakeholder identification - The members of Community along with other community members, villagers, local NGOS and local officials have been identified as the stakeholder for the project. Also, emloyess from Infinite Solutions had attended the meeting. The participation of all

stakeholders in the project has been inclusive, according to individual and gender-independent capacities, cultural identity, and religion.

Key points from the meetings:

The following agenda was followed:

1. Opening of the meeting

2. Registration of the participants

3. About the project and its implementation structure

4. Questions for clarification about project

5. Discussion on environmental, social, and economic benefits from the project

6. Discussion on tree species planted, soil type found in their area

7. Explanation of institutional mechanism for carrying out various activities

8. Closure of the meeting via suggestions taken up from the stakeholders and filling up of the feedback forms

The objective and purpose of the project was explained which is the importance of plantation for our environment and to generate carbon credits by the plantation activities. The participants were updated with the carbon financing aspects as well as the process of validation and verification by a third party (auditor). Also, the topic of climate change and mitigation potential of trees as carbon sink were discussed. The additional benefits from the project in the form of carbon credits were explained and discussed as well.

The suggestions and comments of the participants were documented through the feedback forms while some of the issues and comments raised by the participants were addressed during the meeting. Few questions related to tree species planted, and soil types, harvesting period of tree species planted were asked by the stakeholder during the stakeholder consultation meetings to be included in the project report. In future many more meetings with the stakeholders shall be organized for much more clarity on the carbon assessment and to take feedback from the stakeholders regarding any negative impact of the project at every stage.

Continuous Engagement:

There is a grievance mechanism established by the company in conjunction with the Local NGO's where all the comments/queries/complaints would be addressed to.

Since the project is implemented in conjunction with the communities, thus the decision making is the local community and in case of any grievances the forest department shall take into consideration the best activity for the region Further continuous engagement sessions are planned with the communities as and when the planation is initiated.

2.3 Environmental Impact

The A/R VCS project activity does not have any negative environmental impact because the project activity will directly improve the conditions of the environment due to various plantation activities.

By the plantations that enable sustainable timber production, this project will fight deforestation and thus contributes to the preservation of biodiversity, quality of water resources and the fight against soil erosion. Also, the project is designed to increase sequestration capacity of CO2, therefore playing a positive role in regulation of climate change.

2.4 Public Comments

Public comments if received shall be addressed by project proponent.

2.5 AFOLU-Specific Safeguards

It can be concluded through the local stakeholder meeting conducted that there are no risks to the local people or communities residing near the project area.

Risks to local population -

There are no risks associated with the local population. The impacts on populations are mainly positive.

Enhancement of soil quality -

Due to deforestation in some areas, the soil gradually gets degraded, which limits the growth of plants and trees. But, with the plantation from the project activity the soils will naturally fertilized with nitrogen and carbon. Improvement in soil fertility improves the quality of plants thereby ensuring enhanced returns.

Increased incomes -

This project will provide an opportunity to the local communities to harvest non-timber related forest produce.

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 addition, the following tools are applied by the project:

- Combined tool to identify the baseline scenario and demonstrate additionally in A/R CDM project activities (Version 1)
- Tool for estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities (Version 4.2)
- Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities (Version 1.1.0)
- Tool for carbon stocks and change in carbon stocks in dead wood and litter due to the implementation of A/R CDM project activities (Version 3.1)
- VCS AFOLU Non-Permanence Risk Tool (Version 4.0).

3.2 Applicability of Methodology

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Scenario	JUSTIFICATION
The land subject to the project activity does not fall in wetland category.	As per the IPCC GPG LULUCF 2003, 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 including reservoirs, natural rivers and lakes. The project site consists of degraded land and does not cover any wetlands. Hence, this criterion is applicable.
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 these lands are included within the project boundary: (i) Land containing organic soils; (ii) (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.	The project area is characterized as degraded land. The type of soil in the project area are red, yellow, loamy, sandy and sandy loam soils as described in section 1.13 and, thereafter, does not fall within the types of land referred in points (i) and (ii). Such croplands under tropical conditions have less carbon compared to plantations and forest cover. Therefore, it is expected for soil organic carbon to increase more in the presence of the project activity relative to the previous land use. The lands of Appendix 1 refer to cropland in which soil disturbance is restricted. Plantation in the area, and cultivation with reduced tillage and limited use of inputs are followed by the planters which is not restricted in the methodology. Therefore, the project area does not classify as land listed in Appendix 1. The lands of Appendix 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 Appendix 2.
Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities: a) 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. b) This tool is not applicable to small - scale afforestation and reforestation project activities	a) The project is in compliance with applicable legal and regulatory requirements. b) This project is not a small-scale afforestation and reforestation project, as it does not fulfil the small-scale conditions as defined by VCS.
Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities.	This tool has no internal applicability conditions.
Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities: This tool is applicable when the areas of land, the baseline scenario, and the project activity meet the following conditions: a) The areas of land to which this tool is applied: i. Do not fall into wetland category; or ii. Do not contain organic soils as defined in "Annex A: 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; and ii. Soil disturbance attributable to the A/R CDM project activity, if any, is: • In accordance with appropriate soil conservation practices, e.g. follows the land contours. • Limited to soil	a) Project lands are not wetlands or peatlands. The project area is characterized as degraded land. The type of soil in the project area are red, yellow, clay, loamy, sandy and sandy loam soils. Such lands under tropical conditions have less carbon compared to plantations and forest cover. The lands of Table 1 refer to cropland in which soil disturbance is restricted. Plantation in the area and cultivation with reduced tillage and limited use of inputs are followed by planters which is not restricted in the methodology. Therefore, the 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) In this project case litter is not removed and soil disturbances are limited to those during site preparation (digging of holes to plant seedlings).

disturbance for site preparation before planting and such disturbance is not repeated.	

3.3 Project Boundary

Define the project boundary and identify the relevant GHG sources, sinks and reservoirs for the project and baseline scenarios (including leakage if applicable).

Source		Gas	Included?	Justification/Explanation
Baseline	Biomass	CO_2	Yes	It is expected that carbon stock in these pools will increase due to the implementation of the baseline activity
		CH_4	No	Not required from methodology
		N_2O	No	Not required from methodology
		Other	N/A	-
	SOC and Litter	CO_2	Yes	It is expected that carbon stock in these pools will increase due to the implementation of the baseline activity
		CH_4	No	Not required from methodology
		N_2O	No	Not required from methodology
		Other	N/A	-
Project	Biomass	CO_2	Yes	It is expected that carbon stock in these pools will increase due to the implementation of the baseline activity
		CH_4	No	Not required from methodology
		N_2O	No	Not required from methodology
		Other	N/A	-

Source		Gas	Included?	Justification/Explanation
	SOC and litter	CO_2	Yes	It is expected that carbon stock in these pools will increase due to the implementation of the baseline activity
		CH_4	No	Not required from methodology
		N_2O	No	Not required from methodology
		Other	N/A	-

3.4 Baseline Scenario

The baseline scenario before the implementation of the project activity was degraded land in which there were very few plantations in the form of patches. The baseline scenario of the project area with locations in project area along with the other would be added at a later instance. Without the implementation of the project activity the land would continue to be degrade further.

3.5 Additionality

The demonstration and assessment of the additionality of the project is made in accordance with the applied methodology (AR-ACM0003, Version 01.0.0) following the steps of the "Combined tool to identify the baseline scenario and demonstrate additionally in A/R CDM project activities" (Version 01)

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

The planting activity was conducted from June 2019, which is before the registration date and after 31 December 1999. The starting date of the A/R project was 2019, which was after 31 December 1999.

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

STEP 1. Identification of alternative scenarios

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

According to additionally tool, the alternative land use scenario of the proposed project includes:

The scenario applicable for Degraded land under cultivation are as follows;

- Scenario 1: Continuation of existing land use or status quo
- Scenario 2: Proposed project not undertaken as an A/R Carbon project

- Scenario 3: Commercial plantations on these lands

Degraded land: The land for the project belongs to the individual small and marginal farmers as well as large community land/large farmers. The ownership lies with the land owner. Currently, this land category is subjected to degradation or usage under other agricultural practices. Another alternative is to implement the A/R activity not as a Carbon project

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

The implementation of A/R activity is not a mandatory requirement, the public and private lands would continue to be in the degraded state unless taken action.

Step 2: Barrier analysis

The barrier analysis is used to demonstrate that the alternative use of public and private lands for A/R activity faces investment, technological and ecological barriers.

Investment barrier:

No private capital is available from domestic or international capital markets due to risks associated with investments in forestry projects also the banks in India are conservative and have stringent lending guidelines and high-interest rates for this kind of forestry plantation due to environmental risk factors and no returns. As a case, some bank has an interest rate from 7-13 percent for the agriculture segment[6]. The expected financial benefits obtainable through carbon finance will support the project to overcome the obstacle to some extent. Moreover, banks provide loans only for timber plantations, not for agroforestry plantations[7]. Farmers are marginal / small farmers and don't have the initial capital to invest in plantations.

Further, the revneues to the individual farmers are accrued only after 4-5 years when the trees starts bearing fruits, till that time they have to invest time and resources to nurture and develop the orchard.

This barrier prevents the alternative land use scenarios 2 and 3 (Afforestation/reforestation of the land within the boundaries of the project activities performed without being registered as the ARR VCS project activity.

Technological barriers

Lack of access to planting materials, constraining in using fertilizers, and breakdown of the agricultural economy (including lack of seedsand agricultural equipment) is among the major technological barriers. These barriers have been identified, for example by NABARD, to be among the main reasons for the decrease in agricultural land use and organic farming[8]. The result of

[6] http://www.aryavart-rrb.com/interest_rates_adv.html

[7] https://www.nabard.org/auth/writereaddata/file/Forestry.pdf

[8] https://www.nabard.org/demo/auth/writereaddata/File/OC%2038.pdf

these constraints is to reduce productivity (increase the farm gate cost of fertilizers) and declines the soil organic carbon content with a resultant decline in soil fertility. Due to some regulations and risks associated with agroforestry, the farmers are not having an interest in the plantation[9]. Local communities are committed to planting trees, but without the carbon component, they do not have adequate access to technical and organizational assistance.

Communities need the support of NGOs/FPOs to implement and maintain the project as they are not used to planting trees that don't produce immediate output or other parts for nourishment purposes. In fact, at the beginning of the project, it was difficult to receive support and collaboration from the local people for project implementation due to high risk associated. The proposed project activity has anyhow been able to surpass the initial difficulties working together with the local communities and offering local people knowhow and training.

Barriers related to local tradition

Policy initiatives and strict trade regulations has not supported the wide adaptation of agroforestry in various states. Through prominent agroforestry models being developed in different parts of the country, there is no clear-cut mechanism from seed procurement to marketing of the products in the country (Chavan, S. B. et al)[10].

Barriers due to local ecological conditions:

The local ecological conditions only allow some species to grow but not the fruit-bearing species. The land has been identified as degraded and less productive as per the survey. Due to the limited availability of water, the land is a best case option for water intensive agriculture activities. The land has been degraded because of excessive usage of fertilizer and pesticides in the baseline. In the baseline, the land will continue to be degrading because of chemical use and it will continue to harm the environment in the absence of implemented project activity. The farmers were trained to shift to organic habits and nature-based pesticides (For example- Neem extract, salt water and whitewash). The farmers are provided with the training and participation is ensured in the plan.

Barriers relating to markets, transport, and storage; -

Unregulated and informal markets for products and services prevent the transmission of effective information to project participants; -

The remoteness of land area and undeveloped roads and infrastructure incur large transportation expenditures, thus eroding the competitiveness and profitability of products from the land use.

Possibilities of large price risk due to the fluctuations in the price's products over the project period in the absence of efficient markets and insurance mechanisms

The absence of facilities to convert, store and add value to products resulting from land-use limits the possibilities of carbon capture is not a common and feasible land-use scenario for these projects.

[9] https://agricoop.nic.in/sites/default/files/National%20Agroforestry%20Policy%202014.pdf

[10]Chavan, S. B. et al. "National Agroforestry Policy in India: a low hanging fruit." Current Science 108 (2015): 1826-1834.

Outcome of Step 2a:

- Investment Barrier ((barriers no access to funding)
- Technological Barrier.
- Barriers related to local tradition
- Barriers due to local ecological conditions:
- Barriers relating to markets, transport, and storage; -

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

The alternative scenarios are prevented by at least one of the barriers listed in Step 2a, thus these alternative scenarios are eliminated from further consideration.

Project Alternative	Barrier Faced
Continuation of existing land use or status quo	No Barrier faced
Proposed project not undertaken as an A/R Carbon project	Investment Barrier Technological Barrier Barriers related to local tradition Barriers due to local ecological conditions: Barriers relating to markets, transport, and storage
Commercial plantations on these lands	No Barrier faced

The only alternative scenario not prevented by any barrier is the scenario "The continuation of the current situation, not requiring any investment or expenses to maintain the current situation i.e. continuation of the pre-project land use". In accordance with the applied tool this alternative scenario is identified as the baseline scenario.

Outcome of Sub-step 2b:

List of land use scenarios that are not prevented by any barrier:

- Continuation of pre-project land use (degraded land with no plantation or agricultural land)

Sub-step 2c. Determination of baseline scenario: Scenario 1, continuation of pre-project use, remains the possible baseline scenario.

According to the tool: Is Plantation without being registered as an A/R CDM project activity included in the list of land use scenarios that are not prevented by any barrier? NO

→ If no, then:

Does the list contain only one land use scenario? YES

→ If yes, then the remaining land use is the baseline scenario.

STEP 3. Investment analysis (if needed) Scenario 1 remains the only possible baseline scenario, which makes investment analysis not necessary.

STEP 4. Common practice analysis In the project area, i.e. There is no ARR activities have been implemented previously specifically for implementation of Agro-forestry projects, which is similar to this VCS project. Therefore, the project is not a common practice in the project area.

Outcome: The project is additional.

3.6 Methodology Deviations

There are no methodological deviations.

4 ESTIMATED GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

As described in the above sections, the baseline scenario corresponds to the continuation of the degraded status of the land. Considering the conditions of applicability of the selected methodology, changes in selected carbon pools can be assumed to be Zero for the baseline emission calculations. Following are the requirements of the methodology, the project uses the following equations to calculate the net GHG removal under the baseline scenario.

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

Where:

$\Delta C_{BSL,t}$ = Baseline net GHG removals by sinks in year t; t CO2-e

$\Delta C_{TREE\_BSL,t}$ = 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 CO2-e

$\Delta C_{SHRUB\_BSL,t}$ = 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 CO2-e

$\Delta C_{DW\_BSL,t}$ = 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 CO2-e

$\Delta C_{LI\_BSL,t}$ = 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 CO2-e

In the baseline scenario, the project activity is a deserted wasteland and as per the AR-CDM tool 14. Para.11 (d), the carbon stocks of the project activity are considered zero.

Carbon stock in trees in the baseline are be accounted as zero in the baseline as per tool 14:

A) The pre-project trees are neither harvested, cleared, nor removed throughout the crediting period of the project activity; - the project activity plant agroforestry trees and planned to increase the forest cover on a long-term basis.

B) The pre-project 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, (there were no trees in the pre-project scenario). The trees are planted on breathable sand and continuous water availability as well as proper spacing.

C) The pre-project trees are not inventoried along with the project trees in the monitoring of carbon stocks but their continued existence, consistent with the baseline scenario, is monitored throughout the crediting period of the project activity: - the project activity tends to implement trees on a deserted wasteland with no prior biomass.

The shrub biomass is considered zero as per Tool14.Para.12(d), project activity and litter biomass are considered zero as per the Tool12, Section.7.2, Para 45 of the project activity.

The pools corresponding to soil organic carbon, and litter to be considered for this project as explained above in section 2.3. Therefore, these carbon pools will be assumed as zero in the baseline*).*

4.2 Project Emissions

The GHG emissions resulting from removal of herbaceous vegetation, combustion of fossil fuel, fertilizer application, use of wood, decomposition of litter and fine roots of N-fixing trees,

construction of access roads within the project boundary and transportation attributable to the project activity shall be considered insignificant and therefore accounted as zero.

The actual Net GHGs removal has been calculated by the methodology AR-ACM0003: Afforestation and reforestation of lands except for wetlands.

The actual net GHG removals by sinks shall be calculated as follows:

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

Where,

$\Delta C_{AR-CDM,t}$	=	Net anthropogenic GHG removals by sinks, in year *t*; t CO_2-e
$\Delta C_{ACTUAL,t}$	=	Actual net GHG removals by sinks, in year *t*; t CO_2-e
$\Delta C_{BSL,t}$	=	Baseline net GHG removals by sinks, in year *t*; t CO_2-e
LK_t	=	GHG emissions due to leakage, in year *t*; t CO_2-e

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

Leakage emissions shall be estimated as follows:

$$LK_t = LK_{AGRIC,t}$$ Equation (1)

Where:

LK_t	=	GHG emissions due to leakage, in year t; t CO2-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 the displacement of pre-project agricultural activities in A/R CDM project activity"; t CO2-e

Biomass-

The Biomass of the tree in a stratum has been calculated as per the Para.35 of the tool 14.

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

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

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

$$u_C = \frac{t_{VAL} \times \sqrt{\sum_{i=1}^{M} w_i^2 \times \frac{s_i^2}{n_i}}}{b_{TREE}}$$

C_{TREE} = Carbon stock in trees in the tree biomass estimation strata; t CO2e

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 estimation strata; t d.m. ha^{-1}

wi =Ratio of the area of stratum i to the sum of areas of tree biomass estimation strata (i.e. wi= Ai/A); dimensionless

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

uc = Uncertainty in CTREE

t_{VAL} = Two-sided Student's t-value for a confidence level of 90 per cent and degrees of freedom equal to n – M, where n is the total number of sample plots within the tree biomass estimation strata and M is the total number of tree biomass estimation strata

Si^2 = Variance of tree biomass per hectare across all sample plots in stratum i; (t d.m. ha^{-1}) 2

n_i = Number of sample plots in stratum i

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

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

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

$b_{TREE,p,i}$ = Tree biomass per hectare in plot p of stratum i; t d.m. ha^{-1}

Si^2 = Variance of tree biomass per hectare across all sample plots in stratum I; (t d.m.ha^{-1}) 2

N_i = Number of sample plots in stratum i

Deadwood and litter-

Estimation of dead wood and litter was calculated in accordance with the "Toolforestimation of carbon stocks and change in dead wood and litter due to the implementationofA/R CDM project activities". As per the tool, it is assumed that there will be no deadwood but litter at the same time. The project activity will assume that litter content will increase constantly after the plantation.

The initial carbon stock in the litter at the start of the project is estimated as follows:

$$dC_{LI,(t_1,t_2)} = \frac{C_{LI,t_2} - C_{LI,t_1}}{T}$$ Equation (16)

Where:

$dC_{LI,(t_1,t_2)}$ = Rate of change in carbon stock in litter within the project boundary during the period between a point of time in year t_1 and a point of time in year t_2; t CO_2e yr^{-1}

C_{LI,t_2} = Carbon stock in litter within the project boundary at a point of time in year t_2; t CO_2e

C_{LI,t_1} = Carbon stock in litter within the project boundary at a point of time in year t_1; t CO_2e

T = Time elapsed between two successive estimations ($T=t_2 - t_1$); yr

Change in carbon stock in litter within the project boundary in year t ($t_1 \leq t \leq t_2$) is given by:

$$\Delta C_{LI,t} = dC_{LI,(t_1,t_2)} \times 1\ year \text{ for } t_1 \leq t \leq t_2 \qquad \text{Equation (17)}$$

Where:

$\Delta C_{LI,t}$ = Change in carbon stock in litter within the project boundary in year t; t CO_2e

$dC_{LI,(t_1,t_2)}$ = Rate of change in carbon stock in litter within the project boundary during the period between a point of time in year t_1 and a point of time in year t_2; t CO_2e yr^{-1}

SOC (Soil Organic Carbon)-

Estimation of carbon stock was calculated in accordance with the "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities, Version 01.1.0." As per the tool, it is assumed that the implementation of the Project activity will help in increasing the soil organic carbon of the project zone from the pre-project level to the level that is equal to the steady-state SOC content under native vegetation. The project activity will take place for 20 years and SOC content will increase at a constant level for 20 years after the plantation.

The project activity is according to the tool and in line with requirements: (1) Do not fall into the wetland category, do not contain organic soils, and is not subjected to any land use management activity of inputs limited in Table 1 and 2 of the tools. The initial SOC stock at the start of the project is estimated as follows:

$$SOC_{INITIAL,I} = SOC_{REF,i} * f_{LU,i} * f_{MG,i} * f_{IN,i}$$

Where;

$SOC_{INITIAL,i}$ = SOC stock at the beginning of the A/R CDM project activity in stratum iof the areas of land; t C ha-1

$SOC_{REF,i}$ = 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 type applicable to stratum iof the areas of land;t C ha-1

$f_{LU,i}$ = Relative stock change factor for baseline land-use in stratum iof 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

Symbol	Parameter	Value	Source
$SOC_{REF,i}$	Reference SOC (tC/ha)	47	Table 1 of the tool; Tropical moist, Soils with low activity clay (LAC).
$f_{LU,i}$	Land use factor	1	Table 4 of the tool; All permanent grassland.
$f_{MG,i}$	Management factor	0.70	Table 4 of the tool; Lands are identified as degraded lands.
$F_{IN,i}$	Input factor	1	Table 4 of the tool; Lands are identified as degraded lands.
$SOC_{INITIAL,i}$	SOC at the beginning of the Project activity	Calculated	Calculated, with Eq. Above described

Parameters used for the estimation of the soil organic carbon (SOC).

The rate of change in SOC stock in the project scenario until the steady-state SOC content is reached is estimated as follows:

$$dSOC_{t,i} = \frac{SOC_{REF,i} - (SOC_{INITIAL,i} - SOC_{LOSS,i})}{20\ years} \quad \text{for } t_{PREP,i} < t \leq t_{PREP,i} + 20$$

where:

$dSOC_{t,i}$ = The rate of change in SOC stock in stratum i of the areas of land. in year t; t C ha^{-1} yr^{-1}.

$SOC_{REF,i}$ = Reference SOC stock corresponding to the reference condition in native lands (i.e. non-degraded. unimproved lands under native vegetation ñ normally forest) by climate region and soil type applicable to stratum i of the areas of land; t C ha^{-1}

$SOC_{INITIAL,i}$ = SOC stock at the beginning of the A/R CDM Project activity in stratum i of the areas of land; t C ha^{-1}.

$t_{PREP,i}$ = The year in which first soil disturbance takes place in stratum i of the areas of land.

i = 1. 2. 3. … strata of areas of land; dimensionless.

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

In this case, the soil disturbance attribute for the project activity and the disturbance in soil activity of the area is less than 10 percent hence the carbon loss from the soil is assumed to a zero. The application of these equations results in an estimation of 0.70.

The change in SOC stock for all the strata of the areas of land, in year t, is calculated as below:

$$\Delta SOC_{AL,t} = \frac{44}{12} * \sum_{i} A_i * dSOC_{t,i} * 1year$$

where:

$\Delta SOC_{AL,t}$	Change in SOC stock in areas of land meeting the applicability conditions of this tool, in year *t*; t CO_2-e
A_i	The area of stratum *i* of the areas of land; ha
$dSOC_{t,i}$	The rate of change in SOC stocks in stratum *i* of the areas of land; t C ha^{-1} yr^{-1}
i	*1, 2, 3, …* strata of areas of land; dimensionless

As stated from the above equations the project emissions for this project activity are stated as "Zero".

4.3 Leakage

Leakage emissions shall be estimated as follows*:*

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

Where:

LK_t	=	GHG emissions due to leakage, in year *t*; t CO_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 the displacement of pre-project agricultural activities in A/R CDM project activity"; t CO_2-e

There is no displacement of the agriculture for this project activity hence the leakage is accounted as zero*.*

4.4 Estimated Net GHG Emission Reductions and Removals

The net anthropogenic GHG removals by sinks shall be calculated as follows.

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

Where:

$\Delta C_{AR-CDM,t}$ = Net anthropogenic GHG removals by sinks, in year *t*; t CO_2-e

$\Delta C_{ACTUAL,t}$ = Actual net GHG removals by sinks, in year *t*; t CO_2-e

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

LK_t = GHG emissions due to leakage, in year *t*; t CO_2-e

.

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
2019	0	4199	0	4199
2020	0	7031	0	7031
2021	0	10284	0	10284
2022	0	16310	0	16310
2023	0	19205	0	19205
2024	0	22099	0	22099
2025	0	24994	0	24994
2026	0	27888	0	27888
2027	0	30783	0	30783
2028	0	33678	0	33678
2029	0	36572	0	36572
2030	0	39467	0	39467
2031	0	42361	0	42361
2032	0	45256	0	45256
2033	0	48151	0	48151
2034	0	51045	0	51045
2035	0	53940	0	53940
2036	0	56835	0	56835
2037	0	59729	0	59729
2038	0	61556	0	61556
2039	0	59104	0	59104
2040	0	58461	0	58461
2041	0	56058	0	56058
2042	0	51179	0	51179
2043	0	49789	0	49789
2044	0	47684	0	47684
2045	0	45579	0	45579
2046	0	43474	0	43474
2047	0	41369	0	41369
2048	0	39263	0	39263
Total	0	1183343	0	1183343

5 MONITORING

5.1 Data and Parameters Available at Validation

Complete the.

Data / Parameter	Area
Data unit	Ha
Description	Area of the project activity
Source of data	Latitude and longitude of the area under the project
Value applied:	10000
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Calculation of actual net GHG removals
Comments	-

Data / Parameter	Rtree,j
Data unit	dimensionless
Description	Root-to-shoot species j
Source of data	To be determined later
Value applied:	0.27
Justification of choice of data or description of measurement methods and procedures applied	As per the 2003 IPCC grouped report

Purpose of Data	Calculation of actual net GHG removals
Comments	-

Data / Parameter	Dtree,j
Data unit	t d.m.m-3
Description	Basic wood density for species j
Source of data	World woody biomass density
Value applied:	As per the species included in the PDD.
Justification of choice of data or description of measurement methods and procedures applied	Peer reviews or data published by IPCC
Purpose of Data	Calculation of actual net GHG removals
Comments	-

Data / Parameter	BEFtree,j
Data unit	dimensionless
Description	Biomass Expansion Factor
Source of data	To be determined later
Value applied:	3.6
Justification of choice of data or description of measurement methods and procedures applied	As per the IPCC
Purpose of Data	Calculation of actual net GHG removals

Comments	-

Data / Parameter	CFTREE,j
Data unit	t C / （t d.m.）
Description	Carbon fraction of tree biomass for species or group of species j
Source of data	To be determined later
Value applied:	0.49
Justification of choice of data or description of measurement methods and procedures applied	As per the IPCC
Purpose of Data	Calculation of actual net GHG removals
Comments	N/A

5.2 Data and Parameters Monitored

Data / Parameter	A
Data unit	ha
Description	Project Area (planted area)
Source of data	Agreement/ plantation area
Description of measurement methods and procedures applied	Field measurement: the area shall be delineated either on the ground, using GPS or from geo-referenced remote sensing data
Frequency of monitoring/recording	At the beginning of site preparation, in the final establishment of the Project and each time verification is conducted.

Value applied:	10,000
Monitoring equipment	GPS equipment (precision 1- 5 m) and Remote Sensing data
QA/QC procedures applied	Quality control/quality assurance (QA/QC) procedures prescribed under national forest inventory are applied. In the absence of these, QA/QC procedures from published handbooks, or the IPCC GPG LULUCF 2003, are applied. See section 3.3.3 Procedures for internal auditing and QA/QC.
Purpose of data	Calculation of project emissions
Calculation method	Measurement
Comments	The sample plot location is registered with a GPS and marked on the Project map. See the description for the Establishment of permanent and temporary plots in section 3.3.

Data / Parameter	Project coordinates for the location
Data unit	Lat/Long
Description	Localization of each sampling plot
Source of data	Data field Sampling
Description of measurement methods and procedures applied	Latitude and longitude for each land parcel will be indicated with the GPS
Frequency of monitoring/recording	Once during the validation.
Value applied:	Ex-post
Monitoring equipment	Etrex10 - Garmin GPS
QA/QC procedures applied	Quality control/quality assurance (QA/QC) procedures are applied as per the manual - Etrex10 - Garmin GPS

Purpose of data	-
Calculation method	-
Comments	-

Data / Parameter	DBH
Data unit	CM
Description	Field measurements in sample plots during the verification
Source of data	Data field Sampling
Description of measurement methods and procedures applied	Typically measured at a height of 1.3-meter above-ground level.
Frequency of monitoring/recording	Each time the verification is conducted
Value applied:	Ex-post
Monitoring equipment	Measuring tape
QA/QC procedures applied	Quality control/quality assurance (QA/QC) procedures prescribed under national forest inventory are applied.
Purpose of data	Calculation of project emissions
Calculation method	NA
Comments	NA

Data / Parameter	H
Data unit	m

Description	Total height of the tree
Source of data	Field measurements in sample plots
Description of measurement methods and procedures applied	Data field Sampling
Frequency of monitoring/recording	Each time verification is conducted
Value applied:	Ex-post
Monitoring equipment	Clinometer, measuring tape
QA/QC procedures applied	Persons involved in the field measurement work should be fully trained in-field data collection. Field measurements shall be checked by a qualified person to correct any errors in techniques.
Purpose of data	Calculation of project emissions
Calculation method	-
Comments	-

Data / Parameter	$\Delta SOC_{AL\ t}$
Data unit	t CO2-e
Description	Change in SOC stock in areas of land meeting the above applicability conditions, in year *t*
Source of data	Field measurements in sample plots

Description of measurement methods and procedures applied	Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities (Version 01.1.0)
Frequency of monitoring/recording	Yearly
Value applied:	Calculated
Monitoring equipment	NA
QA/QC procedures applied	None
Purpose of data	Calculation of project emissions
Calculation method	NA
Comments	NA

5.3 Monitoring Plan

As per the requirements of VCS Standard Ver_4.2, each project activity instance to be added to this Grouped Project will describe the process and schedule for obtaining, recording, compiling, and analyzing the monitored data and parameters set out in Section 5.2 (data and parameters monitored) above. The following details should be included.

The organizational structure, responsibilities and competencies of the personnel that will be carrying out monitoring activities.

• The methods for measuring, recording, storing, aggregating and reporting data and parameters, where relevant, also include the procedure for calibrating monitoring equipment.

• The policies for oversight and accountability of monitoring activities.

• The procedures for internal auditing and QA/QC.

• The procedures for handling non-conformances with the validated monitoring plan.

• Any sampling approaches used, including target precision levels, sample sizes, sample site locations, stratification, frequency of measurement and QA/QC procedures.

Following the methodology AR-ACM0003, the purpose of this monitoring plan is to collect all relevant data necessary to:

• Verify that the applicability conditions of the methodology have been met.

• Verify the changes in carbon stocks in the pools selected.

- Verify project and leakage emissions.

Sampling plan

Fixed area plots of 10m X 10m will be established in the plantation and the DBH of those plants will be measured. Using the allometric equation presented in the Project Description, the biomass related to the species will be calculated.

Measuring tape will be used to measure the diameter at breast height. Breast Height is quantified as 1.36 m and everyone working on the monitoring will use a meter stick which will be marked at 1.36 m to ensure that measurements are taken at the right height. Every plant is separately recorded on a field data sheet and a separate page for each plant will be allotted for the recording of the relevant DBH.

Data will be recorded on field sheets and then transcribed to electronic media. Database searches will be made following data entry to identify any anomalous values that require clarification or correction.

The project will develop and maintain an electronic database of GIS coverages that will be archived in both digital and hard copy form. Original datasheets from field monitoring will be archived. All project data will be archived for a minimum of 2 years beyond the project crediting period.

Responsibilities of plantation owner: Ensure that monitoring will take place and that data is transcribed into electronic media. The plantation owner will furthermore ensure that the hard copy data is stored appropriately and will check quality control by looking for outliers and conducting random checking during monitoring.

Responsibilities of plantation owner:. The plantation owner will furthermore ensure that the hard copy data is stored appropriately and will check quality control by looking for outliers and conducting random checking during monitoring.

Responsibilities of plantation manager: To ensure that all farm employees are trained to conduct monitoring. The plantation manager will keep oversight of the monitoring and take random samples as a form of quality control. The plantation manager is furthermore responsible for the transcribing of data into electronic media. The plantation manager will continuously monitor whether fires occur and capture information on the area impacted by fire, supported by photographs. The plantation manager is responsible for the replacement of dead samplings.

Responsibilities of monitoring staff: Staff will count the number of plants and measure the diameter at breast height. For this, they will use a measuring tape, and a measuring stick to

ensure accurate repeated measures of the breast height and data sheets on which the data can be recorded.

Because of the long-term objective of the monitoring plan, data archiving is essential. Field measurement data will be recorded on field sheets, while original data sheets are archived as well as scanned and saved electronically, field data will be entered in an electronic database. All original field data sheets, GIS data layers, reports of analyses and supporting spreadsheets will be stored in both hard copy and digital form for at least 2 years beyond the project crediting period.

- The methods for measuring, recording, storing, aggregating, collating and reporting data and parameters. Where relevant, include the procedures for calibrating monitoring equipment.
- The organizational structure, responsibilities and competencies of the personnel that will be carrying out monitoring activities.
- The policies for oversight and accountability of monitoring activities.
- The procedures for internal auditing and QA/QC.
- The procedures for handling non-conformances with the validated monitoring plan.
- Any sampling approaches used, including target precision levels, sample sizes, sample site locations, stratification, frequency of measurement and QA/QC procedures.

Estimates of carbon stock changes in living biomass of planted trees.

Above-ground biomass shall be estimated through the following steps:

Step 1: Measuring the diameter at breast height (DBH) at 1.36 meters above ground and height of all the trees contained in 20m x 20m area of each of 244 permanent sample plots spread across the entire project area.

Step 2: Estimating the volume of the commercial component of trees based on a locally derived equation, expressed as volume per unit area, m3/ha

The volume of each tree measured is calculated using the volume equation below and multiplied by the number of trees per hectare in the PSPs which gives the volume per unit area, m3/ha:

The calculation for plantation using volumetric equations-

$V = \pi/4 \times dm^2 \times h$[11]

The Huber's volumetric equation was used as per the tool and taken into consideration because of the best fit to the geographical area and a Guide to Monitoring Carbon Storage in Forestry and Agroforestry Projects. The project also includes the mixed agroforestry species to estimate the biomass.

However, in volume calculation trees having DBH < 2 are not considered in the project removal conservatively for being very small in values

Step 3: Choosing BEF, root-shoot ratio, wood density and other parameters. The wood density has been taken from the wood density database[12].

Step 4: Converting the volume of the commercial component of trees into carbon stock in aboveground biomass via basic wood density, BEF root-shoot ratio and carbon fraction, given by:

AGB tree= V * Dj * BEF * CF

Where-	
AGB tree	Carbon stock in above-ground biomass of tree l of species j in plot sp in stratum i at time t; t C tree-1
V	Stem volume of tree l of species j in plot sp in stratum i at time t; m3 tree-1
BEF	Basic wood density of species j; t d.m. m−3 Biomass expansion factor for conversion of stem biomass to above-ground tree biomass for species j; dimensionless
Carbon fraction	Carbon fraction of biomass for tree species j; t C t-1 d.m. (IPCC default value = 0.5 t C t-1 d.m.)
N	The sequence number of trees on the plot
S	1, 2, 3, … MPS strata in the project scenario
Species	1, 2, 3, … SPS tree species in the project scenario
Year	1, 2, 3, … t* years elapsed since the start of the project activity

[11]Huber's volumetric equation- Coelho, J.; Fidalgo, B.; Crisóstomo, M.M.; Salas-González, R.; Coimbra, A.P.; Mendes, M. Non-Destructive Fast Estimation of Tree Stem Height and Volume Using Image Processing. Symmetry 2021, 13,374. https://doi.org/10.3390/sym13030374

[12] http://db.worldagroforestry.org/wd#:~:text=ICRAF%20Database%20%2D%20Wood%20Density&text=Wood%20density%2C%20or%20the%20dry,%2Bc%20%2C%20Ketterings%20et%20al.

Step 5: Converting the volume of the commercial component of trees into carbon stock in belowground biomass via basic wood density, BEF root-shoot ratio and carbon fraction, given by:

BGB= AGB* Rj

Where:

BGB	Carbon stock in below-ground biomass of tree l of species j in plot sp. in stratum i at time t; t C tree-1
AGB	Carbon stock in above-ground biomass of tree l of species j in plot sp. in stratum i at time t; t C tree-1
R/S Tree	Root-shoot ratio appropriate for biomass stock, for species j; dimensionless

Step 6: Calculate carbon stock in above-ground and below-ground biomass of all trees present in plot sp in stratum i at time t.

Step7: Shrub biomass has been calculated as Per Tool 14 of the AR CDM.

Parameter	Value	Ref
CFs	0.47	CDM tool 14
Rs	0.40	CDM tool 14

6 ACHIEVED GHG EMISSION REDUCTIONS AND REMOVALS

6.1 Data and Parameters Monitored

Refer to the Section 5.2.

6.2 Baseline Emissions

For method used refer to the section 4.1. Data monitored will be provided during the verification.

6.3 Project Emissions

For method used *refer to the section 4.2.* Data monitored will be provided during the verification.

6.4 Leakage

Refer to the section 4.3.

6.5 Net GHG Emission Reductions and Removals

To be provided during the verification:

Year	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)
Year A				
Year…				
Total				

For AFOLU projects, include quantification of the net change in carbon stocks. Also, state the non-permanence risk rating (as determined in the AFOLU non-permanence risk report) and calculate the total number of buffer credits that need to be deposited into the AFOLU pooled buffer account. Attach the non-permanence risk report as either an appendix or a separate document.

For AFOLU projects, use the following table:

Year	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)	Buffer pool allocation	VCUs eligible for Issuance
Year A						
Year…						
Total						

APPENDIX X: <TITLE OF APPENDIX>

Use appendices for supporting information. Delete this appendix (title and instructions) where no appendix is required.