



Verified Carbon Standard

PROJECT REIGNITE: TURNING FARM WASTE TO CLIMATE ACTION



Together for Restoration

Project title	Project Reignite: Turning Farm Waste to Climate Action
Project ID	VCS4679
Crediting period	16-Oct-2023 to 30-Jun-2024
Original date of issue	31-October-2025
Most recent date of issue	04-February-2026
Version	1.5
VCS Standard Version	4.7
Prepared by	Together for Restoration

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1 PROJECT DETAILS

1.1 Summary Description of the Project

The rising volume of agricultural waste biomass, intensified by growing population, is mounting to a challenging environmental crisis. In India, farmers practice traditional methods of waste disposal: open field burning and decomposition of biomass. Open field burning boosts carbon dioxide (CO₂) emissions and decomposition of waste biomass results in methane (CH₄) production, magnifying environmental impacts locally and globally. These improper agricultural waste management practices exacerbate climate change and pollute air, water, and soil. This underscores the inevitability of robust biomass waste management strategies in the Indian agricultural sector.

However, this disregarded agricultural waste is a promising opportunity. Properly harnessed, it holds the untapped potential of transforming into a powerful carbon sink. Project Reignite provides a pragmatic solution, empowering smallholder farmers to transform their agricultural waste into biochar for soil enrichment – a tangible step towards climate action. First, by stopping open field burning and preventing decomposition of biomass, we significantly reduce GHG emissions. Next, as biomass captures atmospheric carbon, which, when converted to biochar and applied to soil, gets stored underground for centuries, even millennia, providing long-term GHG sequestration. Lastly, applying biochar enhances soil fertility, promoting better crop growth and further boosting carbon capture. In essence, the project delivers more than just effective biomass waste management—it fosters improved agriculture while benefiting the environment and local communities.

In Project Reignite, farmers use the flame curtain pyrolysis method in steel-shield soil pits to process agricultural waste into biochar. The fire on top creates a 'flame curtain' that limits oxygen access to the biomass below. This initiates the pyrolysis process, producing high-quality biochar. Once the pit is full, the fire is extinguished using water, nutrient solutions, or soil. The dried biochar is then mixed with manure and applied deep into the soil (more than 10 cm subsurface).

Project Reignite aims to uplift the lives of small and marginalized communities, particularly women, in India. Open field burning and overreliance on chemical fertilizers has degraded the soil and local water bodies, diminishing agricultural productivity and jeopardizing community health. By introducing biochar to the soil, Project Reignite transforms farms into high-carbon landscapes, increasing agricultural yield, ensuring food security, improving community health, and increasing income for the communities.

This is a grouped project in India. The first instance of the grouped project is being implemented with 5,000 farmers (defined as biochar producers in the project) in the state of Odisha, India.

The project has a crediting period of 7 years, renewable twice. The first instance of this grouped project is expected to remove an estimated 110,760 tCO₂e annually, leading to the removal of estimated 775,320 tCO₂e over the first crediting period of 7 years.

1.2 Audit History

Audit type	Period	Program	Validation/verification body name	Number of years
<i>Validation</i>	16-October-2023 – 15-October-2030	VCS v4.4	RINA Services S.p.A	7
<i>Verification</i>	16-Oct-2023 - 30-Jun-2024	VCS Standard v4.7	RINA Services S.p.A	<1

1.3 Sectoral Scope and Project Type

Sectoral scope¹	Waste Handling and Disposal (Scope number 13)
Project activity type	Production of biochar and utilization in the soil

1.4 Project Eligibility

1.4.1 General eligibility

The grouped project and its project activities are eligible under the scope of the VCS Program because of the following reasons:

1. The project activity mitigates CO₂ and CH₄ emissions by avoiding open field burning and biomass decomposition. It removes carbon through biochar production and soil application. These actions address CO₂ and CH₄, which come under the seven greenhouse gases outlined in the Kyoto Protocol.
2. Project activity is supported by the VCS methodology VM0044 V1.2 (Methodology for Biochar Utilization in Soil and Non-Soil Applications)
3. The program activity does not come under the excluded project activities in VCS Program as mentioned in Table 1, page 2,3 of the VCS Standard V4.4.

1.5 Project Design

- Single location or installation
- Multiple locations or project activity instances (but not a grouped project)
- Grouped project*

1.5.1 Grouped project design

New project activity instances will be added in the future.

Eligibility Criteria

Table 1: New Project Activity Instance Eligibility Criteria

S. No.	Criteria provided in Standard	Evaluation Condition for new instances	Applicability to the current instances
1.	Meet the applicability conditions set out in the methodology applied to the project.	Each new project activity instance must meet the applicability conditions set out in the Methodology VM0044 v1.2.	This project activity instance is compliant with the applicability conditions as explained in Section 3.2.
2.	Use the technologies or measures specified in the project description.	Each new project activity instance must involve conversion of waste biomass to biochar and its utilization in soil application. For all new project instances to be added in the future, the same technology would be used, i.e. the process of biochar production by soil pit pyrolysis technique, using steel shield	This project activity instance is compliant with the measures specified as the activity is conversion of waste biomass to biochar for soil application.
3.	Apply the technologies or measures in the same manner as specified in the project description.	Each new project activity instance must use low technology pyrolysis.	This project activity instance uses flame curtain pyrolysis technology in steel-shield soil pit.
4.	Are subject to the baseline scenario determined in the project description for the specified project activity and geographic area.	The baseline scenario for each new project activity instance must be open field burning or decomposition of waste biomass. The geographical area of the	The baseline scenario of this project activity instance is open field burning and decomposition of waste biomass as described in Section 3.14. The

		new instance must be within India.	geographical area of this instance is within India as demonstrated in Section 1.12.
5.	Have characteristics with respect to additionality that are consistent with the initial instances for the specified project activity and geographic area.	Each new project activity is required to demonstrate additionality characteristics that are in line with the first instance of the project activity.	The project activity demonstrates regulatory surplus. The project activity, processing of waste biomass to biochar, is the basis for a positive list in the methodology VM 0044 V1.2 and this project activity instance meets all the applicability conditions as described in Section 3.2 of the methodology. Thus, the project is deemed as additional as further described in Section 3.5.

Table 2: Inclusion of New Project Activity Instance

S. No.	Criteria	Evaluation	Applicability to the current instance
1.	Occur within one of the designated geographic areas specified in the project description.	Each project activity instance must be in the geographic boundary of India.	This project activity instance is in the state of Odisha, which comes under the geographic boundary of India.
2.	Conform with at least one complete set of eligibility criteria for the inclusion of new project activity instances. Partial conformance with multiple sets of eligibility criteria is insufficient.	Each new project activity instance must comply with the complete set of eligibility criteria as established in this document.	This project activity instance complies with the eligibility criteria established for new project activity instances.

3.	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.	Each new project activity instance must be included in the monitoring report with sufficient technical, geographic, and other relevant information to demonstrate conformance with the eligibility criteria and provide evidence to the VVB.	This project activity instance outlines a monitoring plan described in Section 5 and will be included in the monitoring report with all relevant information to demonstrate conformance with the eligibility criteria to enable evidence gathering by the VVB.
4.	Be included in the updated project description, with updated project location information (as set out in Section 3.11), which shall be validated at the time of verification against the applicable set of eligibility criteria.	The project description document (including the project location information in Section 3.11) must be updated each time a project activity instance is added.	This project description document includes this project activity instance. The geographic boundary of this instance is included in Section 3.11.
5.	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).	Each new project activity instance must demonstrate ownership by the project proponent from the prospective start date.	This project activity instance is owned and operated by SRCNatura Sure Pvt. Ltd. as mentioned in Section 1.7.
6.	Have a start date that is the same as or later than the grouped project start date.	Each new project activity instance must have a start date that is the same or later than the grouped project start date, which is 16 th October 2023.	This project activity instance's start date is 16 th October 2023, which is the same as the grouped project's start date because it is the first instance.

7.	Be eligible for crediting from the start date of the project activity instance throughout to the end of the project crediting period (only).	Each new project activity instance must be eligible for crediting from the start date of the project activity instance throughout to the end of the project crediting period.	This project activity instance is eligible for crediting from 16 th October 2023 to the end of the first crediting period, which is 15 th October 2030.
8.	Only eligible for crediting from the start of the verification period in which they were added to the grouped project.	Each new project activity instance is only eligible for crediting from the start of the verification period in which they were added to the grouped project.	The crediting period for this project activity instance begins on 16 th October 2023.
9.	Not be or have been enrolled in another VCS project.	Each new project activity instance must not be or have been enrolled in another VCS project.	This project activity instance has not been and will not be enrolled in another VCS project.
10.	Adhere to the clustering and capacity limit requirements for multiple project activity instances set out in 3.6.8 – 3.6.9.	Each new project activity instance must adhere to the clustering and capacity limit requirements.	There are no project instances within 10kms of this project activity instance. Project activity does not involve any capacity limits. Therefore, this condition is met.

1.6 Project Proponent

Organization name	SRCNatura Sure Pvt. Ltd.
Contact person	Mr. Rajesh Aggarwal
Title	Director
Address	Plot No. 200, Sector 56, Phase V, Kundli, Sonipat, Haryana, India-131028
Telephone	+91 9582433509

Email	team@togetherforrestoration.org
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1.7 Other Entities Involved in the Project

No other entity is involved in the project. Hence, this section is not applicable.

1.8 Ownership

SRCNatura Sure Pvt. Ltd. is the owner of the group project and responsible for management of the project. All VCS credits issued under the group project will be the legal property of SRCNatura Sure Pvt. Ltd. SRCNatura Sure Pvt. Ltd. has agreements with every farmer to demonstrate its legal ownership of the project.

1.9 Project Start Date

Project start date	16 th October 2023
Justification	Date of first batch of biochar production and application under this grouped project activity

1.10 Project Crediting Period

Crediting period	<input checked="" type="checkbox"/> Seven years, twice renewable <input type="checkbox"/> Ten years, fixed <input type="checkbox"/> Other (state the selected crediting period and justify how it conforms with the VCS Program requirements)
Start and end date of first or fixed crediting period	6 October 2023 and ends on 15 October 2030

1.11 Project Scale and Estimated GHG Emission Reductions or Removals

- < 300,000 tCO₂e/year (project)
- ≥ 300,000 tCO₂e/year (large project)

Calendar year of crediting period	Estimated GHG emission reductions or removals (tCO ₂ e)
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Year 2023 (16 th October- 31 st December)	23,366
Year 2024	110,760
Year 2025	110,760
Year 2026	110,760
Year 2027	110,760
Year 2028	110,760
Year 2029	110,760
Year 2030 (1 st January to 15 th October)	87,394
Total estimated ERRs during the first or fixed crediting period	775,320
Total number of years	7
Average annual ERRs	110,760

1.12 Description of the Project Activity

Project Reignite (grouped project) aims to transition farmers from traditional practices of uncontrolled combustion and biomass decomposition to the production and soil application of biochar in their farms. By introducing farm-level, low-technology pyrolysis method, the project proponent ensures net GHG removals through the following steps:

- 1 Agricultural waste biomass is sustainably collected and air/sun dried within the farm.
- 2 The biomass undergoes careful pyrolysis in a steel-shield soil pit located in the farm.
- 3 The resulting biochar is dried, mixed with manure, and applied to 10cm soil subsurface.

Biochar Producers

A biochar producer in Project Reignite refers to the farmer who works under the project proponent's supervision. They collect feedstock from their own/ family's/ neighbours' farms, manually produce biochar using a steel-shield soil pit located in their farm, and then apply the produced biochar to the farmland where waste biomass originated. The biochar produced is for their own/family's/ neighbours' captive consumption. The initial project instance involves 5000 farmers. Over time, the project will expand with more such instances added.

Pyrolysis Equipment

In project Reignite, the pyrolysis equipment used for biochar production is a steel-shield soil pit. Here, biochar is crafted manually from farm residues in a non-mechanized yet precise manner, ensuring its high quality. Each biochar producer hosts one such facility in their farm, which they maintain. The steel-shield soil pit is expected to last for an average of three years. The only equipment used in the project is “steel shields” as per the design shown in the diagram at section 3.3. The project uses only passive equipment; no active equipment such as with moving parts or mechanisms is used by the project. Therefore, other considerations such as equipment lifetime, capacity, efficiency that would normally apply in the case of active equipment, are not relevant to the project.

Pyrolysis Technology

The project uses flame curtain pyrolysis technology.

Procedure

Production of Biochar:

“The principle of the flame curtain pyrolysis consists of pyrolyzing biomass layer by layer in the [steel-shield soil pit]. A fire is started in the kiln, and the burning embers spread to form a first layer on the bottom of the kiln. A thin layer of biomass is then added on top of the embers, heats quickly and starts outgassing. The rising pyrolysis gas is caught in the flames and reacts with combustion air entering the kiln from the top. When ash appears on the outside of the carbonizing biomass, the next layer of biomass is homogeneously spread on top. Convective and radiant energy from the flames above and from the hot pyrolyzing layers below heat the fresh biomass layer, which starts to pyrolyze. The biochar below the upper pyrolysis layer is shielded from oxygen access by the fire curtain itself. The combustion zone thus forms a flame curtain that protects the underlying biochar from oxidizing and cleanly burns all pyrolysis smoke and gases as they pass through this hot fire front. ... The manual layering of biomass is repeated until the [steel-shield soil pit] is filled. The pyrolysis process is then actively ended by quenching with water or a nutrient solution (e.g., urine, dissolved fertilizer) or, where water is not easily available, by snuffing with a layer of soil” (Cornelissen et al., 2016).²¹

Application of Biochar:

Once the biochar has sufficiently cooled, it is carefully extracted from the steel shield soil pit. The biochar undergoes a sun/air drying phase, is quantitatively assessed, and then applied to the farmland. Specifically, it's mixed with manure and embedded at depths exceeding 10 cm beneath the soil's surface. This meticulous application enhances the soil fertility and bolsters the farm's adaptive capacity against the unprecedented fluctuations of climate change.

²¹ Available at <https://doi.org/10.1371/journal.pone.0154617>

Project Measures Employed

- Training

Theoretical Knowledge: The Project Reignite training program has been carefully crafted to offer an in-depth understanding of biochar production technology and the overall process. The biochar producers engage in an extensive theoretical session that covers the principles of flame curtain pyrolysis, procedures for quality control, safety protocols, and maintenance of pyrolysis equipment.

Practical Demonstrations: Beyond theoretical knowledge, live, hands-on demonstrations are conducted, enabling biochar producers to learn directly from experienced field officers. This practical approach ensures that all biochar producers gain the necessary skills to conduct the project activity.

Exceptional case handling: The third component in training is exceptional case handling. All farmers are shown how to handle cases that do not go as planned for example poor fire, sudden change in weather, emergencies etc.

- Testing

Following the completion of the training program, biochar producers undergo a rigorous field test. Under the supervision of the field officers, they must successfully produce high-quality biochar that fulfils the project criteria. Only those who demonstrate competence and meet the necessary quality standards are approved and enrolled in the project, ensuring a consistent and high level of expertise across all biochar producers.

- Monitoring and Auditing

Project Reignite has set up a monitoring team structure which comprises of field officers, managers, and a general manager. Field officers regularly visit farms, collect data, verify production and application, and supervise the work of farmers. Managers conduct regular field audits, oversee the work of field officers, and provide support where needed. The general manager coordinates at various levels to ensure compliance of the project activity and monitoring requirements. The monitoring plan is further described in Section 5.

1.13 Project Location

The location of Project Reignite (grouped project) is India. The geographical boundary for projects located in India is delineated in the form of extreme geographic coordinates of India as:

Latitude - 8°4' to 37°6' N, Longitude - 68°7' to 97°25' E

The first project activity instance is in the state of Odisha, India. The state of Odisha extends from 17.31N latitude to 22.31N latitude and from 81.31E longitude to 87.29E longitude.

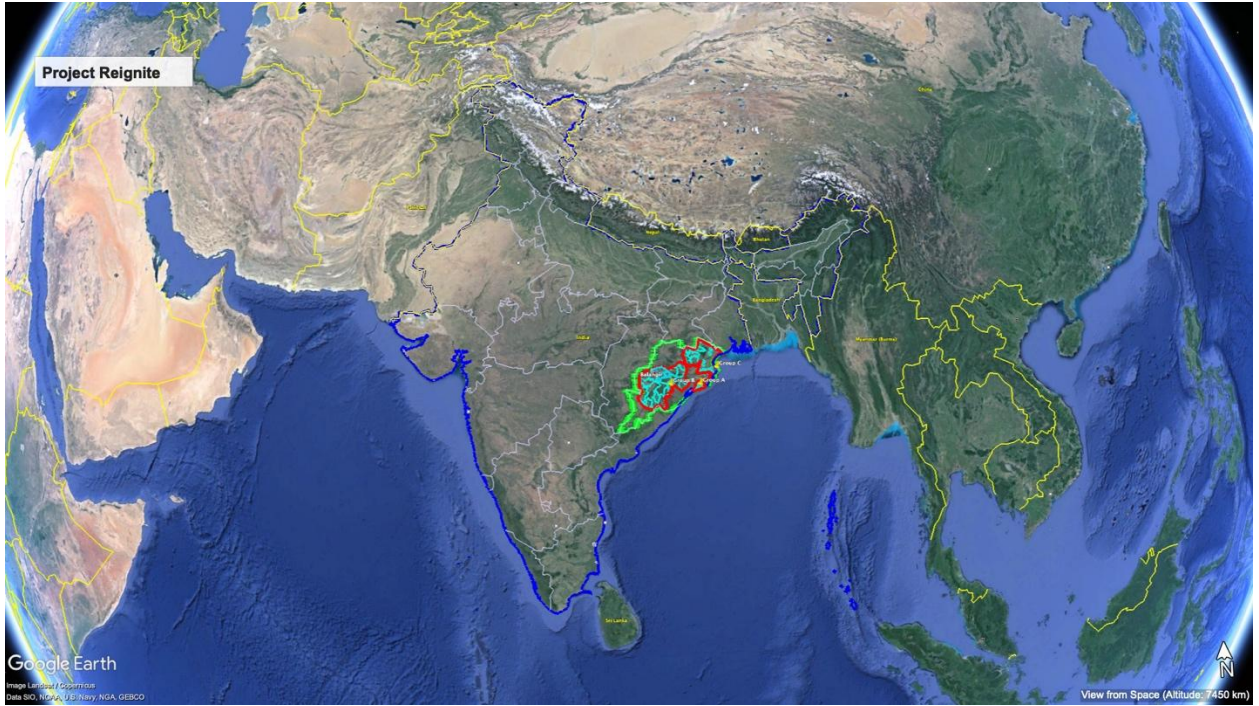
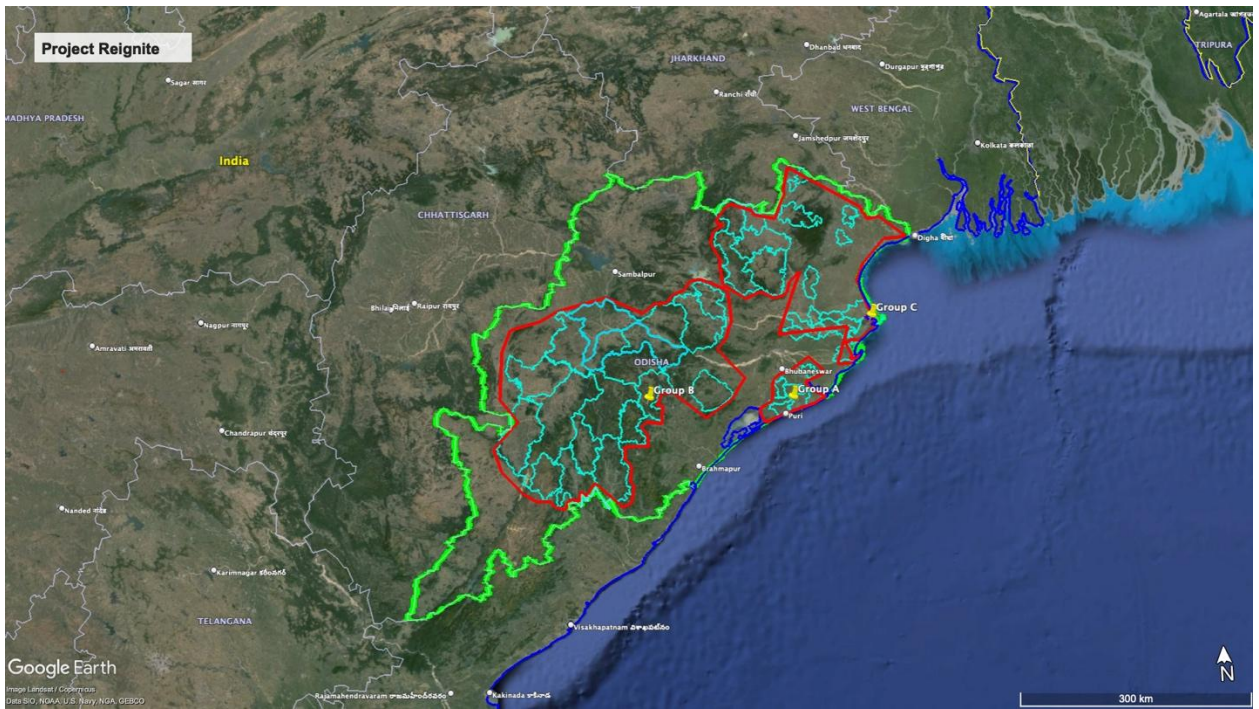
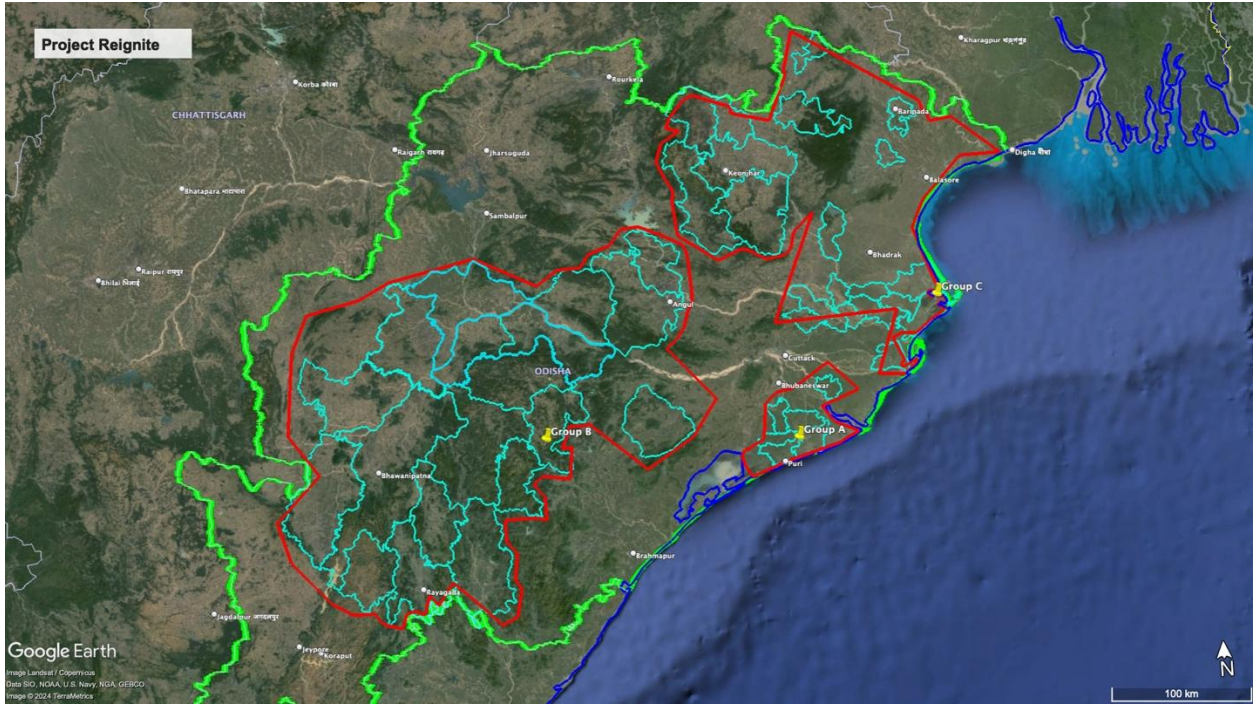


Figure. 2. Map outlining Project Reignite's location.



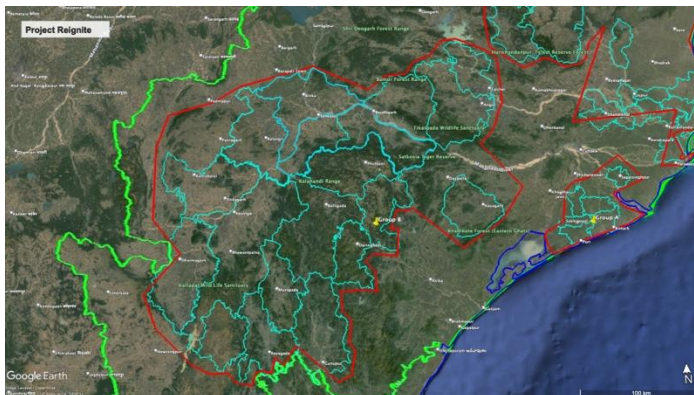
State of Odisha marked in Green



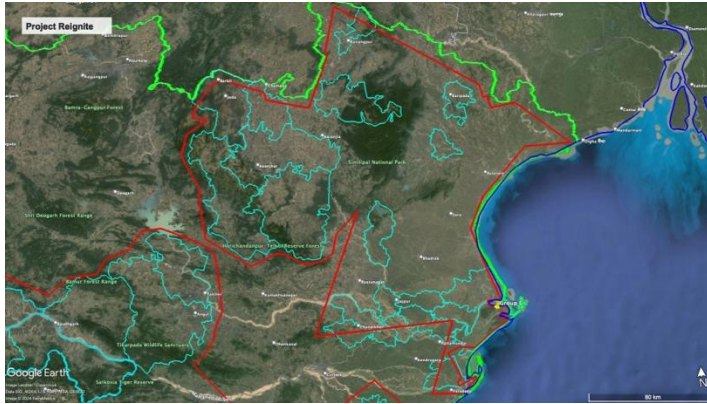
Groups A, B, and C of farmers in the state of Odisha



Group A



Group B



Group C

1.14 Conditions Prior to Project Initiation

The baseline scenario is the same as the conditions existing prior to the project initiation. Please refer to Section 3.4 for further details.

1.15 Compliance with Laws, Statutes and Other Regulatory Frameworks

There are no laws, statutes, or other regulatory frameworks that prevent the implementation of activities mentioned in the project. Currently, there are no enforced biochar production and soil application laws in place in the state of Odisha in India by the central or state governments. In addition, the Central Pollution Control Board of India (CPCB) and State Pollution Control Board of Odisha (OSCPB) websites³² suggest that there are currently no regulatory requirements that prevent the project activity. The project does not deal with any type of waste which is regulated in India.

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

If yes, provide required evidence of no double issuance as outlined by the VCS Standard.

1.16.2 Registration in Other GHG Programs

³² Available at <https://cpcb.nic.in/> and <https://ospcb.org/>

Has the project registered under any other GHG programs?

Yes No

If yes, provide the registration number and the date of project inactivity under the other GHG program.

Is the project active under the other program?

Yes No

Project proponents, or their authorized representative, must attest that the project is no longer active in the other GHG program in the Registration Representation.

1.16.3 Projects Rejected by Other GHG Programs

Has the project been rejected by any other GHG programs?

Yes No

If yes, provide the program name(s), reason(s) and date for the rejection, justification of eligibility under the VCS Program, and any other relevant information.

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? See the *VCS Program Definitions* for definitions of emissions trading program and binding emission limit.

Yes No

If yes, provide all required evidence of no double claiming as outlined by the VCS Standard.

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? See the *VCS Program Definitions* for definition of GHG-related environmental credit system.

Yes No

If yes, provide all required evidence of no double claiming as outlined by the VCS Standard.

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

If yes:

Is the project proponent(s) or authorized representative a buyer or seller of the product(s) (goods or services) that are part of a supply chain?

Yes No

If yes:

Has the project proponent(s) or authorized representative posted a public statement on their website saying, “Carbon credits may be issued through Verified Carbon Standard project [project ID] for the greenhouse gas emission reductions or removals associated with [project proponent or authorized representative organization name(s)] [name of product(s) whose emissions footprint is changed by the project activities].”

Yes No

1.18 Sustainable Development Contributions

Project Reignite has many benefits and contributes towards UN’s sustainable development goals through environmental, social, economic, and health wellbeing in the following ways:

Table 3: Sustainable Development Goals

SDG Goal Number and Title	Applicability
1. No Poverty	This project involves small stakeholder farmers who are solely dependent on agriculture for income. Project Reignite increases the income stream of farmers by increasing the productivity of their lands and thus reducing poverty. In addition, the project creates employment opportunities for field officers and other indirect jobs created by the farmers for production of biochar.
2. Zero Hunger	The use of biochar in soil improves soil fertility, thereby increasing crop yields. With increasing quality of soil, farmers can produce more food, helping combat local and global food insecurity.
3. Good Health and Wellbeing	Open field burning of agricultural waste contributes to air pollution, which has significant implications on respiratory health of local

	<p>communities and nearby areas. By transitioning farmers to biochar production, Project Reignite will help reduce the incidence of respiratory health issues in communities. Additionally, healthier soils can produce more nutritious crops, contributing to better overall community health.</p>
5. Gender Equality	<p>Women in rural India face the problem of disguised employment. Project Reignite focuses on women empowerment by enabling women of the household to be biochar producers and field officers. By generating work opportunities for women and promoting gender equality, the project will empower women and provide them with financial independence and decision-making power.</p>
6. Clean Water and Sanitation	<p>Community water bodies have been contaminated due to excessive use of chemical fertilizers in the past. Application of biochar to soil reduces the need of chemical fertilizers for agriculture. Biochar's properties of enhancing soil's water-holding capacity reduce the need for irrigation, conserving freshwater resources. In addition, biochar absorbs pollutants, mitigating groundwater contamination and enhancing overall sanitation of the community.</p>
8. Decent Work and Economic Growth	<p>Project Reignite enhances working conditions by shifting farmers from harmful open field burning to safer biochar production. This change increases their income stream. Higher incomes lead to increased purchasing power, stimulating local economic growth. The project also generates new job opportunities, contributing to inclusive long-term economic growth and decent work for all.</p>
10. Reduced Inequalities	<p>Project Reignite addresses this goal by selecting farmers from lowest socio-economic status and highest risk to the effects of climate change for the project activity to increase their income through biochar production and utilization, thereby fostering economic inclusivity. The project does not segregate or discriminate stakeholders on the basis of religion, caste, gender etc.</p>

<p>11. Sustainable Cities and Communities</p>	<p>Project Reignite enables farmers to manage agricultural waste innovatively and sustainably, reducing potential health risks and promoting cleaner, safer rural communities. Additionally, biochar application aids in sustainable land management, supporting the health of surrounding ecosystems, thereby contributing to sustainability of local communities.</p>
<p>12. Responsible Consumption and Production</p>	<p>Project Reignite operates under the principles of a circular economy, converting what was traditionally considered a liability - agricultural waste - into a productive asset. By converting residual biomass from one harvest into biochar, we are enhancing both the yield and quality of subsequent crops. This innovative approach not only minimizes waste generation but also actively contributes to environmental preservation. It embodies a sustainable model of production and consumption, ensuring the efficient utilization of resources while minimizing ecological impacts.</p>
<p>13. Climate Action</p>	<p>Project Reignite actively addresses climate change by promoting the transformation of biomass into biochar, a process that sequesters atmospheric carbon and stores it in a stable form. This process not only serves as a significant carbon sink but also mitigates climate change directly. Furthermore, by ensuring the discontinuation of open field burning and biomass decay- practices known to emit substantial amounts of greenhouse gases – Project Reignite's approach offers a dual mechanism for reducing GHG emissions and actively sequestering carbon.</p>
<p>15. Life on Land</p>	<p>Biochar application to soil contributes to sustainable land management by enhancing soil health, reducing soil erosion, improving water retention, and mitigating land degradation. It builds resilience of ecosystems to disturbances, thus aligning with the preservation of terrestrial ecosystems under SDG 15.</p>
<p>17. Partnerships for the Goals</p>	<p>Project Reignite encourages multi-stakeholder engagement and partnerships between farmers</p>

	<p>and investors/buyers of carbon offsets. This broad cooperation aligns with SDG 17, demonstrating that complex sustainability issues require integrated solutions across different sectors and levels of society. This successfully builds a constructive bridge necessary for the engagement between local communities and investors/ buyers to promote environmental sustainability and socio-economic development.</p>
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1.19 Additional Information Relevant to the Project

1.19.1 Leakage Management

There are no leakage emissions applicable to the project as there is no transportation involved in any stage of the biochar lifecycle from sourcing of biomass to application of biochar in the project.

1.19.2 Commercially Sensitive Information

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

1.19.3 Further Information

There are no further relevant legislative, technical, economic, sectoral, social, environmental, geographic, site-specific and/or temporal information that may have a bearing on the eligibility of the project, the net GHG emission reductions or removals, or the quantification of the project's net GHG emission reductions or removals.

2 SAFEGUARDS AND STAKEHOLDER ENGAGEMENT

2.1 Stakeholder Engagement and Consultation

Our stakeholder engagement strategy for Project Reignite, focused on smallholder farmers in India, was carefully planned and executed to ensure every voice was acknowledged and all concerns were addressed. This approach, refined with continuous improvement, will serve as the benchmark for future instances of the project. The process was carried out in the following stages:

2.1.1 Stakeholder Identification

Stakeholder Identification	<p>First, districts for the project were identified. The criteria for identification was based on local community needs and their susceptibility to the effects of climate change. A similar criterion was used to identify the gram panchayats to be included. To involve the communities, we held information sessions and consultations at the gram panchayat level. These meetings took place in local schools or shelters. Every household within the gram panchayat was considered a local stakeholder.</p>
Legal or customary tenure/access rights	<p>Participating stakeholders retain full legal and customary ownership of their lands. The project does not involve land acquisition, land-use change, or restriction of access to land or resources. Biochar is produced from agricultural residues generated on participating farms and applied on the same land. No collective or conflicting tenure rights were identified.</p>
Stakeholder diversity and changes over time	<p>Stakeholders include smallholder farmers with varying land sizes, income levels, and farming practices, reflecting the social and economic diversity of rural Odisha. Women are included as participants, biochar producers and field officers. Stakeholder composition is expected to remain stable over time, with no anticipated changes in group structure or representation.</p>
Expected changes in well-being	<p>Relative to the baseline scenario, stakeholders are expected to experience improved well-being through reduced exposure to air pollution from open-field burning, improved soil fertility and water retention, reduced dependence on chemical fertilizers, increased crop productivity, and additional income opportunities from biochar-related activities.</p>
Location of stakeholders	<p>Stakeholders are located within the rural project areas of Odisha, India, corresponding to where project activities are implemented. No impacts are expected outside the project area.</p>
Location of resources	<p>Agricultural land, biomass residues, and biochar production sites are located on or adjacent to participating farmers' land within the project area. Biochar is applied locally on the same farms where the biomass is sourced.</p>

2.1.2 Stakeholder Consultation and Ongoing Communication

<p>Date of stakeholder consultation</p>	<p>15-January-2023 to 30-April-2023</p>
<p>Stakeholder engagement process</p>	<p>To involve the communities, we held information sessions and consultations at the gram panchayat level. These meetings took place in local schools or shelters. Every household within gram panchayat was considered a local stakeholder. Personal invitations were handed out to the head woman of each household, supplemented by posters in village communal spots and word-of-mouth. Invitations were sent out 2 weeks in advance to give everyone enough time to prepare. The consultation period lasted from 15th January 2023 to 30th April 2023. The sarpanch and committee members of the gram panchayats were present in all the meetings to represent the stakeholders. The meetings were conducted in the local language Odia and followed a structured format:</p> <ol style="list-style-type: none"> 1. Project Introduction: Our representative began the session by warmly welcoming the stakeholders and offering a concise overview of the project. We delved into the methodology of transforming waste biomass into biochar, emphasizing its advantages for farmland rejuvenation and potential economic benefits for the community. Additionally, we highlighted the project's capacity to foster employment opportunities, catering to both skilled and unskilled labor in the area. 2. Technical Briefing: Next, we delved into the technical specifics of the project. We detailed its environmental, social, and economic impacts, and further clarified the carbon mechanism integral to our project and its associated requirements. 3. Discussion and Q&A Session: Upon concluding our presentation, we invited stakeholders to ask questions and voice their concerns. This open forum allowed us to address any uncertainties and foster a sense of ownership among the community members. 4. Documentation: We carefully recorded all queries and feedback during these discussions. By doing so, we ensured that the concerns of stakeholders were not only

noted but also aptly addressed, reinforcing their contentment with the project's execution. Below are some of the most recurrent questions posed across the meetings, along with summaries of the responses given by our team. Please note, these questions and answers have been translated from the local language, Odia, to English:

- a) What is the difference between burning the waste directly on the farm or in soil pit?
- Practicing open field burning releases excessive amounts of carbon dioxide (CO₂) among other pollutants. Carbon dioxide (CO₂) emissions contribute to climate change while the pollutants released worsen air quality, further posing risks to the community's respiratory health. However, biomass is pyrolyzed in the soil pit and converts to biochar.
- b) What is climate change and how is it affecting us?
- Climate change refers to long-term changes and fluctuations in temperature and weather patterns, primarily characterized by a global temperature increase. This phenomenon profoundly affects rural and coastal communities. Direct consequences include altered precipitation patterns, soil quality degradation, and health challenges. Indirect effects encompass economic setbacks like loss of income and forced migrations from areas adversely impacted by climatic shifts.
- c) Will you collect the biochar we produce from us?
- No, the purpose of biochar production is to promote sustainability on your own farmland. You will be producing the biochar from your farm waste and applying it within the same farm. No one will be collecting the biochar you produce, and you will not be allowed to give the biochar to anyone else for any other use.
- d) How will the project solve the problems we are currently facing with farmlands?
- There will be a lot of benefits from producing and applying biochar and few of them are as following. First, production of biochar will enable you to sustainably dispose of agricultural waste feedstock instead of burning it, which is harmful for soil and your health. Second, biochar will reduce your reliance on chemical fertilizers,

which will further help reduce chemical toxicity of soil and nearby water bodies. Third, the organic soil matter of the soil will increase which will lead to increased yields.

e) What kinds of feedstock can be used to produce biochar?

- You are only eligible to use paddy straw, maize cobs, tree pruning, bamboo pruning, ipomoea carnea, and water hyacinth. No other feedstock is allowed for production of biochar.

f) How much biomass will be used to produce 1kg of biochar?

- On an average, 4 kg of biomass will be used to produce 1 kg of biochar.

g) How will we know how to produce biochar?

- We will be providing you with complete training and demonstrations on how to produce biochar. In addition, you will always have the support of training materials and field officers.

h) Is there any particular time of the day we have to produce biochar?

- No, there is no such fixed time when you have to produce biochar. You can produce it as per your convenience.

i) Is there any specific way biochar has to be applied to the farm?

Yes. Biochar must be dried and mixed with manure first and then applied at least 10cms below the surface of the farm.

j) How much time does it take to make biochar?

- One run of biochar production takes approximately 3 hours.

k) Do I need to pay any amount to you to join this project?

- No, you do not need to pay or invest in anything to join the project. You will be provided with the equipment, training, and support materials to join the project. In fact, the purpose of the project is to enhance your income.

l) What equipment or things do I need to join the project?

- You only require some space in your farm for the pit.

m) What impact will it have on microbes?

- Microbes have a significant role to play in soil productivity. The application of biochar will catalyze microbes to enhance mineralization of soil organic carbon.

Everyone was given an opportunity to ask questions. At the end of the information sessions, all attendees were given a handout which included brief details about the project and the names and contact numbers of local representatives in case anyone had follow-up questions and wanted additional information. Names of all attendees were recorded in an attendance register for each information session.

Sign Up Sessions

After a thorough addressal of all stakeholder queries, each farming family was identified and registered in the project. The registration process was conducted through in-person visits by our local representatives and collection of vital identification details. The sessions were conducted in the month of May 2023.

Training

Training took place in the month of June 2023. Our field officers have been thoroughly trained and tested. The field officers trained all the farmers who were signed up. The farmers were given theoretical training in their local language (Odia) which was then followed by practical demonstrations of production of biochar. After successful completion of theoretical and practical training, farmers were taught how to handle exceptional situations that arise in the field. Training took place in a central place in villages where all signed up farmers were present. In case of absence of any farmer, they were invited to the training that took place in a nearby village in the future.

Testing and Registration

After conducting all training camps, each farmer was tested in their local scenario in July 2023. Our field officers visited each trained farmer and tested them. Farmers were also deliberately put in exceptional situations by the field officer to ensure the farmer knows his/her art and produces high-quality biochar. Once the farmer qualified the training program, they were

	<p>registered in the project and classified as a biochar producer. They were given a booklet of operating guidelines.</p>
<p>Consultation outcome</p>	<p>As described above, the stakeholder consultation was concluded in a manner that provided the local stakeholders every opportunity to voice any concerns, grievances, or reservations the project. During the stakeholder consultation period from 15/01/2023 to 30/04/2023, a series of meetings were held with the local stakeholders belonging to the area of operations of the project. Local stakeholders were encouraged to ask questions to the representatives holding the meetings. The queries and feedback from the locals have been documented thoroughly and serve as evidence of what transpired at the stakeholder consultation process. Though there were a number of queries from the meetings, each of those queries was satisfactorily replied to by the ground team and the attendees were satisfied with the replies provided to their queries. There were no outstanding concerns at the end of the stakeholder consultation process that were not satisfactory. There were no requests from the local stakeholders during the consultation process to alter or modify the project design, procedures, methodology of producing biochar, or the monitoring. Therefore, the project design was informed by the local stakeholder consultations and consequently there was no need to update the VCS-PD as a consequence of the stakeholder consultation process.</p>
<p>Ongoing communication</p>	<p>This section includes processes that focus on establishing a robust system for continuous communication with local stakeholders, ensuring their concerns are acknowledged and that our project design remains responsive to their needs.</p> <p>To initiate an open line of communication, we informed all end users about the establishment of a grievance register. The purpose of this register is to collect and document any concerns or complaints related to the project. There have not been any grievances or complaints till now and will be documented in the project description in case any arise in the future.</p> <p>Our field officers play a pivotal role in this process. They carry the responsibility of collecting grievances and concerns from stakeholders during the project operation. It is their duty to ensure that these grievances are communicated effectively to the project participants for timely redressal.</p>

	<p>This grievance mechanism forms a critical component of our ongoing communication with stakeholders. All concerns received through this channel during the operation of the project are scrutinized for their relevance to the project activities. Once identified as pertinent, these concerns are addressed promptly and effectively.</p> <p>To supplement this mechanism and ensure comprehensive stakeholder engagement, we have also provided a dedicated helpline number. This helpline connects stakeholders directly to the core team of the project. It serves as an alternative medium for stakeholders to voice their concerns, ask questions, and provide feedback on the project activities.</p> <p>Our approach to ongoing communication is rooted in transparency, accessibility, and responsiveness. We believe in maintaining a two-way dialogue with our stakeholders, which informs and enhances our project design while ensuring that the community remains actively involved and invested in the project's success.</p>
<p>Stakeholder input</p>	<p>All stakeholder input received during consultations was documented and reviewed by the project team. As no unresolved concerns or requests for changes were identified, no updates to the project design were required</p>

2.1.3 Free Prior and Informed Consent

<p>Obtaining consent</p>	<p>We approached consent and agreement processes with utmost respect for the local communities, including Indigenous Peoples (IPs), Local Communities (LCs), and customary rights holders. To ensure transparency and mutual agreement, we engaged in a series of community meetings and discussions. These were aimed at thoroughly explaining the project's goals, potential impacts, and benefits. We provided detailed information in accessible language and formats, considering the low-tech environment of the stakeholders. Consent was obtained through a participative approach, ensuring that all parties had the opportunity to express their views, ask questions, and suggest modifications to the project plan. Throughout the project, we have maintained open lines of communication with the communities to</p>
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	<p>monitor any potential or ongoing conflicts. To date, there have been no unresolved conflicts related to our project. We are committed to ensuring that our activities do not exacerbate existing conflicts or influence their outcomes in any way. Regular meetings and feedback sessions are held to address any concerns promptly and to adapt our approaches as necessary to maintain harmony and support the well-being of the communities involved.</p>
<p>Outcome of FPIC</p>	<p>Throughout the project, we have maintained open lines of communication with the communities to monitor any potential or ongoing conflicts. To date, there have been no unresolved conflicts related to our project. We are committed to ensuring that our activities do not exacerbate existing conflicts or influence their outcomes in any way. Regular meetings and feedback sessions are held to address any concerns promptly and to adapt our approaches as necessary to maintain harmony and support the well-being of the communities involved.</p>

2.1.4 Grievance Redress Procedure

<p>Development process</p>	<p>The grievance redress mechanism for Project Reignite was developed as a part of the project’s stakeholder engagement and monitoring framework and implemented prior to the start of biochar production in October 2023. This mechanism was designed to ensure grievances can be raised, recorded, tracked and solved in the best way. During stakeholder consultations and farmer onboarding, all participating households were informed of the grievance mechanism and the available channels for raising concerns. Field officers, village leaders, and the central project management team were assigned defined roles in receiving, documenting, escalating and solving grievances. The mechanism was integrated into routine field operations and supported by the Project Reignite digital MRV system, which enables structured documentation and internal review.</p>
<p>Grievance redress procedure</p>	<p>Stakeholders may raise grievances through multiple accessible channels:</p> <ul style="list-style-type: none"> - Via Field Officers during regular field visits. Field officers actively collect feedback from farmers and community

members. Any grievance raised verbally is documented by the field officer and communicated to project management.

- Through a grievance register to formally record complaints, concerns, or suggestions related to project activities.
- There is a dedicated helpline that stakeholders can use to contact the project team directly and raise concerns or request clarification.
- Village leadership and anonymous reporting: Stakeholders may also raise concerns through village chiefs or submit anonymous written grievances via village offices, which are then escalated to the project's general manager.

Project Reignite places a strong emphasis on the openness and availability of grievance reporting mechanisms, ensuring all stakeholders have accessible and varied means to voice concerns. We've established a culture of transparency where feedback is not only encouraged but also seen as vital for project improvement and stakeholder satisfaction. Despite the comprehensive measures in place for continuous communication and ongoing consultation, we have not yet received any grievances. Our aim is to use a proactive approach in addressing potential concerns and be committed to maintaining an open dialogue with all involved parties. We aim to create a supportive environment for grievance reporting for the well-being of the communities and the success of the project.

2.1.5 Public Comments

Comments received	Actions taken
<p>How are you manage the data on such a large scale? The tech for data collection must be explained in details in the description. Otherwise its a pointless thing.</p>	<p>We are managing the data on such a large scale using the Reignite mobile app. The mobile app has been developed and is maintained by the Together for Restoration Software Engineering team consisting of software engineers dedicated for the project. The app is private and only available to the</p>

	<p>Reignite monitoring team to monitor and report biochar production and application. The procedure for data collection is explained in the monitoring plan in the PDD. The data is stored in a Google Cloud database with a backup facility.</p>
<p>Why is this project being done in Odisha and why not any other state. How was this selection made?</p>	<p>We have been working with farmers in Odisha for years and we are introducing the project for the betterment of local communities in Odisha. It is also noted that in the state of Orissa, paddy is the principal crop. The biochar from cultivation of the paddy crop is estimated by us to be 9.5 tonnes per production facility (such as envisaged in the project) per year, on a dry weight basis. Among other crop residues, paddy has one of the highest residue yields and therefore the potential of emission removals to be claimed is high wherever paddy is the main crop. This was one of the main considerations behind the selection of the state of Orissa for planning the biochar project.</p>
<p>Has the project proponent taken permission from government bodies to burn stubble? Stubble burning is not a big issue in Odisha.</p>	<p>The project does not involve burning of stubble. In fact, the project is meant to stop stubble burning which is currently happening across India. Farmers will be producing biochar using a special technique called flame curtain pyrolysis. Biochar production does not require any government permissions as of now. We would like to point out that the widespread practice of “open burning” or “left to decay” of crop residues results in the loss of carbon absorbed during the life of the crop. By converting the biomass residue into biochar and its further soil application, the project prevents this loss from taking place.</p>
<p>Biomass claimed is very large. What is source of tracking for this biomass.</p>	<p>The source of tracking for biomass is the Reignite mobile app. Our field officers interview farmers at the beginning of each agricultural season for the estimated amounts</p>

of biomass available and expert judgment is used further to validate the estimates. Regarding the quantities of biomass residues that our project would utilize, we would like to state that the estimations of biochar yield per production facility per year have been derived on the basis of our longstanding experience in agricultural biomass waste projects as well as empirical knowledge in the field. The estimations made in Table 1.1 of the VCS PD are also supported by expert technical opinion.

2.2 Risks to Stakeholders and the Environment

2.2.1 Management Experience

The management team has been actively working with local communities since 2001, focusing on empowering them—particularly farmers—to become self-sustainable and thrive economically. Over the years, the team has developed in-depth expertise in understanding the unique needs and challenges of these communities.

The work centers on designing and implementing programs that address socio-economic development, environmental conservation, and sustainable livelihoods. The team is highly qualified and well-equipped, consisting of experts with PhDs. These experts bring a deep understanding of nature-based solutions and socio-economic dynamics within local contexts.

The team has specialized knowledge in areas such as sustainable agriculture, natural resource management, ecosystem restoration, and community-driven development. This robust expertise enables them to create impactful, tailored solutions that balance ecological sustainability with socio-economic growth.

The work of the management team is grounded in years of groundwork, applying research-based approaches to solve challenges faced by local communities.

2.2.2 Risk Assessment

	Risks identified	Mitigation or preventative measure(s) taken
Natural and human-induced risks to	No risk identified	N/A

stakeholders' wellbeing		
Risks to stakeholder participation	No risk identified	N/A
Working conditions	No risk identified	N/A
Safety of women and girls	No risk identified	N/A
Safety of minority and marginalized groups, including children	No risk identified	N/A
Pollutants (air, noise, discharges to water, generation of waste, and release of hazardous materials and chemical pesticides and fertilizers)	No risk identified	N/A

2.3 Respect for Human Rights and Equity

2.3.1 Labor and Work

	Risks identified⁴	Mitigation or preventative measure(s) taken
Discrimination	Throughout the monitoring period, there have been zero reports of discrimination or sexual harassment. A strict anti-harassment policy is in place for the project and there is zero tolerance for the same.	A strict anti-discrimination policy is enforced, with zero tolerance for such incidents. Stakeholders are educated on inclusivity, and a grievance redressal mechanism allows for the anonymous reporting and resolution of issues. Periodic monitoring ensures compliance.
Sexual harassment	Throughout the monitoring period, there have been zero reports of discrimination or sexual	The project maintains a strict anti harassment policy, with ongoing awareness campaigns and

	<p>harassment. A strict anti-harassment policy is in place for the project and there is zero tolerance for the same.</p>	<p>training for all workers and stakeholders. Anonymous complaint systems and regular audits are in place to prevent and address any incidents</p>
<p>Gender equity in labor and work</p>	<p><i>The project adheres to a policy of gender equality, offering equal pay for equal work and ensuring representation of all genders in leadership roles.</i></p>	<p>Policies are implemented to ensure equal pay for equal work, alongside a focus on fair representation in decision-making and leadership roles. Periodic reviews of gender equity are conducted, and feedback systems are available to address any disparities.</p>
<p>Forced labor</p>	<p>There is no forced labor involved. The project enforces a non-negotiable condition of work at free-will.</p>	<p>Comprehensive verification of labor contracts is conducted to ensure all work is voluntary. Regular audits, worker interviews, and oversight mechanisms are in place to detect and prevent forced labor.</p>
<p>Child labor</p>	<p>Children are not allowed to be within the vicinity of project operations. The biochar producers are enforced to not allow children in any part of the work. The ground operations team keeps that in strict check.</p>	<p>Strict enforcement ensures children are not permitted within the project premises. Monitoring teams conduct regular inspections, and producers are required to comply with policies that ban child labor. Awareness campaigns are also conducted for stakeholders.</p>
<p>Human trafficking</p>	<p>Strict verification of labor sources is conducted to ensure no involvement of human trafficking, forced labor, or child labor. Regular inspections by the monitoring team validate compliance with labor laws and ethical standards.</p>	<p>Labor sources are thoroughly vetted through background checks and documentation verification. Regular monitoring by the project team ensures compliance with anti trafficking laws. Inspections and audits reinforce adherence to ethical labor practices.</p>

2.3.2 Human Rights

Risks identified	Mitigation or preventative measure(s) taken
N/A	Project Reignite is committed to the rights of Local Communities (LCs) and customary rights holders, operating in full alignment with international human rights law, the United Nations Declaration on the Rights of Indigenous Peoples, and ILO Convention 169. We engage in regular dialogue with community leaders, ensuring our activities honor their traditions and land use practices. Our initiatives are co-designed to reflect their knowledge and consent, and we provide clear benefits directly to these communities, thus reinforcing our dedication to upholding and promoting their fundamental rights and sovereignty.

2.3.3 Indigenous Peoples and Cultural Heritage

Risks identified	Mitigation(s) or preventative measure taken
N/A	The biochar project is designed to have a neutral impact on cultural heritage. It neither involves activities that alter cultural sites nor requires changes in cultural practices. By integrating biochar production into existing agricultural practices, the project supports sustainable farming without encroaching on or modifying cultural heritage. This approach ensures that the project's activities are in harmony with the preservation and protection of local cultural traditions and landmarks.

2.3.4 Property Rights

Risks identified	Mitigation or preventative measure(s) taken
N/A	Project Reignite operates with a strict adherence to the property rights of IPs, LCs, and customary rights holders. We engage in regular

	consultations with community leaders to ensure our activities align with their land use practices and property rights. A responsive grievance mechanism is in place to immediately address any concerns related to property rights in case they arise.
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2.3.5 Benefit Sharing

Process used to design the benefit sharing plan	Consultation with the participating farmers.
Summary of the benefit sharing plan	Project Reignite incurs all costs of biochar production, its application, and monitoring.
Approval and dissemination of benefit sharing plan	The benefit sharing mechanism is in place in which farmers are paid for biochar production costs and biochar is applied in their and family farms. The approval and dissemination of benefit sharing plan happens through the agreement between the farmers and PP.

2.4 Ecosystem Health

	Risks identified	Mitigation or preventative measure(s) taken
Impacts on biodiversity and ecosystems	No risk identified	N/A
Soil degradation and soil erosion	No risk identified	N/A
Water consumption and stress	No risk identified	N/A
	No risk identified	N/A

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

Species and habitat	The biochar production under Project Reignite has no negative impact on habitats for rare, threatened, or endangered species. Instead, it has only contributed positively to the ecosystem by improving soil health, enhancing carbon sequestration, and supporting greater biodiversity.
Areas needed for habitat connectivity	N/A

	Risks identified	Mitigation or preventative measure(s) taken
Habitats for rare, threatened, and endangered species	N/A	No risk identified. The project activities are conducted in agricultural areas that do not overlap with natural habitats of rare, threatened, or endangered species. A baseline environmental assessment confirmed no impact on such habitats. Regular monitoring ensures this remains the case
Areas for habitat connectivity	N/A	No risk identified. The project does not disrupt any wildlife corridors or areas essential for habitat connectivity. Operations are confined to farmland, avoiding natural landscapes critical for species movement. Continuous environmental assessments are in place to verify this.

2.4.2 Introduction of Species

Species introduced	Classification	Justification for use	Adverse effects and mitigation
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N/A	N/A	N/A	N/A
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Existing invasive species	Mitigation measures to prevent the spread or continued existence of invasive species
Water Hyacinth	Species is being eradicated as a part of the project
Ipomoea Carnea	Species is being eradicated as a part of the project

	Risks identified	Mitigation or preventative measure(s) taken
Invasive species	N/A	N/A
Ecosystem conversion	N/A	N/A

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

Type (methodology, tool or module).	Reference ID, if applicable	Title	Version
Methodology	VM0044 Sectoral Scope 13	VM0044 Biochar Utilization in Soil and Non-Soil Applications, v1.2	Version 1.2 Published on 27 June 2025

3.2 Applicability of Methodology

The project proponent has installed new (greenfield) biochar production facilities (steel-shield soil pit) at the farm level where waste agricultural biomass will originate and biochar will be produced and applied.

The project proponent will (1) source waste biomass, (2) produce biochar and (3) ensure the biochar is utilized in soil application. The project activities meet the following conditions:

Table 5: Technological scope

S. No.	Applicability Condition	Justification of Compliance
1)	<p>The methodology is applicable when biochar is produced from eligible waste biomass through a thermochemical process such as pyrolysis, gasification, and biomass boilers and the biochar is subsequently applied to an end-use (soil or non-soil applications). Torrefaction and hydrothermal carbonization as processes of biochar production are excluded from the methodology.</p>	<p>The methodology is applicable as the biochar will be produced from eligible waste biomass (described in Table 6 below) using flame curtain pyrolysis technology and the biochar will be subsequently applied to soil as an end use. No other process of biochar production is a part of the project activity.</p>
2)	<p>The methodology is applicable to projects using either low or high technology production facilities to produce biochar, as per the definitions of each provided in Section 3 of this methodology.</p>	<p>The project activity uses low technology production facilities to produce biochar. Steel-shield soil pit complies with the definition of low-tech production facility as provided in Section 3 of the methodology.</p>
3)	<p>The biochar producers must have a health and safety program to protect workers from airborne pollutants and other hazards.</p>	<p>Biochar producers will be following a health and safety program to protect their health. The summary of the health and safety program is following:</p> <ol style="list-style-type: none"> 1. The production facility (steel-shield soil pit) will be located at a safe distance from physical structures to prevent fires. 2. The biochar producer will wear a face mask and hand gloves during production for protection. 3. The biochar producer will maintain a safe distance from the fire and should use a long stick to control the fire. 4. The biochar producer will wear non-inflammable clothing during production and will have access to safety kits in close vicinity.

Table 6: Eligible feedstocks and production

S. No.	Condition	Applicability
4 a)	Feedstock must be purely biogenic waste biomass and not purpose-grown.	Biochar producers will only be using biogenic waste biomass originating from their own/family's/neighbours' farms to produce biochar. As waste biomass is the by-product of cultivation of crops (primary activity of farmers), it will not be purpose-grown.
4 b)	Feedstock must have been otherwise left to decay or combusted for the purposes other than energy production.	<p>In the absence of the project activity, feedstock will be combusted in the open field for purposes other than energy production. Following information source has been used to demonstrate the same:</p> <p>The source of biomass is identified as the biochar producer's or their family's/neighbours' fields, and the biomass is not being used in the baseline scenario as farmers are practicing open field burning and decay of biomass. Signed attestations in line with Appendix 2 of the methodology confirm that the biomass was not used for alternative purposes but was getting burnt in open field fires and left to decay in the five years preceding the project start date. During the survey, it was found that waste agricultural biomass is left to decay in the field and burnt. As part of the survey, the farmers provided signed statements conforming that prior to the project, they were resorting to open field burning of biomass residue, or in some cases, it was left to decay. No farmer reported the use of biomass as combustion fuel for energy purpose.</p>

4 c)	Feedstock must not have been imported from other countries.	The biochar producers will only be using waste biomass from their own/family's/neighbours' farms to produce biochar. No transportation of biomass, except walking distance, will take place. Thus, feedstock will not be imported from other countries.
4 d)	Feedstock must meet the sustainability conditions provided in Table 1. This table is not an exhaustive list of waste biomass examples.	Feedstocks that will be used for biochar production in the project activity meet the sustainability conditions provided in Table 1 of the methodology and the applicability is described in Table 7 below.

Table 7: Sustainability Criteria for Feedstock

Feedstock Sourcing Category	Sustainability Criteria	Waste Biomass	Applicability
Agricultural Waste Biomass	A. Where project proponents are using agricultural waste biomass directly from fields and not from a centralized biomass-processing operation (e.g., food processing facilities), project proponents must provide documentation that the project activity is not leading to a decline in soil carbon stocks or a reduction in crop productivity, or that in the baseline agriculture waste biomass was burned without energy	Rice Straw Maize Cobs Tree Pruning Bamboo Pruning Ipomoea Carnea (Shrub)	In the baseline scenario, agricultural waste is being burnt without energy production. Currently, majority of the waste biomass is put on fire to clear the field and some of the biomass that comes out during harvesting is left to decay on corners of the farm. The baseline scenario is described in Section 3.5. Documentation as described in Table 6 Point 4b (in line with Appendix 2 of the methodology) proves that in the baseline, agriculture waste biomass was burned without energy production. Furthermore, in the project activity, biochar will be mixed with manure and applied to the same farms from which waste biomass originates, and

	<p>production (e.g., open burning or stubble)</p> <p>B. In the absence of documentation, feedstock removal is limited to no more than 50 percent of total residues to protect against soil degradation (Andrew 2006; Battaglia et al., 2020).</p>		<p>the project activity will increase soil carbon stocks over time. "... studies have indicated that the simultaneous application of biochar and compost resulted in enhanced soil fertility, water holding capacity, crop yield and C sequestration benefit" (Agegnehu et al., 2017).³ Blanco-Canqui et al.⁴ demonstrated significant increases in soil carbon concentrations 6 years after biochar application in his study, which supports using biochar applications to store carbon in soils.</p>
<p>Aquaculture Plants</p>	<p>A. Waste must be by-products of aquaculture.</p> <p>B. Project proponents must be demonstrated that waste invasive species such as water hyacinth (<i>Eichhornia crassipes</i>) were not purposely introduced in order to qualify as feedstock for biochar production.</p>	<p>Water Hyacinth (<i>Eichhornia crassipes</i>)</p>	<p>Water Hyacinth (<i>Eichhornia crassipes</i>), a pervasive invasive species, has plagued Odisha's water ecosystems for nearly a century. Historical records show that its problematic spread was already recognized in 1930, with efforts to combat its growth recorded by the Legislative Council of Bihar and Odisha (Sinha et al. 1930).⁵ Narayanan et al. (2007)⁶ further emphasize its widespread presence in India. This species, with its well-documented invasive history, was not deliberately introduced and its utilization adheres with the sustainability conditions.</p>

³ Available at <https://doi.org/10.1016/j.apsoil.2017.06.008>

⁴ Available at <https://doi.org/10.1111/gcbb.12665>

⁵ Available at <http://archives.biharvidhanmandal.in/jspui/handle/123456789/121330>

⁶ Available at https://www.researchgate.net/publication/315917487_Water_hyacinth_Eichhornia_crassipes_-_management_of_an_invasive_weed_the_Indian_scenario

Table 8: Continued Eligible Feedstocks and Production Conditions

S. No.	Condition	Applicability
5)	Biochar made from a single or mixed eligible feedstock must comply with the latest version of the IBI Biochar Testing Guidelines or the EBC Production Guidelines.	Biochar will be made from a single feedstock per batch and will comply with the conditions applicable to low-technology production facilities (steel-shield soil pit using flame curtain pyrolysis in our case) in the latest version of the EBC Production Guidelines. ⁷
6)	The waste biomass used as feedstock to produce biochar and the resulting biochar to be utilized in soil or non-soil application may be transported via ships, boats, and vehicles other than road transportation up to a distance of 200km. However, it must only be transported by vehicles (i.e., road transportation) for distances more than 200km as defined under CDM Tool 12: Project and leakage emissions from transportation and freight.	There will not be any transportation involved as the biochar will be produced and applied in the same/nearby farm from where waste biomass originated. Hence, this condition is not applicable.
7)	Mineral additives such as lime, rock minerals, and ash may comprise up to 10 percent of the mass when added. If the addition exceeds 10 percent on a dry weight basis, the biochar producer must present laboratory tests indicating that the final product meets IBI Biochar Testing Guidelines or EBC Production Guidelines thresholds for organic and inorganic contaminants.	This condition is not applicable as mineral additives will not be added in production.
8)	Other evidence that may be used to demonstrate compliance with waste biomass sustainability criterion are	No other evidence is required or used.

⁷ Available at https://www.european-biochar.org/media/doc/2/version_en_10_3.pdf

	<p>biomass certification schemes such as the Roundtable on Sustainable Biomaterials (RSB), International Sustainability and Carbon Certification (ISCC) or any other certification scheme approved and/or endorsed by a relevant legislative body or international body such as the European Union, CORSIA, and national/state governments.</p>	
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Table 9: Eligible biochar end-use application criteria

S. No.	Condition	Applicability
9)	<p>Biochar is eligible to be utilized and accounted for under the methodology if it is being utilized within one year of its production. Biochar is subject to natural decay and the permanence of biochar is calculated for a period of 100 years. To adhere to the decay factor established for 100 years and prevent any decay before application, biochar must be utilized in soil or non-soil applications within the first year of its production.</p>	<p>Biochar will be produced from the waste biomass after the agricultural season ends and crops are harvested. Biochar producers will apply biochar as production takes place. Thus, biochar will be utilized within a few weeks of its production. The monitoring plan described in Section 5.3 includes tracking of the biochar applied.</p>
10)	<p>Biochar is eligible to be used as a soil amendment on land other than wetlands. Eligible land types include cropland, grassland, vegetated urban soils, and forest. Biochar is eligible to be applied either to the soil surface or subsurface. For surface application, the biochar must be mixed with other substrates such as compost, manure or digestate from anaerobic digestion. For subsurface application, the biochar may be applied either as a unique soil amendment or mixed with other substrates. For any soil application, the biochar must:</p> <p>a) comply with biochar material standards to avoid the risk of transferring unwanted heavy metals and organic contaminants to soil. Project proponents must meet the IBI Biochar Testing</p>	<p>Biochar will be applied to the soil subsurface as a mixed soil amendment with manure (cow dung).</p> <p>a) There is no risk of transferring unwanted heavy metals and organic contaminants to soil. Farmers will be applying biochar made from biomass that originated from the same farm. Thus, there is no risk of cross contamination as the biochar will not be transported to a</p>

	<p>Guidelines or EBC Production Guidelines, or relevant national regulations for avoiding soil contamination.</p> <p>b) have a hydrogen to organic carbon molar ratio ($H:C_{org}$) of less than or equal to 0.7</p>	<p>centralised facility. The laboratory analysis report of representative biochar samples confirms that the heavy metals and contaminants content in biochar meets the EBC Production Guidelines.</p> <p>b) $H:C_{org}$ will be monitored annually as described in Section 5.2 using nationally accredited laboratory results following EBC production guidelines to ensure hydrogen to organic carbon molar ratio of less than or equal to 0.7.</p>
<p>11)</p>	<p>Biochar is eligible to be used in non-soil applications including but not limited to cement, asphalt, and any other applications where long-term storage of the biochar is possible. Only biochar produced in high technology production facilities, as defined under the methodology, is eligible to be used in non-soil applications.</p>	<p>Biochar will not be used in non-soil applications in the project. Thus, the condition is not applicable.</p>

12)	<p>Project proponents must demonstrate that biochar and/or final products are long-lived via credible evidence such as laboratory results, peer reviewed research papers or any other third party-evaluated product assessment, such as decay rate analysis, as applicable. The information provided must include the lifetime of the product in which biochar is stored long term. The resultant product must be compliant with national/international product quality standards/specifications as applicable (e.g., the American Concrete Institute Standards in the US).</p>	<p>Biochar production in Project Reignite employs flame curtain pyrolysis, which is high temperature ranging between 650 °C and 750 °C (Cornelissen et al. 2016). Such temperatures yield robust biochar with significant resistance to decay. The Intergovernmental Panel on Climate Change (IPCC) has reported that biochar produced under these conditions retain 89% of their mass after a century (IPCC, 2019).⁸ “Pyrolysis temperature influences biochar stability, with temperatures > 500 °C generally leading to longer-term half-lives (> 1000 years)” (Ippolito et al., 2020).⁹ Another notable study by Spokas (2010)¹⁰ supports the long-term stability of high-temperature biochar.</p>
13)	<p>The methodology must not be applied if biochar is used for energy purposes, burned as a fuel (e.g., as a substitute for charcoal or coke) or used in other soil or non-soil applications where biochar cannot be demonstrated to be a long-lived and persistent carbon sink.</p>	<p>Biochar will only be used for soil application and will not be used for any other purposes.</p>
14)	<p>Biochar must not be used in applications in which substantial amounts of the biochar are oxidized (e.g., burned or used as a reduction agent in steel production, processed into activated carbon, or other uses that are fossil fuel-intensive).</p>	<p>Biochar will only be used for soil application. Thus, it will not be used in application in which substantial amounts of the biochar are oxidised.</p>

⁸ Available at https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/4_Volume4/19R_V4_Ch02_Ap4_Biochar.pdf

⁹ Available at <https://doi.org/10.1007/s42773-020-00067-x>

¹⁰ Available at <https://doi.org/10.4155/cmt.10.32>

15)	Non-soil applications are ineligible under the methodology if there is a loss of more than 50 percent of the carbon measured by dry weight basis (e.g., some activated carbon, due to excessive fossil fuel input, results in a loss of more than 50 percent of the original biochar carbon material and therefore would not be eligible).	Biochar will not be used in non-soil application.
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3.3 Project Boundary

The project boundary for the grouped project is India. The project boundary for the first instance of the grouped project is Odisha. It encompasses farms that are part of the project where project activity will be taking place.

Map of the physical locations of the various installations:

5000 production sites are in Odisha. Please refer to the Project Location Section 1.12 in the document for the map. The production facilities are situated on the farms of each registered biochar producer, where all project activities are conducted.

Production Facility Diagram:

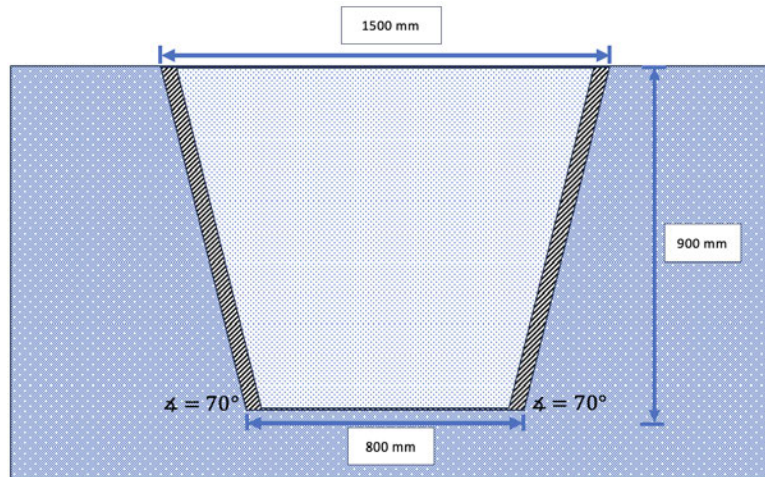


Figure 3. Diagram of Steel-shield Soil pit

Project Activity Lifecycle:

In the project activity, all three stages take place at the farm level itself. The following mass and energy flow diagram demonstrates the lifecycle of the project activity which takes place in each registered production facility site in the project.

1. Waste biomass is sustainably sourced from the biochar producer's or their family's/neighbors' farms and is sun/air dried.
2. Waste biomass is treated through the flame curtain pyrolysis process in the steel-shield soil pit located in the biochar producer's farm, biochar is produced, and sun/air dried.
3. The final application of biochar mixed with manure in soil occurs more than 10 cm subsurface in the farms from where waste biomass originated.

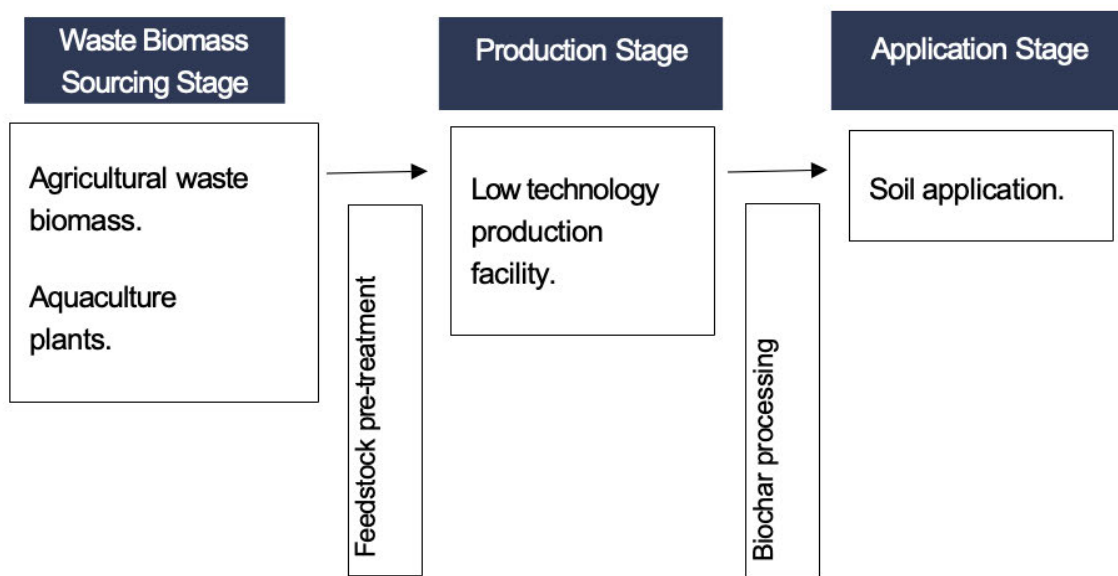


Figure 4 Project Boundary adapted from VM0044 Methodology Figure 1

The greenhouse gases included in or excluded from the project boundary are shown in the table below.

Source	Gas	Included?	Justification/Explanation	
Baseline	Feedstock Production	CO ₂	No	As per the methodology, all are excluded because waste biomass is considered renewable per eligibility conditions.
		CH ₄	No	
		N ₂ O	No	
	Feedstock Transportation	CO ₂	No	Feedstock will not be transported as production will take place at the farm level.
		CH ₄	No	
		N ₂ O	No	
	CO ₂	No		

Source		Gas	Included?	Justification/Explanation
	Combustion, aerobic, and anaerobic decomposition of feedstocks	CH ₄	No	There are CO ₂ and CH ₄ emissions from combustion of biomass or its decay in the absence of project activity. However, the methodology assumes baseline emissions to be zero (conservative assumption).
		N ₂ O	No	
Project	Feedstock production	CO ₂	No	As the project does not use purpose grown crops, there are no emissions from feedstock production. Waste biomass is considered renewable as per the methodology referring to CDM renewable biomass definition and applicability conditions.
		CH ₄	No	
		N ₂ O	No	
	Pyrolysis or thermochemical conversion (low technology systems)	CO ₂	No	As per the methodology, default methane emission value for steel-shield soil pit (low-technology production facility) are taken from published literature (Cornelissen et al. 2016).
		CH ₄	Yes	
		N ₂ O	No	
	Electricity and/or fossil fuels consumed during eligible thermochemical process	CO ₂	No	No electricity or fossil fuels are consumed during the pyrolysis process.
		CH ₄	No	
		N ₂ O	No	
	Biochar Transportation	CO ₂	No	No emissions are involved as there is no transportation of biochar in the project activity.
		CH ₄	No	
		N ₂ O	No	
	Pre-treatment of feedstocks (e.g., grinding, grinding)	CO ₂	No	No emissions are involved as no pre-treatment of feedstocks takes place.
		CH ₄	No	
		N ₂ O	No	

Source		Gas	Included?	Justification/Explanation
	Biochar application (e.g., preparation of biochar for final use)	CO2	No	No emissions take place during biochar application as it is applied manually by farmers.

3.4 Baseline Scenario

Introduction

India's agricultural landscape, abundant with crop yields, faces the prevalent challenges of open field burning and biomass decay. As a major agricultural contributor, the state of Odisha in India, where the first instance of the grouped project is being implemented, is no exception to this issue. To record this challenge, the project proponent conducted its own survey.

Empirical Investigation Summary:

Survey Design: To understand the current practices of farmers regarding agricultural waste biomass disposal, the survey consisted of closed-ended questions. The questions were clear, in local-language Odia, and unbiased.

Initial Test: To refine the questions and ensure clarity, the questionnaire was initially tested with a small group of 20 farmers. These 20 farmers were later part of the baseline survey also.

Survey: All 5000 farmers (100% of the farmers in the first project instance) were sent the survey questionnaire to which their responses were solicited.

Training of Surveyors: To ensure consistency in data collection, all surveyors were provided rigorous uniform training.

Data Collection: To collect qualitative information, informed consent was taken from participants and face-to-face data collection took place.

Data Analysis: An overwhelming majority (94%) of the farmers responded that they have been practicing open field burning with the biomass residue in their fields.

Interpretation of Results: The survey results indicate that in the baseline scenario, open field burning is the overruling practice among farmers.

3.5 Additionality

3.5.1 Regulatory Surplus

Is the project located 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

Project activities are not mandated by any national or state-level law, statute, or regulatory framework in India. While certain regulations and advisories exist to discourage open field burning of agricultural residues, there is no legal requirement for farmers or project proponents to implement biochar production or residue conversion technologies. As such, the question of systematic enforcement of mandated project activities is not applicable. The project therefore demonstrates regulatory surplus.

3.5.2 Additionality Methods

Additionality for the project is determined as follows:

Step 1: Regulatory Surplus

- a) **Absence of Government Mandate:** Currently, project proponent has not identified any laws, regulations, policies, or mandates instituted by the Government of India or Government of Odisha that necessitate the project activity (conversion of waste agricultural biomass into biochar and its subsequent application to agricultural soils.) While there exists recommendations and initiatives by government bodies, no mandatory regulation for biochar production and application is in place in the host state and country.
- b) **Project Voluntariness:** This biochar project operates entirely on a voluntary basis and participation is based on the will of the farmers. It is not compelled or prescribed by any legal instrument, statute, regulation, or decree within the host state and country.
- c) **Exclusion from International Frameworks:** Furthermore, the project is not dictated or mandated by international conventions or frameworks, including but not limited to the United Nations Framework Convention on Climate Change (UNFCCC).
- d) **Conclusion:** Given the aforementioned points, the project operates beyond existing regulatory requirements, fulfilling the criteria of regulatory surplus as formed by the standard. In addition, the project proponent will regularly assess new laws and guidelines in the future.

Step 2: Positive List

a) Activity Penetration Method

The positive list determination pivots on the concept of activity penetration, emphasizing that if biochar production doesn't exceed 5% of its potential, it's considered to be additional.

b) Establishing the Basis for Positive List

The premise for biochar additionality is rooted in its nascent stage of development. As the global biochar production from waste biomass remains underexplored, projects that contribute to this can be classified as additional if they do not push global production beyond 5% of the available waste biomass.

c) Calculation of Activity Penetration in the project

i) Expected Observed Adoption (OA_y) Post Incorporation of Project Reignite's first instance

With the estimated 2021 global biochar production standing at 773,787 metric tonnes (excluding our project), the inclusion of our annual expected production of 75,000 metric tonnes elevates it to:

$$New\ OA_y = 773,787 + 75,000 = 848,787$$

ii) Expected Activity Penetration of the first instance of Project Reignite

Using the globally recognized formula (as used in the methodology)

$$AP_y = \left(\frac{OA_y}{MAP_y} \right) \times 100$$

Where MAP_y (Maximum Adoption Potential) for the given year remains constant at 1,369,486,910 tonnes, we derive:

$$AP_y = \left(\frac{848,787}{1,369,486,910} \right) \times 100 = 0.062\%$$

$$AP_y \ll 5\%$$

This activity penetration, inclusive of our project's contribution, remains significantly below the critical 5% threshold.

d) Conclusion

Project Reignite, will contribute estimated 75,000 tons of biochar production annually, which seamlessly fits within the parameters set by the VCS Methodology Requirements. The derived activity penetration, even with the project's contribution, is 0.062%, which is well beneath the 5% benchmark.

Project Reignite not only aligns with the guidelines but also contributes meaningfully to the global push for biochar production, without tipping the balance of the positive list criteria. Thus, the project is additional in accordance with the principles established by the VCS methodology.

Step 3: Investment Analysis

Project Reignite produces biochar using flame curtain pyrolysis. This section presents the investment analysis undertaken to demonstrate that Project Reignite is not financially viable in the absence of revenues from carbon removal credits, in accordance with Verra Tool VT0008 v1.0, Section 5.4.

The evaluation is done using Option 1: Investment Comparison Analysis. Because there is no established market for biochar in India and no comparable financial alternative that generates the same product or outcome, the investment comparison approach is applied. The tool states that “Where the project activity and the alternatives do not generate any financial or economic benefits, the project proponent may apply investment comparison analysis (Option 1) without cash inflows.”

This analysis demonstrates that the project’s economic performance depends entirely on revenues from the sale of verified carbon units (VCUs).

Project Context

The project implements decentralized biochar production for smallholder farmers using flame curtain pyrolysis technology. Farmers are trained, tested, and equipped by Project Reignite team to produce biochar from crop residues that would otherwise be openly burned. There is currently no viable market for biochar as an agricultural input in India, and smallholder farmers lack both the capacity and incentive to pay for or sell biochar. Consequently, the activity generates no commercial income other than the sale of carbon removal credits.

Option 1: Investment Comparison Analysis

- a) Identify a financial indicator, such as internal rate of return (IRR), net present value (NPV), cost-benefit ratio, or levelized cost suitable for the project type and decision-making context.

The project is OPEX-based. Hence, the best financial indicator that can be used is Levelized Cost (Cost to produce and apply 1 tonne of biochar) in line with the additionality tool VT0008.

The levelized cost i.e. cost to produce and apply a tonne of biochar is Rs. ██████████ (Reference: Agreement with the FPCs (Farmer Producer Company)).

- b) Calculate the financial indicator for all alternative scenario

There are two possible scenarios in the context of biochar production with smallholder farmers in rural India. They are below:

- 1) No project activity is undertaken and the biomass residues are burned in the open field or left to decay.

This was the baseline scenario among the participating farmers and has been the age-old practice as it does not have any real cost. However, the practice is detrimental to the environment due to release of CO₂ as well as harmful pollutants, which poses a health risk.

- 2) Biochar production

The agricultural residues are recycled and pyrolyzed into biochar. The use of such biochar is soil application, especially in the context of this project i.e. Production in rural regions with limited or no road access.

The biochar produced cannot be sold because there is no market for biochar in India and the farmers near the project regions are small and marginal farmers and have no financial capacity to pay for it.

- c) Present a clear comparison of the financial indicator for all alternative scenarios and rank the alternative scenarios according to the financial indicator.

Scenario	Rank according to costs	Cost	Comparison
Open field burning/ Decay of Biomass	1	No costs incurred	There are no costs incurred if the biomass is burnt or left to rot. In this alternative scenario, no effort has to be taken and no costs are incurred; however, it has detrimental environmental and social effects because of open field burning/ decay of biomass in the baseline.
Biochar Production	2	Cost to produce is Rs. [REDACTED] / tonne of biochar	This alternative involves expenditure outgo as significant cost is incurred to produce biochar and is therefore, financially unattractive when compared to alternative 1 above.

- d) Demonstrate that the project activity would not be the most economically attractive scenario in the absence of carbon credit revenues.

As mentioned earlier, since there is no market for biochar in India and there is no willingness among farmers to pay for biochar, without the presence of carbon revenues, there are only costs for the project activity and nil financial returns. In the absence of carbon revenues, as biochar production is financially unattractive, the baseline scenario of open field burning or decay of biomass will continue. If the project produces biochar without carbon revenues, the project has no income and operates at a loss. Therefore, the activity is not financially attractive and would not proceed without external finance such as from the sale of carbon removal credits. Carbon revenues are thus the determining factor that allows the project to achieve financial viability.

In the presence of carbon revenues, INR [REDACTED] ~ USD [REDACTED] is used towards production of 1 tonne of biochar i.e. levelized cost. As the project produces approximately 110,760 carbon removal credits from 75,000 tons of biochar production and soil application (Ref. section 4.4 of this document), the approximate conversion from 1 tonne of biochar to tCO₂eq is 1.48 (110,760 / 75000 = 1.48). Hence, the cost of biochar production is approximately USD [REDACTED]⁵ (INR [REDACTED] ~ USD [REDACTED] @ USD/INR conversion of 86) per carbon removal credit (1 tCO₂eq). In this project, the community does not incur any costs as the revenues are received from the VCUs.

- e) Conduct a sensitivity analysis to demonstrate that the condition in (4) is met under reasonable variations in the critical assumptions.

The major cost of the project is the operational cost of per tonne of biochar produced (> 20 % of total cost or revenue). Below is the sensitivity analysis for the same. For the sensitivity analysis, the realizable VCU price is assumed at net of USD 80 received by the PP after other additional costs such as verification charges, registry fees, VCU marketing costs, commissions of intermediaries etc.

Factor under Variance	Variation	Result
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⁵ Cost of biochar production is INR [REDACTED]/tonne and 1 tonne of biochar results in 1.48 emission removal credits (VCUs). Therefore, cost of generating 1 VCU from biochar production is [REDACTED]/1.48 = INR [REDACTED] per VCU generated. At a USD/INR currency conversion rate of 86, this is equivalent to USD [REDACTED] per VCU generated (INR [REDACTED]/86 = USD [REDACTED])

<p>Cost of Production</p>	<p>+10%</p>	<p>If the cost of production rises by 10%, the cost of production per credit rises to approximately INR █████ i.e. USD █████ which is USD █████ per VCU. The project would still be financially feasible assuming the net VCU price received by the PP is USD 80 but the cost of production is USD █████, making the project financially feasible. As the project only incurs costs for biochar production and the only source of revenue is from VCUs, even with the rise of cost of production of biochar, the project is unfeasible in the absence of carbon revenues.</p>
<p>Cost of Production</p>	<p>-10%</p>	<p>If the cost of production decreases by 10%, the cost of production per VCU credit reduces to INR █████ i.e. USD █████ per ton of biochar which is USD █████ per VCU, making the project better financially attractive. However this is an unlikely scenario, as the project proponent does not envisage a reduction in the production cost. Based on the experience gained from implementing the project so far, the project proponent expects an increase in the production cost rather than a reduction in it. As the project only incurs costs for biochar production and the only source of revenue is from VCUs, even with the reduction of cost of production of biochar, the project is unfeasible in the absence of carbon revenues.</p>
<p>Carbon Removal Credit Price</p>	<p>+10%</p>	<p>For the sensitivity analysis, we assume the net realizable price of VCU received by PP is USD 80. If the price of carbon credit goes up by 10% i.e. USD 88, it makes the project more financially attractive. Hence, the project is still financially viable if revenues increase. However, the project is not viable if there are no carbon removal revenues from VCUs.</p>
<p>Carbon Removal Credit Price</p>	<p>-10%</p>	<p>If the net price of carbon removal credit reduces by 10%, the net price of credit reduces from USD 80 to USD 72. The project is still financially feasible as the cost of production of biochar is USD █████, although the margin between the cost of production and the revenue inflow would substantially reduce but the project is still viable. However, the project is not viable if there are no carbon removal revenues from VCUs..</p>

In conclusion, the project is not financially viable unless it gains revenue from VCU sales and it is demonstrated in the above sensitive analysis that even with a 10% variation in levelized cost ie. Cost of biochar production or carbon removal price, it still remains

financially unviable without revenues from VCUs. Without the carbon revenues, the PP will continue making heavy losses year after year and the project cannot happen.

The above analysis demonstrates that carbon finance is unequivocally the decisive factor to enable successful implementation of Project Reignite. The project has negative financial returns without carbon revenues and needs VCUs revenue to sustain its implementation. The project is therefore financially additional; carbon removal credits being a vital and decisive factor for its continued implementation.

The analysis meets requirements outlined in the VT 0008 VCS Tool for Additionality Assessment as shown above. Accordingly, Project Reignite fulfills all criteria outlined in VT0008 and is therefore deemed financially additional, with carbon removal credit revenues being the decisive element for its implementation and continuation.

3.6 Methodology Deviations

Project Reignite takes a deviation from the methodology in the following ways:

The deviation is related to the frequency of monitoring of the two parameters below, as the values of these parameters do not vary much from month to month and are nearly the same, except for the monsoon months. However, there is no biochar production expected during the monsoon, due to the wet conditions during the monsoon.

Table 11: Proposed Deviations

S. No.	Parameter	Requirement of the methodology	Proposed Deviation
1)	Moisture content for calculation of biochar on dry weight basis	Frequency of recording: Moisture content should be monitored for each batch of biochar type <i>t</i> .	Frequency of monitoring will be on a monthly basis for random samples of biochar produced of type <i>t</i> . The field sample size will be determined using the Standard for Sampling and Surveys for CDM project activities and programme of activities as a guideline. The laboratory will be testing a representative sample from the field samples.

2)	H:C _{org} (Ratio of hydrogen to organic carbon) of biochar produced	Frequency of recording: Each batch of biochar produced at the production facility p .	Frequency of monitoring will be on an annual basis for random samples of biochar produced of type t . The field collection sample size will be determined using the Standard for Sampling and Surveys for CDM project activities and programme of activities as a guideline. The laboratory will be testing a representative sample from the field samples.
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4 QUANTIFICATION OF ESTIMATED GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

4.1.1 Sourcing Stage

As explained in Section 3.4, in the absence of the project activity, waste biomass would have been left to decay or would have been combusted for purposes other than energy production in the year biochar will be made within the project boundary. According to the methodology, the default net baseline emission avoidance is defined as zero following a conservative scenario (BE_{ss,y}).

4.1.2 Production Stage

In the baseline scenario at production stage, no biochar is produced for the purposes of the project activity and therefore no GHG removals or related emissions are considered.

4.1.3 Application Stage

In the baseline scenario at application stage, since no biochar was produced, no GHG removals or related emissions are considered.

4.2 Project Emissions

4.2.1 Sourcing Stage

At the sourcing stage, waste agricultural biomass will be collected from the same or nearby farm (within walking distance) where the production facility (steel-shield soil pit) is located. Therefore, the emissions at the sourcing stage ($PE_{ss,y}$) are set to zero.

4.2.2 Production Stage

$$ER_{PS,y} = \sum_t \left(\left(\sum_k CC_{t,k,y} \times \frac{44}{12} \right) - \left(\sum_p PE_{PS,t,p,y} \right) \right)$$

Where:

$ER_{PS,y}$ = GHG emissions removals at production stage in year y (tCO_{2e})

$CC_{t,k,y}$ = Organic carbon content on a dry weight basis for biochar type t used for application type k in year y (tonnes)

$PE_{PS,t,p,y}$ = Project emissions at production stage for production of biochar type t at production facility p in year y (tCO_{2e})

$\frac{44}{12}$ = Coefficient to convert organic carbon to tCO_{2e}

4.2.2.1 Low Tech Production Facilities

Step 1: Estimate organic carbon content ($CC_{t,k,y}$) of biochar

$$CC_{t,k,y} = \sum_p (M_{t,k,p,y} \times F_{Cp,t,p} \times PR_{de,k})$$

$CC_{t,k,y}$ = Organic carbon content on a dry weight basis for biochar type t used for application type k in year y (tonnes). Biochar type is based on the feedstock used to produce the biochar

$M_{t,k,p,y}$ = Mass on a dry weight basis of biochar type t for application type k produced at production facility p in year y (tonnes)

Table 12: Estimated Biochar Production per facility p

Feedstock	Estimated Mass of biochar on a dry weight basis for 1 production facility (tonnes) per year ⁶¹¹
Paddy Straw	9.5

¹¹ Estimates are based on expert judgement.

Tree Pruning	1
Bamboo Pruning	2
Maize Cobs	1
Ipomoea Carnea	1
Water Hyacinth	0.5

$F_{Cp,t,p}$ = Organic carbon content of biochar type t produced in production facility per tonne of biochar, taken on a dry weight basis (percent). Project Reignite will be determining these values through laboratory material analysis of biochar annually which will be provided to the VVB during verification. At the validation stage, values provided in Table 4AP.1 taken from IPCC (2019) Appendix 4: Method for Estimating the Change in Mineral Soil Organic Carbon Stocks from Biochar Amendments: Basis for Future Methodological Development have been used.

Table 13: Organic carbon content for different types of feedstocks

Feedstock Type	Feedstock	Organic Carbon Content
Rice husks and rice straw	Paddy Straw	0.49
Wood	Tree Pruning	0.77
	Bamboo Pruning (Only taken from mature bamboo with woody stems)	
Herbaceous	Maize Cobs	0.65
	Ipomoea Carnea	
	Water Hyacinth	

$PR_{de,k}$ = Permanence adjustment factor due to decay of biochar to be defined for application type k (dimensionless). Biochar is subject to natural decay rate when used in soil applications such as in agriculture, forests, croplands, or grasslands.

“The temperature in the main pyrolysis zone just below the flame curtain is 680 °C to 750 °C and cools down slowly below the main pyrolysis zone when new feedstock layers are added to 150–450 °C depending on the duration of batch before final quenching” (Cornelissen et al. 2016). It matches with average values collected from a sample of production facilities during process

testing as described in Section 5. Due to high temperature pyrolysis, the fraction of biochar remaining after hundred years is 0.89 (Table 4AP.2 of IPCC (2019)).

It was determined through tests conducted by an external laboratory that the temperature achieved during the flame curtain pyrolysis process is in excess of 600 degrees C. The laboratory was commissioned to conduct a series of temperature measurements while the pits were charged with the biomass and the pyrolysis process was being carried out. The laboratory results showed that the temperature during the pyrolysis was always more than 600 degrees C. This supports the value of $PR_{de,k}$ taken as 0.89 corresponding to temperatures above 600 degrees C. In addition, T_{prod} is a monitored parameter in the project where temperature is measured on a continuous basis for each batch of biochar produced.

Calculation of carbon content for each biochar type t , application type k (soil application), year y

1) Paddy Straw

$$CC_{paddystraw,k,y} = \sum_{p=1}^{5000} (9.5 \times 0.49 \times 0.89)$$

$$CC_{paddystraw,k,y} = 20,714.75$$

2) Tree Pruning

$$CC_{treeprunings,k,y} = \sum_{p=1}^{5000} (1 \times 0.77 \times 0.89)$$

$$CC_{treeprunings,k,y} = 3,426.5$$

3) Bamboo Pruning

$$CC_{bambooprunings,k,y} = \sum_{p=1}^{5000} (2 \times 0.77 \times 0.89)$$

$$CC_{bambooprunings,k,y} = 6,853$$

4) Maize Cobs

$$CC_{maizecobs,k,y} = \sum_{p=1}^{5000} (1 \times 0.65 \times 0.89)$$

$$CC_{maizecobs,k,y} = 2,892.5$$

5) Ipomoea Carnea

$$CC_{ipomoeacarnea,k,y} = \sum_{p=1}^{5000} (1 \times 0.65 \times 0.89)$$

$$CC_{ipomoeacarnea,k,y} = 2,892.5$$

6) Water Hyacinth

$$CC_{waterhyacinth,k,y} = \sum_{p=1}^{5000} (0.5 \times 0.65 \times 0.89)$$

$$CC_{waterhyacinth,k,y} = 1446.25$$

Step 2: Estimate project emissions $PE_{PS,p,y}$ for low technology production facilities

$$PE_{PS,p,y} = (P_{ED,p,y} + P_{EP,p,y} + P_{EC,p,y}) \times \frac{\sum_t \sum_k M_{t,k,p,y}}{M_{p,y}}$$

Where:

$PE_{PS,p,y}$ = Project emissions at the production stage at production facility p in year y (tCO_{2e})

$P_{ED,p,y}$ = Emissions associated with the pre-treatment of waste biomass at production facility p in year y (tCO_{2e})

$P_{EP,p,y}$ = Emissions associated with the conversion of waste biomass into biochar at production facility p in year y (tCO_{2e})

$P_{EC,p,y}$ = Emissions due to the utilization of auxiliary energy for the purpose of pyrolysis at production facility p in year y (tCO_{2e})

i) Determining $P_{EP,p,y}$: Emissions associated with the pre-treatment of feedstock at production facility p in year y for low technology facilities

$$P_{ED,p,y} = P_{EDE,p,y} + P_{EDF,p,y}$$

$P_{ED,p,y} = 0$ as there is no pre-treatment of feedstock involved. Feedstock is air/sun dried.

ii) Determining $P_{ED,p,y}$: Emissions associated with the thermochemical process at production facility p in year y for low technology facilities

$$P_{EP,p,y} = \sum_k \sum_t (F_e \times GWP_{CH_4} \times M_{t,k,p,y})$$

Where:

$P_{EP,p,y}$ = Emissions associated with the conversion of waste biomass into biochar at production facility p in year y (tCO_{2e})

F_e = Average methane emissions from producing one tonne of biochar in year y (tCH₄/tonne). Values from Table 3 in Cornelissen et al. (2016) may be used based on the corresponding type (i.e., low technology production facility type). The first instance of project Reignite uses

Steel-shield soil pit (low technology production facility type t). Thus, $F_e = 0.014$ for steel-shield soil pit.

GWP_{CH_4} = Global warming potential of methane. Use value referenced in the latest version of the VCS standard

As per VCS standard V4.4, $GWP_{CH_4} = 28$

$M_{t,k,p,y}$ = Mass on a dry weight basis of biochar type t and application type k produced at production facility p in year y (tonnes).

Calculation of emissions during production for each production facility p in year y:

$$P_{EP,p,y} = (0.014 \times 28 \times 9.5) + (0.014 \times 28 \times 1) + (0.014 \times 28 \times 2) + (0.014 \times 28 \times 1) + (0.014 \times 28 \times 1) + (0.014 \times 28 \times 0.5)$$

$$P_{EP,p,y} = (0.014 \times 28) \times (9.5 + 1 + 2 + 1 + 1 + 0.5)$$

$$P_{EP,p,y} = (0.392) \times (15)$$

$$P_{EP,p,y} = 5.88$$

iii) Determining $P_{EC,p,y}$: Emissions due to the utilization of auxiliary energy for the purpose of pyrolysis

$$P_{EC,p,y} = 0$$

As no external energy is required to initiate and maintain the pyrolysis, the emissions are 0.

$$P_{EPS,p,y} = (0 + 5.88 + 0) \times \frac{75,000}{75,000}$$

Thus, following is calculation for $ER_{PS,y}$:

$$ER_{PS,y} = \sum_t \left(\left(\sum_k CC_{t,k,y} \times \frac{44}{12} \right) - \left(\sum_p P_{EPS,t,p,y} \right) \right)$$

$$CC_{t,k,y} = (20,714.75) + (3,426.5) + (6,853) + (2,892.5) + (2,892.5) + (1,446.25)$$

$$\sum_k CC_{t,k,y} = 38,225.5$$

$$\sum_p PE_{PS,t,p,y} = \sum_{p=1}^{5000} 5.88 = 29,400$$

$$ER_{PS,y} = \left(38,225.5 \times \frac{44}{12} \right) - (29,400)$$

$$ER_{PS,y} = 110,760$$

4.2.3 Application Stage

$PE_{AS,y} = 0$ as project Reignite does not involve any processing. Biochar is manually applied to the same farm from where the biomass originates from. The biochar is air/ sun dried. Hence, there is no combustion of fossil fuels or consumption of electricity in the application stage.

4.3 Leakage Emissions

$LE_y = 0$ as there are no transmissions at any stage of the biochar life cycle. Biochar is produced and applied within the same farm from where the biomass originates from. All transportation is done manually as everything is located within walking distance.

4.4 Estimated GHG Emission Reductions and Carbon Dioxide Removals

Emission reductions at the sourcing stage ($ER_{SS,y}$) are 0 as the methodology conservatively assumes default value of zero (tCO_{2e})

Net GHG emission reductions and removals are calculated as follows:

$$ER_y = ER_{SS,y} + ER_{PS,y} - PE_{AS,y} - LE_y$$

Where:

ER_y = Net GHG emissions reductions and removals in year y (tCO_{2e})

$ER_{SS,y}$ = GHG emission reductions at sourcing stage in year y (tCO_{2e})

$ER_{PS,y}$ = GHG emission removals at production stage in year y (tCO_{2e})

$PE_{AS,y}$ = GHG emissions at application stage in year y (tCO_{2e})

LE_y = Total leakage emissions in year y (tCO_{2e})

$$ER_y = 0 + 110,760 - 0 - 0$$

Thus, estimated annual emission reductions are 110,760 (tCO_{2e})

Year	Estimated baseline emissions or removals (tCO ₂ e)	Estimated project emissions or removals (tCO ₂ e)	Estimated leakage emissions (tCO ₂ e)	Estimated net GHG emission reductions or removals (tCO ₂ e)
Year 2023 (<u>16-10-2023– 31-12-2023</u>)	0	23,366	0	23,366
Year 2024	0	110,760	0	110,760
Year 2025	0	110,760	0	110,760
Year 2026	0	110,760	0	110,760
Year 2027	0	110,760	0	110,760
Year 2028	0	110,760	0	110,760
Year 2029	0	110,760	0	110,760
Year 2030 (<u>01-01-2030– 15-10-2030</u>)	0	87,394	0	87,394
Total	0	775,320	0	775,320

Vintage period	Estimated baseline emissions (tCO ₂ e)	Estimated project emissions (tCO ₂ e)	Estimated leakage emissions (tCO ₂ e)	Estimated buffer pool allocation (tCO ₂ e)	Estimated reduction VCU (tCO ₂ e)	Estimated removal VCU (tCO ₂ e)	Estimated total VCU issuance (tCO ₂ e)
Year 2023 (<u>16-10-2023– 31-12-2023</u>)	0	23,366	0	0	0	23,366	23,366
Year 2024	0	110,760	0	0	0	110,760	110,760
Year 2025	0	110,760	0	0	0	110,760	110,760
Year 2026	0	110,760	0	0	0	110,760	110,760
Year 2027	0	110,760	0	0	0	110,760	110,760

Year 2028	0	110,760	0	0	0	110,760	110,760
Year 2029	0	110,760	0	0	0	110,760	110,760
Year 2030 <u>(01-01-2030-15-10-2030)</u>	0	87,394	0	0	0	87,394	87,394
Total	0	775,320	0	0	0	775,320	775,320

5 MONITORING

5.1 Data and Parameters Available at Validation

Data / Parameter	$F_{Cp,t,p}$
Data unit	Percent (%)
Description	Organic carbon content of biochar for each biochar type t produced in production facility p per tonne of biochar, on a dry weight basis (%)
Source of data	At validation stage, default values provided in Table 4AP.1 are used, which are taken from IPCC (2019) Appendix 4: Method for Estimating the Change in Mineral Soil Organic Carbon Stocks from Biochar Amendments: Basis for Future Methodological Development

Value applied	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="padding: 5px;">Feedstock Type</th> <th style="padding: 5px;">Feedstock</th> <th style="padding: 5px;">Organic Carbon Content</th> </tr> </thead> <tbody> <tr> <td style="padding: 5px;">Rice husks and rice straw</td> <td style="padding: 5px;">Paddy Straw</td> <td style="padding: 5px;">0.49</td> </tr> <tr> <td style="padding: 5px;">Wood</td> <td style="padding: 5px;">Tree Pruning Bamboo Pruning (Only taken from mature bamboo with woody stems)</td> <td style="padding: 5px;">0.77</td> </tr> <tr> <td style="padding: 5px;">Herbaceous</td> <td style="padding: 5px;">Maize Cobs Ipomoea Carnea Water Hyacinth</td> <td style="padding: 5px;">0.65</td> </tr> </tbody> </table>	Feedstock Type	Feedstock	Organic Carbon Content	Rice husks and rice straw	Paddy Straw	0.49	Wood	Tree Pruning Bamboo Pruning (Only taken from mature bamboo with woody stems)	0.77	Herbaceous	Maize Cobs Ipomoea Carnea Water Hyacinth	0.65
Feedstock Type	Feedstock	Organic Carbon Content											
Rice husks and rice straw	Paddy Straw	0.49											
Wood	Tree Pruning Bamboo Pruning (Only taken from mature bamboo with woody stems)	0.77											
Herbaceous	Maize Cobs Ipomoea Carnea Water Hyacinth	0.65											
Justification of choice of data or description of measurement methods and procedures applied	<p>At validation, IPCC (2019) stated global estimates of organic carbon content of biochar as a function of feedstock and heating temperature are used. During the project implementation (crediting period,) the values will be monitored using biochar material analysis at an accredited laboratory for calculation.</p>												
Purpose of Data	<p>Calculation of project emissions</p>												
Comments	<p>Below are the reasonings for classification of each feedstock type:</p> <ol style="list-style-type: none"> 1. Paddy Straw: Category: Rice husks and rice straw Reasoning: Paddy straw is the residue left after the rice grain is harvested. Given its direct relation to rice production, it is most appropriately classified with rice husks and straw. 2. Tree Pruning: Category: Wood Reasoning: Tree pruning are derived from trees, which are inherently woody plants. The pruned branches and twigs have the same woody characteristics as the main tree and are therefore classified under wood. 3. Bamboo Pruning: Category: Wood Reasoning: While bamboo is technically a grass, mature bamboo develops a woody stem known as a culm. These woody culms 												

	<p>give bamboo its rigidity and strength, making it akin to wood in many applications. Thus, for purposes of biomass classification, mature bamboo pruning will be categorized as wood.</p> <p>4. Maize Cobs: Category: Herbaceous Reasoning: Maize (or corn) is a type of grass, and while the cob is harder and more rigid than the rest of the plant, it does not have the woody properties found in trees or mature bamboo. Therefore, it fits best under the herbaceous category.</p> <p>5. Ipomoea Carnea: Category: Herbaceous Reasoning: Ipomoea Carnea is a type of forb. Forbs are broad-leaved herbaceous plants, and thus, they fit squarely within the herbaceous category.</p> <p>6. Water Hyacinth: Category: Herbaceous Reasoning: Water hyacinth is a free-floating perennial aquatic plant. Its rapid growth and herbaceous nature make it best suited for the herbaceous category.</p>
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Data / Parameter	PR _{de,k}
Data unit	Dimensionless
Description	Permanence adjustment factor due to decay of biochar (dimensionless) defined for application type k
Source of data	IPCC (2019) Appendix 4: Method for Estimating the Change in Mineral Soil Organic Carbon Stocks from Biochar Amendments: Basis for Future Methodological Development
Value applied	“The temperature in the main pyrolysis zone just below the flame curtain is 680 °C to 750 °C and cools down slowly below the main pyrolysis zone when new feedstock layers are added to 150–450 °C depending on the duration of batch before final quenching” (Cornelissen et al. 2016). As pyrolysis temperature for flame curtain pyrolysis method is known to be >600 °C and as observed in practice, permanence adjustment factor is 0.89 from IPCC (2019) Appendix 4 AP.2.
Justification of choice of data or description of	Biochar is a stable material that may be used for soil and non-soil applications. As a material, it has a decay rate that must be accounted for. This parameter considers how much of the

measurement methods and procedures applied	<p>original carbon will remain in the biochar and may be accounted as a carbon sink after its final application.</p> <p>IPCC and EBC are internationally recognized, and the data provided in the guidelines are peer reviewed.</p>
Purpose of Data	Calculation of project emissions
Comments	<p>The methodology suggests that for low technology production facilities, project proponents must use a conservative default value of 0.56. The conservative default value is suggested only in case the pyrolysis temperature is unknown (Figure 4Ap.1 in IPCC, 2019). However, in the case of Project Reignite, pyrolysis temperature is known to be higher than 600 °C as flame curtain pyrolysis method is used in steel-shield soil pit. The project activity has been process tested for the average production temperature by a laboratory and the report will be available at the time of validation. The project activity has been process tested for the average production temperature by a laboratory and it was found that the temperature was higher than 600 degrees Celsius. In addition, T_{prod} is measured on a continuous basis for each batch of biochar and is a monitoring parameter.</p>

Data / Parameter	GWP _{CH4}
Data unit	Tonnes CO2e per tonne CH4 (tCO2e/ tCH4)
Description	Global warming potential of methane
Source of data	IPCC Fifth Assessment Report
Value applied	28
Justification of choice of data or description of measurement methods and procedures applied	The VCS Standard V4.4 requires that CH4 is converted to CO2e using the 100-year global warming potential derived from IPCC Fifth Assessment Report.
Purpose of Data	Calculation of project emissions
Comments	The latest standard version at the time of listing suggested GWP _{CH4} to be 28. The latest IPCC Assessment Report (Sixth) suggested GWP _{CH4} to be 21. However, a conservative value of 28 is applied.

Data / Parameter	Fe
Data unit	tonnes CH4 per tonne biochar (t CH4/t)

Description	Average methane emissions from producing one tonne of biochar in year y in a low technology production facility
Source of data	Table 3 in Cornelissen et al. (2016)
Value applied	14kg CH ₄ / tonne of biochar for steel-shield soil pit
Justification of choice of data or description of measurement methods and procedures applied	Methane emissions must be accounted for as methane is the main gas released from low technology production facilities. The value of methane emissions per tonne of biochar produced in a steel-shield soil pit (low-technology production facility) has been taken from Table 3 in Cornelissen et al. (2016).
Purpose of Data	Calculation of project emissions
Comments	None
Data / Parameter	Biomass categories and quantities used for selection of the baseline scenario and production of biochar utilized in the project activity
Data unit	tonnes (t) on dry basis

Description	Biomass Categories and Quantities at each production facility ¹² :		
	Feedstock Type	Feedstock	Estimated Amount available at baseline (in tonnes) each year
	Agricultural Waste Biomass	Rice Straw	57
		Tree Pruning	6
		Bamboo Pruning	12
		Maize Cobs	6
		Ipomoea Carnea (Shrub)	6
	Aquaculture Plants	Water Hyacinth (Eichhornia crassipes)	3
	Biomass Quantities available at all production facilities (derived from the above values):		
	Feedstock Category	Feedstock	Estimated Amount available at baseline (in tonnes) each year
	Agricultural Waste Biomass	Rice Straw	285,000
		Tree Pruning	30,000
		Bamboo Pruning	60,000
		Maize Cobs	30,000
		Ipomoea Carnea (Shrub)	30,000
	Aquaculture Plants	Water Hyacinth (Eichhornia crassipes)	15,000
	<ul style="list-style-type: none"> • Biomass is sourced from the same/neighbor farm where the production facility is located. • Biomass would have been burnt in the open field or left to decay in the absence of the project activity. Details are provided in Section 3.4. • Sustainability criteria for all biomass is met. It is described in Section 3.2. 		

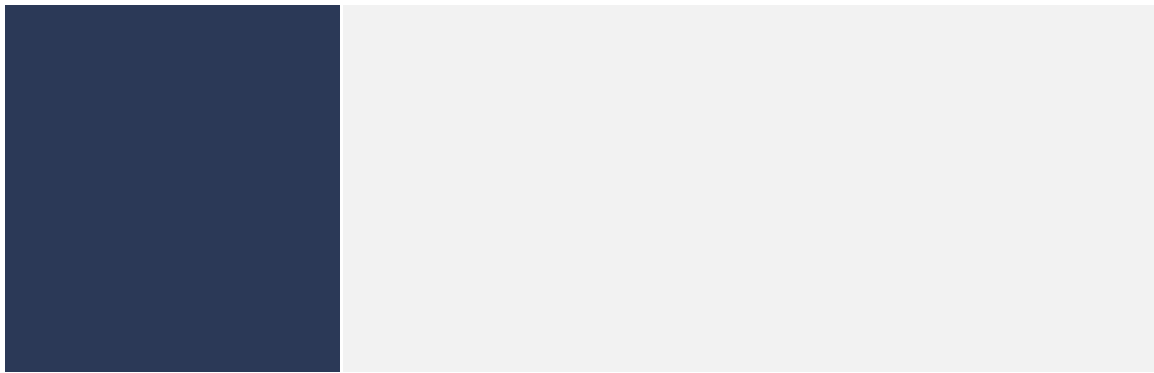
¹² Estimates are based on expert judgement.

Source of data	Expert judgement based on on-site assessment of biomass categories and quantities
Description of measurement methods and procedures applied	Using weight meters and moisture meters. Adjusted by moisture content in order to determine the quantity of dry biomass.
Frequency of Monitoring/ recording	Data monitored once before validation
QA/QC procedures to be applied	Cross-check the measurements with an annual mass balance.
Purpose of Data	Monitoring of eligible biomass categories and quantities used as feedstock for production of biochar
Comments	For each biochar type t to be produced, a laboratory has performed field testing for yield rates. Results will be available at the time of validation.

5.2 Data and Parameters Monitored

Data / Parameter	$M_{p,y}$
Data unit	tonnes (t)
Description	Total mass on a dry weight basis of biochar produced in production facility p in year y
Source of data	On-site measurements
Description of measurement methods and procedures to be applied	Total weight of biochar produced at production facility p in year y will be measured using a weighing scale. Moisture content will be monitored for the project using laboratory analysis of representative sampling of biochar produced every month from the beginning of the crediting period.
Frequency of monitoring/recording	Monitored continuously, recorded for each batch produced and summed as a total
Monitoring equipment	Weighing scale as per details provided for $M_{t,k,p,y}$ below.
QA/QC procedures to be applied	Calibration of weighing scales on-site by the Reignite monitoring team (defined in Section 5.3) using a known weight to be done annually.
Purpose of data	Calculation of project emissions

Calculation method	N/A
Comments	Biochar quantity will be weighed separately using a weighing scale for each biochar type t at each biochar production facility p. The sum is recorded as $M_{p,y}$
Data / Parameter	$M_{t,k,p,y}$
Data unit	tonnes (t)
Description	Mass on dry weight basis of biochar type t and application type k produced at production facility p in year y
Source of data	On-site measurements
Description of measurement methods and procedures to be applied	Total weight of biochar type t, used for application type k, produced at production facility p in year y will be measured using a weighing scale. Moisture content will be monitored for the project using laboratory analysis of representative sampling of biochar produced every month from the beginning of the crediting period.
Frequency of monitoring/recording	Monitored continuously, recorded for each batch applied
Monitoring equipment	Weighing scale Specification: Aliston Electronic Portable Fishing Hook Type Digital LED Screen Weighing Scale
QA/QC procedures to be applied	Calibration of weighing scales on-site by the Reignite monitoring team (defined in Section 5.3) using a known weight, to be done annually.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	<p>Biochar quantity will be weighed separately using a weighing scale for each biochar type t at each biochar production facility p.</p> <p>Moisture content will be measured using testing done by a laboratory every month from the start date of the project. Field sampling will be done using the Sampling and Surveys Standard for CDM Project Activities and Program of Activities, as a guideline. The laboratory will be using a representative sample from the field samples for testing. The laboratory will follow ASTM D1762-84 Standard Test Method for Chemical Analysis of Wood Charcoal or a similar testing method. The dry weight of biochar will be measured using the results.</p>



Data / Parameter	T _{prod}
Data unit	Degrees Celsius (C)
Description	Average annual production temperature during pyrolysis
Source of data	Data records of biochar production
Description of measurement methods and procedures to be applied	Use instruments with recordable electronic signal (digital).
Frequency of monitoring/recording	Continuous, monitored for each batch produced, aggregated to annual averages
Monitoring equipment	Handheld high temperature industrial infrared thermometer
QA/QC procedures to be applied	Periodic calibration against a primary device provided by an independent NABL accredited laboratory.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	It was determined through tests conducted by an external laboratory that the temperature achieved during the steel shield soil pit pyrolysis process is in excess of 600 degrees C. The laboratory was commissioned to conduct a series of temperature measurements, while the pits were charged with the biomass and the pyrolysis process was being carried out. The laboratory results showed that the temperature during the pyrolysis was always more than 600 degrees C. This supports the value of PR _{de,k} taken as 0.89 corresponding to temperatures above 600 degrees C.

Data / Parameter	$F_{Cp,t,p}$
Data unit	Percent (%)
Description	Organic carbon content of biochar for each biochar type t produced in production facility p per tonne of biochar, taken on a dry weight basis
Source of data	Laboratory material analysis
Description of measurement methods and procedures to be applied	Laboratory material analysis following EBC Production Guidelines on the production of biochar will determine F_{Cp} values on a regular basis.
Frequency of monitoring/recording	Testing will be performed annually as there will not be a material change in feedstock or thermochemical production parameters more frequent than annually.
QA/QC procedures to be applied	Laboratory accredited by India's national agency NABL (National Accreditation Board for Testing and Calibration Laboratories).
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	Field sampling will be done using the Sampling and Surveys for CDM Project Activities and Program of Activities Standard as a guideline. The lab will be using a representative sample from the field samples for the testing.

Data / Parameter	$H:C_{org}$
Data unit	Dimensionless
Description	Ratio of hydrogen to organic carbon
Source of data	Laboratory analysis
Description of measurement methods and procedures to be applied	Nationally Accredited Laboratory analysis following EBC Production Guidelines.
Frequency of monitoring/recording	Annually field samples will be collected using the Sampling and Surveys Standard for CDM Project Activities and Program of Activities as a guideline. Laboratory will be using a representative sample out of the field samples collected using Sampling.
QA/QC procedures to be applied	Laboratory accredited by India's national agency NABL (National Accreditation Board for Testing and Calibration Laboratories).

Purpose of data	Used to demonstrate eligibility for use in soil applications. As per applicability condition 10, biochar used in soils must have an H:C _{org} of less than 0.7.
Calculation method	N/A
Comments	As all production facilities will be utilizing the same technology and same feedstocks, a representative sample will be tested annually. Field sampling will be done using the Sampling and Surveys Standard for CDM Project Activities and Program of Activities as a guideline. Laboratory will be taking a representative sample from the field samples.

5.3 Monitoring Plan

1. Main Objective

The main objective of the monitoring plan is to prove the carbon sink from the final application of biochar and to quantify the emissions resulting from the project activity during the project crediting period, prior to each verification.

2. Sampling approach

For the periodic monitoring of parameters $M_{p,y}$ and $M_{t,k,p,y}$ described in the monitoring plan in section 5.2 above, the values of weight of the biochar produced and applied will be measured and recorded for every batch of biochar produced. These values being weights of dry biochar produced, will be derived by subtracting the moisture content of the biochar from the total weight measured by means of weighing scales. While the weight of each batch produced will be taken and recorded, the value of moisture content will be monitored using a sampling approach. Values of the parameters $F_{cp,t,p}$ (organic carbon content of biochar) and H:C_{org} (ratio of hydrogen to carbon in the biochar) will also be determined using a sampling approach.

The sampling approach that will be followed is based on the CDM Standard for Sampling & Surveys for CDM project activities and programme of activities (Version 9.0 of the standard from EB 110 Annex 1) and the CDM Guideline on Sampling & Surveys for CDM project activities and programme of activities (version 4.0 of the guideline from EB 67 Annex 6). The sampling approach is described as below.

Step 1: Choose the parameter of interest for sampling

For all of the 3 parameters, viz., “moisture content”, “ $F_{cp,t,p}$ ” and “H:C_{org}”, the parameter of interest is a mean value of the respective parameters.

Moisture content	The mean value of moisture content of the wet biochar is the desired parameter of interest
$F_{cp,t,p}$	The mean value of organic carbon content of the dry biochar is the desired parameter of interest
H:C _{org}	The mean value of ratio of hydrogen to carbon in the dry biochar is the desired parameter of interest

Step 2: Select the sampling scheme

As the biochar producing farms in the project are located within a single region (i.e. the state of Odisha in India), as similar in area and crop, there is homogeneity between the facilities and hence, a “Simple Random Sampling (SRS)” is appropriate for the sampling scheme.

Step 3: Determine the expected value of the parameter of interest

Pilot studies conducted through external laboratories will provide data on the range of value each parameter is expected to take. The range of value is characterized as both “mean value (μ_e)” of the parameter and “standard deviation (σ_e)”.

Step 4: Select the confidence interval for the sampling

For the purpose of the sampling exercise, a confidence interval of 90/10 has been applied. The values determined by the sampling would have a level of precision of +/-10% relative to the parameter’s true value, with a 90% level of confidence in the result

Step 5: Calculate the sample size for the monitoring

The sample size will be calculated as

$$n \geq \frac{1.645^2 NV}{(N-1) \times 0.1^2 + 1.645^2 V}$$

where,

n= sample size

N= total number of biochar batches produced in the project

V= $(\sigma_e/\mu_e)^2$

1.645 represents the 90% confidence required

0.1 represents the 10% relative precision

Step 6: Results of sampling

The samples, calculated as per Step 5 above will then be sent to an external laboratory for testing of ‘Moisture content’, ‘F_{cp,t,p}’ and ‘H:C_{org}’. The laboratory will independently carry out its tests and provide results of the test to the PP. The test results will be provided by the laboratory and will be arrived at by considering the mean values for each parameter.

Step 7: Check for the reliability of the estimate from the sampling

This step involves three further steps:

Step 7a: Find the ‘t-value’ corresponding to the sample size (n) and confidence level (90%) from statistical tables or by using the MS Excel function TINV(0.1,(n-1)).

Step 7b: Find the standard error (ϵ) of the mean value estimate as

$$\epsilon = \sqrt{\left(1 - \frac{n}{N}\right) \sigma^2 / n}$$

Step 7c: Calculate the precision of the estimate as the product of ‘t-value’ and ϵ

The relative precision (R.L.) is (t-value x ϵ)/ σ_{sample}

Step 7d: Reliability test:

If R.L. < 0.1 or =0.1, the estimate is reliable; the value of σ_{sample} is accepted as a reliable monitored value for the parameter (i.e. Moisture content/F_{cp,t,p}/H:C_{org})

If R.L. > 0.1, the estimate cannot be considered as reliable; the sampling must be repeated with a higher sample size

3. Organizational Structure (Roles, responsibilities, and capacity of monitoring team)

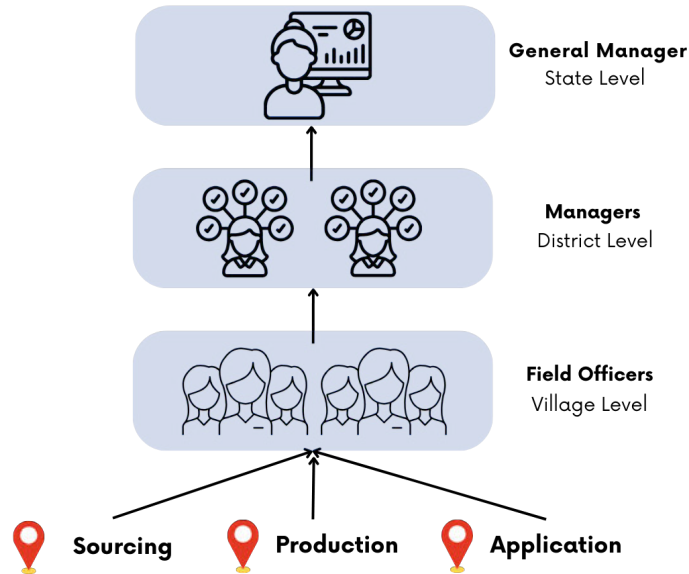


Figure 5: Structure of monitoring team

Institutionally, permanent Reignite Monitoring Team 1 has been established for the first instance of the grouped project. A dedicated monitoring team will be established for every instance of the grouped project. The team consists of a General Manager, Managers, and Field Officers.

The General Manager is responsible for leading the team and is appointed at the state level.

Managers are specialists in agriculture and oversee the work of field officers. They are appointed at a district level. Their duties include on-site inspections, reviewing records, comparing new data with past figures for accuracy, and ensuring quality controls are in place. They also coordinate field officers to maintain consistent implementation and measurements.

Field officers are responsible for field inspections of biochar production, and application. Further, they perform the data collection and use Project Reignite internal mobile app to monitor and report ground data. The main tasks of the field officers are as follows:

- a. Regular inspections of farms under their supervision
- b. Weight measurements of the biochar produced at the farms (this includes the first and second weighing if the seals are broken to ensure that there is no loss or diversion of biochar for other uses and to record only the lower of the weight measurements which will enable the emission removals to be conservatively calculated)
- c. Ensuring that every batch of biochar produced at each participating farm will use the same type of biomass feedstock and that there would be no mixing of biomass types while charging the soil pits

All members of the team have expertise in agriculture and have experience ranging from 10 (field officers) - 35 years (general manager). They have been trained and tested by our scientific experts on biochar production and monitoring.

4. Training, Testing, and Registration of Personnel

First, entire monitoring team (including the general manager, managers, and field officers) has been trained and tested by our scientific experts on biochar production and monitoring. Second, each biochar producer, who will be a part of the project and shifting from traditional practices to biochar production to manage their farm waste, has been trained, tested, and registered in the project by the field officers. The training covered instructions on performance of activities related to sourcing, production, storage, and biochar application. Biochar producers have been assigned an ID that represents their production facility.

5. Type of technology used to produce biochar

Flame curtain pyrolysis technology in steel-shield soil pit is used to produce biochar. It is further described in Section 1.11.

6. Description of Monitoring Tasks

As majority of farmers are located in remote areas, they do not have access to smartphones or internet, or have the ability to use a mobile app. Thus, the field officers will regularly inspect and report data using the Project Reignite mobile app. Following are the monitoring tasks that are carried out:

- Sourcing
 - Biochar producers (farmers) will be sourcing waste biomass from their own/family's/ neighbors' farms. Field officers will interview the biochar producers at the beginning of each sourcing cycle (end of agricultural season) to identify the types and estimated amounts of waste biomass available at the production site.
- Production
 - The field officers visit the biochar producer (farmer) for each batch produced and conclude their inspections weekly to inspect the biochar production during the week. During the visit, the field officer measures and verifies the biochar production physically and seals the bags filled with the biochar produced. They enter the below information on the app:
 - Inspection ID (generated automatically, linked with the field officer's and biochar producer's ID)
 - Weight of biochar produced
 - Date range of biochar production
- Application
 - Once the biochar producer (farmer) is ready to apply the inspected biochar to the soil, the field officer visits the farm and opens the sealed bags. The sealed bags are opened only in the presence of the field officer inspecting the farm. For any bag whose seal is found broken, the field officer will order a second weighing to be done. The lower of the two weight readings would be applied to determine the values of the mass parameter $M_{t,k,p,y}$ for the further calculations of carbon content $CC_{t,k,y}$ and project emissions $PE_{PS,p,y}$. They supervise the biochar producer

during application to ensure all biochar produced has been applied to the soil. They collect the following data points after supervision of application:

- Date of Application
- GPS Coordinates of Application
- Signature of the Biochar Producer
- Signature of the Field Officer

7. Internal Auditing to Check Data Integrity and Monitoring (QA/QC Procedure):

Managers will regularly conduct internal audits of biochar producers to validate the data submitted by field officers through the app. This multi-layered verification approach not only reviews digital records but also corroborates them with physical evidence, producer statements, and other forms of verification. Managers are responsible for confirming the proper implementation of all quality control and quality assurance measures, which includes inspecting the calibration of weighing equipment, providing ongoing training for field officers, and ensuring the uniform application of best practices in data collection and reporting. Additionally, managers play a crucial role in keeping both field officers and biochar producers updated on the latest biochar production standards and best practices for monitoring.

8. Maintenance and Data Storage of the Project System

Because of the long-term nature of the project, data collection and archiving are crucial components. All field data, data analyses, models, calculations of carbon stocks, and copies of the monitoring reports will be stored in a dedicated cloud database with a backup facility. The data will be stored and maintained in the database for 9 years from the start date of the project (project crediting period (7 years) + 2 years).

APPENDIX 1: COMMERCIALLY SENSITIVE INFORMATION

The cost of biochar production (INR per tonne of biochar produced by farmers) is not disclosed in this document as it is of 'commercially sensitive' nature.

APPENDIX 2: REFERENCES

Agegnehu, G., Srivastava, A. K., & Bird, M. I. (2017). *The role of biochar and biochar-compost in improving soil quality and crop performance: A Review*. *Applied Soil Ecology*, 119, 156–170. <https://doi.org/10.1016/j.apsoil.2017.06.008>

Blanco-Canqui, H., Laird, D. A., Heaton, E. A., Rathke, S., & Acharya, B. S. (2020). *Soil carbon increased by twice the amount of biochar carbon applied after 6 years: Field evidence of negative priming*. *GCB Bioenergy*, 12(4), 240–251. <https://doi.org/10.1111/gcbb.12665>

Cornelissen, G., Pandit, N. R., Taylor, P., Pandit, B. H., Sparrevik, M., & Schmidt, H. P. (2016). *Emissions and char quality of flame-curtain “Kon tiki” kilns for farmer-scale charcoal/biochar production*. *PLOS ONE*, 11(5). <https://doi.org/10.1371/journal.pone.0154617>

European Biochar Certificate (EBC). (2022). *Guidelines for a sustainable production of biochar, version 10.1*. European Biochar Foundation. https://www.european-biochar.org/media/doc/2/version_en_10_3.pdf

International Biochar Initiative (IBI). (2015). *Standardized product definition and product testing guidelines for biochar that is used in soil, version 2.1*. International Biochar Initiative. https://www.biochar-international.org/wpcontent/uploads/2018/04/IBI_Biochar_Standards_V2.1_Final.pdf

Intergovernmental Panel on Climate Change (IPCC). (2019). *Appendix 4: Method for estimating the change in mineral soil organic carbon stocks from biochar amendments: Basis for future methodological development*. In *IPCC, 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry and Other Land Use*.

Ippolito, J.A., Cui, L., Kammann, C. et al. *Feedstock choice, pyrolysis temperature and type influence biochar characteristics: a comprehensive meta-data analysis review*. *Biochar* 2, 421–438 (2020). <https://doi.org/10.1007/s42773-020-00067-x>

Narayanan, S. P., Anitha, K., & Prasad, S. N. (2007). *Water hyacinth (Eichhornia crassipes) management of an invasive weed, the Indian scenario*. *Sarovar Saurabh-ENVIS Newsletter Wetland Ecosystem*, 3(4), 3-7.

Sinha, M. B. J., & Misra, M. B. G. (1930, March 18). *Clearance of water- hyacinth in Orissa*. Bihar Vidhan Mandal: CLEARANCE OF WATER- HYACINTH IN ORISSA. <http://archives.biharvidhanmandal.in/jspui/handle/123456789/121330>

Spokas, K. A. (2010). *Review of the stability of biochar in soils: Predictability of O:C molar ratios*. *Carbon Management*, 1(2), 289–303. <https://doi.org/10.4155/cmt.10.32> .

Reference for KML File: <https://www.surveyofindia.gov.in/>