VCS MR Project 4679 16102023-30062024

Project Title	Project Reignite: Turning Farm Waste to Climate Action
Project ID	4679
Project Website	togetherforrestoration.org
Monitoring Period	16-Oct-2023 - 30-Jun-2024
Original Date of Issue	28-Aug-2024
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Version	1.2
VCS Standard Version	VCS Standard v4.7
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Prepared By	Together for Restoration Team

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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

Project Reignite represents a transformative approach to waste management for agricultural communities in India, addressing the critical challenge of unsustainable agricultural residue disposal. Traditionally, these communities have relied on open field burning as a convenient and cost-effective method to prepare fields for subsequent planting seasons. This practice, driven by limited resources and a lack of awareness, has had significant adverse effects on environment, human health, and soil quality.

The core objective of Project Reignite is to facilitate a paradigm shift among these communities towards more sustainable, climate-resilient agricultural practices. By introducing biochar, the project aims to lower the impacts of climate change on the communities, enhance soil health, improve overall ecosystem, and work towards mitigation of climate change. This initiative not only focuses on long-term carbon removal but also aims to deliver substantial socio-economic benefits to the participating farming families.

The project commenced following extensive groundwork that included stakeholder consultations, complete baseline environmental, social, and economic assessments, infrastructural developments, and comprehensive training programs. These preparatory phases were crucial for the successful deployment of biochar production through flame-curtain pyrolysis—a technique selected for its efficiency and suitability for the local context. Prior to the project's launch on 16th October 2023, a total of 5,000 biochar producers representing their families were trained in sustainable biomass procurement, biochar production, and the application of biochar-manure blend to agricultural soils. Additionally, participants were educated on safety protocols, emergency response measures, and the importance of ongoing monitoring, continuous evaluation, and improvement.

The operational phase of Project Reignite has yielded as-expected results, with 69,860.10 tons of biochar produced and applied to the soil from 16th October 2023 to 30th June 2024. The project does not produce biochar in the months of July, August, and September due to the monsoon season, which causes increased moisture content in biomass. This intervention has effectively eliminated the need for open field burning among the participating farmers, leading to the direct avoidance of emissions from such practice and the removal of 115,103 tCO2 equivalent through biochar production. These outcomes were meticulously documented through the Project Reignite mobile application by the Project Reignite monitoring team consisting of field officers, managers, and a general manager, with data securely stored within the project's AWS-based database.

This report provides an analytical overview of the project's implementation, detailing the quantifiable benefits of biochar application on carbon removal and the broader environmental and social impacts. This report delineates the comprehensive monitoring and evaluation framework employed by Project Reignite to systematically assess the effectiveness and impact of biochar in advancing sustainable agricultural practices among local communities in India.

1.2 Audit History

Using the table below, include the audit history of the project. This table should include all monitoring periods, including the period of this monitoring report.

Audit Type	Period From	Period To	Program	Validation/verification body name	Number of years
Validation	2023-10-16	2023-12-31	VCS	RINA S.p.A (RINA)	<1

Verification	2023-10-16	2024-06-30	VCS	RINA S.p.A (RINA)	<1

1.3 Sectoral Scope and Project Type

Sectoral Scope	13. Waste handling and disposal
Project Activity Type	Biochar Production and Soil Application

1.4 Project Proponent

Primary	Yes
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

1.5 Other Entities Involved in the Project

N/A

1.6 Project Start Date

Start Date	16-Oct-2023
Justification	Date of first batch of biochar production and application under this grouped project activity

1.7 Project Crediting Period

Crediting period

- ◉ Seven years, twice renewable.
- ○ Ten years, fixed.
- ○ Other (state the selected crediting period and justify how it conforms with the VCS Program requirements)

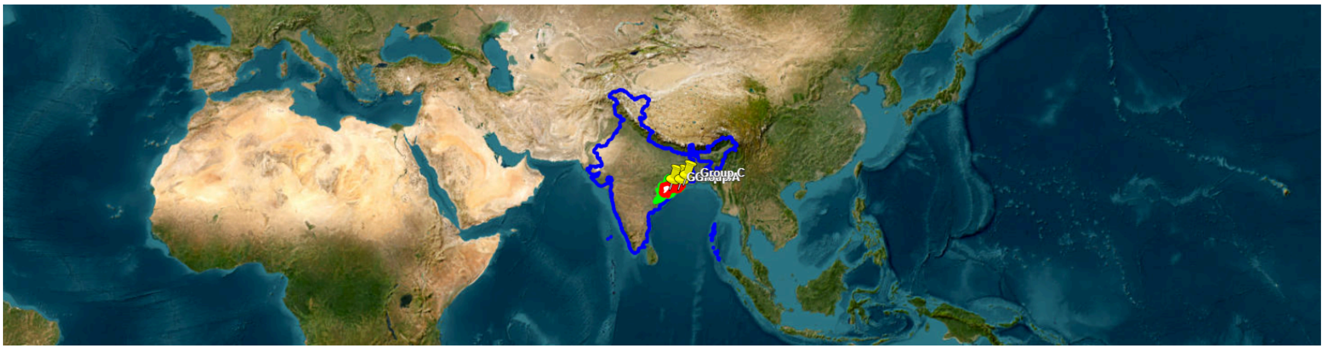
Start and end date of first or fixed crediting period

The project crediting period is from 16-Oct-2023 to 15-Oct-2030

1.8 Project Location

Project Instance	1
Country Name	India
State Name	Odisha
City/Region	Odisha
Project Location Format	Geodetic Point (Decimal Degrees)
Project Latitude	20.6300376
Project Longitude	86.689882

KML File



1.9 Title and Reference of Methodology

VM0044 - Methodology for Biochar Utilization in Soil and Non-Soil Applications Version 1.1

1.10 Double Counting and Participation under Other GHG Programs

1.10.1 No Double Issuance

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

○ Yes ◉ No

1.10.2 Registration in Other GHG Programs

Is the project registered or seeking registration under any other GHG programs?

○ Yes ◉ No

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

1.11.1 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

1.11.2 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

1.11.3 Supply Chain (Scope 3) Emissions

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

○ Yes ◉ No

1.12 Sustainable Development Contributions

Project Reignite applies agronomic research and sustainable resource management strategies to address multifaceted sustainability challenges faced by farming families, who are affected by the effects of climate change. Project Reignite, grounded in scientific evidence and ground observations, leverages the physicochemical properties of biochar to enhance soil, water, and air health, mitigate climate change impacts, and foster socio-economic development. The following sections summarize the project's contributions to environmental, social, and economic stability.

Environmental Impact: Biochar's Role in Soil, Water, and Air Health

The environmental efficacy of Project Reignite stems from the application of biochar and manure blend to agricultural soils. Biochar has a porous structure and high surface area, which enhances soil's physical and chemical properties. It increases nutrient retention, thereby reducing leaching into water bodies and improving the efficiency of nutrient uptake by plants. This further leads to reduction in the use of synthetic fertilizers by farmers, reducing chemical leakage to local water bodies, and improving quality of freshwater. Moreover, biochar's stability in soil makes it an effective tool in capturing and storing atmospheric CO_2. Its application also increases long-term biomass growth and soil carbon sequestration. The project activity directly contributes to mitigating climate change by reducing the net flux of greenhouse gases into the atmosphere.

Social Equity: Women's Role in Climate Action, Advancing Health, and Knowledge Transfer

The project's social dimension emphasizes the empowerment of rural women, community health improvements, and training and education of communities. Firstly, it empowers women by providing work opportunities through biochar production and monitoring activities. This approach not only elevates women's roles within their communities but also integrates gender equality into rural economic development. Secondly, Project Reignite addresses respiratory health risks from traditional biomass burning. From a public health perspective, this reduction is significant as exposure to biomass burning pollutants is linked with respiratory infections and other diseases. Thirdly, the project fosters capacity building, education opportunities, and knowledge transfer on sustainable agricultural practices, enhancing community resilience and adaptive capacity to environmental changes. This educational component is crucial for integrating scientific understanding of climate-positive agriculture within local communities to ensure long-term adoption of biochar and other sustainable practices.

Economic Advantages: Enhancing Agricultural Productivity

Research and ground observations have indicated that biochar application leads to increased agricultural yield through improved soil fertility, water retention, and pH regulation. These benefits derived from biochar's chemical composition and physical structure are facilitating a positive environment for microbial activity and plant growth for farmers. The economic implications are significant, increasing income for farmers through higher crop yields and reduced input costs. Furthermore, the project is creating additional employment opportunities for local communities directly and indirectly from biochar production and monitoring activities.

Methodology for Quantifying contributions to SDGs:

This section outlines the comprehensive methodology employed in Project Reignite to quantify its contributions towards the Sustainable Development Goals (SDGs). The methodology is constructed upon a foundation of empirical data collection, scientific analysis, and stakeholder engagement, ensuring a rigorous assessment of the project's impacts.

Baseline Assessment and Target Demographic:

A pivotal component of our methodology is the baseline assessment conducted at the project's inception in 2023. This assessment catalogued the pre-existing environmental conditions, socio-economic dynamics, and the health status of the target population and their surrounding ecosystems. The targeted demographic encompasses farming families actively participating in biochar production and application, focusing on the enhancement of their farmland's productivity and surrounding environmental health.

Data Collection and Analysis Framework:

Our methodology integrates four principal elements:

1. Continuous Monitoring for GHG Removals: Leveraging the Project Reignite mobile application, we implement a continuous monitoring strategy to record biochar production volumes and its application in farmland. This data is instrumental in calculating the net GHG removals, serving as a crucial indicator of the project's climate action efficacy.
2. Annual Comprehensive Stakeholder Surveys: Each year, a holistic survey is conducted across the entire cohort of participating farming families. This survey is meticulously designed to extract both quantitative and qualitative insights into the project's socio-economic and environmental footprint, capturing data on agricultural output, soil and water quality enhancements, and alterations in community health paradigms.
3. Evidence-Based Assumptions: Recognizing the necessity of projecting long-term impacts, our approach employs scientifically validated assumptions regarding biochar's environmental and agronomic benefits. These assumptions are drawn from peer reviewed research, ensuring that our projections of the project's contributions to the SDGs are both credible and conservative.

Surveys and lab testing evaluations will be conducted annually to capture substantive changes and trends. GHG removals verification will be completed annually and will provide an ongoing impact assessment. However, measurable contributions to the SDGs through Project Reignite will only be available annually and thus, available in the monitoring period from the next verification. This report provides a blueprint of the same.

ROW NUMBER	SDG TARGET	SDG INDICATOR	NET IMPACT ON SDG INDICATOR	CURRENT PROJECT CONTRIBUTIONS	CONTRIBUTIONS OVER PROJECT LIFETIME

1	1.1	1.1.1 Proportion of population below the international poverty line by sex, age, employment status, and geographic location (urban/rural)	Implemented activities to decrease the proportion of population below the international poverty line	The project is directly improving soil fertility by improving soil structure, increasing water retention, and enhancing nutrient availability. It has increased the income of farmers through increase in crop yield (due to improvement in soil health as a result of sowing biochar), better quality produce, reduction in use of chemical fertilizers, lowering crop failure rates, and increasing shelf life of produce. Healthier soils lead to higher crop yields.	The project has increased farm yields, leading to higher crop output and increased income for the participating farmers involved in biochar production. It has led to the mitigation of poverty. However, its impact on the proportion of population below the international poverty line would be known only when annual survey reports on poverty reduction are available, that cover a sufficiently long period of time. The current monitoring period (16/10/2023 to 30/06/2024) is too short to be able to arrive at a quantified estimate of the same.
2	1.4	1.4.1 By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance.	Implemented activities to increase the proportion of population living in households with access to basic services	The project has directly made climate finance accessible to 5,000 families, out of which 3,595 families have actively benefitted in this crediting period. These families now have increased access to basic services, due to the additional income they have gained.	5,000 families now have access to climate finance, out of which 3,595 families have benefitted from it in the first crediting period. Consequently, these families now have better access to basic facilities.

3	1.5	Project Parameter: Number of Farming Families building resilience and reducing vulnerability to climate related economic, environmental shocks	Implemented activities to increase	The 3595 farming families who have produced biochar in their fields now stand a better chance of combating climate change induced shocks including flooding, droughts, increasing temperature, since the sown biochar absorbs water, provides cooling effects, and prevents the soil from getting degraded.	3,595 agricultural families who have applied biochar in their fields report its potentially beneficial effects in water absorption and prevention of soil degradation, than if no biochar had been produced and used at all.
4	2.3	2.3.1 Volume of production per labour unit by classes of farming/pastoral/forestry enterprise size	Implemented activities to increase the volume of production per labour unit	It is a known fact that biochar application in fields augments crop yields as a result of its beneficial effects on the soil. Crop output per unit area (acre or hectare of land) is increased. It will take more time to collect sufficient data on increase in crop production per acre/hectare of land. The present monitoring period of eight months and a half is not sufficiently long to arrive at reliable estimates.	Biochar application does increase crop yield in fields wherever it is applied. Research publications can readily testify to this fact. In the case of the project, however, the current monitoring period is not long enough to be able to work out reliable estimates of production increases per unit of farm area.

5	2.4	2.4.1 Proportion of agricultural area under productive and sustainable agriculture	Implemented activities to increase the area of land under biochar application	All the 5,000 farmers in the project are small-scale food producers. Approx. 32,000 hectares of farmland is registered for biochar application in the project. In the current monitoringperiod, approx. 23,008 hectares have been under biochar application, increasing the proportion of land under sustainable agriculture.	In the current crediting period, approx. 23,008 hectares have been under biochar application, increasing the proportion of land under sustainable agriculture.

6	3.9	3.9.1 Mortality rate attributed to household and ambient air pollution	Implemented activities to decrease the mortality rate	Converting biomass waste to biochar helps avoid its open field burning. This leads to a marked reduction in air pollution due to the release of particulate matter PM 2.5 and PM 10. During the baseline survey conducted, more than 90% of the farmers had reported someone or the other in their family having a breathing problem due to air pollution. Reduction in air pollution levels has therefore lowered health risks and increased longevity. However, exact data on the same can be collected only over time. It is not possible to report any quantified data on mortality rate attributed to air pollution for the current monitoring period which is only eight and a half months' duration and is thus too short for the same.	Reduction in mortality rates due to lowering of health risks from local air pollution will happen over a period of time. The number cannot be quantified for the current lifetime of the project, as it is not feasible to quantify this data solely on account of reduced air pollution as a result of the project. As a rough estimate, however, close to 40000 persons from the areas in which the project is under implementation now have a reduced exposure to smoke from open burning of biomass residues in fields.

7	3.9	3.9.2 Mortality rate attributed to unsafe water, unsafe sanitation and lack of hygiene (exposure to unsafe Water, Sanitation and Hygiene for All (WASH) services)	Implemented activities to decrease the mortality rate	Availability of fresh water for human consumption has increased due to biochar use, as less water is needed for irrigation. The health benefits due to plentiful availability of fresh water and its effect in reduction of mortality rates can only be evident over a longer period of time than the eight and a half months of the current monitoring period.	Biochar use in soil affects fresh water requirements for irrigation and farming. Higher fresh water availability has beneficial effects on human health. These effects would only be evident over a longer period of time than the eight and a half months of the current monitoring period.
8	5.1	Project Indicator: Selection of women to be biochar producers to increase equality and reduce discrimination in access to work	Implemented activities to increase women participation in biochar producing activities	The project emphasizes on selection of women for the production. 57% of 5,000 biochar producers are women. As a result, participating women now have access to work opportunities in the project.	in the project. 57% of 5,000 biochar producers in the project are women. This is a step towards gender equality and reduced discrimination in access to work.

9	5.4	5.4.1 Proportion of time spent on unpaid domestic and care work, by sex, age and location	Implemented activities to decrease the time spent on idle hours and unpaid work	Due to disguised employment in the farm and unavailability of work, the families, especially women, were left with no choice but to do unproductive work. Time spent on biomass collection, biochar production, and its application has improved their productivity and increased access to productive employment. 2,850 women have had access to productive work opportunities during the monitoring period..	2,850 women have received access to productive work opportunities and benefits from it this far in the project's lifetime.
10	5.5	5.5.2 Proportion of women in managerial positions	Implemented activities to increase women in managerial roles	The management team of the project consists of 26 members, out of which 13 are women. The project ensures equal access to employment in managerial positions for both men and women.	Currently, the project has appointed 13 women in managerial roles.
11	5.b	5.b.1 Proportion of individuals who own a mobile telephone, by sex	Implemented activities to increase proportion	188 field officers and 13 managers in the project are women. The field officers in the project use the Reignite monitoring mobile app to monitor the farmers and report the results of the project. 201 women have been trained in the use of mobile smartphones technology and the use of dMRV.	188 women are field officers and 13 are managers, who have been rigorously trained on usage of the Reignite mobile app for monitoring.

12	6.3	6.3.2 Proportion of bodies of water with good ambient water quality	Implemented activities to increase water quality level in the water bodies	The implementation of the project has caused an improvement in the quality of local water bodies, particularly removal of ipomoea carnea (invasive species) and the reduction of chemical fertilizer use, as well as biochar's water cleaning effects. However, an exact estimation of this proportion is not feasible for the short duration of the current monitoring period.	The proportion of water bodies with good water quality has increased over the lifetime of the project thus far, due to the positive effects of biochar. The exact estimation of a proportion value can, however, be quantified only over a period of time.
13	6.4	6.4.1 Change in water-use efficiency over time	Implemented activities to increase water use efficiency	The biochar's water holding capacity and increase in moisture retention in the farm has led to an increase in water use efficiency due to the decrease in freshwater consumption for agricultural activities and reduction in leaching of nutrients. An exact estimation of the increase is not feasible, however, for the short duration of the current monitoring period.	The current monitoring period is not a sufficient period of time to report measurable benefits in water use efficiency. Results from the effects of biochar application can be quantified over a period of time. However, the water use efficiency has gone up due to decrease in fresh water consumption for agricultural activities and reduction in leakage has taken place.

14	6.4	6.4.2 Level of water stress: freshwater withdrawal as a proportion of available freshwater resources	Implemented activities to decrease freshwater withdrawal	Biochar application to the soil reduces water needs for irrigation and brings about savings in fresh water withdrawal. Quantification of fresh water withdrawal as a proportion of the total available fresh water resources can be done, however, over a period of time. It is not feasible to quantify this improvement over as short a period as the current monitoring period.	The project has reduced water stress as a result of reduction in freshwater withdrawal. However, quantifying the same is not feasible over the current monitoring period which is even less than a year.
15	6.6	6.6.1 Change in the extent of water-related ecosystems over time	Implemented activities to have a beneficial effect of water related ecosystems	Removal of ipomoea carnea has benefited the local water bodies. The project has removed approx. 22,900 tons of ipomoea carnea that infests local water bodies.	Production of biochar using ipomoea carnea, local invasive species, has benefited local water ecosystems. 22,900 tons of ipomoea carnea has been removed in the current monitoring period and so far in the project. implementation lifetime. .
16	8.3	8.3.1 Proportion of informal employment in total employment, by sector and sex	Implemented activities to decrease informal employment	The project has created working opportunities for 401 people. In this monitoring period, 3,595 farmers have benefited from the employment opportunity created as a result of the biochar making activity.	401 work opportunities for members of monitoring team and 3,595 work opportunities for farmers have been created in the lifetime that the project has been operated so far.

17	10.1	10.1.1 Growth rates of household expenditure or income per capita among the bottom 40 per cent of the population and the total population	Implemented activities to increase average household income	Biochar making activities have created an additional source of income for the participating farmers. The additional income, part of which is disposable, has led to increased household expenditure. However, the short duration of the current monitoring period does not permit substantial data to be collected, analysis of which could be used to verify expenditure trends.	Overall increase in income has led to growth in household expenditure too, since part of that income is disposable. The project plans to conduct annual farmer surveys to check expenditure growth, especially among the bottom 40% stratum of the rural population in villages within which the project is being implemented. From the next verification once the project completes an year, data would be available to confirm the progress achieved on this indicator..
18	10.2	Project Parameter: Number of smallholder farming families connected with global value chain and included in voicing for climate action	Implemented activities to increase	With the implementation of the project, 5,000 families are now directly connected to a platform (Project Reignite), which is in turn connected to the global value chain for credits (supplier-trade-buyer) and have thus found a voice in climate action through active stakeholder engagement. 3595 families have benefitted from it in the current monitoring period.	5,000 families are now connected with the global carbon removal value chain, which they would not have been in the absence of the project. The stakeholders are continuously contributing to biochar carbon removal efforts, research, and shaping the presence of climate action. 3595 families have benefitted from it in the current monitoring period.

19	11.6	11.6.2 Annual mean levels of fine particulate matter (e.g. PM2.5 and PM10) in cities (population weighted)	Implemented activities to decrease the fine particulate matter (PM 2.5 and PM 10)	Prevention of approx. 280,000 tons of biomass from open field burning in villages in the project has directly reduced the presence of fine particulate matter (PM 2.5 and PM 10) in the villages and nearby populated areas. The exact levels of PM 2.5 and PM10 are difficult to track and quantify due to the extent and geographical spread of the project, which makes the collection of data on PM 2.5 , PM 10 extremely difficult.	The project has directly contributed to decreasing emissions and increasing air quality as it has avoided the common practice of stubble burning of crop residues in fields. The project has directly avoided emissions of PM2.5 and PM10 that would have otherwise occurred from the open field burning of 280,000 tons of biomass in the baseline scenario.The exact levels of PM 2.5 and PM10 are difficult to track and quantify due to the extent and geographical spread of the project, which makes the collection of data on PM 2.5 , PM 10 extremely difficult.

20	12.2	12.2.2 Domestic material consumption, domestic material consumption per capita, and domestic material consumption per GDP	Implemented activities to increase sustainable consumption	The project, by producing biochar, in significant amounts, has avoided the use of chemical fertilizers that would have been required in the baseline scenario. Reduction in the use of chemical fertilizers has reduced its consumption and consumption per capita has reduced its consumption levels. However, an exact quantification of the decrease in consumption would not be feasible in the short duration of this monitoring period, of only eight months and a half.	Saving of chemical fertilizer that would have been used in the absence of the project is a decrease in domestic material consumption and material consumption per capita, since all chemical fertilizers are sourced locally and are therefore counted as domestic consumption. An exact quantification of how much the material consumption has decreased, would not be feasible to do at this stage of the project. As time progresses, more data on chemical use would become available and estimates would be prepared.
21	12.5	12.5.1 National recycling rate, tons of material recycled	Implemented activities to increase	By repurposing waste biomass to biochar, the project moves towards establishing circular economics in the farms. This has resulted in 100% reuse of close to 280,000 tons of waste biomass annually. This transition from a linear “take-make-dispose” model to a circular one is a key step towards sustainable production and consumption.	So far, the recycling rate of 3,595 farmers has shifted from negligible to 100% in the context of waste biomass. This has also led to nutrient recycling which would have earlier been lost.

22	13.0	Tonnes of greenhouse gas emissions avoided or removed	Implemented activities to increase emission removals	Avoidance of baseline emission from open field burning of waste biomass and removal of 115,103 tCO2eq has taken place due to the project.	So far, the project has removed 115,103 tCO2eq for a period of at least 100 years.
23	15.3	15.3.1 Proportion of land that is degraded over total land area	Implemented activities to decrease the proportion of degraded land	The project has prevented farmland belonging to marginalized local communities from further degradation and has promoted soil health through biochar-manure blend application and prevention of excessive use of chemical fertilizers. The project will be preventing approx. 32,000 hectares of agricultural land from degradation through biochar application, when implemented by all the farmers. The current monitoring period covers approx. 23,008 hectares of biochar application, as the number of biochar producers who have been active the project so far in the monitoring period is 3595.	Biochar's ability to improve soil structure, water retention, and nutrient availability is well-supported by scientific literature. To date, in the operational lifetime of the project so far, approximately 23,008 hectares have been subjected to biochar application.

24	17.7	Project Indicator: Use of science and technologies invented and documented in developed countries being used in the project	Implemented activities to increase use of science and technologies	The project has implemented biochar making with 3,595 families in this monitoring period through the scientific method of flame curtain pyrolysis. It has also trained the Reignite monitoring team in technological tools using smartphones and Reignite dMRV mobile application for recording project activities.	The project is facilitating transfer of sustainable agriculture technology from developed countries to developing areas. The concept of flame curtain pyrolysis and "Kon-tiki" has been conceptualized by Ithaka Institute in Switzerland and is being implemented in India for the benefit of smallholder farmers.

1.13 Commercially Sensitive Information

No information has been excluded from the public version of this document.

2 SAFEGUARDS AND STAKEHOLDER ENGAGEMENT

2.1 Stakeholder Engagement and Consultation

2.1.1 Stakeholder Identification

Stakeholder Identification	The stakeholder profile has not changed since validation. All stakeholders were identified before validation and complete consultations were performed. The project proponent is keeping a track of additional stakeholders and potential changes. If there are any, they will be reported in the future monitoring reports. All stakeholders till now have been identified and made aware of each other. The proponent manages all steel shielded soil pits and Project Reignite monitoring team keeps track of maintenance. The identification of stakeholders is carried out through comprehensive local stakeholder consultations. These sessions are systematically organized within each block where the project operates. The process involves active participation from biochar producers, farming families, and other members of the local communities. Village leaders, particularly the heads of each village, are consulted and informed about the project. Their role as leaders in the stakeholder identification process ensures transparent communication and effective involvement of local stakeholders. The identified stakeholders are categorized as follows: 1. Primary Stakeholders: This group includes biochar producers and farming families directly involved in and impacted by the project. 2. Secondary Stakeholders: This category comprises the neighboring families and other villagers residing in the project area who are indirectly influenced by the project activities but are not directly involved by the project.
Legal or customary tenure/access rights	The project respects and acknowledges all legal and customary tenure and access rights held by stakeholders, particularly biochar producers and their families. These stakeholders have full ownership of the territories and resources used within the project. There are no interventions or changes in the land ownership or tenure rights of the farmers. The project operates within the framework of existing legal and customary systems, ensuring harmony with established practices and avoiding conflicts over land or resources.

Stakeholder diversity and changes over time	The stakeholder groups involved in the project are characterized by social, economic, and cultural diversity that reflects the rural context of the project area. Stakeholders include farming families with varying economic capacities and farming practices. However, there is no anticipated change in the diversity of stakeholder composition over time, as the demographic and cultural context of the region is relatively stable. The interactions between stakeholder groups are cooperative and collaborative, further supporting the project's implementation and goals.
Expected changes in well-being	The project is expected to positively impact the well-being of stakeholders over its duration. Key improvements include: • Elimination of open-field burning, which leads to better air quality. • Reduction in the use of chemical fertilizers, promoting healthier soils and reducing input costs for farmers. • Enhanced crop yields, both in quality and quantity, leading to increased agricultural income. • Improvement in local water quality due to reduced runoff of harmful chemicals. These changes collectively contribute to better health, financial stability, and environmental conditions for the stakeholders involved in the project.
Location of stakeholders	The stakeholders, including biochar producers, farming families, and other members of the community, are primarily located within the state of Odisha, India. The project's activities and impacts are concentrated within these specific areas. No adverse effects are anticipated for regions outside the defined project boundaries.
Location of resources	The resources associated with the stakeholders, including their lands and biochar production facilities, are located within Odisha, India. The biochar produced is fully owned by the stakeholders and utilized on their family farms to enhance soil fertility and crop productivity. This localized ownership ensures sustainability and direct benefits for the communities involved.

2.1.2 Stakeholder Consultation and Ongoing Communication

Ongoing consultation	Following measures are taken for continuous communication and ongoing consultation: 1. Regular project updates delivered to biochar producers: Project Reignite monitoring team is updated on the project status regularly. They are further responsible to communicate changes to all biochar producers in the project. They act as a channel of communication for biochar producers as well. Project Reignite monitoring team has a messaging feature on their mobile app through which they can directly communicate concerns or questions of biochar producers and other members of local communities. The communication is stored in the Project Reignite database and the management is always updated on the communication. 2. Regular meetings organized by management: Project proponent's management team visits all villages of project area regularly to meet with local stakeholders, hear their concerns, deliver updates, and gather feedback. 3. Helpline number: All local stakeholders have been made aware about the project helpline number, which they can call and raise their concerns, ask questions, or provide feedback. 4. Village chiefs as a point of contact: We understand that there might be occasions where members might not want to contact us directly. Hence, they can contact their village chief, who can further contact the general manager of the project. 5. Anonymous reporting: Local stakeholders can write their concerns and drop the letter at the village chief's office anonymously to report their concerns if there is any feedback. We aim to achieve inclusivity and maintain a transparent ongoing communication process between local stakeholders.
Date(s) of stakeholder consultation	15-Jan-2023

Communication of monitored results	Project Reignite monitoring team views all monitoring records on their app. They have all records available at all points in time and they are further responsible to communicate them with biochar producers. In addition, all biochar producers are made aware of the monitoring records once internal verification is successfully completed for those records. Hence, the Reignite monitoring team acts as a continuous communication channel for the biochar producers. Any member can also call on the helpline number and ask questions about the results.
Consultation records	All questions asked during the local stakeholder consultation were recorded and analyzed. Feedback from consultations has been incorporated in the project. A summary of the record can be found in Section 2.2 of the PD. All feedback/ questions/ concerns have been recorded, analyzed, incorporated, and stored in the project data room.
Stakeholder input	The project development and management team received all the documented ground feedback and implemented it in the project design.

2.1.3 Free Prior and Informed Consent

Consent	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 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.
Outcome of FPIC	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.

2.1.4 Grievance Redress Procedure

Grievances received	Resolution and outcome

N/A	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

Summary of comments received	Actions taken
N/A	All public comments were resolved during validations and no further actions were required.

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 centres 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 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
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, release of hazardous materials)	No risk identified	N/A

2.3 Respect for Human Rights and Equity

2.3.1 Labor and Work

	Risks identified	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 harassment. A strict anti-harassment policy is in place for the project and there is zero tolerance for the same.	The project maintains a strict anti-harassment policy, with ongoing awareness campaigns and training for all workers and stakeholders. Anonymous complaint systems and regular audits are in place to prevent and address any incidents.
Gender equity in labor and work	The project adheres to a policy of gender equality, offering equal pay for equal work and ensuring representation of all genders in leadership roles.	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.
Forced labor	There is no forced labor involved. The project enforces a non-negotiable condition of work at free-will.	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.
Child labor	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.	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.
Human trafficking	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.	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.

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 or preventative measure(s) 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.

2.3.5 Benefit Sharing

Summary of the benefit sharing plan	Project Reignite incurs all costs of biochar production, its application, and monitoring.
Benefit sharing during the monitoring period	The benefit sharing mechanism is in place in which farmers are reimbursed for biochar production costs and biochar is applied in their and family farms.

2.4 Ecosystem Health

	Risks identified	Mitigation or preventative measure(s) taken during the monitoring period
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

2.4.1 Rare, Threatened, and Endangered species

Species or habitat	The biochar production under Project Reignite has had 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

Use the table below to identify and summarize any risks related to habitats for rare, threatened, and endangered species, and for areas for habitat connectivity. Describe the commensurate mitigation or preventative measure(s) in place to prevent or mitigate the identified risk during the monitoring period. Where no risk is identified, write 'No risk identified' in the first column, and provide justification in the second column.

	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
N/A	N/A	N/A	N/A

Where invasive species exist in the project area, list such species in the table below and describe the commensurate mitigation measure(s) in place to prevent the spread or continued existence of invasive species.

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

Use the table below to identify and summarize any risks related to invasive species. Describe the commensurate mitigation or preventative measure(s) in place to prevent or mitigate the identified risk during the monitoring period. Where no risk is identified, write 'No risk identified' in the first column, and provide justification in the second column.

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

2.4.3 Ecosystem conversion

	Risks identified	Mitigation or preventative measure(s) taken
N/A	N/A	N/A

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

Project Reignite's implementation of biochar production training and testing protocols aimed to ensure the transfer of knowledge and skills necessary for the production of biochar through flame curtain pyrolysis. The initiative commenced in June 2023, encompassing a multi-faceted approach divided into theoretical learning, practical demonstrations, and adaptive response training.

The theoretical component addressed the foundational concepts of flame-curtain pyrolysis, safety measures, equipment maintenance, and quality control processes. Training materials were translated into the local language, Odia, to facilitate comprehensive understanding among farmers. This phase was designed to equip farmers with the necessary scientific knowledge of biochar production and its implications on soil quality and crop yield.

Following the theoretical sessions, practical demonstrations were conducted, where farmers engaged in hands-on activities under the guidance of trained and tested field officers. This experiential learning segment was critical for bridging the gap between theory and practice, allowing farmers to apply their knowledge in a controlled setting, reinforcing technical skills, and operational procedures.

Additionally, the training incorporated a section on exceptional case handling, preparing farmers for non-standard operational scenarios such as equipment malfunctions or uncertain environmental variables that could affect the pyrolysis process. Simulation of these scenarios was important to build resilience and problem-solving capacities among the farmers.

In July 2023, the testing phase started, serving as both an evaluative and reinforcing educational step. Field officers conducted on-site assessments for all farmers to verify the ability to produce high-grade biochar while adhering to the established safety and quality guidelines. The testing phase included deliberate exposure to atypical situations to ensure each farmer's ability to navigate unforeseen challenges.

Farmers who satisfied the project's quality criteria were formally registered and titled as biochar producers. This registration process was backed by the distribution of operational guideline booklets, consolidating the training's content and protocols.

Concurrently, Project Reignite monitoring team, composed of field officers, managers, and a general manager, underwent specialized training to proficiently execute supervision, monitoring and auditing tasks. This training was aligned to ensure data collection, verification of production practices, and compliance with project standards were systematically conducted.

The monitoring framework, detailed in Section 5 of the project design document, outlines the hierarchical structure and responsibilities of the monitoring team. This structure ensures ongoing adherence to production standards, enabling proactive identification and correction of deviations from the project's guidelines.

In summary, Project Reignite's training and testing regimen for both farmers and the monitoring team was developed and executed in the summer of 2023, ensuring high-quality training process of farmers and establishment of a robust monitoring system to uphold the project's standards.

Following the project’s training and testing, steel-shield soil pits were installed and verified throughout Q3 in 2023.

Biochar production and soil application commenced on 16th October, 2023.

Biochar producers used the residues of agricultural produce and invasive species in their farm to produce biochar. The biomasses used included paddy base and straw, maize cobs, bamboo trimmings, Tree prunings, water hyacinth, and ipomoea carnea. Biochar production and application monitoring took place in accordance with the monitoring plan detailed in Project Reignite PD v1.1.

The monitoring period in this report is from 16th October 2023- 30th June 2024. A total of 69,860.1 tons of biochar was produced among 3,595 farmers out of the entire cohort of 5,000 farmers using 6 types of feedstocks. The biochar application resulted in sequestration and storage of 115,103 tCO_2 equivalent.

3.2 Deviations

3.2.1 Methodology Deviations

Table: Methodology Deviations Applied

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 *t*.	Frequency of monitoring will be on a monthly basis for random samples of biochar produced of type *t*. 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.

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.

3.2.2 Project Description Deviations

This monitoring period makes two additions to the project compared with the Project Description. They are as follows:

1. Addition of Moisture Content of Biomass as a Monitoring Parameter
2. Addition of Cotton Stalks as a biomass

Please find below the descriptions of requirements set forth by VCS Standard 4.7 for PD Deviations:

1. Addition of Moisture Content of Biomass as a Monitoring Parameter

To enhance the quality of biochar production, the project has introduced a new monitoring parameter: biomass moisture content. This parameter ensures that only suitable biomass is used in the production process.

Field officers are equipped with handheld moisture meters and are responsible for checking the moisture content of biomass before each batch of biochar is produced. For each batch, a field officer randomly collects a handful of biomass and uses the moisture meter to measure its moisture content.

If the biomass moisture content is below 15%, the officer authorizes the producer to proceed with biochar production. If it is above 15%, the biomass must undergo additional sun or air drying before it can be used. Although biomass naturally tends to dry below 15% moisture due to exposure to heat, this monitoring step has been added to formalize quality control.

As an additional safeguard, the project suspends biochar production during July, August, and September, corresponding to the monsoon season. During this period, higher ambient humidity makes it difficult to maintain biomass at the required moisture levels. The addition of this parameter makes the monitoring plan more complete and ensures better control over the production process. Also, it improves the quality of the biochar output. The inclusion of this parameter has no effect on the applicability of the methodology, validity of the baseline scenario and the project additionality. Therefore, adding this parameter is in line with the paragraph 3.21 of the VM 0044 v1.1 methodology.

2. Addition of Cotton Stalks as a biomass

The project has introduced an additional biomass: cotton stalks. Cotton Stalks are woody stems of the cotton plant and are residues of the cotton crop. They are commonly burnt by smallholder farmers in India. As cotton stalks are of the same nature and similar carbon content as tree pruning, it can be classified under woody biomass. The deviation positively impacts the project and matches the baseline, additionality, and applicability conditions of other types of biomasses in the project.

- Whether the deviation impacts the applicability of the methodology, the project additionality, or the appropriateness of the baseline scenario.
  - As per the VCS Standard v4.7, paragraph 3.21, whether deviation does not impact the applicability of the methodology. The biomass matches all the applicability conditions of the methodology, additionality, and the baseline. In summary, cotton stalks, which are biogenic in origin, are also subjected to open field burning in the baseline scenario and is subjected to the flame curtain pyrolysis to produce biochar, which is applied in the same farms where the biomass originates from. Also, the cotton stalks are locally grown and sourced; do not need to be imported from other regions or districts and fulfill the sustainability conditions for eligible biomass types, as justified in the tables below.
  - Further, the choice of cotton stalks as a waste biomass type to be used for biochar making has no effect on the additionality of the project, because the project is additional merely by its being on the positive list and the types of biomass used has no bearing on its additionality.
  - The project proponent (1) sources waste biomass, (2) produces biochar and (3) ensures the biochar is utilized in soil application. Cotton Stalks meet the following applicability conditions, same as other biomasses in the project:

Table: Technological scope

S. No.	Condition	Applicability
1)	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.	Cotton Stalks, which is added in this monitoring period, matches the sustainability conditions. The methodology is applicable as the biochar is being produced from eligible waste biomass (described in Table 6 below) using flame curtain pyrolysis technology and the biochar is subsequently applied to soil as an end use. No other process of biochar production is a part of the project activity.
2)	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.	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.
3)	The biochar producers must have a health and safety program to protect workers from airborne pollutants and other hazards.	Cotton Stalks is also produced using the same production technology. Biochar producers are following a health and safety program to protect their health. The summary of the health and safety program is following: 1. The production facility (steel-shield soil pit) should be located at a safe distance from physical structures to prevent fires. 2. The biochar producer should wear a face mask and hand gloves during production for protection. 3. The biochar producer should maintain a safe

		distance from the fire and should use a long stick to control the fire. 4. The biochar producer should wear non-inflammable clothing during production and should have access to safety kits in close vicinity.

Table: Eligible feedstocks and production

S. No.	Condition	Applicability
4 a)	Feedstock must be purely biogenic waste biomass and not purpose-grown.	Biochar producers only use biogenic waste biomass originating from their own/family's/neighbours' farms to produce biochar. Cotton Stalks is also biogenic waste biomass originating from their own/family's/neighbours' farms. As waste biomass is the by-product of cultivation of crops (primary activity of farmers), it is not purpose-grown. Cotton Stalks is a by-product of cultivation of the cotton crop.
4 b)	Feedstock must have been otherwise left to decay or combusted for the purposes other than energy production.	In the absence of the project activity, feedstock would have been and will be combusted in the open field for purposes other than energy production. Following information source has been used to demonstrate the same: The source of biomass (cotton stalks) 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 were practicing open field burning and decay of biomass. Signed

		attestations in line with Appendix 2 of the methodology confirm that the biomass (cotton stalks) 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 (cotton stalks) 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.
4 c)	Feedstock must not have been imported from other countries.	The biochar producers only use waste biomass (cotton stalks) from their own/family's/neighbours' farms to produce biochar. No transportation of biomass, except walking distance, takes place. Thus, feedstock is 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 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: 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 propends 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 production (e.g., open burning or stubble) 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).	Cotton Stalks	In the baseline scenario, agricultural waste was being burnt without energy production. Earlier, majority of the waste biomass was put on fire to clear the field and some of the biomass that comes out during harvesting was 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 (cotton stalks) was burned without energy production. Furthermore, in the project activity, biochar is bein mixed with manure and applied to the same farms from which waste biomass originates, and 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.

[3] Available at https://doi.org/10.1016/j.apsoil.2017.06.008

[4] Available at https://doi.org/10.1111/gcbb.12665

Table: 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 is made from a single feedstock (cotton stalks in this case) per batch and complies 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 is no transportation involved as the biochar is 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 are not 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

	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.	

Table: Eligible biochar end-use application criteria

S. No.	Condition	Applicability
9)	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.	Biochar is produced from the waste biomass after the agricultural season ends and crops are harvested. Cotton is produced within the farm and stalks are the leftovers after harvesting of cotton. Biochar producers apply biochar as production takes place. Thus, biochar is utilized within a few weeks of its production. The monitoring plan described in Section 5.3 includes tracking of the biochar applied.
10)	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:	Biochar is applied to the soil subsurface as a mixed soil amendment with manure (cow dung). a) There is no risk of transferring unwanted heavy metals and organic contaminants to soil. Farmers are applying biochar made from biomass that originated from

	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 Guidelines or EBC Production Guidelines, or relevant national regulations for avoiding soil contamination. b) have a hydrogen to organic carbon molar ratio ($H:C_{org}$) of less than or equal to 0.7	the same farm. Thus, there is no risk of cross contamination as the biochar is not transported to a centralised facility. b) $H:C_{org}$ is being 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.
11)	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.	Biochar is not used in non-soil applications in the project. Thus, the condition is not applicable.

12)	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).	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.
13)	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.	Biochar is not used for soil application and will not be used for any other purposes.

[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

14)	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).	Biochar is only used for soil application. Thus, it will not be used in application in which substantial amounts of the biochar are oxidised.
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 is not used in non-soil application.

- Provide an explanation of the outcome of any deviations.
    - The deviation does not impact the project negatively. The biochar made from cotton stalks is similar in nature to tree pruning and bamboo pruning as the biomass is woody in nature. The biochar made from cotton stalks was subjected to the same process and monitoring conditions as other biomasses in the project. The deviation, in fact, positively impacts the project as the carbon content is higher than majority of the biomass types and has a lower H:C ratio, which is positive for the permanence of biochar. Hence, the addition of cotton stalks as a biomass does not impact any outcome of the project other than positively impacting it in terms of additional carbon removal and higher permanence of the biochar.

3.3 Grouped Projects

No new project instances are being added in this monitoring period for the grouped project.

3.4 Baseline Reassessment

Did the project undergo baseline reassessment during the monitoring period?

○ Yes ◉ No

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

<table>
<tr><td>Data / Parameter</td><td>$F_{Cp,t,p}$</td></tr>
<tr><td>Data unit</td><td>Percent (%)</td></tr>
<tr><td>Description</td><td>Organic carbon content of biochar for each biochar type t produced in production facility p per tonne of biochar, on a dry weight basis (%)</td></tr>
<tr><td>Source of data</td><td>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</td></tr>
<tr><td>Value applied</td><td>
<table>
<tr><th>Feedstock Type</th><th>Feedstock</th><th>Organic Carbon Content</th></tr>
<tr><td>Rice husks and rice straw</td><td>Paddy Straw</td><td>0.49</td></tr>
<tr><td rowspan="2">Wood</td><td>Tree Pruning</td><td rowspan="2">0.77</td></tr>
<tr><td>Bamboo Pruning (Only taken from mature bamboo with woody stems)</td></tr>
<tr><td rowspan="3">Herbaceous</td><td>Maize Cobs</td><td rowspan="3">0.65</td></tr>
<tr><td>Ipomoea Carnea</td></tr>
<tr><td>Water Hyacinth</td></tr>
</table>
</td></tr>
<tr><td>Justification of choice of data or description of measurement methods and procedures applied</td><td>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.</td></tr>
<tr><td>Purpose of Data</td><td>Calculation of project emissions</td></tr>
<tr><td>Comments</td><td>Below are the reasonings for classification of each feedstock type:

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:</td></tr>
</table>

	Category: Wood Reasoning: While bamboo is technically a grass, mature bamboo develops a woody stem known as a culm. These woody culms 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. 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. 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. 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.

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 measurement methods and procedures applied	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 original carbon will remain in the biochar and may be accounted as a carbon sink after its final application. IPCC and EBC are internationally recognized, and the data provided in the guidelines are peer reviewed.
Purpose of Data	Calculation of project emissions

Comments	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, Tprod is measured on a continuous basis for each batch of biochar and is a monitoring parameter.

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 CH4/ 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

<table>
<tr><td>Data / Parameter</td><td>Biomass categories and quantities used for selection of the baseline scenario and production of biochar utilized in the project activity</td></tr>
<tr><td>Data unit</td><td>tonnes (t) on dry basis</td></tr>
<tr><td>Description</td><td>Biomass Categories and Quantities at each production facility[12]:
<table>
<tr><td>Feedstock Type</td><td>Feedstock</td><td>Estimated Amount available at baseline (in tonnes) each year</td></tr>
<tr><td rowspan="5">Agricultural Waste Biomass</td><td>Rice Straw</td><td>57</td></tr>
<tr><td>Tree Pruning</td><td>6</td></tr>
<tr><td>Bamboo Pruning</td><td>12</td></tr>
<tr><td>Maize Cobs</td><td>6</td></tr>
<tr><td>Ipomoea Carnea (Shrub)</td><td>6</td></tr>
<tr><td>Aquaculture Plants</td><td>Water Hyacinth (Eichhornia crassipes)</td><td>3</td></tr>
</table>
Biomass Quantities available at all production facilities (derived from the above values):
<table>
<tr><td>Feedstock Category</td><td>Feedstock</td><td>Estimated Amount available at baseline (in tonnes) each year</td></tr>
<tr><td rowspan="5">Agricultural Waste Biomass</td><td>Rice Straw</td><td>285,000</td></tr>
<tr><td>Tree Pruning</td><td>30,000</td></tr>
<tr><td>Bamboo Pruning</td><td>60,000</td></tr>
<tr><td>Maize Cobs</td><td>30,000</td></tr>
<tr><td>Ipomoea Carnea (Shrub)</td><td>30,000</td></tr>
<tr><td>Aquaculture Plants</td><td>Water Hyacinth (Eichhornia crassipes)</td><td>15,000</td></tr>
</table>

Biomass is sourced from the same/neighboring 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.
</td></tr>
<tr><td>Source of data</td><td>Expert judgement based on on-site assessment of biomass categories and quantities</td></tr>
</table>

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.

4.2 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 each production facility p in year y has been measured using a weighing scale. Moisture content has been 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
Value Monitored	2023- 23,561.80 2024- 46,298.30 Both 2023 and 2024- 69,860.1 tons (Sum of all production facilities where biochar was produced)
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 done at the beginning of the project and to be done every year.
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 has been measured using a weighing scale. Moisture content has been 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
Value Monitored	**2023:**

Feedstock (biochar type t)	**Total Mass of biochar on a dry weight basis for all production facilities p (tonnes) for this monitoring period**
Paddy Straw and Roots	12,885.68
Tree Pruning	2,923.00
Cotton Stalks	3,103.13
Bamboo Pruning	2,816.76
Maize Cobs	0
Ipomoea Carnea	1,833.23
Water Hyacinth	0
Total	**23,561.80**

2024:

Feedstock (biochar type t)	**Total Mass of biochar on a dry weight basis for all production facilities p (tonnes) for this monitoring period**
Paddy Straw and Roots	28681.02
Tree Pruning	1,596.89
Cotton Stalks	8,235.20
Bamboo Pruning	3889.80
Maize Cobs	0
Ipomoea Carnea	3895.39
Water Hyacinth	0
Total	**46,298.30**

Table 12: Total Biochar Production for all facilities *p per biochar type t 2023 and 2024 combined*

Feedstock (biochar type t)	**Total Mass of biochar on a dry weight basis for all production facilities p (tonnes) for this monitoring period**
Paddy Straw	41,566.7
Tree Pruning	4,519.89
Cotton Stalks	11,338.33
Bamboo Pruning	6,706.56

Maize Cobs	0
Ipomoea Carnea	5,728.62
Water Hyacinth	0
Total	**69,860.10**

Monitoring equipment	Weighing scale Specification: Electronic Portable 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 was done before the project and will be done annually.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	Biochar quantity has been weighed separately using a weighing scale for each biochar type t at each biochar production facility p. Moisture content has been 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 has used a representative sample from the field samples for testing. The laboratory has followed a similar testing method as ASTM D1762-84 Standard Test Method for Chemical Analysis of Wood Charcoal. The dry weight of biochar has been measured using the results. The values were cross verified using bulk density of each type of biochar filled in standardized bags and their count for each batch as an internal check. Lower of weight value obtained between moisture content and bulk density approach has been used.

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

<table>
<tr><td>Values Monitored</td><td>

Year	Temperature Average
2023	691 Degrees Celsius
2024	704 Degrees Celsius

</td></tr>
<tr><td>Monitoring equipment</td><td>Handheld high temperature industrial infrared thermometer</td></tr>
<tr><td>QA/QC procedures to be applied</td><td>Periodic calibration against a primary device provided by an independent NABL accredited laboratory.</td></tr>
<tr><td>Purpose of data</td><td>Calculation of project emissions</td></tr>
<tr><td>Calculation method</td><td>N/A</td></tr>
<tr><td>Comments</td><td>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 PRde,k taken as 0.89 corresponding to temperatures above 600 degrees C.</td></tr>
</table>

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 has been performed in the beginning of the project and will be performed annually as there will not be a material change in feedstock or thermochemical production parameters more frequent than annually.

<table>
<tr><td>Values Monitored</td><td>

Feedstock Type	Organic Carbon Content
Paddy Base (Roots) and Straw	53.92% (i.e. 0.5392)
Maize Cobs	Not Measured due to no production
Tree Pruning	80.84% (i.e. 0.8084)
Cotton Stalks	78.93% (i.e. 0.7893)
Bamboo Pruning	79.37% (i.e. 0.7937)
Water Hyacinth	Not Measured due to no production
Ipomoea Carnea	58.03% (i.e. 0.5803)

</td></tr>
<tr><td>QA/QC procedures to be applied</td><td>Laboratory accredited by India’s national agency NABL (National Accreditation Board for Testing and Calibration Laboratories).</td></tr>
<tr><td>Purpose of data</td><td>Calculation of project emissions</td></tr>
<tr><td>Calculation method</td><td>N/A</td></tr>
<tr><td>Comments</td><td>Field sampling has been done using the Sampling and Surveys for CDM Project Activities and Program of Activities Standard as a guideline.</td></tr>
</table>

<table>
<tr><td>Data / Parameter</td><td>$H:C_{org}$</td></tr>
<tr><td>Data unit</td><td>Dimensionless</td></tr>
<tr><td>Description</td><td>Ratio of hydrogen to organic carbon</td></tr>
<tr><td>Source of data</td><td>Laboratory analysis</td></tr>
<tr><td>Description of measurement methods and procedures to be applied</td><td>Nationally Accredited Laboratory analysis following EBC Production Guidelines.</td></tr>
<tr><td>Frequency of monitoring/recording</td><td>Annually field samples were collected using the Sampling and Surveys Standard for CDM Project Activities and Program of Activities as a guideline. Laboratory used a representative sample out of the field samples collected using Sampling.</td></tr>
<tr><td>Values Monitored</td><td>

Type of Biomass	Mean	Standard Deviation
Paddy Straw and Roots	0.34	0.06
Tree Pruning	0.28	0.07
Cotton Stalks	0.33	0.04
Bamboo Pruning	0.32	0.05
Ipomoea Carnea	0.40	0.07

</td></tr>
<tr><td>QA/QC procedures to be applied</td><td>Laboratory accredited by India’s national agency NABL (National Accreditation Board for Testing and Calibration Laboratories).</td></tr>
</table>

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 has been tested at the beginning of the project and will be tested annually. Field sampling has been done using the Sampling and Surveys Standard for CDM Project Activities and Program of Activities as a guideline.

Data / Parameter	Moisture Content of Biomass (Additional Project Parameter)
Data unit	%
Description	Moisture content of biomass being used for biochar production
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 to verify eligibility of biomass
Values Monitored	<table><tr><th>Type of Biomass</th><th>Moisture Content of Biomass Range</th></tr><tr><td>Paddy Straw and Roots</td><td>4.6- 11.1% (i.e. 0.046 - 0.111)</td></tr><tr><td>Tree Pruning</td><td>7.1- 12.2% (i.e 0.071 - 0.122)</td></tr><tr><td>Cotton Stalks</td><td>6.5- 8.9% (i.e. 0.065 - 0.089)</td></tr><tr><td>Bamboo Pruning</td><td>8.2- 12.6% (i.e. 0.082 - 0.126)</td></tr><tr><td>Ipomoea Carnea</td><td>7.9- 10.3% (i.e 0.079 - 0.103)</td></tr></table>
Monitoring equipment	Handheld moisture meter
QA/QC procedures to be applied	Periodic calibration as per the device manufacturer.
Purpose of data	Eligibility of biomass for biochar production
Calculation method	N/A

Comments	Project Reignite has introduced a project parameter by going beyond the methodology to ensure high quality biochar production. A random sample of biomass is extracted and used for each batch of biochar production to check the moisture content of the biomass. If the moisture content is beyond 15%, the biomass is not eligible for biochar production and is subject to additional drying in the air and under the sun. If the moisture content is below 15%, the farmer proceeds to make the biochar. The parameter is not required for the quantification; however, it is used to ensure production of high-quality biochar and ensuring the integrity of the process.

4.3 Monitoring Plan

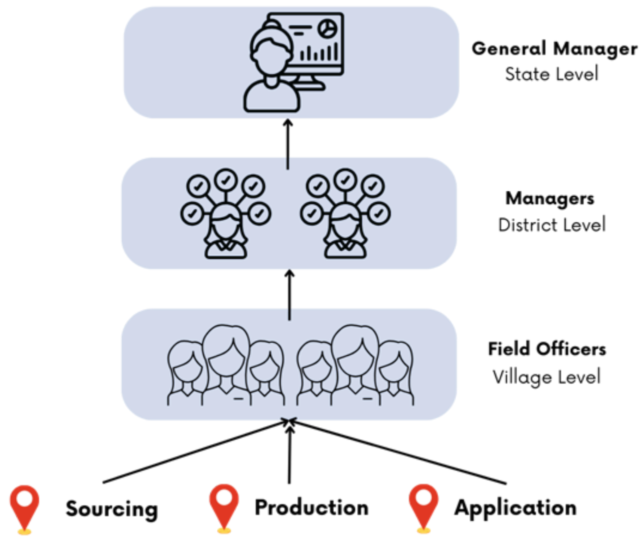
Description of Monitoring Plan

Main Objective

The main objective of the monitoring was 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 and presented for each verification. This process will continue to be used in future verifications to ensure ongoing accuracy and reliability of the project's carbon sink and emission quantifications.

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

Institutionally, a 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 consisted of a General Manager, Managers, and Field Officers. The General Manager has been responsible for leading the team and was appointed at the state level. Managers, specialists in agriculture, have been overseeing the work of field officers and were appointed at a district level. Their duties included on-site inspections, reviewing records, comparing new data with past figures for accuracy, and ensuring quality controls were in place. They have also been coordinating field officers to maintain consistent implementation and measurements. Field officers were responsible for field inspections of biochar production and application, further performing the data collection and using Project Reignite's internal mobile app to monitor and report ground data. All members of the team have expertise in agriculture and had experience ranging from 10 (field officers) to 35 years (general manager). They had been trained and tested by our scientific experts on biochar production and monitoring. This organizational structure and expertise will be maintained and expanded upon in future project instances to ensure the effective monitoring of biochar application and its impacts.



1. **Figure 5: Structure of monitoring team**

Training, Testing, and Registration of Personnel

Initially, the entire monitoring team (including the general manager, managers, and field officers) had been trained and tested by our scientific experts on biochar production and monitoring. Each biochar producer, shifting from traditional practices to biochar production to manage their farm waste, had 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 had been assigned an ID that represents their production facility. This comprehensive training and registration process will continue to be a crucial aspect of the project's implementation, ensuring that all personnel and biochar producers are well-prepared for their roles.

Type of technology used to produce biochar

Flame curtain pyrolysis technology in steel-shield soil pits was used to produce biochar, as further described in Section 1.11. This technology choice, based on its efficiency and environmental benefits, will remain the standard method for biochar production in the project, ensuring consistency and reliability in biochar quality and production processes.

Description of Monitoring Tasks

As the majority of farmers are located in remote areas without access to smartphones, internet, or the ability to use a mobile app, field officers regularly inspected and reported data using the Project Reignite mobile app. The monitoring tasks carried out included sourcing, where biochar producers (farmers) sourced waste biomass from their own or neighbouring farms, and production, where field officers visited biochar producers to inspect and verify the biomass and biochar production. Application tasks involved field officers supervising the application of biochar to the soil and collecting relevant data points. This hands-on approach to monitoring tasks will continue to ensure accurate and timely data collection and reporting.

The field officers in the project use the Reignite monitoring app to record biochar production and application performed by biochar producers in the project. The field officers monitor each batch of biochar produced and collect data points in the process.

- Sourcing
    - Biochar producers (farmers) sourced waste biomass from their own/ family's/ neighbors' farms. Field officers interviewed 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 visited the biochar producer (farmer) for each batch produced. During the visit, the field officer measured and verified the biochar production physically and sealed the bags filled with the biochar produced. They entered the below information on the app:
        - Inspection ID (generated automatically, linked with the field officer's and biochar producer's ID)
        - Type of biomass used to produce biochar (it can only be 1 type for a batch)
        - Moisture content of biomass used to produce biochar
        - Temperature of biochar production taken using a hand-held infrared thermometer
        - Weight of biochar produced
        - Number of standardized bags of biochar
        - Date of biochar production
- Application

- Once the biochar producer (farmer) was ready to apply the inspected biochar to the soil, the field officer visited the farm and opened the sealed bags. The sealed bags were opened only in the presence of the field officer inspecting the farm. For any bag whose seal was found broken, the field officer performed a second weighing and revised the total weight of the batch recorded on the app. The lower of the two weight readings was 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 supervised the biochar producer during application to ensure all biochar produced has been applied to the soil. They collected 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

Internal Auditing to Check Data Integrity and Monitoring (QA/QC Procedure):
Managers regularly conducted internal audits of biochar producers to validate the data submitted by field officers through the app. This multi-layered verification approach reviewed digital records and corroborated them with physical evidence, producer statements, and other forms of verification. Managers were responsible for confirming the proper implementation of all quality control and quality assurance measures. This ongoing process of internal auditing and quality control will continue to play a crucial role in ensuring the integrity and reliability of the project's data.

Maintenance and Data Storage of the Project System
Given the long-term nature of the project, data collection and archiving were crucial components. All field data, data analyses, models, calculations of carbon stocks, and copies of the monitoring reports were stored in a dedicated cloud database with a backup facility. This system for maintenance and data storage will remain a foundational aspect of the project, ensuring that all relevant information is securely stored and accessible for future analysis, reporting, and verification purposes.

Sampling Approach for Lab Tests

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 have been measured and recorded for every batch of biochar produced. These values being weights of dry biochar produced, were 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 was taken and recorded, the value of moisture content was 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) were also determined using a sampling approach.

The sampling approach that has been 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 provided 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 were sent to an external laboratory for testing of 'Moisture content', '$F_{cp,t,p}$' and '$H:C_{org=}$'. The laboratory independently carried out its tests and provide results of the test to the PP. The test results were provided by the laboratory and were 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

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

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)/μ_e

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

Initial Sampling Pilot Study:

1. Paddy Straw and Roots Biochar

Pilot Study
Sample Size: 10

Parameter	Mean	Standard Deviation
Moisture content	11.06%	2.20%
$F_{cp,t,p}$	54.29%	1.23%
$H:C_{org}$	0.35	0.07

Sample Size calculation using the below formula:

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

where,
n= sample size
N= total number of biochar batches produced in the project

To take a conservative value of N, 300,000 was taken. The project proposes to produce 75k tonnes of biochar annually. Each batch of biochar produced in a steel shield soil pit on average weighs 250kgs. Thus, considering all batches, N= 300,000. While number of batches per month for moisture content will be lower, 300,000 was used as a conservative value to derive a higher sample size.

V= $(\sigma_e/\mu_e)^2$
1.645 represents the 90% confidence required
0.1 represents the 10% relative precision

Moisture Content:

$$n \geq \frac{1.645^2 \ x \ 300{,}000 \ x \ (\frac{2.20}{11.06})^2}{((300{,}000-1) \ x \ 0.1^2) + \ 1.645^2 \ x \ (\frac{2.20}{11.06})^2}$$

$F_{cp,t,p}$:

$$n \geq \frac{1.645^2 \ x \ 300{,}000 \ x \ (\frac{1.23}{54.29})^2}{((300{,}000-1) \ x \ 0.1^2) + \ 1.645^2 \ x \ (\frac{1.23}{54.29})^2}$$

$H{:}C_{org}$:

$$n \geq \frac{1.645^2 \ x \ 300{,}000 \ x \ (\frac{0.07}{0.35})^2}{((300{,}000-1) \ x \ 0.1^2) + \ 1.645^2 \ x \ (\frac{0.07}{0.35})^2}$$

Results:

Parameter	Sample Size
Moisture content	11
$F_{cp,t,p}$	1
$H{:}C_{org}$	11

2. Tree Pruning

Pilot Study
Sample Size: 10

Parameter	Mean	Standard Deviation
Moisture content	11.39%	2.55%
$F_{cp,t,p}$	81.04%	1.90%
$H{:}C_{org}$	0.30	0.08

Sample Size calculation using the below formula:

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

where,

n= sample size
N= total number of biochar batches produced in the project
To take a conservative value of N, 300,000 was taken. The project proposes to produce 75k tonnes of biochar annually. Each batch of biochar produced in a steel shield soil pit on average weighs 250kgs. Thus, considering all batches, N= 300,000. While number of batches per month for moisture content will be lower, 300,000 was used as a conservative value to derive a higher sample size.

$V = (\sigma_e/\mu_e)^2$
1.645 represents the 90% confidence required
0.1 represents the 10% relative precision

Moisture Content:

$$n \geq \frac{1.645^2 \ x \ 300{,}000 \ x \ (\frac{2.55}{11.39})^2}{((300{,}000 - 1) \ x \ 0.1^2) + 1.645^2 \ x \ (\frac{2.55}{11.39})^2}$$

$F_{cp,t,p}$:

$$n \geq \frac{1.645^2 \ x \ 300{,}000 \ x \ (\frac{1.90}{81.04})^2}{((300{,}000 - 1) \ x \ 0.1^2) + 1.645^2 \ x \ (\frac{1.90}{81.04})^2}$$

$H{:}C_{org}$:

$$n \geq \frac{1.645^2 \ x \ 300{,}000 \ x \ (\frac{0.08}{0.30})^2}{((300{,}000 - 1) \ x \ 0.1^2) + 1.645^2 \ x \ (\frac{0.08}{0.30})^2}$$

Results:

Parameter	Sample Size
Moisture content	14
$F_{cp,t,p}$	1
$H{:}C_{org}$	20

3. Cotton Stalks

Pilot Study
Sample Size: 10

Parameter	Mean	Standard Deviation
Moisture content	11.97%	2.68%
$F_{cp,t,p}$	78.11%	2.63%
$H{:}C_{org}$	0.31	0.03

Sample Size calculation using the below formula:

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

where,

n= sample size

N= total number of biochar batches produced in the project
To take a conservative value of N, 300,000 was taken. The project proposes to produce 75k tonnes of biochar annually. Each batch of biochar produced in a steel shield soil pit on average weighs 250kgs. Thus, considering all batches, N= 300,000. While number of batches per month for moisture content will be lower, 300,000 was used as a conservative value to derive a higher sample size.

$V= (\sigma_e/\mu_e)^2$
1.645 represents the 90% confidence required
0.1 represents the 10% relative precision

Moisture Content:

$$n \geq \frac{1.645^2 \ x \ 300{,}000 \ x \ (\frac{2.68}{11.97})^2}{((300{,}000 - 1) \ x \ 0.1^2) + \ 1.645^2 \ x \ (\frac{2.68}{11.97})^2}$$

$F_{cp,t,p}$:

$$n \geq \frac{1.645^2 \ x \ 300{,}000 \ x \ (\frac{2.63}{78.11})^2}{((300{,}000 - 1) \ x \ 0.1^2) + \ 1.645^2 \ x \ (\frac{2.63}{78.11})^2}$$

$H{:}C_{org}$:

$$n \geq \frac{1.645^2 \ x \ 300{,}000 \ x \ (\frac{0.03}{0.31})^2}{((300{,}000 - 1) \ x \ 0.1^2) + \ 1.645^2 \ x \ (\frac{0.03}{0.31})^2}$$

Results:

Parameter	Sample Size
Moisture content	14
$F_{cp,t,p}$	1
$H{:}C_{org}$	3

4. Bamboo Trimmings

Pilot Study
Sample Size: 10

Parameter	Mean	Standard Deviation
Moisture content	10.17%	2.21%
$F_{cp,t,p}$	79.06%	1.79%
$H{:}C_{org}$	0.31	0.05

Sample Size calculation using the below formula:

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

where,
n= sample size
N= total number of biochar batches produced in the project

To take a conservative value of N, 300,000 was taken. The project proposes to produce 75k tonnes of biochar annually. Each batch of biochar produced in a steel shield soil pit on average weighs 250kgs. Thus, considering all batches, N= 300,000. While number of batches per month for moisture content will be lower, 300,000 was used as a conservative value to derive a higher sample size.

V= $(\sigma_e/\mu_e)^2$
1.645 represents the 90% confidence required
0.1 represents the 10% relative precision

Moisture Content:

$$n \geq \frac{1.645^2 \ x \ 300{,}000 \ x \ (\frac{2.21}{10.17})^2}{((300{,}000 - 1) \ x \ 0.1^2) + \ 1.645^2 \ x \ (\frac{2.21}{10.17})^2}$$

$F_{cp,t,p}$:

$$n \geq \frac{1.645^2 \ x \ 300{,}000 \ x \ (\frac{1.79}{79.06})^2}{((300{,}000 - 1) \ x \ 0.1^2) + \ 1.645^2 \ x \ (\frac{1.79}{79.06})^2}$$

$H:C_{org}$:

$$n \geq \frac{1.645^2 \ x \ 300{,}000 \ x \ (\frac{0.05}{0.31})^2}{((300{,}000 - 1) \ x \ 0.1^2) + \ 1.645^2 \ x \ (\frac{0.05}{0.31})^2}$$

Results:

Parameter	Sample Size
Moisture content	13
$F_{cp,t,p}$	1
$H:C_{org}$	8

5. Ipomoea Carnea

Pilot Study
Sample Size: 10

Parameter	Mean	Standard Deviation
Moisture content	13.10%	2.25%
$F_{cp,t,p}$	57.92%	2.01%
$H:C_{org}$	0.41	0.06

Sample Size calculation using the below formula:

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

where,
n= sample size
N= total number of biochar batches produced in the project
To take a conservative value of N, 300,000 was taken. The project proposes to produce 75k tonnes of biochar annually. Each batch of biochar produced in a steel shield soil pit on average weighs 250kgs. Thus, considering all batches, N= 300,000. While number of

batches per month for moisture content will be lower, 300,000 was used as a conservative value to derive a higher sample size.

$V = (\sigma_e/\mu_e)^2$
1.645 represents the 90% confidence required
0.1 represents the 10% relative precision

Moisture Content:

$$n \geq \frac{1.645^2 \ x \ 300{,}000 \ x \ (\frac{2.25}{13.10})^2}{((300{,}000 - 1) \ x \ 0.1^2) + 1.645^2 \ x \ (\frac{2.25}{13.10})^2}$$

$F_{cp,t,p}$:

$$n \geq \frac{1.645^2 \ x \ 300{,}000 \ x \ (\frac{2.01}{57.92})^2}{((300{,}000 - 1) \ x \ 0.1^2) + 1.645^2 \ x \ (\frac{2.01}{57.92})^2}$$

$H:C_{org}$:

$$n \geq \frac{1.645^2 \ x \ 300{,}000 \ x \ (\frac{0.06}{0.41})^2}{((300{,}000 - 1) \ x \ 0.1^2) + 1.645^2 \ x \ (\frac{0.06}{0.41})^2}$$

Results:

Parameter	Sample Size
Moisture content	8
$F_{cp,t,p}$	1
$H:C_{org}$	6

6. Maize Cobs

Pilot Study
Sample Size: 10

Parameter	Mean	Standard Deviation
Moisture content	13.46%	2.76%
$F_{cp,t,p}$	68.51%	1.05%
$H:C_{org}$	0.38	0.10

Sample Size calculation using the below formula:

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

where,
n= sample size
N= total number of biochar batches produced in the project
To take a conservative value of N, 300,000 was taken. The project proposes to produce 75k tonnes of biochar annually. Each batch of biochar produced in a steel shield soil pit on average weighs 250kgs. Thus, considering all batches, N= 300,000. While number of

batches per month for moisture content will be lower, 300,000 was used as a conservative value to derive a higher sample size.

V= $(\sigma_e/\mu_e)^2$
1.645 represents the 90% confidence required
0.1 represents the 10% relative precision

Moisture Content:

$$n \geq \frac{1.645^2 \ x \ 300{,}000 \ x \ (\frac{2.76}{13.46})^2}{((300{,}000 - 1) \ x \ 0.1^2) + \ 1.645^2 \ x \ (\frac{2.76}{13.46})^2}$$

$F_{cp,t,p}$:

$$n \geq \frac{1.645^2 \ x \ 300{,}000 \ x \ (\frac{1.05}{68.51})^2}{((300{,}000 - 1) \ x \ 0.1^2) + \ 1.645^2 \ x \ (\frac{1.05}{68.51})^2}$$

$H:C_{org}$:

$$n \geq \frac{1.645^2 \ x \ 300{,}000 \ x \ (\frac{0.10}{0.38})^2}{((300{,}000 - 1) \ x \ 0.1^2) + \ 1.645^2 \ x \ (\frac{0.10}{0.38})^2}$$

Results:

Parameter	Sample Size
Moisture content	12
$F_{cp,t,p}$	1
$H:C_{org}$	19

7. Water Hyacinth

Pilot Study
Sample Size: 10

Parameter	Mean	Standard Deviation
Moisture content	17.41%	5.51%
$F_{cp,t,p}$	67.58%	1.49%
$H:C_{org}$	0.56	0.04

Sample Size calculation using the below formula:

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

where,
n= sample size
N= total number of biochar batches produced in the project
To take a conservative value of N, 300,000 was taken. The project proposes to produce 75k tonnes of biochar annually. Each batch of biochar produced in a steel shield soil pit on average weighs 250kgs. Thus, considering all batches, N= 300,000. While number of

batches per month for moisture content will be lower, 300,000 was used as a conservative value to derive a higher sample size.

$V = (\sigma_e/\mu_e)^2$
1.645 represents the 90% confidence required
0.1 represents the 10% relative precision

Moisture Content:

$$n \geq \frac{1.645^2 \ x \ 300{,}000 \ x \ (\frac{5.51}{17.41})^2}{((300{,}000-1) \ x \ 0.1^2) + \ 1.645^2 \ x \ (\frac{5.51}{17.41})^2}$$

$F_{cp,t,p}$:

$$n \geq \frac{1.645^2 \ x \ 300{,}000 \ x \ (\frac{1.49}{67.58})^2}{((300{,}000-1) \ x \ 0.1^2) + \ 1.645^2 \ x \ (\frac{1.49}{67.58})^2}$$

$H{:}C_{org}$:

$$n \geq \frac{1.645^2 \ x \ 300{,}000 \ x \ (\frac{0.04}{0.56})^2}{((300{,}000-1) \ x \ 0.1^2) + \ 1.645^2 \ x \ (\frac{0.04}{0.56})^2}$$

Results:

Parameter	Sample Size
Moisture content	28
$F_{cp,t,p}$	1
$H{:}C_{org}$	2

After the initial pilot study ended, sampling was repeated once for the $F_{cp,t,p}$ and $H{:}C_{org}$ for annual determination of the parameters for each biomass and monthly for Moisture content for each biomass. As a conservative measure, sample size was determined as 30 for each biomass for each parameter to ensure accurate and representative results. Production of biochar only took place for Paddy Straw and Roots biomass, Tree Pruning biomass, Cotton Stalks biomass, Bamboo Trimmings biomass, and Ipomoea Carnea biomass. Production did not take place for Maize Cobs and Water Hyacinth, which is why their tests were not conducted for the production period. Below are the summarized results:

Results for the project:

1. Paddy Straw and Roots Biochar

Sample Size: 30
$F_{cp,t,p}$ and $H:C_{org}$ Tested Annually:

Parameter	Mean	Standard Deviation
$F_{cp,t,p}$	53.92%	1.07%
$H:C_{org}$	0.34	0.06

Moisture Content tested monthly:

Month	Mean (%)	Standard Deviation (%)
October 2023	11.26	2.62
November 2023	10.52	2.31
December 2023	10.34	2.26
January 2024	10.11	1.89
February 2024	10.04	1.76
March 2024	9.94	1.88
April 2024	9.51	1.67
May 2024	9.45	1.43
June 2024	9.25	1.28

T Value for Sample Size 30 = 1.699127027

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

The relative precision (R.L.) = (t-value x ε)/μ_e

Calculations:
1. $F_{cp,t,p}$

$$R.L. = \frac{1.699127027x\sqrt{\left(1-\frac{30}{300{,}000}\right)(1.07)^2/30}}{53.92}$$

= 0.00616 < 0.1

2. $H:C_{org}$

$$R.L. = \frac{1.699127027x\sqrt{\left(1-\frac{30}{300{,}000}\right)(0.06)^2/30}}{0.34}$$

= 0.0547 < 0.1

3. Moisture Content

October:

$$R.L. = \frac{1.699127027\ x\sqrt{\left(1-\frac{30}{300{,}000}\right)(2.62)^2/30}}{11.26}$$

= 0.0722 < 0.1

November:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300{,}000}\right)(2.31)^2/30}}{10.52}$$

= 0.0681 < 0.1

December:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300{,}000}\right)(2.26)^2/30}}{10.34}$$

= 0.0678 < 0.1

January:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300{,}000}\right)(1.89)^2/30}}{10.11}$$

= 0.0580 < 0.1

February:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300{,}000}\right)(1.76)^2/30}}{10.04}$$

= 0.0544 < 0.1

March:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300{,}000}\right)(1.88)^2/30}}{9.94}$$

= 0.0587 < 0.1

April:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300{,}000}\right)(1.67)^2/30}}{9.51}$$

= 0.0545 < 0.1

May:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300{,}000}\right)(1.43)^2/30}}{9.45}$$

= 0.0469 < 0.1

June:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300{,}000}\right)(1.28)^2/30}}{9.25}$$

= 0.0429 < 0.1

As R.L. < 0.1 for all the results, the estimate is reliable for all parameters; the value of σ_{sample} is accepted as a reliable monitored value for the parameters i.e. Moisture content, $F_{cp,t,p}$,$H:C_{org}$

2. Tree Pruning

Sample Size: 30
$F_{cp,t,p}$ and $H:C_{org}$ Tested Annually:

Parameter	Mean	Standard Deviation
$F_{cp,t,p}$	80.84%	1.79%
$H:C_{org}$	0.28	0.07

Moisture Content tested monthly:

Month	Mean (%)	Standard Deviation (%)
October 2023	10.96	2.44
November 2023	11.19	2.11
December 2023	10.72	2.37
January 2024	10.91	2.24
February 2024	10.26	1.92
March 2024	10.87	2.08
April 2024	11.14	2.29
May 2024	9.93	1.92
June 2024	9.73	1.17

T Value for Sample Size 30 = 1.699127027

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

The relative precision (R.L.) = (t-value x ε)/μ_e

Calculations:

1. $F_{cp,t,p}$

$$R.L. = \frac{1.699127027x\sqrt{\left(1-\frac{30}{300,000}\right)(1.79)^2/30}}{80.84}$$

= 0.00687 < 0.1

2. $H:C_{org}$

$$R.L. = \frac{1.699127027x\sqrt{\left(1-\frac{30}{300,000}\right)(0.07)^2/30}}{0.28}$$

= 0.0776 < 0.1

3. Moisture Content

October:

$$R.L. = \frac{1.699127027\ x\sqrt{\left(1-\frac{30}{300,000}\right)(2.44)^2/30}}{10.96}$$

= 0.0691 < 0.1

November:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300,000}\right)(2.11)^2/30}}{11.19}$$

= 0.0585 < 0.1

December:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300,000}\right)(2.37)^2/30}}{10.72}$$

= 0.0686 < 0.1

January:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300,000}\right)(2.24)^2/30}}{10.91}$$

= 0.0637 < 0.1

February:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300,000}\right)(1.92)^2/30}}{10.26}$$

= 0.0580 < 0.1

March:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300,000}\right)(2.08)^2/30}}{10.87}$$

= 0.0594 < 0.1

April:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300,000}\right)(2.29)^2/30}}{11.14}$$

= 0.0638 < 0.1

May:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300,000}\right)(1.92)^2/30}}{9.93}$$

= 0.0600 < 0.1

June:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300,000}\right)(1.17)^2/30}}{9.73}$$

= 0.0373 < 0.1

As R.L. < 0.1 for all the results, the estimate is reliable for all parameters; the value of σ_{sample} is accepted as a reliable monitored value for the parameters i.e. Moisture content, $F_{cp,t,p}$,$H:C_{org}$

3. Cotton Stalks

Sample Size: 30
$F_{cp,t,p}$ and $H:C_{org}$ Tested Annually:

Parameter	Mean	Standard Deviation
$F_{cp,t,p}$	78.93%	1.93%
$H:C_{org}$	0.33	0.04

Moisture Content tested monthly:

Month	Mean (%)	Standard Deviation (%)
October 2023	12.22	2.48
November 2023	11.70	2.00
December 2023	11.39	2.41
January 2024	10.87	1.95
February 2024	11.27	1.75
March 2024	11.05	1.67
April 2024	10.71	1.66
May 2024	9.95	1.39
June 2024	9.12	0.80

T Value for Sample Size 30 = 1.699127027

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

The relative precision (R.L.) = (t-value x ε)/μ_e

Calculations:

1. $F_{cp,t,p}$

$$R.L. = \frac{1.699127027x\sqrt{\left(1-\frac{30}{300,000}\right)(1.93)^2/30}}{78.93}$$

= 0.0076 < 0.1

2. $H:C_{org}$

$$R.L. = \frac{1.699127027x\sqrt{\left(1-\frac{30}{300,000}\right)(0.04)^2/30}}{0.33}$$

= 0.0376 < 0.1

3. Moisture Content

October:

$$R.L. = \frac{1.699127027\ x\sqrt{\left(1-\frac{30}{300,000}\right)(2.48)^2/30}}{12.22}$$

= 0.0630 < 0.1

November:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300,000}\right)(2.00)^2/30}}{11.70}$$

= 0.0530 < 0.1

December:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300,000}\right)(2.41)^2/30}}{11.39}$$

= 0.0656 < 0.1

January:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300,000}\right)(1.95)^2/30}}{10.87}$$

= 0.0556 < 0.1

February:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300,000}\right)(1.75)^2/30}}{11.27}$$

= 0.0482 < 0.1

March:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300,000}\right)(1.67)^2/30}}{11.05}$$

= 0.0469 < 0.1

April:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300,000}\right)(1.66)^2/30}}{10.71}$$

= 0.0481 < 0.1

May:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300,000}\right)(1.39)^2/30}}{9.95}$$

= 0.0433 < 0.1

June:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300,000}\right)(0.80)^2/30}}{9.12}$$

= 0.0272 < 0.1

As R.L. < 0.1 for all the results, the estimate is reliable for all parameters; the value of σ_{sample} is accepted as a reliable monitored value for the parameters i.e. Moisture content, $F_{cp,t,p}$,$H:C_{org}$

4. Bamboo Pruning

Sample Size: 30
$F_{cp,t,p}$ and $H:C_{org}$ Tested Annually:

Parameter	Mean	Standard Deviation
$F_{cp,t,p}$	79.37%	2.10%
$H:C_{org}$	0.32	0.05

Moisture Content tested monthly:

Month	Mean (%)	Standard Deviation (%)
October 2023	10.12	2.70
November 2023	9.98	2.73
December 2023	10.04	3.03
January 2024	10.77	2.90
February 2024	9.73	2.91
March 2024	8.87	2.35
April 2024	9.04	2.52
May 2024	8.80	2.28
June 2024	8.34	1.67

T Value for Sample Size 30 = 1.699127027

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

The relative precision (R.L.) = (t-value x ε)/μ_e

Calculations:

1. $F_{cp,t,p}$

$$R.L. = \frac{1.699127027x\sqrt{\left(1-\frac{30}{300,000}\right)(2.10)^2/30}}{79.37}$$

= 0.0082 < 0.1

2. $H:C_{org}$

$$R.L. = \frac{1.699127027x\sqrt{\left(1-\frac{30}{300,000}\right)(0.05)^2/30}}{0.32}$$

= 0.0485 < 0.1

3. Moisture Content

October:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300,000}\right)(2.70)^2/30}}{10.12}$$

= 0.0828 < 0.1

November:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300,000}\right)(2.73)^2/30}}{9.98}$$

= 0.0849 < 0.1

December:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300,000}\right)(3.03)^2/30}}{10.04}$$

= 0.0936 < 0.1

January:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300,000}\right)(2.90)^2/30}}{10.77}$$

= 0.0835 < 0.1

February:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300,000}\right)(2.91)^2/30}}{9.73}$$

= 0.0928 < 0.1

March:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300,000}\right)(2.35)^2/30}}{8.87}$$

= 0.0822 < 0.1

April:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300,000}\right)(2.52)^2/30}}{9.04}$$

= 0.0865 < 0.1

May:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300,000}\right)(2.28)^2/30}}{8.80}$$

= 0.0804 < 0.1

June:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300,000}\right)(1.67)^2/30}}{8.34}$$

= 0.0621 < 0.1

As R.L. < 0.1 for all the results, the estimate is reliable for all parameters; the value of σ_{sample} is accepted as a reliable monitored value for the parameters i.e. Moisture content, $F_{cp,t,p}$, $H:C_{org}$

5. Ipomoea Carnea

Sample Size: 30
$F_{cp,t,p}$ and $H:C_{org}$ Tested Annually:

Parameter	Mean	Standard Deviation
$F_{cp,t,p}$	58.03%	2.16%
$H:C_{org}$	0.40	0.07

Moisture Content tested monthly:

Month	Mean (%)	Standard Deviation (%)
October 2023	13.37	1.97
November 2023	13.17	1.56
December 2023	13.05	1.54
January 2024	12.97	1.80
February 2024	12.97	1.83
March 2024	13.31	1.76
April 2024	12.80	1.69
May 2024	12.47	1.45
June 2024	11.96	1.19

T Value for Sample Size 30 = 1.699127027

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

The relative precision (R.L.) = (t-value x ε)/μ_e

Calculations:

1. $F_{cp,t,p}$

$$R.L. = \frac{1.699127027x \sqrt{\left(1 - \frac{30}{300,000}\right) (2.16)^2/30}}{58.03}$$

= 0.0115 < 0.1

2. $H:C_{org}$

$$R.L. = \frac{1.699127027x \sqrt{\left(1 - \frac{30}{300,000}\right) (0.07)^2/30}}{0.40}$$

= 0.0543 < 0.1

3. Moisture Content

October:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300,000}\right)(1.97)^2/30}}{13.37}$$

= 0.0457 < 0.1

November:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300,000}\right)(1.56)^2/30}}{13.17}$$

= 0.0367 < 0.1

December:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300,000}\right)(1.54)^2/30}}{13.05}$$

= 0.0366 < 0.1

January:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300,000}\right)(1.80)^2/30}}{12.97}$$

= 0.0431 < 0.1

February:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300,000}\right)(1.83)^2/30}}{12.97}$$

= 0.0438 < 0.1

March:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300,000}\right)(1.76)^2/30}}{13.31}$$

= 0.0410 < 0.1

April:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300,000}\right)(1.69)^2/30}}{12.80}$$

= 0.0410 < 0.1

May:

$$R.L. = \frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300,000}\right)(1.45)^2/30}}{12.47}$$

= 0.0361 < 0.1

June:

R.L. = $\frac{1.699127027\ x\ \sqrt{\left(1-\frac{30}{300,000}\right)(1.19)^2/30}}{11.96}$

= 0.0309 < 0.1

As R.L. < 0.1 for all the results, the estimate is reliable for all parameters; the value of σ_{sample} is accepted as a reliable monitored value for the parameters i.e. Moisture content, $F_{cp,t,p}$, H:C_{org}

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

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 ($BE_{SS,y}$).

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.

Application Stage

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

5.2 Project Emissions

Sourcing Stage

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

Production Stage

As production facilities and technologies differ in terms of potential to measure and report relevant parameters, the methodology provides two options (low and high technology) to derive the respective parameters based on characteristics of the technology used in the production facility. Please choose which option best fits your project:

- ○ Option P.1: High Technology Production Facility
- ◉ Option P.2: Low Technology Production Facility

All the production facilities in the project are classified under Low Technology Production Facilities.

Step 1: Estimate organic carbon content of biochar for low technology facilities

Below is the description of the calculation:

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

$CC_{t,k,y}$ = 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)

It was measured for each batch of biochar produced using handheld weighing scales and monitored on the Reignite monitoring app. Below are the sums for each year for the application type "soil application" for each biomass type.

The values were cross verified using bulk density of each type of biochar filled in standardized bags and their count for each batch as an internal check. Lower of weight value obtained between moisture content and bulk density has been used.

2023:

Feedstock (biochar type t)	Total Mass of biochar on a dry weight basis for all production facilities p (tonnes) for this monitoring period
Paddy Straw and Roots	12,885.68
Tree Pruning	2,923.00
Cotton Stalks	3,103.13
Bamboo Pruning	2,816.76
Maize Cobs	0
Ipomoea Carnea	1,833.23
Water Hyacinth	0
Total	**23,561.80**

2024:

Feedstock (biochar type t)	Total Mass of biochar on a dry weight basis for all production facilities p (tonnes) for this monitoring period
Paddy Straw and Roots	28681.02
Tree Pruning	1,596.89
Cotton Stalks	8,235.20
Bamboo Pruning	3889.80
Maize Cobs	0
Ipomoea Carnea	3895.39
Water Hyacinth	0
Total	**46,298.30**

Table 12: Total Biochar Production for all facilities *p per biochar type t 2023 and 2024 combined*

Feedstock (biochar type t)	Total Mass of biochar on a dry weight basis for all production facilities p (tonnes) for this monitoring period
Paddy Straw	41,566.7
Tree Pruning	4,519.89
Cotton Stalks	11,338.33
Bamboo Pruning	6,706.56
Maize Cobs	0
Ipomoea Carnea	5,728.62
Water Hyacinth	0
Total	**69,860.10**

Determining F_Cp: Values for organic carbon content per tonne of biochar per production type

Below is the description of the calculation:

$F_{Cp,t,p}$ = Organic carbon content of biochar type *t* produced in production facility per tonne of biochar, taken on a dry weight basis (percent). Project Reignite has determined these values through laboratory material analysis of biochar for this annum and has been 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.

Feedstock Type	Organic Carbon Content
Paddy Base (Roots) and Straw	53.92%
Maize Cobs	Not Measured due to no production
Tree Pruning	80.84%
Cotton Stalks	78.93%
Bamboo Pruning	79.37%
Water Hyacinth	Not Measured due to no production
Ipomoea Carnea	58.03%

$PR_{de,k}$ = 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)).

Temperature was monitored continuously, for each batch produced, and was aggregated to annual averages.

Year	Temperature Average	Permanence Factor Applied
2023	691 Degrees Celsius	0.89
2024	704 Degrees Celsius	0.89

YEARWISE CALCULATIONS:

2023:

Calculation of carbon content for each biochar type t, application type k (soil application), year 2023

1) Paddy Straw

$$CC_{paddystraw,k,y} = 12,885.68 \times 0.5392 \times 0.89$$
$$CC_{paddystraw,k,y} = 6183.68$$

2) Tree Pruning

$$CC_{woodprunings,k,y} = 2{,}923.00 \times 0.8084 \times 0.89$$
$$CC_{woodprunings,k,y} = 2{,}103.03$$

3) Cotton Stalks

$$CC_{cottonstalks,k,y} = 3{,}103.13 \times 0.7893 \times 0.89$$
$$CC_{cottonstalks,k,y} = 2{,}179.88$$

4) Bamboo Pruning

$$CC_{bambooprunings,k,y} = 2{,}816.76 \times 0.7937 \times 0.89$$
$$CC_{bambooprunings,k,y} = 1989.74$$

5) Maize Cobs (Not measured because of 0 production)

$$CC_{maizecobs,k,y} = 0 \times 0 \times 0.89)$$
$$CC_{maizecobs,k,y} = 0$$

6) Ipomoea Carnea

$$CC_{ipomoeacarnea,k,y} = 1{,}833.23 \times 0.5803 \times 0.89$$
$$CC_{ipomoeacarnea,k,y} = 946.80$$

7) Water Hyacinth (Not measured because of 0 production)

$$CC_{waterhyacinth,k,y} = (0 \times 0 \times 0.89)$$
$$CC_{waterhyacinth,k,y} = 0$$

2024:

Calculation of carbon content for each biochar type t, application type k (soil application), year 2024

1) Paddy Straw

$$CC_{paddystraw,k,y} = 28{,}681.02 \times 0.5392 \times 0.89$$
$$CC_{paddystraw,k,y} = 13{,}763.68$$

2) Tree Pruning

$$CC_{woodprunings,k,y} = 1{,}596.89 \times 0.8084 \times 0.89$$
$$CC_{woodprunings,k,y} = 1{,}148.90$$

3) Cotton Stalks

$$CC_{cottonstalks,k,y} = 8{,}235.20 \times 0.7893 \times 0.89$$
$$CC_{cottonstalks,k,y} = 5{,}785.04$$

4) Bamboo Pruning

$$CC_{bambooprunings,k,y} = 3{,}889.80 \times 0.7937 \times 0.89$$
$$CC_{bambooprunings,k,y} = 2{,}747.73$$

5) Maize Cobs (Not measured because of 0 production)

$$CC_{maizecobs,k,y} = 0 \times 0 \times 0.89)$$
$$CC_{maizecobs,k,y} = 0$$

6) Ipomoea Carnea

$$CC_{ipomoeacarnea,k,y} = 3895.39 \times 0.5803 \times 0.89$$
$$CC_{ipomoeacarnea,k,y} = 2{,}011.84$$

7) Water Hyacinth (Not measured because of 0 production)

$$CC_{waterhyacinth,k,y} = (0 \times 0 \times 0.89)$$
$$CC_{waterhyacinth,k,y} = 0$$

Step 2: Estimate project emissions 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)

Determining P_ED,p,y: Emissions associated with the pre-treatment of feedstock at production facility p in year y for low technology facilities

2023:

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

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

2024:

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

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

Determining P_EP,p,y: Emissions associated with the thermochemical process (pyrolysis) at production facility p in year y for low technology facilities

Below is the procedure for quantification:

2023:

$$P_{EP,p,y} = \sum_{k}\sum_{t}(F_e \times GWP_{CH4} \times M_{t,k,p,y})$$

Where:
$P_{EP,p,y}$ = Emissions associated with the conversion of waste biomass into biochar at production facility p in year y (tCO2e)

F_e = Average methane emissions from producing one tonne of biochar in year y (tCH_4/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_{CH4} = Global warming potential of methane. Use value referenced in the latest version of the VCS standard
As per VCS standard V4.4, GWP_{CH4} = 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:

$$P_{EP,p,y} = (0.014 \times 28 \times 23{,}561.8)/\ 3595$$

$$P_{EP,p,y} = \frac{9236.2256}{3595}$$

$$P_{EP,p,y} = 2.569$$

2024:

$$P_{EP,p,y} = \sum_{k}\sum_{t}(F_e \times GWP_{CH4} \times M_{t,k,p,y})$$

Where:
$P_{EP,p,y}$ = Emissions associated with the conversion of waste biomass into biochar at production facility p in year y (tCO2e)

F_e = Average methane emissions from producing one tonne of biochar in year y (tCH_4/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_{CH4} = Global warming potential of methane. Use value referenced in the latest version of the VCS standard
As per VCS standard V4.4, GWP_{CH4} = 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 2024:

$$P_{EP,p,y} = (0.014 \times 28 \times 46{,}298.30)/\ 3595$$

$$P_{EP,p,y} = \frac{18{,}148.9336}{3595}$$

$$P_{EP,p,y} = 5.048$$

Determining P_EC,p,y: Emissions due to the utilization of auxiliary energy for the purpose of pyrolysis

2023:

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

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

2024:

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

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

2023:

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

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

$$CC_{t,k,y} = (6183.68) + (2103.30) + (2179.88) + (1989.74) + (0) + (946.80) + (0)$$

$$\sum_k CC_{t,k,y} = 13{,}403.1$$

$$\sum_p PE_{PS,t,p,y} = 9236.2256$$

$$ER_{PS,y} = \left(13{,}403.1 \times \frac{44}{12}\right) - (9236.23)$$

$ER_{PS,y}$ = 39,908.58935 ~ 39,909

2024:

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

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

$$CC_{t,k,y} = (13{,}763.68) + (1{,}148.90) + (5{,}785.04) + (2{,}747.73) + (0) + (2{,}011.84) + (0)$$

$$\sum_k CC_{t,k,y} = 25{,}457.19$$

$$\sum_p PE_{PS,t,p,y} = 18{,}148.93$$

$$ER_{PS,y} = \left(25{,}457.19 \times \frac{44}{12}\right) - (18{,}148.93)$$

$ER_{PS,y}$ = 75,194.10 ~ 75,194

Application Stage

Determining E_P,k,y: Emissions associated with processing of biochar for application type k

$PE_{AS,y}$ = 0 as project Reignite does not involve any processing. The biochar is air/ sun dried. Hence, there is no combustion of fossil fuels or consumption of electricity in the application stage.

Determining E_ap,k,y: Emissions associated with utilization of biochar for application k

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

5.3 Leakage Emissions

Describe the procedure for quantification of leakage emissions in accordance with the applied methodology. Include all relevant equations, and explain and justify all relevant methodological choices (e.g., with respect to selection of emission factors and default values)

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.

$LE_{as,y}$: Leakage due to activity shift in year y (tCO_2e). Leakage due to activity shift is zero as use of purposely grown biomass for production of biochar is currently not allowed.

$LE_{bd,y}$: Leakage due to biomass diversion in year y(tCO_2e). Leakage due to biomass (waste/residue) diversion is considered negligible since only biomass which would have been combusted or left to decay is utilized for biochar production.

$LE_{ts,y}$: Leakage emissions due to transport of waste biomass from sourcing to biochar production facility in year y(tCO_2e). As per CDM Tool 16: Project and leakage emissions from biomass, (Available at https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-16-v4.pdf) GHG emissions must be accounted for only if transportation distance is more than 200 km. Project proponent must use CDM Tool 12: Project and leakage emissions from transportation of freight(Available at https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-12-v1.1.0.pdf) to calculate $LE_{ts,y}$.

$LE_{tap,y}$: Leakage emissions from transportation of biochar from the production facility to the site of end application in year y(tCO_2e).As per CDM Tool 16: Project and leakage emissions from biomass, GHG emissions must be accounted for only if transportation distance is more than 200 km. Project proponent must use CDM Tool 12: Project and leakage emissions from transportation of freight to calculate $LE_{tap,y}$.

year	$LE_{as,y}$	$LE_{bd,y}$	$LE_{ts,y}$	$LE_{tap,y}$	Justification for quantification
2023	0	0	0	0	No transportation is involved
2024	0	0	0	0	No transportation is involved

5.4 GHG Emission Reductions and Carbon Dioxide Removals

Describe the procedure for quantification of net GHG emission reductions and removals. Include all relevant equations.
Provide the ex-ante calculation (estimate) of baseline emissions/removals, project emissions/removals, leakage emissions and net GHG emission reductions and removals in the table below. Specify the breakdown of GHG emissions reductions and removals by calendar year.

For data and parameters monitored, use estimates. Document how each equation is applied, in a manner that enables the reader to reproduce the calculation. Provide example calculations for all key equations, to allow the reader to reproduce the calculation of estimated net GHG emission reductions or 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)

$$ER_y = 0 + 115{,}103 – 0 – 0$$

Thus, estimated annual emission removals are 115,103 (tCO_2e)

Table: Baseline, project, leakage, and net GHG emission reductions (tCO2e) by Vintage period.

Vintage Period	Baseline emissions (tCO_2e)	Project emissions (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)
16-Oct-2023 - 31-Dec-2023	0	39,909	0	39,909

01-Jan-2024 - 30-Jun-2024	0	75,194	0	75,194
Total	**0**	**115,103**	**0**	**115,103**

For all projects, state the estimated ex-ante GHG emission reductions and removals and the achieved emission reductions and removals for this monitoring period. Report the percentage difference and justify the difference. The quantities of GHG emission reductions and removals are the total quantities before any deductions for buffer credits.

Vintage Period	Ex-ante estimated reductions/removals	Achieved reductions/removals	Percent difference	Explanation for the difference
01-Jan-2024 - 30-Jun-2024	77,704	75,194	3.28	The achieved removals are similar to ex-ante estimated removals.
16-Oct-2023 - 31-Dec-2023	33,056	39,909	18.78	Ex-ante removal estimates were based on IPCC results, as lab results became available only after production began. The lab results, reflecting the actual values of the biochar produced, were higher than the IPCC estimates, leading to a difference. Additionally, biochar production does not occur evenly across the 9 productive months, which was assumed in the ex-ante calculations. This uneven distribution of production was not accounted for in the ex-ante estimates and the achieved removals are based on actual production data. This trend is expected to continue in future years of the project.
Total	110,760	115,103	3.85	The actual carbon testing of biochar produced during the monitoring period showed a slight increase in emissions removals compared to the IPCC values considered at validation. Overall, the removals for the monitoring period align closely with the estimated values.

Submit all the calculation spreadsheets and supporting documentations:

Name	Description	Upload Document
ER Sheet	N/A	ER Sheet.xlsx

6 APPENDIX

N/A

6.1 Appendix 1: COMMERCIALLY SENSITIVE INFORMATION

Appendix 1 : Commercially Sensitive Information

N/A

Appendix - 2

REFERENCES

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Appendix - 3

Project Photos

Appendix 1A: Calculation Output

Table: Baseline, project, leakage, and net GHG emission reductions (tCO2e) by Vintage period and instance ID.

Vintage Period	Instance ID	Baseline emissions (tCO_2e)	Project emissions (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)
16-Oct-2023 - 31-Dec-2023	1	0	39,909	0	39,909
01-Jan-2024 - 30-Jun-2024	1	0	75,194	0	75,194
Total	**--**	**0**	**115,103**	**0**	**115,103**

Data / Parameter:	$ER_{PS,y}$
Data unit:	tCO_2e
Description:	GHG emissions removals at production stage in year y
Value applied:	**Table: $ER_{PS,y}$ (tCO_2e) by Vintage period and instance ID**

Year	Instance ID	$ER_{PS,y}$
2023	1	39,909
2024	1	75,194

Data / Parameter:	$CC_{t,k,y}$
Data unit:	tonnes
Description:	Organic carbon content on a dry weight basis for biochar type t used for application type k in year y
Value applied:	**Table: $CC_{t,k,y}$ (tonnes) by Vintage period and instance ID**

Year	Instance ID	$CC_{t,k,y}$
2023	1	13,403
2024	1	25,457

Data / Parameter:	$PE_{PS,p,y}$
Data unit:	tCO_2e
Description:	Project emissions at the production stage for production of biochar at production facility p in year y
Value applied:	**Table: $PE_{PS,p,y}$ (tCO_2e) by Vintage period and instance ID**

Year	Instance ID	$PE_{PS,p,y}$
2023	1	9,236
2024	1	18,149

Data / Parameter:	$P_{ED,p,y}$
Data unit:	tCO_2e
Description:	Emissions associated with pre-treatment of feedstock at production facility p in year y
Value applied:	**Table: $P_{ED,p,y}$ (tCO_2e) by Vintage period and instance ID**

Year	Instance ID	$P_{ED,p,y}$
2023	1	0
2024	1	0

Data / Parameter:	$P_{EC,p,y}$
Data unit:	tCO_2e
Description:	Emissions due to the utilization of auxiliary energy for the purpose of pyrolysis at production facility p in year y
Value applied:	**Table: $P_{EC,p,y}$ (tCO_2e) by Vintage period and instance ID**

Year	Instance ID	$P_{EC,p,y}$
2023	1	0
2024	1	0

Data / Parameter:	$P_{EP,p,y}$
Data unit:	tCO_2e
Description:	Emissions associated with the conversion of waste biomass into biochar at production facility p in year y
Value applied:	**Table: $P_{EP,p,y}$ (tCO_2e) by Vintage period and instance ID**

Year	Instance ID	$P_{EP,p,y}$
2023	1	9,236
2024	1	18,149

Data / Parameter:	$PE_{AS,y}$
Data unit:	tCO_2e
Description:	GHG emissions at application stage in year y
Value applied:	**Table: $PE_{AS,y}$ ($t CO_2e$) by Vintage period and instance ID**

Year	Instance ID	$PE_{AS,y}$
2023	1	0
2024	1	0

Data / Parameter:	$E_{P,k,y}$
Data unit:	tCO_2e
Description:	Emissions from processing of biochar for application type k in year y
Value applied:	**Table: $E_{P,k,y}$ (t CO_2e) by Vintage period and instance ID**

Year	Instance ID	$E_{P,k,y}$
2023	1	0
2024	1	0

Data / Parameter:	LE_y
Data unit:	tCO_2e
Description:	Total leakage emissions in year y
Value applied:	**Table: LE_y (t CO_2e) by Vintage period and instance ID**

Year	Instance ID	LE_y
2023	1	0
2024	1	0