RWANDA RIPARIAN RESTORATION PROJECT

Document Prepared by EcoPlanet Bamboo Group, LLC

Camille Rebelo: crebelo@ecoplanetbamboo.com

Project Title	Rwanda Riparian Restoration Project
Version	1.5
Date of Issue	09-09-2023
Prepared By	Camille Rebelo, EcoPlanet Bamboo Group, LLC
Contact	crebelo@ecoplanetbamboo.com / http://www.ecoplanetbamboo.com / +44.7801.999.862

CONTENTS

1 PROJECT DETAILS

1.1 Summary Description of the Project

The Rwanda Riparian Restoration Project is an AFOLU project, aimed at restoring key watershed areas in the landlocked hilly nation of Rwanda, through the planting of select species of sympodial (clumping) bamboos as riparian buffers. This carbon financed project is located on land that is legally classified as riparian buffer zones. The vegetation along the riverbanks was cleared decades ago due to demand for agricultural land. Subsequently, in 2010 the Government of Rwanda prohibited farming or agricultural production on these lands which at the project start date are typically bare or with grass cover. No forests have been present on these lands for the last 10 year period before the project start date, and no forests or native ecosystems are cleared for the proposed planting activities. Specifically, the project is a revegetation project, targeting the planting and management of select species of giant clumping bamboo in a linear manner along rivers and lakes as chosen by the Rwanda Water Resources Board. Such riparian buffer zones represent state owned land, under the jurisdiction of the Rwanda Water Resources Board, a government entity that reports directly to the Prime Minister. The width of the riparian buffer zones are determined by the size classification of the rivers, and or lakes which the planting buffers.

Clumping bamboo species represent an effective mechanism for biological carbon removals and represent a long term carbon sink. As the clumps grow and develop they sequester atmospheric carbon, which is stored in the woody culms, auxilliary material (branches and leafy material) and the underground root and rhizome system. The project is a pure environmental / conservation project. No harvesting of the planted bamboo will occur and there are no financial returns associated with the project.

The project builds upon a successful pilot project carried out between 2019-2021 which has provided positive impacts on the surrounding ecosystems. The first phase of the project, which is under the control of the project proponent at the time of validation covers the planting of 400,000 bamboo clumps, representing an area of 1,000 hectares or approximately 1,000 km of riparian buffer zones within a single catchment area across four districts, Ngororero, Karongi, Muhanga and Ruhango. The project is a grouped project, with additional revegetation activities to occur specifically on riparian buffer zones, with the national boundaries of Rwanda representing the boundaries of the grouped project. Additional project areas will be added in 2023 onward. Planting of the first project instance of 200,000 bamboo clumps will occur during the October 2022-March 2023 planting season. The second project instance represents a further 200,000 bamboo clumps planted during the October 2023-March 2024 planting season. This initial project area at the time of validation represents total potential GHG emission removals of 1,039,272 tCO_2e over the twenty year project period. This represents an average annual GHG emission removal of 51,964 tCO_2e.

1.2 Sectoral Scope and Project Type

The project is a grouped project that falls within sectoral scope 14, of Agriculture, Forestry and Other Land Use (AFOLU), within the Afforestation, Revegetation and Revegetation (ARR) project category. The project meets the VCS definition of revegetation[1] – specifically it is a direct human-induced activity to increase carbon stocks of woody biomass on sites through the establishment of vegetation that covers a minimum area of 0.05 hectares and does not meet the definitions of afforestation or reforestation.

The project manually plants species of sympodial (non-invasive, non-spreading) bamboos grown from seed within land designated as riparian buffer zones. Such land areas were cleared of primary forest and native ecosystems more than 10 years prior to the project start date. The land undergoing such planting activities is currently classified as non-forested land with the categorization of riparian buffer zones.

1.3 Project Eligibility

The proposed project activities have been designed to meet the eligibility requirements of the VCS framework, as described in the VCS Standard v4.3. The project activities result in GHG emission removals from project activities in the forestry sector, and under the rules and requirements of the VCS Program. This VCS Program defines eligible activities in the Afforestation, Revegetation and Revegetation category as " activities that increase carbon stocks in woody biomass (and in some cases soils) by establishing, increasing and/or restoring vegetative cover through planting, sowing and/or the human assisted natural regeneration of woody vegetation". The proposed project activities specifically aim to plant select species of woody bamboo with the specific purpose of increasing the carbon stock and associated GHG emission removals.

The project uses a CDM methodology, as approved under the scope of the VCS for ARR projects and follows the eligibility requirements as specified by this methodology.

The project activities do not result in any clearance or conversion of native ecosystems, nor do they include any draining of native ecosystems or degradation of ecological functions. In contrast, the project has been designed according to the VCS Program Definitions v4.1 whereby the land on which project activities are occurring was once forested, but whereby deforestation occurred more than ten years prior to the project start date. Evidence for this eligibility requirement is provided in Section 1.13 below.

[1] Verified Carbon Standard Program Definitions v4.1, January 2022

The project proponent is also the implementation partner, and is responsible for all activities related to the implementation, management, monitoring and reporting of the project over the project crediting period.

1.4 Project Design

The proposed project activities are occurring on land classified as riparian buffer zones, which are those lands that are adjacent to various water resources, both lakes and rivers of varying sizes. As a result, the project activities occur across a wide geographic area due to the spatial nature of such water resources. As a result of this spatial layout of the project activities, the project represents a revegetation project, rather than revegetation, as although the planting areas are contiguous, the linear manner is not truly representative of a forest.

The project utilizes select species of giant clumping bamboo planted at spacing intervals of 5m along the edges of rivers and / or lakes. The number of rows of bamboo planted within any one area is determined by the size of the waterbody that it buffers. The Government of Rwanda has classified water resources into four different categories, and the riparian buffer zones associated are determined by these categories:

- Lakeshores have a riparian buffer zone of 50m from the shoreline
- Big rivers have a riparian buffer zone of 10m
- Small rivers have a riparian buffer zone of 5m
- Unclassified rivers have a riparian buffer zone of 2m

The project is initially targeting planting activities on rivers. Big rivers will have two rows of bamboo clumps which results in a one hectare area, or 400 planted bamboo clumps representing 500m of buffer plantings (with plantings occurring on both sides of the river). Small and unclassified rivers will have a single row of planted bamboo clumps which results in a one hectare area being the equivalent of a 1km of plantings.

Where any existing vegetation or individual standing trees occurs within the planting line, this area is simply missed, and planting continues at a 5m distance on the other side. This can be evidenced in the Project Area maps for the first planting instance which occurred in 2022, where the planting of 500km represents a total Project Area of 510.54 hectares and occurs across many individual planting locations.

The first 400,000 bamboo will be planted over a 2 year period (October 2022 – March 2024). The exact timeline of project activity instances will depend upon natural climatic factors that play an influence on any revegetation activity and the length of the planting season. Additional areas will be identified and added for future areas.

Table 1 Revegetation Activity Timeline at Time of Validation

Year	Number of Planted Hectares	Number of Planted Bamboo Clumps
2022-2023	500	200,000
2023-2024	500	200,000
Total	**1,000**	**400,000**

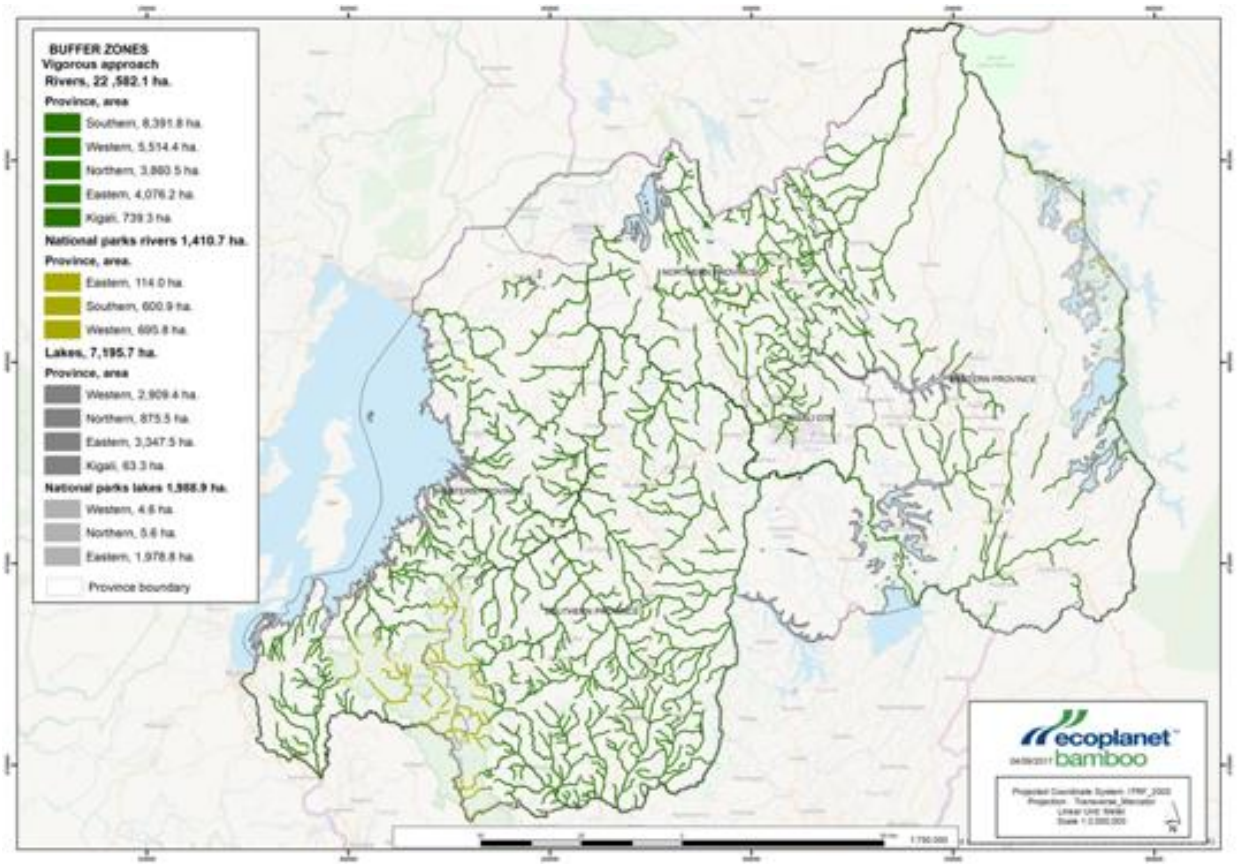
The main planting season in Rwanda runs from October through March. Therefore the 2022 planting season begins in October 2022 but runs through March 2023.

The grouped project activity includes only a single project activity, which is human assisted revegetation with species of clumping bamboo. All future project activity instances will include only this project activity. The total scale of the project is limited by the riparian buffer zones determined by the Rwanda Water Board, the entity responsible for the management of such land, to be suitable for the planting of bamboo.

The total riparian buffer zones in Rwanda are shown in Figure 1 and 2 below[2]. These show two different approaches – conservative mapping of riparian buffer zones which does not include unclassified or seasonal water resources, and an all-inclusive overview of the country's water resources.

[2] *A Feasibility Study for a Bamboo Based Bio-Economy for Rwanda; 2017. A report carried out for the Republic of Rwanda, Ministry of Lands and Forestry.*

Figure 1 Mapping of All Riparian Buffer Zones



Eligibility Criteria

The project is a grouped project. At the time of validation an agreement is held with the Rwanda Water Board for the proposed revegetation activity on an initial 1,000 hectares as defined in this PD. Additional areas are limited to those lands legally classified as riparian buffer zones, that meet the same baseline criteria as detailed in Section 3.4 below.

By their nature, such areas will be identical to those already included, and will adhere to the same eligibility criteria, defined as:

All new project activity instances will meet the applicability conditions as defined by the methodology used by the project, AR-ACM0003 “Afforestation and revegetation of lands except wetlands” version 2.0.

1. No project activities will be implemented on any land designated as a wetland – all project activities are limited to land defined as riparian buffer zones;
2. Soil disturbance as the result of project activities will not cover more than 10% of the area on either of the following types of land:

   a. Lands containing organic soils;

   b. Croplands or grasslands as defined by the methodology.

3. All future project activity instances will follow the same technologies for land preparation, planting, maintenance and monitoring as detailed within this project document.

4. All future project instances will use similar or identical species of sympodial bamboo.

5. The baseline for all future project activity instances will undertake a baseline approach identical to the approach taken in this project document, described as the pre-project scenario of gradual deforestation, forest degradation and conversion to agriculture.

6. All future project activity instances face the identical barriers to implementation as have been detailed within the Tool for the Demonstration and Assessment of Additionality within this project document.

Furthermore, prior to the inclusion of any new areas, such compartments will be formally included into the agreements between the project proponent and the Rwanda Water Board.

Figure 2 Grouped Project Area

The grouped project area represents the Rwanda Country Boundary with riparian buffer zones associated with all rivers.

1.5 Project Proponent

Organization name	EcoPlanet Bamboo Group, LLC
Contact person	Camille Rebelo
Title	Chief Operating Officer
Address	4023 Kennett Pike, Wilmington DE 19807, USA
Telephone	+44.7801.999.862
Email	crebelo@ecoplanetbamboo.com

1.6 Other Entities Involved in the Project

Organization name	EcoPlanet Bamboo Rwanda, Ltd
Role in the project	EcoPlanet Bamboo Rwanda Ltd. Is a wholly owned subsidiary of EcoPlanet Bamboo Group, LLC, registered in Rwanda. This entity holds the legal agreement with the Rwanda Water Resources Board, detailed in Section 1.7 below. This entity works under the organizational structure and management of the project proponent, to carry out all aspects associated with project implementation, on-site management and monitoring. This entity is responsible for employing all staff as required to fulfill the project activities.
Contact person	Camille Rebelo
Title	Managing Director
Address	Nyarugenge, Nyarugenge, Umujyi wa Kigali, Rwanda
Telephone	+250.727.000.973
Email	crebelo@ecoplanetbamboo.com

1.7 Ownership

The project proponent meets the ownership requirements of the VCS Program specifications as detailed in section 3.6 of the VCS Standard v4.3 Specifically, the project proponent has the legal right to control and operate all project activities for the duration of the crediting period.

Specifically, ownership is demonstrated according to Clause 4 of the VCS Program Standard:

"Project ownership arising by virtue of a statutory, property or contractual right in the land, vegetation or conservational or management process that generated GHG emission reductions and/or removals (where the project proponent has not been divested of such project ownership)."

The project proponent, EcoPlanet Bamboo, through the subsidiary detailed in Section 1.6 above holds the contractual right to the implement the proposed project activities, along with the associated ownership of the GHG emission removals. This contractual right is evidenced by a Memorandum of Understanding[3] and a Letter of Authorization issued by the Rwanda Water Resources Board[4].

Within the terms of this Agreement, EcoPlanet Bamboo holds the legal right to utilize carbon financing to implement and operate the program activities, as well as to all and any GHG emission removals generated by the project during the crediting period. These agreements are available to auditors as part of validation and subsequent verification events.

1.8 Project Start Date

October 1st 2022

This date corresponds to the date of first planting.

1.9 Project Crediting Period

The proposed project crediting period is 20 years.

Start date: October 1st 2022

End date: September 30th 2042

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

[3] *Memorandum of Understanding Between Rwanda Water Board and EcoPlanet Bamboo Rwanda, Ltd, executed 01.06.22.*

[4] *Letter of Authorization – Carbon Emission Removals, issued 05.07.22.*

Project Scale	
Project	x
Large project	

Year	Estimated Cumulative GHG emission removals (tCO_2e)
2023	2,280.50
2024	8,560.49
2025	18,845.20
2026	43,673.28
2027	91,725.48
2028	163,582.81
2029	297,685.37
2030	505,017.34
2031	742,767.75
2032	938,172.81
2033	1,012,871.55
2034	1,015,804.88
2035	1,018,738.21
2036	1,021,671.55
2037	1,024,604.88
2038	1,027,538.21
2039	1,030,471.55
2040	1,033,404.88
2041	1,036,338.21
2042	1,039,271.55
TOTAL ESTIMATED ERs	**1,039,272**
TOTAL NUMBER OF CREDITING YEARS	**20**
AVERAGE ANNUAL ERS	**51,964**

1.11 Description of the Project Activity

Jurisdictional REDD+

The AFOLU project activity does not include any land areas covered by a jurisdictional REDD program.

Planting & Maintenance Activities

The project involves the direct planting of Rwanda's riparian buffer zones with seedlings of select species of giant sympodial (clumping) bamboo at a spacing equivalent to 5m by 5m, or 400 bamboo clumps per km of riparian buffer zone, equivalent to one hectare land area.

The project includes the following activities all of which are carried out manually:

- Seedlings for the project are developed in specialized nurseries owned and managed by the project proponent.
- Smallholder farmers and members from the communities surrounding each project instance are trained in the correct techniques for land preparation and pitting over the course of a number of months.
- The project team marks the planting pits at the correct spacing of 5m intervals following the natural course of the water source and ensuring that the planting put is at a minimum distance from the edge of the water source.
- Smallholder farmers and community members are hired by the project to carry out these activities at the appropriate timing and provided with the correct PPE.
- Seedlings are transported from the nursery to select points at the onset of the rainy season in October. From these strategic points they are distributed to smallholder farmers and community members who carry the seedlings manually to the prepared planting pits.
- After planting the bamboo seedlings are mulched.
- At the end of the planting season GPS points are taken for every planted bamboo and entered into a database.
- Replacement planting of any mortality that may have occurred post planting occurs at the next raining season, to achieve a full planting density of 400 clumps per km/hectare.
- Maintenance activities are carried out manually including ring weeding of the bamboo to reduce competition, and mulching during the dry season. Such maintenance activities occur for an initial 3 year period post each planting, at which point the bamboo clumps are expected to have achieved canopy closure and no longer require active maintenance.
- Where needed the bamboo plants are protected from livestock, and rangers engaged to ensure their protection until they are well established.

The project activity does not include any harvesting.

The carbon benefits are limited to the increase in bamboo biomass resulting from the activities above.

Bamboo Species

The project is initially focusing on two species of giant sympodial bamboos:

- *Bambusa polymorpha: The* extremely dense clumping pattern of this species makes it ideal as for riparian planting. It is native to China, Bangladesh and Thailand. The color of the culms is light green or white grey when young to greyish-green and have relatively thick walls of 1-2 cm, which is occasionally solid near the base. It can also be identified by the fine white hairs that cover newer culms and its slightly protruding nodes. It grows to a height of 15-25 meters with culm diameters of 7-15 cm.
- *Bambusa textilis spp*: a dense-clumping bamboo of southwest China origin. This species is a hardy, drought resistant species that performs well in harsh climates and is suited to the soils, climate and rainfall of the project location. This species has dark green culms with extremely long internode lengths. Culms grow to a maximum known diameter of 12-15 cm but have the unique property of being almost solid at the lower parts making the biomass availability, and thus carbon sequestration is high. This species is targeted for rockier soil areas within the project boundary.

Rwanda has only two native species of bamboo:

- *Yushania alpina* is a monopodial bamboo that occurs in the highland (high altitude) areas. It is a bamboo that spreads laterally, rather than growing in a tight knit clump. This growth pattern makes it unsuitable as a riparian buffer zone species.
- *Oxytenanthera abyssinica* commonly called African lowland bamboo, occurs at low altitude areas across sub-Saharan Africa. This species cannot survive at the altitudes of the targeted water catchment areas which are the focus of this riparian restoration project.

As a result the project is planting the above described non-native species. However, both have been introduced into Rwanda many years before the project start date and have been identified as priority species for the country, including by the International Network of Bamboo and Rattan (INBAR). Both species are approved by the Rwanda Forests Authority and Rwanda Water Board. Prior to the proposed project activities, trials of both species were undertaken in the project area, with 150km of riparian plantings having been undertaken in 2019 to assess performance. These pilot plantings provided confidence on the suitability of both species to the site-specific conditions, and their suitability for use in the riparian buffer zones with the specific purpose of binding soils in order to reduce erosion, flooding and water siltation, while providing permanent forest cover and associated ecosystem services.

Figure 3 *Bambusa polymorpha* (above) and *Bambusa textilis spp* (below)

1.12 Project Location

All areas included within the Project Area, and therefore all areas to undergo bamboo planting activities are riparian buffer zones, under the state ownership of the Government of Rwanda, and under the jurisdiction of the Rwanda Water Resources Board. Shape files used for the delineation of the riparian buffer zones included within the project area are official government files.

Under the terms of the agreement between the project proponent and the Rwanda Water Resources Board, the project location for the 500km of riparian buffer zones for the 2022 planting season was provided in advance of validation. All areas are first assessed for eligibility, based off historical and current landcover. Within such eligible areas, ground truthing is then required to define the exact planting area, due to a range of aspects that may mean eligible areas are not suitable for planting. Such areas include accessibility, where the likelihood of landslides is too high, where there is no suitable soil within the riparian area for planting, or other aspects that can only be determined by the project's team of GIS technicians on the ground.

Following validation the 2022 proposed planting area was subsequently ground truthed and planted during Q4 of 2022, during which the validation process has been ongoing.

As a result, the Project Area relating to the 500km of riparian plantings that occurred in 2022 are shown below, and the associated KML file provided. The position of the first planting instance within Rwanda is shown in Figure 5 below.

The 500km of riparian buffer zones to be planted during the 2023 planting season will be ground truthed in advance of the Q4 2023 planting season and finalized during the land preparation process.

Figure 4 Project Area – 1st Planting Instance

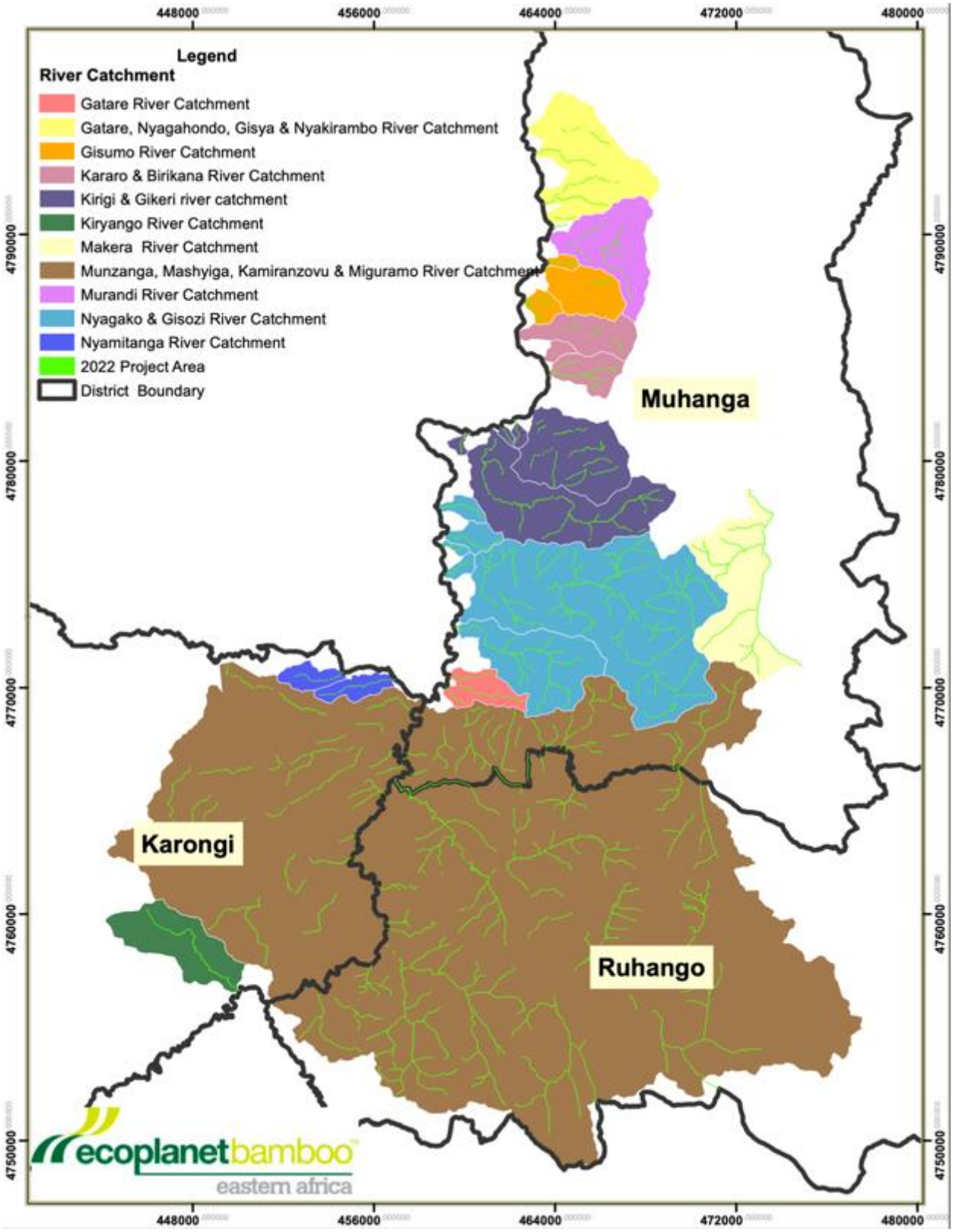
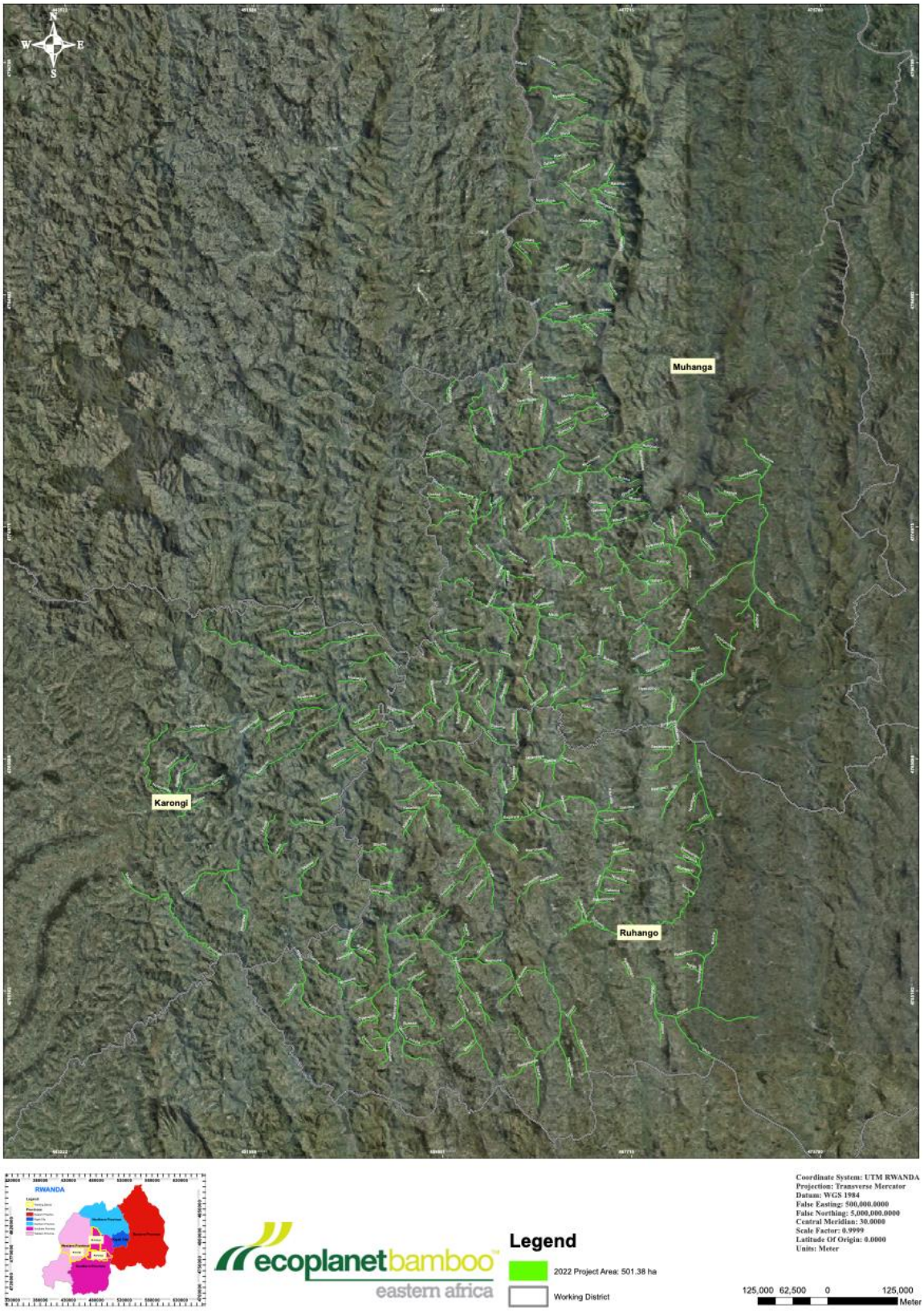


Figure 5 KMZ Image of Project Location of the 1st Planting Instance



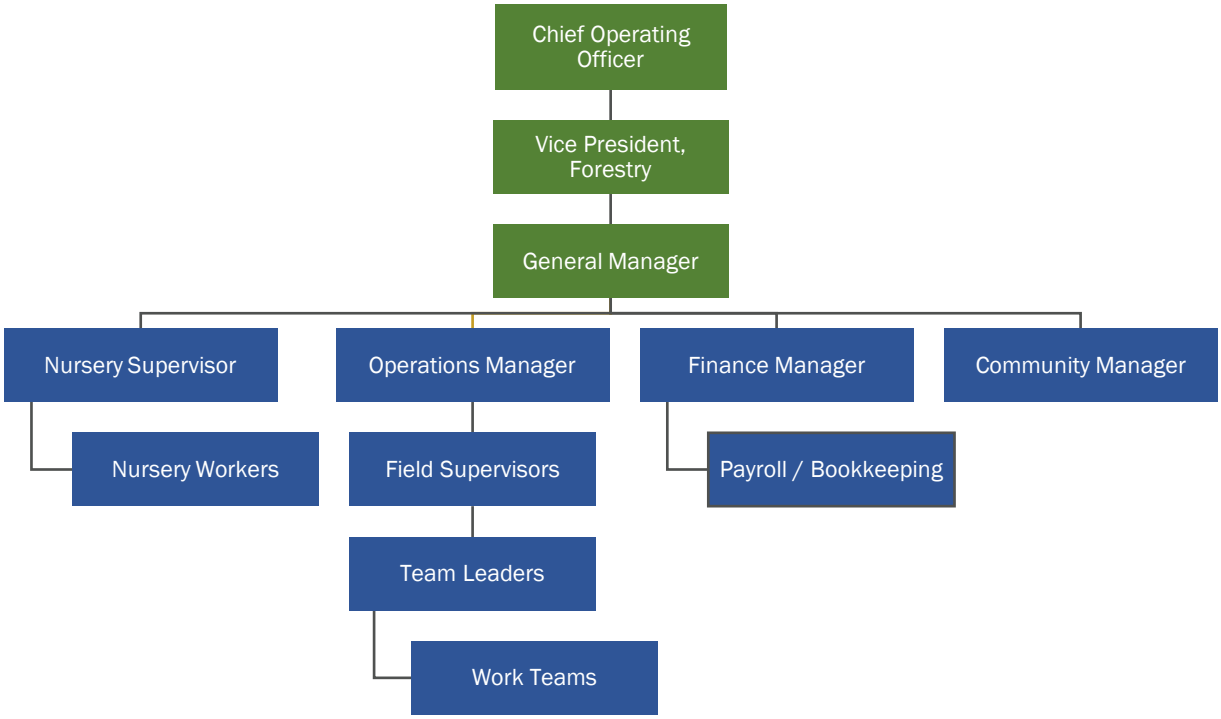
The project area in the 1st project instance covers four districts, namely Ngororero, Karongi, Muhanga and Ruhango. The total project area for the 1st planting instance represents 583.9km of rivers that are categorized as "small" and therefore will only have a single line of planting on each bank. This 583.9km project area is therefore greater than the total area to be planted (approximately 500km) allowing for non plantable areas (such as rocky patches or areas where the river bank is too steep for planting) that can only be determined during the planting season as the planting teams walk each river bank.

As such, the final project area and associated KML files are determined ex post, and this mapping comprises an important part of project monitoring activities, as further detailed in Section 5 below.

Entities Involved

The project proponent is also the project implementing entity. All project activities are carried out by the project proponent by a full operating team that is based within the proximity of the project boundaries. The structure of such involvement is provided in the organizational chart below. There are no other entities involved in the development or ownership of the project of the project.

Figure 6 Rwanda Riparian Restoration Project Organizational Chart



1.13 Conditions Prior to Project Initiation

The baseline scenario is the same as the conditions that exist prior to the project initiation and therefore readers should reference Section 3.4 Baseline Scenario. However, the detailed environmental conditions of the project area have been presented below.

Climatic Conditions

The annual average temperature is around 20°C. The annual rainfall averages 1,090 mm. The climate is characterized by 4 seasons:

- The short rain season or Season A (mid-September – mid-January) considered as main planting season.
- The short dry season with intermittent heavy rainfall (Mid-January to February) in which planting may take place.
- The long rain season or Season B (March-May) where planting can occur until April.
- The long dry season with intermittent light rainfall (June – mid-September) where no planting occurs.

Figure 7 Mean Monthly Rainfall Data

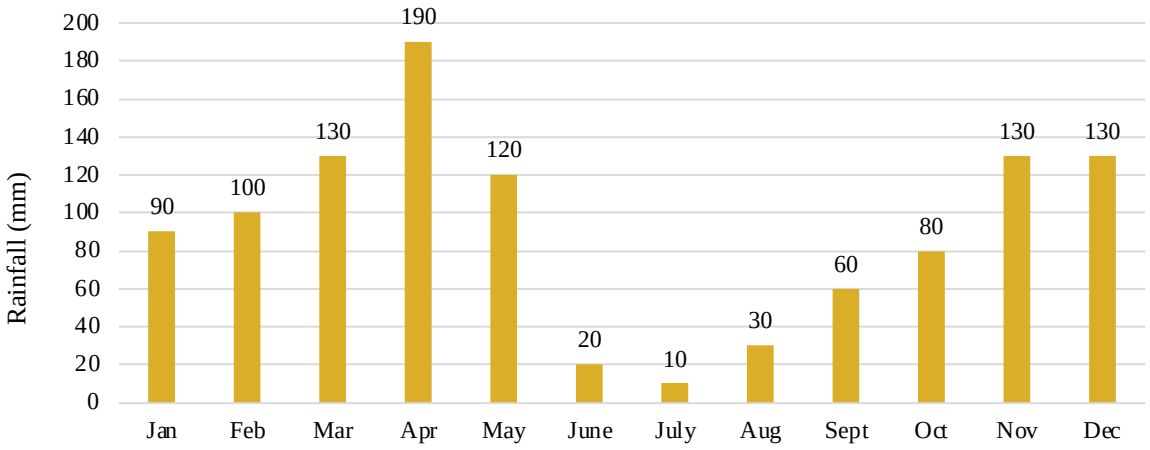
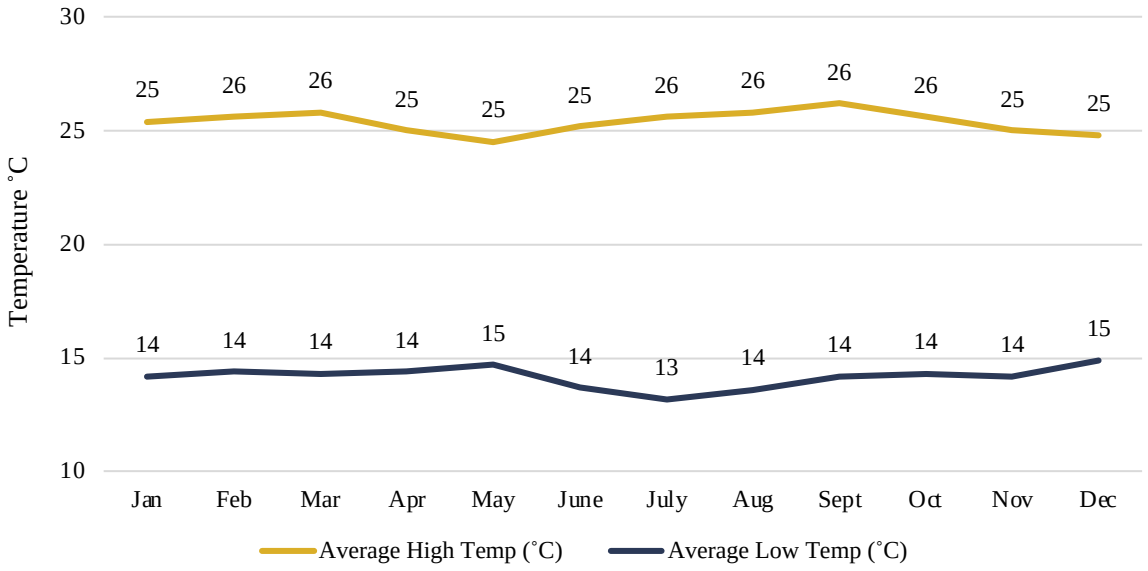


Figure 8 Mean Monthly Temperature Data



Source: *Rwanda Meteorology Agency*

Topography & Geology

The project area is located across 3 adjoining districts in 2 provinces: Muhanga District in Southern Province, Ruhango District in Southern Province and Karongi District in Eastern Province. This area is characterized by highlands where over 50% of the hills are classified as very steep with over a 40% grade. The elevation across the project area ranges from 2,750 meters down to 1,500 meters where the watersheds empty into the Nyabarongo river and lake. At the bottom of the slopes and in the valleys lies the river network of the watersheds to be planted with bamboo that feed into the Nyabarongo river and lake.

Geologically, the steep intensively cultivated hills consist of deep soils over granite/gneiss complexes, schist/quartzite complexes and pegmatites complexes.

The larger rivers in the catchment mainly alternate between meandering and wandering sand beds but in specific places the river exhibits characteristics of anabranching rivers that occur in high suspended sediment load / low energy environments most probably where the river gradient reduces. This is characterized by anabranching (Photo A), mobile mid-channel and point bars (Photo B), deltaic deposits at confluences (Photo C), braiding (Photo D) and channel avulsion (Photo D).

Additionally, rivers often suffer from flooding their banks and erosion on the riverbanks that leads to widening of the rivers and has resulted in access bridges being destroyed as well as encroachment on croplands. This is particular prominent on the smaller rivers in the catchment.

Figure 9 River Geomorphology

Source: *Water for Growth Pre-Feasibility Study 2019*

Photo 1 Riverbank Erosion

Soils

Across the watersheds, Cambisol, Ferralsols and Nitrisol groups are the main soil types. Cambisol and Nitrisol soils are developed in medium and fine-textured materials derived from a wide range of rocks, mostly in alluvial and colluvial. Most of these soils make good agricultural land and are intensively used. However they are often associated with erosion when they occur in association with mature tropical soils as found in Rwanda. Ferralsols or oxisols present a low fertility due to the lack of organic matter and the almost complete absence of soluble minerals leached by the wet and humid climate. Despite this soil type being low fertility, along the river banks soils are more fertile as topsoil from the hills and upriver in other areas of the catchment settles here.

Vegetation & Ecosystems

Rwanda is a landlocked country with limited available land. The project area is located within watershed catchment areas that are characterized by heavy agricultural use that consist of smallholder croplands and smallholder plantation forest plots. Programs promoting terracing on steep slopes have been initiated by the government to improve farming techniques that minimize environmental degradation, particularly soil erosion which is a widespread problem throughout the catchment.

Natural vegetation that once held the soils and stopped the rivers from migrating have been completely removed, which has negatively impacted the stability of the rivers. There is little, if any, native vegetation or ecosystems left within the project area.

Photo 2 Farming activities occurring along the rivers

Photo 3 Steep Slopes and River Adjacent Farming

Historic Conditions

Rwanda is one of the most densely populated countries in Africa and is highly dependent on rural agricultural for subsistence. From 1948 to 1992, Rwanda's population grew from 1.9 million to 7.5 million people. Rwanda's deforestation was driven by the need for agricultural land, food, medicine, charcoal, and timber as the populations grew.

The loss of so many trees in a rainy, mountainous country has had severe environmental consequences. In addition to tremendous loss of biodiversity, the region experiences soil erosion, degradation and landslides.

The Government of Rwanda has implemented and promoted revegetation across the country, focused on the use of Eucalyptus and Pine for wood lots. As a result, deforestation in the last 3 decades has been low compared to the overall gain in tree cover. Between 1990 and 2010, Rwanda lost an average of 5,850 ha or 1.84% per year. In total, between 1990 and 2010, Rwanda gained 36.8% of its forest cover, or around 117,000 ha. However, this revegetation is occurring with non-native species.

The project is being carried out on land the has been cleared of vegetation along the riverbanks decades ago due to demand for agricultural land and therefore no clearance of forest or any native ecosystems occurs as part of the revegetation activity.

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

The following laws, statutes and other regulatory frameworks are relevant to the proposed project.

EcoPlanet Bamboo Rwanda, Ltd operates within all of the below laws, statues and regulatory frameworks, as confirmed to the VVB during the validation interviews with key government entities and representatives.

National Legislation	General Provision	Applicability to the Project
Constitution of Rwanda	Provides the overarching legal framework for Rwanda, including key Articles: a. Article 49: each Person has the right to a healthy and satisfying environment. Each person is responsible to protect, conserve and promote the environment. The state ensures environmental protection. b. Article 29: every person has a right to property and that property shall not be interfered with except in public interest and after fair and prior compensation.	EcoPlanet Bamboo operates within the parameters of all laws of the Government of Rwanda.

National Legislation	General Provision	Applicability to the Project
Law Governing Land n° 27/2021 of 10/06/2021	Articles 30 and 31 indicate that lands on the banks of rivers are state lands in the public domain and are inalienable.	The project is located on the banks of the rivers and therefore is public domain.
The Ministerial Order Determining the Length of Land on Shores of Lakes and Rivers Transferred to Public Property n°007/16.01 of 15/07/2010	Determines the length of land on shores of lakes and rivers transferred to public property: a. In its article 4 states that "Public land referred to in this Order shall be a protected area. Authorities are not allowed to issue this land as a private property. No activities or buildings are authorized on the said land except activities aiming at protecting lakes, rivers, shores or activities authorized by the Minister in charge of environment and when such activities are deemed not destructive to the environment on condition that a prior environmental impact assessment study has been done" b. In Article 5 about Safeguarding and restoring shores of lakes and rivers, it is well stated that ''the land within a distance of fifty (50) meters from the lakeshore and the land on the river shore within the distance referred to in Article 3 (the land within a distance of ten (10) and five (5) meters from the shore of big rivers and small rivers respectively is public property) are reserved as natural vegetation. Artificial vegetation can be grown on this land in case of restoring the damaged land or if that vegetation is responsible for protecting the environment by stopping soil erosion, being habitats for living organisms''	The project plants on the buffer zones of the rivers which is determined within this legislation to be 5 meters or 10 meters depending on the size of the rivers. The Rwanda Water Board has actively promoted the planting of select species of sympodial bamboo, such as those that the PP is planting, as a specific recommended activity for the safeguarding and restoring of lakes and rivers. The project operates under a framework that is approved by the Rwanda Water Board, with such documentation available to auditors.
Law Establishing Rwanda Water Board N° 71/2019 of 29/01/2020	This law established Rwanda Water Board and provided its legal framework granting administrative and financial autonomy. It falls within the category of non-commercial public institutions.	EcoPlanet Partners with this institution and it is a key stakeholder of the project.
Law Governing Biodiversity in Rwanda N° 70/2013 of 02/09/2013	This law defines protected areas, rules on protected species and invasive species. This law also requires import permits when bringing in plant material to Rwanda, whether native or non-native species.	No bamboo species is included on the list of protected species. The species being planted by the project are sympodial (clumping) bamboo species that are not invasive, nor have any potential to become invasive.

National Legislation	General Provision	Applicability to the Project
		The project obtains the necessary import permits for the importation of seed of the target species being planted.
Environmental Organic Law N° 04/2005 OF 08/04/2005	Creates the precedent for environmental impact assessments (EIAs).	The planting of bamboo for riparian protection does not include any activities that trigger an EIA as it is an activity that is promoted by the Rwanda Water Board, the government entity that manages the riparian areas, and as a result an EIA is not required for the proposed project activities.
Law Governing Labor in Rwanda N° 66/2018 of 30/08/2018:	Provides a framework for labour relations and employment in Rwanda.	EcoPlanet Bamboo operates within this Act.

The project therefore complies with all laws, as detailed above.

1.15 Participation under Other GHG Programs

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

The project is not registered or seeking registration under any other GHG program.

1.15.2 Projects Rejected by Other GHG Programs

The project has not been rejected by another GHG program.

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

The emission removals resulting from the project are not included in any emissions trading program or similar mechanism.

The Letter of Authorization issued by the Government of Rwanda, through the Rwanda Water Resources Board, which provides the project proponent with the right to the carbon removal benefits generated from the project activities, confirms that "the revegetation activities associated with the project are not within the scope of the Republic of Rwanda's Nationally Determined Contributions and therefore, as a result, any corresponding adjustments associated with the project are not applicable"[5].

1.16.2 Other Forms of Environmental Credit

The project has not sought nor received another form of GHG-related environmental credit and is not eligible to participate in any such program.

1.17 Sustainable Development Contributions

No long-term restoration project can be successful without a broader focus on the positive and sustainable development of a region and ensuring that people that might be dependent upon an area benefit in the long run from project activities.

Rwanda has adopted and is implementing Vision 2050 along with other key National Development plans including the Economic Development and Poverty Reduction (EPDRS) and the Green Growth and Climate Resilience Strategy. These plans have a strong focus on landscape restoration, environmental protection and poverty reduction, which creates a positive framework for this project. This project will contribute to Rwanda's national development plans by:

1. Controlling erosion through the revegetation of sensitive riparian lands;
2. Increasing the countries forest cover and thereby contributing to its forest landscape restoration goals (FLR) within a relatively short time frame;
3. Providing livelihoods for farmers that complement national development plans;
4. Creating jobs, upskilling for local youths and contributing to the tax base of the local and national government;
5. Improving water quality which will reduce the cost of water filtration and make access to clean water more attainable; and
6. Improve water quality to improve the efficiency of hydropower and irrigation, supporting energy and food security.

Additionally, this project aims to have a positive impact on the following Sustainable Development Goals.

[5] *Letter of Authorization – Carbon Emission Removals, issued 05.07.22.*

SDG 1: No Poverty: EcoPlanet Bamboo's core social goal is the provision of secure, attractive and longterm employment in areas of the world where few opportunities exist. Providing individuals and communities with secure income, while ensuring that they become integrated within formal systems (for banking, health care and social security) is the first step in achieving a world with out poverty. Indirect benefits include the provision of training and education opportunities, and the multitude of community development projects carried out in surrounding communities each year.

SDG 6: Clean Water & Sanitation The project aims specifically to improve the quality of water throughout Rwanda, by reducing soil erosion and associated siltation.

SDG 8: Decent Work & Economic Growth Secure employment goes hand in hand with sustainable land and resource management and is the key to ensuring that development can occur in a linear and continuous fashion. EcoPlanet Bamboo strives to provide employment opportunities that are attractive, fair, and most importantly secure, not for a year or two, but for a generation. Secure livelihoods and steady income drives economic growth in rural areas. This mechanism of development has been proven to be far more successful than aid or charity, which is short term.

SDG 13: Climate Action: Deforestation and land use change contribute more than 25% of global annual greenhouse gas emissions. EcoPlanet Bamboo's alternative fiber products not only reduce such emissions through the reduction of pressure and therefore deforestation and degradation of the world's remaining forests, but in addition restore huge tracts of degraded land. Such restoration activities sequester significant volumes of atmospheric carbon dioxide, and store it in permanent carbon sinks. Such restored ecosystems provide additional adaptation benefits, creating micro climates that can better regulate local weather patterns and rainfall. The sustainable development of involved communities and the provision of secure income allows them increased ability to adapt to short term climate change. As such EcoPlanet Bamboo's operations are a significant tool in the mitigation of global climate change and provide immense adaptation benefits.

The project proponent monitors Key Performance Indicators associated with each goal on a quarterly basis and reports annually on these KPIs and its associated contribution to these aspects as part of its commitment to the United Nation's Global Compact and associated required Communication on

Progress. Such annual monitoring reports will be made available to auditors as part of project verification events.

1.18 Additional Information Relevant to the Project

Leakage Management

The project is a revegetation activity carried out on state owned land that has clearly defined and regulated uses. No movement of people or communities occurs, and the project is not claiming GHG emission reduction / removals from any activity which might result in leakage. Therefore no leakage management is necessary.

Commercially Sensitive Information

Commercially sensitive information surrounding the financing arrangements of the project have been excluded from the PD and the associated Non Permanence Risk Assessment, but have been made available to auditors. Such documentation is the VER Purchase Agreement, Rwanda Riparian Restoration Project, March 19th 2022.

Further Information

Not applicable, all information is provided elsewhere within this document.

2 SAFEGUARDS

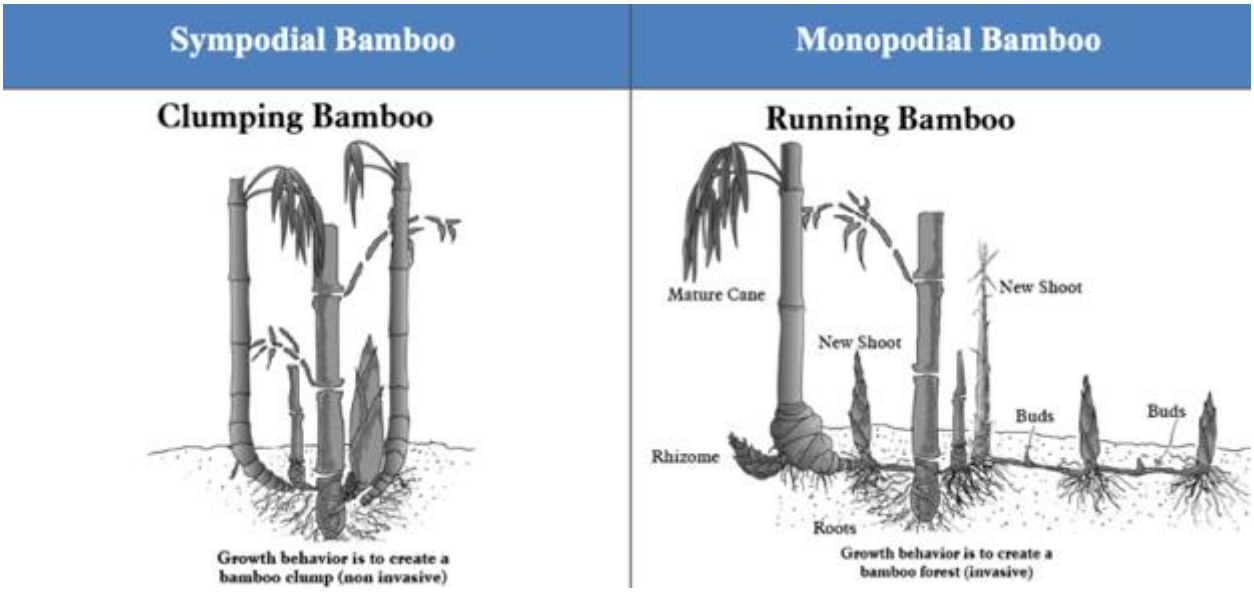
2.1 No Net Harm

Environmental Impact: The project is utilizing species of clumping (sympodial) bamboo to restore and reconnect remnant forest patches, while conserving all remaining standing trees. The project uses non-native bamboo species as the native species of *Yushania alpina* is only located in the highlands of the volcanic regions of the country and does not survive outside these areas. *Yushania alpina* is also a loose clumping bamboo species and does not have the intricate root system required to bind soils. As a result, Rwanda Water Board promotes the use of *Bambusa polymorpha* and *Bambusa textilis* as well as similar species of the same genus for riparian restoration.

These species are sympodial, or clumping bamboo species. Clumping bamboo species have no chance of invasiveness.

- The growth pattern of these species is to develop as a tight knit clump that stays within a contained area.
- The rhizomes of clumping bamboo species are very short, emerging as close as possible to the parent plant and forming a dense clump of multiple culms.
- Each clump remains compact and has no ability to spread horizontally.

Figure 10 Comparison of Growth Patterns of Clumping vs Running Bamboo



The targeted species have been chosen by the project proponent and approved by the Government of Rwanda specifically due to their growth form which creates a very tight knit clump with no potential to spread. This growth pattern not only results in these species having no potential for spreading or invasiveness, but is also what provides the net positive benefits relating to the binding and protection of soils and the fragile interface between farmed areas and water bodies.

Historical GIS and remote sensing mapping shows that it is extremely likely that in the without project activities scenario that these areas would not return to the native vegetation that once protected the riparian areas as farming activities would continue up to the riverbanks.

At the same time, in the baseline scenario the occurrence of farming up to the riverbanks results in erosion, which causes hardships by reducing topsoil making farmland less productive and results in a suit of negative environmental and social impacts such as the widening of rivers and increased siltation as riverbanks erode away. Moreover, the high levels of siltation in Rwanda's water ways impact a number of key development sectors from power generation, as hydropower is less efficient, to agriculture, as the cost to irrigate increases with the need to filter water, to access to potable water, as it becomes increasingly more expensive to filter water for Rwanda's growing population.

The project activities are designed to reduce the risk of erosion, by planting bamboo that binds the soils reducing landslides and stabilizing riverbanks to reduce siltation in the rivers, all the while rehabilitating the watershed.

Therefore not only does the project not represent any net harm, but in contrast the bamboo brings a suite of environmental benefits, in addition to the carbon removals and associated climate change benefits. In addition to controlling erosion and siltation, these environmental benefits include:

- Select bamboo species are planted that have tight root structures to quickly bind soils and stabilize riverbanks to reduce flooding on surrounding farmland.
- The bamboo creates microclimates that controls temperature fluctuations and stabilizes rainfall benefiting farmers.
- The bamboo controls the flow of rainfall from sky to soil, reducing runoff and slowing the flow of water into rivers.

All activities included within the project are carried out in a low intensity manner, relying almost entirely on manual work, and with all activities working hand in hand with the full ecosystem.

The project therefore does not have any potential negative environmental impacts that require risk mitigation activities.

Socio-Economic Impact: The project is being carried out on land that is legally classified as riparian buffer zone, which is under legal land tenure owned by the Government of Rwanda, and utilizes private financing. Smallholder farmers have encroached within the buffer zone clearing existing vegetation that once binded the soils and helped prevent flooding. As a result, these riverside farm plots often flood resulting in crop failure in croplands beyond the encroached buffer zone areas, which negatively impacts farmers. At the same time increased economic activity in the project area is expected to result in significantly improved standards of living for communities living in the catchments. The project therefore has the following impacts:

- Long term and secure employment allows additional funds to flow into communities where previously few opportunities existed;
- Improved farming as the loss of topsoil is controlled and riverbank flooding minimized by the planted bamboo;
- Empowerment of women as the project works to empower women, which in turn results in an increase in community spending on critical development aspects such as health and education;
- Secondary opportunities as the project supports secondary opportunities that arise to service the project's operations by sourcing goods and services locally.

The project therefore does not have any potential negative socio-economic impacts and in contrast is committed to delivering long-term benefits to the greater area.

2.2 Local Stakeholder Consultation

As described further in Section 2.5 below, the project has two categories of local stakeholders, the Government of Rwanda and local communities. The limited number of stakeholders is due to the tenure of the land included within the project boundary being under the ownership of the Government of Rwanda as a riparian buffer zone and the local communities being important custodians of the plantings to ensure longevity of the project.

The design of the project was carried out through video and in-person meetings between the project proponent and Rwanda Water Board, which resulted in the establishment of a Memorandum of Understanding (MoU) for the project. The revegetation design follows the structure conducted in the pilot project of the neighbouring Secoko Catchment, which was a program under Rwanda Water Board and implemented by the project proponent.

Procedures for Engaging Stakeholders: EcoPlanet Bamboo engaged Rwanda Water Board with an opportunity to expand the pilot Secoko Catchment Restoration to neighbouring watersheds through

carbon financing. Through project design consultations, which took place on February 3rd 2022, during a virtual meeting and on February 23rd, 2022, Rwanda Water Board and EcoPlanet Bamboo partnered to take forward the project with EcoPlanet Bamboo serving as the implementing partner and Rwanda Water Board providing the operating framework.

Stakeholder consultations therefore are undertaken following existing structures that are used across Rwanda to implement riparian restoration projects:

1. Rwanda Water Board has a government mandate to protect the riparian areas around the country, with the planting of bamboo being a key program implemented on rivers across the country since 2010. Rwanda Water Board provides the framework to the District Government under which projects are undertaken through the provision of technical guidance and funding on the coordination of watershed management projects. As a result, Rwanda Water Board already has in place agreements with all Districts in the Southern Province and Eastern Province, which is where the project area occurs, to undertake restoration of the riparian areas.
2. Operating under the agreement with the Districts, the Rwanda Water Board consulted with the involved leadership of the included Districts on the location, scale and timeline of planned protection works. On agreement, the project becomes an official activity on the work plan of the District and they become responsible to oversee that it is completed and that the plantings survive to keep bringing positive social and environmental benefits to the area. These types of projects are typically carried out by contractors hired by the District Government as they do not implement. In the project scenario, EcoPlanet Bamboo acts as the implementing partner of Rwanda Water Board and the District Government.
3. The District Governments consult with the Sector Governments who are responsible for community engagement and working with contractors (in this case EcoPlanet Bamboo as the implementing partner) in order to sensitize communities on project activities. The Sector Governments work hand and hand with the Cell and Village Governments, who operate underneath them and who are given the mandate to communicate project activities leading up to as well as during project implementation at regular community meetings that occur monthly in each village. Topics included at the community meetings include sensitizing communities on the project benefits and why it is necessary to protect the buffer zones, informing farmers to cease any illegal farming that may be occurring in the buffer zone as well as potential job opportunities available. EcoPlanet Bamboo has a community liaison officer and a team of technicians who will regularly take part in these community meetings through project implementation.

There are no communities or individuals located within the Project Area and as a result none that have the potential to be directly impacted by the project.

However, as a society Rwanda has very clear structures, and adjacent to the project area there are three levels of organization, both governmental and community based. Identification and associated mapping of these communities, local stakeholders and areas outside the project area but within the area of influence was carried out for the targeted 1st planting instance, in advance of the project start date.

The organizational structure is as follows:

The districts involved in the 1st planting instance have been shown in Section 1.12 above.

Identification of the involved Sectors, Cells and Villages are shown in the relevant maps below along with the location of the 1st planting instance.

Figure 11 1st Planting Instance – Adjacent Sectors

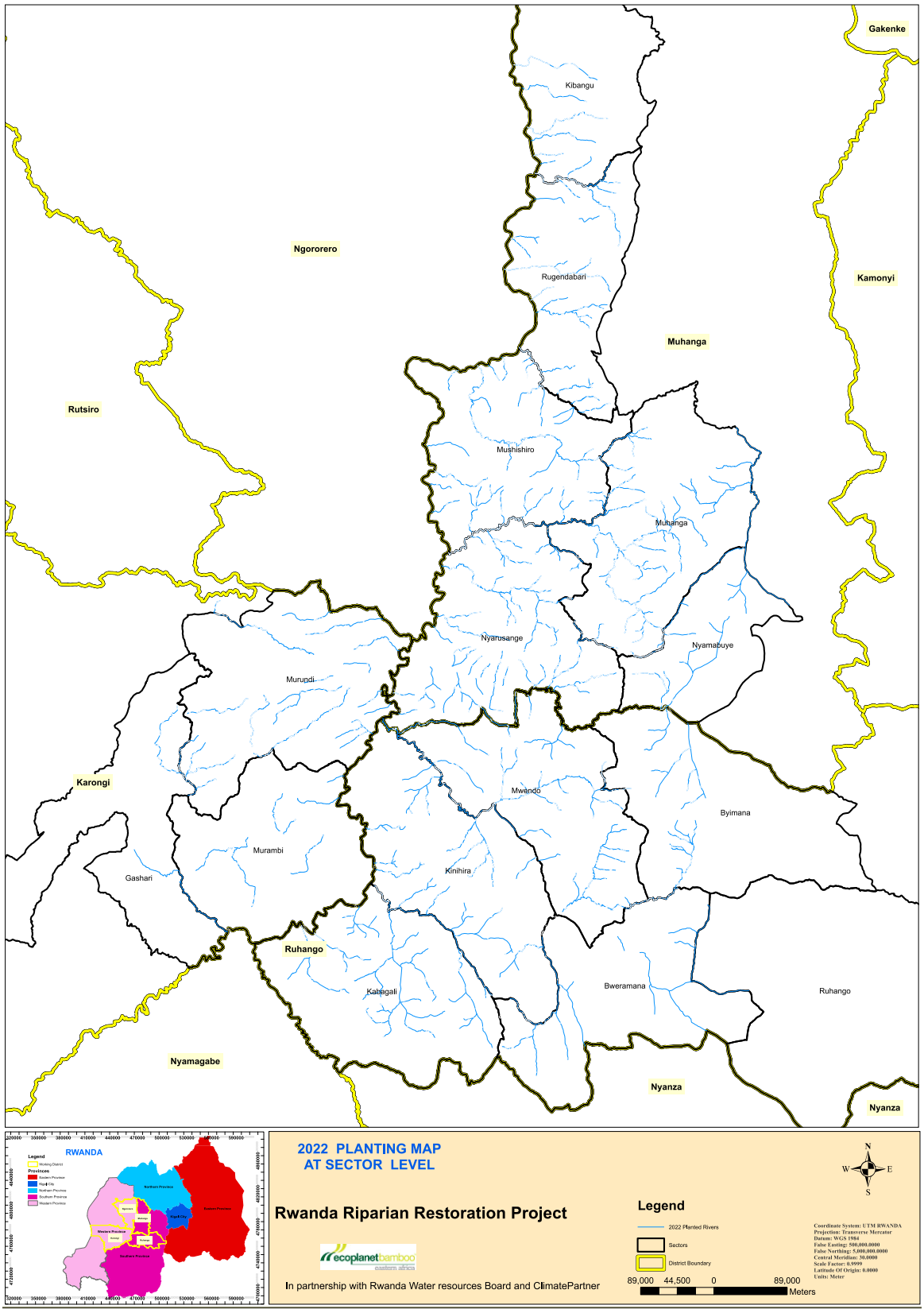


Figure 12 1st Planting Instance – Adjacent Cells

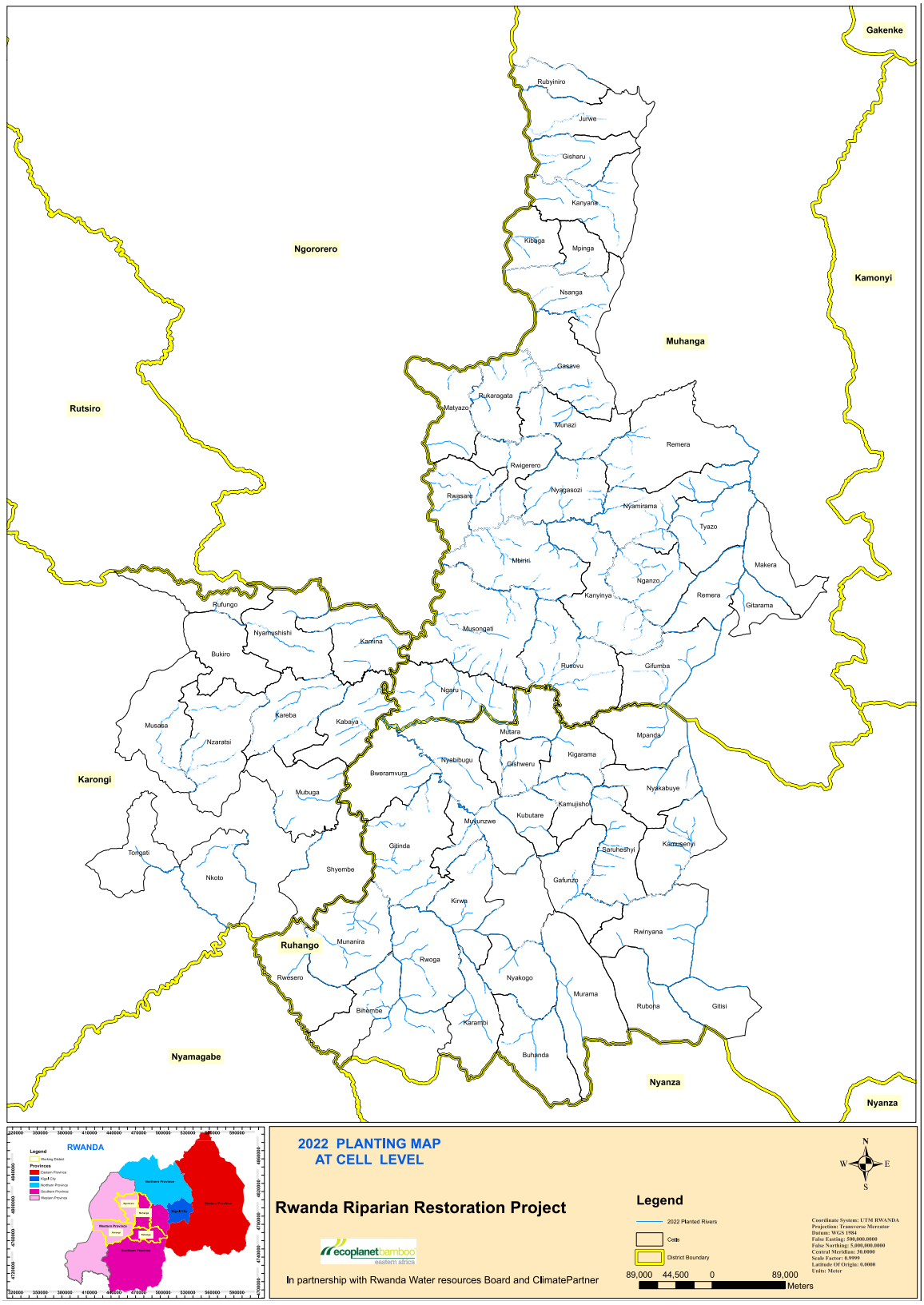
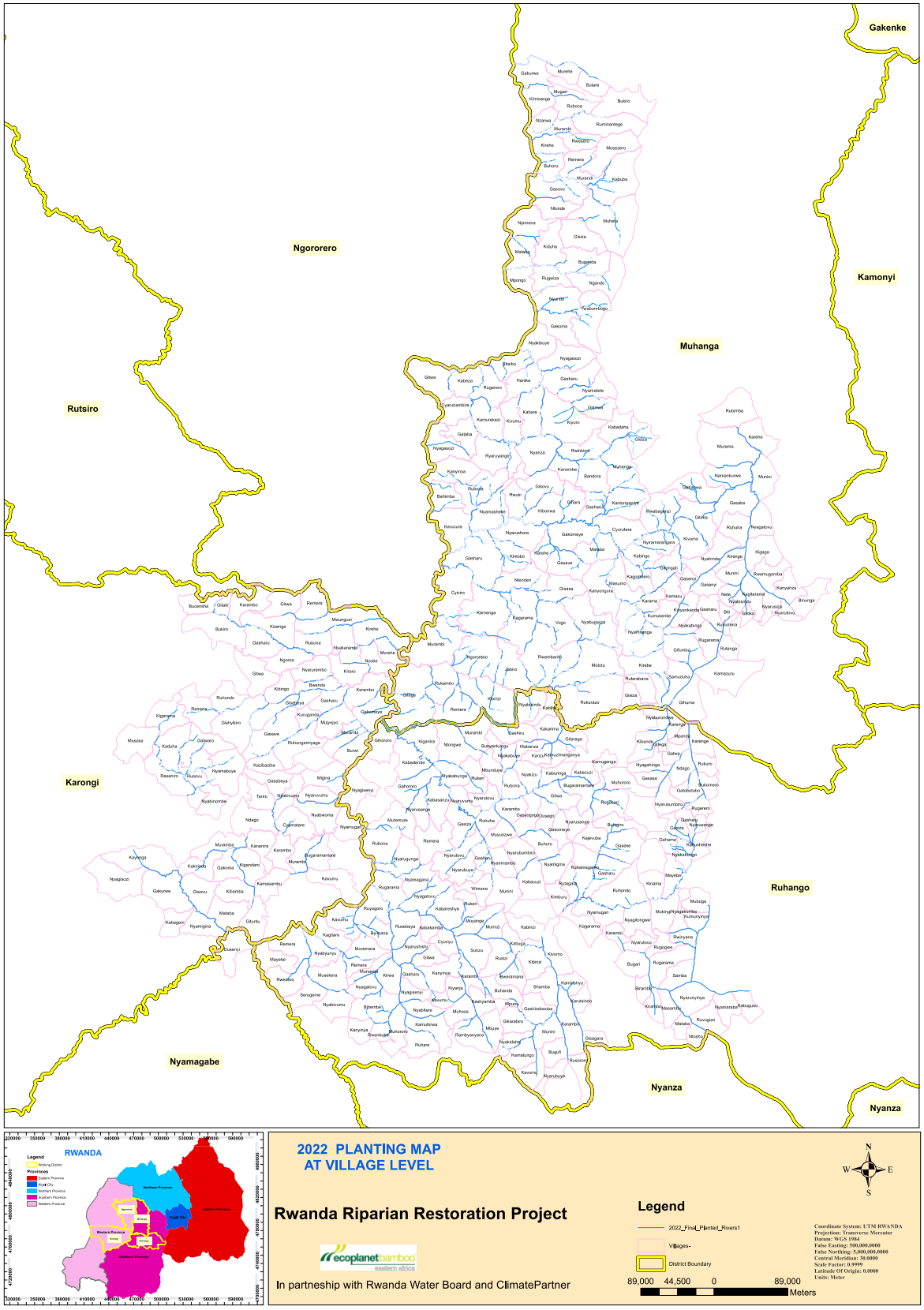


Figure 13 Planting Instance – Adjacent Villages (Communities)



Within all locations, stakeholder consultations were completed within identified areas for the 1st planting instance, prior to any land preparation activities occurring within any particular village or cell.

Photo 4 Example of District to Sector Consultations

Photo 5 Example of Cell and Community Consultations

Documentation Procedures: meetings are organized via phone call with the dedicated representatives of the Rwanda Water Board, District and/or Sector representatives and EcoPlanet. Rwanda Water Board

is responsible for determining the positions and representatives to attend formal meetings. Minutes and attendance registers are taken for all formal stakeholder engagement meetings.

In addition, meeting logs are kept by EcoPlanet's Community Liaison Officer for Cell and Village level community meetings.

Project Design Consultations: the project was designed through a pilot project and in close co-operation with the Rwanda Water Board. Meetings with the different levels of government as well as communities focused on the below aspects. A summary of meetings has been provided to the VVB[6] including photographic evidence of all meetings.

Project Communication of Key Aspects

i. Project design, implementation and results of monitoring: as described above, the project design and proposed implementation plan is being communicated extensively to stakeholders through a variety of mechanisms and the key stakeholder of the Government of Rwanda involved in all stages of such project design. During implementation, the communication of implementation achievements, and subsequent monitoring will occur through the channels and operating procedures detailed in Section 2.5 below. All meeting logs and minutes are available in the project office for viewing by auditors.

ii. Risks, costs and benefits of the project to local stakeholders: a pilot project was carried out in the neighbouring Secoko Catchment, which informed the development of this project. This pilot provided an analysis to both sides of the risks, costs and benefits, and formed the basis of the MoU and project agreements. These legal documents are available to auditors.

iii. Relevant laws and regulations covering workers' rights: the project proponent has a strict set of environmental health and safety procedures against which all operations will occur. During the initiation and training period of new workers which will occur prior to the October 1st 2022 project start date, all details surrounding workers' rights will be provided. Such rights will also be discussed during monthly meetings where workers will have the chance to ask questions. Printed and laminated copies detailing key aspects of local labor law will be made available within strategic locations in the project area. Furthermore, the project is committed to undertaking Forest Stewardship Council (FSC) certification within 2 years after the completion of planting activities. FSC has strict procedures on workers' rights.

[6] 2022 Overview Stakeholder & Community Meetings

iv. The process of VCS program validation and site visit: prior to validation the project proponent was been in continuous communication with the key local stakeholders. Once the date of the validation audit was finalized formal communication was provided to Rwanda Water Board detailing the upcoming audit. This formal communication was followed up with an in person meeting between the project proponent and these stakeholders in order to disseminate details pertaining to the validation audit.

Use of Non Native Species: With regards to the use of non-native species, the Verra Standard v4.3 states that "To reduce damage to the ecosystems on which the local stakeholders rely:" "The project shall justify the use of non-native species over native species, explaining the possible adverse effects of non-native species". The project is using non-native species that are not expected to have any adverse effects on local ecosystems and instead has been designed specifically to enhance and restore the functions of such ecosystems. The use of such species has been approved by Rwanda Water Board as there is only one native bamboo species in Rwanda – *Yushania alpina* - and this highland bamboo species is not suitable for the range of altitudes covered by the targeted planting locations. Furthermore this species is not a dense clumper but spreads laterally, making it unsuitable to be maintained as a physical buffer following the line of the riparian areas. Lastly, this species does not have a tight enough root system to provide the necessary binding of the soil. Furthermore, given the land tenure as state controlled riparian buffer zones, there are no stakeholders that have rights to the project areas, and therefore there are no stakeholders that rely on the project area, and as a result no possible adverse effects on local stakeholders resulting from the use of non-native species.

2.3 Environmental Impact

An EIA is not a requirement for the project activities, given the tenure of land, and the approval of activities by a government body, Rwanda Water Board. All design of the project activities is done hand in hand with Rwanda Water Board.

2.4 Public Comments

The project underwent a public comment period from 30.06.2022 to 30.07.2022. No public comments were received during this period.

2.5 AFOLU-Specific Safeguards

Stakeholder Identification: A stakeholder is commonly defined as "a person or party that has an interest in a company and can either affect or be affected by the business". In this case stakeholders would be people or parties that have an interest in the project activities and can either affect or be affected by the project. Such stakeholders can be categorized as either external (people outside of the organization or project) or internal (people within the organization or project).

External Stakeholders: the project has multiple external stakeholders, which are divided into stakeholder representing the Government of Rwanda, local communities and the project funder.

1. The Government of Rwanda has a decentralized government administrative structure and as a result, there are multiple stakeholders representing the Government of Rwanda from national government down to local leadership:
    - Rwanda Water Board: A government agency under the Ministry of Environment that is mandated to ensure the availability and quality of water resources across Rwanda, including catchment restoration and protection.
    - District Government: Districts are responsible for the promotion of sustainable development within their administrative area, including promoting solidarity and development of their people as well as protection of the environment. They are the main custodian of riparian protection projects that occur within their administrative boundaries.
    - Sector, Cell and Village Government: Local government units that work closely with local communities to carry out project mandates on behalf of the districts. The location of such stakeholders were identified and mapped out for the 1st planting instance, as per the information provided in Section 2.2 above.
2. Communities within the Catchment: While communities have no legal rights to the buffer zone that is under government ownership, they play a key role in the long-term survival of the plantings through sensitization on the importance of the plantings to provide environmental protection and social benefits to them. Prior to the project start date the project proponent carried out a socio-economic baseline assessment[7], in order to gather data on these communities that could guide the details of project implementation. Key factors determined by this study were utilized to refine the project design:
    - Maximizing employment and benefits: in order to spread the economic benefits as widely as possible, the project employed 450 farmers to undertake the activities associated with the first planting instance;
    - Payment above minimum wage: communities indicated that agricultural jobs typically pay minimum wage, whereas less attractive jobs in small scale mining pay higher. The project used this data to determine an above minimum wage pay scale;

[7] *Socio-Economic Baseline Assessment- a review of the lifestyle and livelihoods of rural Rwanda farmers in the areas adjacent to riparian buffer zones*

- Engagement of bamboo rangers: communities highlighted that it would be beneficial to hire individuals from each village to protect the bamboo. As a result the project has put in place a long term team of "bamboo rangers";
- Engagement of youth: communities requested the project proponent to provide training and motivation for youth to become involved, due to a lack of opportunities and resulting socio-economic issues with unemployed youth;
- Longer term participation: communities highlighted that most projects are short term in nature and requested longer term participation. This aligns with the projects extended life time.

3. ClimatePartner: This entity is responsible for securing the carbon financing for the project.

Aside from the above entities, there are no local nor international organizations that can be considered stakeholders to the project as there are no further organizations that have any interest in the project, nor can they be affected by or have an effect on the project activities.

Internal Stakeholders: the project's internal stakeholders consist of employees. These employees have an interest in the success of the project to the extent that they are able to maintain employment and their livelihoods, and as employees they have the potential to affect and be affected by the project.

Customary Access; all land within the project area is defined as public property under the jurisdiction of the Rwanda Water Resources Board. There are no areas within the project area to which any other local stakeholders own or to which they have customary access. Adjacent to the project area, as per the maps provided in Section 2.2 above, are villages that have customary access to the farm lands adjacent to the riparian buffer zones on which the project activities are located, however such adjacent farm lands are outside of the project area and there is no direct impact of the project activities on such adjacent farm lands. In addition to the adjacent farmlands, although local stakeholders are prohibited from law from carrying out activities within the project area, they have access to the water within the adjacent rivers. The project does not interfere with, prohibit or in any way change such access.

Risks, Costs and Benefits to Stakeholders: the key risks of the project are provided in detail in the project Non Permanence Risk Assessment. Specific risks raised by stakeholders during the meetings detailed in Section 2.2 above are provided below:

- Loss of Bamboo Due to Extreme Erosion: In some areas, the stability of the riverbanks may be too far damaged for the planting of bamboo to be the solution to protect that section of the river. For instance, where erosion is already cutting underneath a riverbank and threatening its collapse. In such cases, engineering works may be needed to stabilize the rivers. To mitigate this, the bamboo is planted slightly back from the bank to stabilize against further riverbank loss. Moreover, potential loss is accounted within the bufferstock of the project.

- Damage by Community Livestock: due to the proximity near a water source, livestock is often lead to the rivers to drink and may graze on the plants in the early years. To mitigate this, community sensitization occurs on the importance of protecting the bamboo and in areas of high occurrence of livestock, the bamboo is protected with a cage barrier.
- Illegal Farming in the Buffer Zone: Once the project is planted, some farmers may not want the bamboo to survive in order to continue farming illegally in the buffer zone and therefore may remove the plants. To mitigate this, the project has security patrols and conducts on going community sensitization, which significantly reduced occurrences of the destruction of the bamboo during an initial pilot project.

Risks to Stakeholder Resources: The Government of Rwanda holds the rights to the land or resources within the project area of the riparian buffer zones. Given that this entity has approved the project activities as being aligned with national development strategies and the desired restoration of these rivers. There are no other stakeholders that hold any property rights and therefore there is no likelihood of the project impacting local stakeholder property rights, and therefore no associated stakeholder mitigation measures are required. Mitigation measures for any negative impacts that might occur as the result of the project reducing the occurrence of illegal activities has been detailed in Section 2.1 above.

Discrimination or Sexual Harassment: Neither the project proponent nor any other entity involved in project design or implementation are or have been involved in any form of discrimination or sexual harassment.

Culturally Appropriate Communication and Consultation: all communication and consultation is designed to be carried out in a manner that meets local culture, including the organized structure of Rwanda's rural societies. This includes the following steps all of which are undertaken by the project's dedicated Community Manager, in local language and following the local customs at each level of society organization:

- Rwanda Water Resources Board provides a letter of introduction between the project proponent and the District in advance of a formal meeting, as shown in Section 2.2;
- Each Sector has a team of dedicated agricultural technicians that work with smallholder farmers across these agrarian communities. These technicians work closely with the cells and villages within their Sector including having monthly community meetings. It is during these meetings, that these agricultural technicians introduce the project and answer questions. EcoPlanet's team are present to answer questions but do not lead these meetings.
- Women comprise a significant portion of smallholder farmers across Rwanda, and are equally represented in the above ongoing meetings. Community leaders in this part of Rwanda typically

request one member of each household to attend such monthly meetings, with no gender discrimination which is apparent through the diversity of the meeting participants.

- Following initial introduction of the meeting which occurs as above as part of non project related meetings between District, Sector and Cell community leaders, EcoPlanet's Community Liasion Manager carries out a dedicated meeting which the community leaders open to all participants. This meeting allows for questions and in addition provides the opportunity for smallholder farmers to participate in the paid opportunities associated with the project.
    - During the 1st planting instance more than 450 farmers engaged with the project during these meetings to become involved in land preparation and planting activities. Of this approximately 40% were women.

Procedures for On-Going Stakeholder Communication: in addition to the steps taken above, the project proponent has a set of Environmental Health & Safety Standard Operating Procedures (EH&S SOPs) that guide all operations, including stakeholder communication and consultations. These procedures include EcoPlanet EH&S Standard Operating Procedure #7 "Communication Procedure", which specifically deals with stakeholder consultations:

- Annual Meetings: formal stakeholder meetings are held annually with external and internal stakeholders, which cover: An update on project activities;
    a. Results of any monitoring or changes to the project in the last year;
    b. Discussion on project impacts, including risks costs and benefits the project may bring;
    c. Review of relevant laws and regulations covering workers' rights.
- Bi-Annual Meetings: twice a year the Project Manager meets with the full team to discuss any concerns, issues, complaints or grievances.
- Monthly Meetings: on the first working day of each month the Project Manager meets with the full team to discuss updates, priorities and work plans for the month.
- Monthly Community Meetings: the Community Liaison Officer attends monthly meetings across held by local government and communities to share project updates and conduct on-going sensitization with communities.
- Weekly Meetings: each Monday the Project Manager meets with the Area Supervisors to discuss the achievements of the previous week, challenges, and the schedule for the week ahead.
- World Bamboo Day: September 18th is World Bamboo Day. The project proponent uses this annual opportunity to provide environmental education and detailed understanding surrounding

the project's revegetation activities to Government teams, employees and surrounding communities.

- The Project Manager is in daily contact with EcoPlanet's corporate team.
- The General Manager and project team is in regular contact with the Executive of the Sector Government.

In addition to the team meetings detailed in Section 2.4 above, the project has in place a Complaints, Grievances, Disputes & Conflict Resolution Mechanism, which has been made available to the validation body.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

The project is utilizing the below approved CDM methodology:

AR-ACM0003 A/R Large-scale Consolidated Methodology: Afforestation and revegetation of lands except wetlands Version 02.0

The methodology requires the use of a number of tools. The following A/R methodological tools are applicable to the project activity and the carbon sinks under development:

- "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities";
- Tool for the "Estimation of Carbon Stocks and Change in Carbon Stocks of Trees and Shrubs in A/R CDM Project Activities" UNFCC/CCNUCC 2011a
- Tool for "Estimation of Change in Soil Organic Carbon Stocks due to the Implementation of Project Activities" UNFCC/CCNUCC 2010a;
- Tool for the "Estimation of Carbon Stocks and Changes in Carbon Stocks of Dead Wood and Litter in A/R CDM Project Activities" UNFCC/CCNUCC 2010;
- Tool for the "Estimation of non-CO_2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity" UNFCC/CCNUCC 2011;
- Tool for the "Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in the A/R project activity" UNFCC/CCNUCC 2011;
- Tool for "Demonstrating Appropriateness of Allometric Equations for Estimation of Aboveground Tree Biomass in A/R CDM Project Activities" UNFCC/CCNUCC 2011;
- Tool for the "Calculation of the Number of Sample Plots for Measurements within A/R CDM Project Activities" (UNFCC/CCNUCC 2009)

3.2 Applicability of Methodology

The VCS allows for the use of accepted CDM methodologies.

The project activities meet the following required eligibility requirements, as described in Section 2.2 of the methodology:

Applicability Condition: The land subject to the project activity does not fall in wetland category.

Project Justification: As per the IPCC GPG LULUCF 2003, wetlands are defined as lands that are covered or saturated by water for all or part of the year (e.g., peatland) and that does not fall into the forest land, crop land, grass land or settlements categories including reservoirs, natural rivers and lakes. The project site consists of land defined as riparian buffer zones, and represent areas that are not subject to being covered or saturated by water for all or part of the year.

Applicability Condition: Soil disturbance attributable to the project activity does not cover more than 10 per cent of the area in each of the following types of land, when these lands are included within the project boundary":

i. "Land containing organic soils"

ii. "Land which, in the baseline, is subjected to land-use and management practices and receives inputs listed in appendices 1 and 2 to this methodology" - the baseline prior to the project start date was degraded transitional forest lands, which had no active management or inputs, as described in section 3.4.

Project Justifications

i. The soils in the project area are classified as sandy loam soils, as described in Section 1.13.

ii. The lands of Appendix 1 refer to cropland in which soil disturbance is restricted. The project activities are not occurring on cropland. Therefore, the project area does not classify as land listed in Appendix 1.

   The lands of Appendix 2 refer to grassland in which soil disturbance is restricted. There are no grasslands in the project area with the use of any inputs. Therefore, the project area does not classify as land listed in Appendix 2.

The methodology requires the use of a number of tools, as detailed in Section 3.1 above. The applicability conditions and associated project justifications of each tool is detailed in the table below.

Table 2 Tool Applicability Conditions and Associated Justifications

Tool: Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities	
Applicability Condition	**Justification**
a) Forestation of the land within the proposed project boundary performed with or without being registered as the A/R CDM project activity shall not lead to violation of any applicable law even if the law is not enforced.	a) The project is in compliance with applicable legal and regulatory requirements. (See section 1.14)
b) This tool is not applicable to small - scale afforestation and reforestation project activities	b) This project is not a small-scale afforestation and reforestation project, as it does not fulfil the small-scale conditions as defined by VCS (VCS Program Definition Booklet).
Tool: Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities.	
Applicability Condition	**Justification**
No applicability conditions	No justifications required
Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities	
Applicability Condition	**Justification**
This tool is applicable when the areas of land, the baseline scenario, and the project activity meet the following conditions: a) The areas of land to which this tool is applied: i. Do not fall into wetland category; or ii. Do not contain organic soils as defined in "Annex A: glossary" of the IPCC GPG LULUCF 2003. iii. iii. Are not subject to any of the land management practices and application of inputs as listed in the Tables 1 and 2.	a) Project lands are not wetlands or peatlands. The project area is characterized as riparian buffer zones. The type of soil in the project area are Cambisol, Ferralsols and Nitrisol as described in section 1.13. The project area does not classify as land listed in Table 1. The lands of Table 2 refer to grassland in which soil disturbance is restricted. There are no grasslands in the project area with the use of any inputs. Therefore, the project area does not classify as land listed in Table 2.

b) The A/R CDM project activity meets the following conditions: i. Litter remains on site and is not removed in the A/R CDM project activity; and ii. Soil disturbance attributable to the A/R CDM project activity, if any, is: • In accordance with appropriate conservation practices, e.g., follows the land contours. • Limited to soil disturbance for site preparation before planting and such disturbance is not repeated in less than twenty years.	b) Soil disturbance associated with the project activities are limited to those during site preparation (digging of holes to plant seedlings).
Tool for the estimation of carbon stocks and changes in carbon stocks of dead wood and litter in A/R CDM project activities	
Applicability Condition	**Justification**
No applicability conditions	No justifications required
Tool for demonstrating appropriateness of allometric equations for estimation of aboveground tree biomass in A/R CDM project activities	
Applicability Condition	**Justification**
No applicability conditions	No justifications required
Tool for the calculation of the number of sample plots for measurements within in A/R CDM project activities	
Applicability Condition	**Justification**
No applicability conditions	No justifications required

3.3 Project Boundary

The carbon pools and GHG included in the baseline and project scenarios are described in the table below.

Table 3 Project Carbon Pools & Included GHG in the Baseline (Top) and Project (Bottom) Scenario

Source		Gas	Included?	Justification/Explanation
Baseline	Above and Below Ground Biomass	CO_2	Yes	These are the major carbon pools for both the baseline and project scenario.
		CH_4	No	Excluded as per the requirements of the methodology
		N_2O	No	Excluded as per the requirements of the methodology

Source		Gas	Included?	Justification/Explanation
		Other	No	There are no other GHG sources relevant for the chosen baseline scenario.
	Soil Organic Carbon (SOC)	CO_2	No	The increase in SOC over the 20 year project period is estimated as an annual increase, following the applicable tool. Therefore, this carbon pool is not included in the baseline, but is included within the project scenario.
		CH_4	No	Excluded as per the requirements of the methodology
		N_2O	No	Excluded as per the requirements of the methodology
		Other	No	There are no other GHG sources relevant for the chosen baseline scenario.
	Dead Wood	CO_2	No	Given the trend of deforestation and degradation within the project boundary, the project activities are expected to result in an increase in dead wood in comparison to the baseline scenario. Excluding this carbon pool from the baseline scenario is therefore considered to be conservative.
		CH_4	No	Excluded as per the requirements of the methodology
		N_2O	No	Excluded as per the requirements of the methodology
		Other	No	There are no other GHG sources relevant for the chosen baseline scenario.
	Litter	CO_2	No	Given the trend of deforestation and degradation within the project boundary, the project activities are expected to result in an increase in litter in comparison to the baseline scenario. Excluding this carbon pool from the baseline scenario is therefore considered to be conservative.
		CH_4	No	Excluded as per the requirements of the methodology
		N_2O	No	Excluded as per the requirements of the methodology
		Other	No	There are no other GHG sources relevant for the chosen baseline scenario.

Source		Gas	Included?	Justification/Explanation
Project	Above and Below Ground Biomass	CO_2	Yes	These are the major carbon pools for both the baseline and project scenario.
		CH_4	No	Excluded as per the requirements of the methodology
		N_2O	No	Excluded as per the requirements of the methodology
		Other	No	There are no other GHG sources relevant for the chosen baseline scenario.
	Soil Organic	CO_2	Yes	The project activities are expected to trigger an increase in SOC over time as assessed using the applicable tool.

Source		Gas	Included?	Justification/Explanation
	Carbon (SOC)	CH_4	No	Excluded as per the requirements of the methodology
		N_2O	No	Excluded as per the requirements of the methodology
		Other	No	There are no other GHG sources relevant for the chosen baseline scenario.
	Dead Wood	CO_2	No	The ecological growth patterns of clumping bamboo means that there is a constant number of culms that die, as new culms emerge during each annual growing season. These are thinned but are not left on site and therefore this pool is not included within the project scenario.
		CH_4	No	Excluded as per the requirements of the methodology
		N_2O	No	Excluded as per the requirements of the methodology
		Other	No	There are no other GHG sources relevant for the chosen baseline scenario.
	Litter	CO_2	Yes	The bamboo clumps drop significant volumes of leafy material each year, resulting in an increase in this carbon pool.
		CH_4	No	Excluded as per the requirements of the methodology
		N_2O	No	Excluded as per the requirements of the methodology
		Other	No	There are no other GHG sources relevant for the chosen baseline scenario.

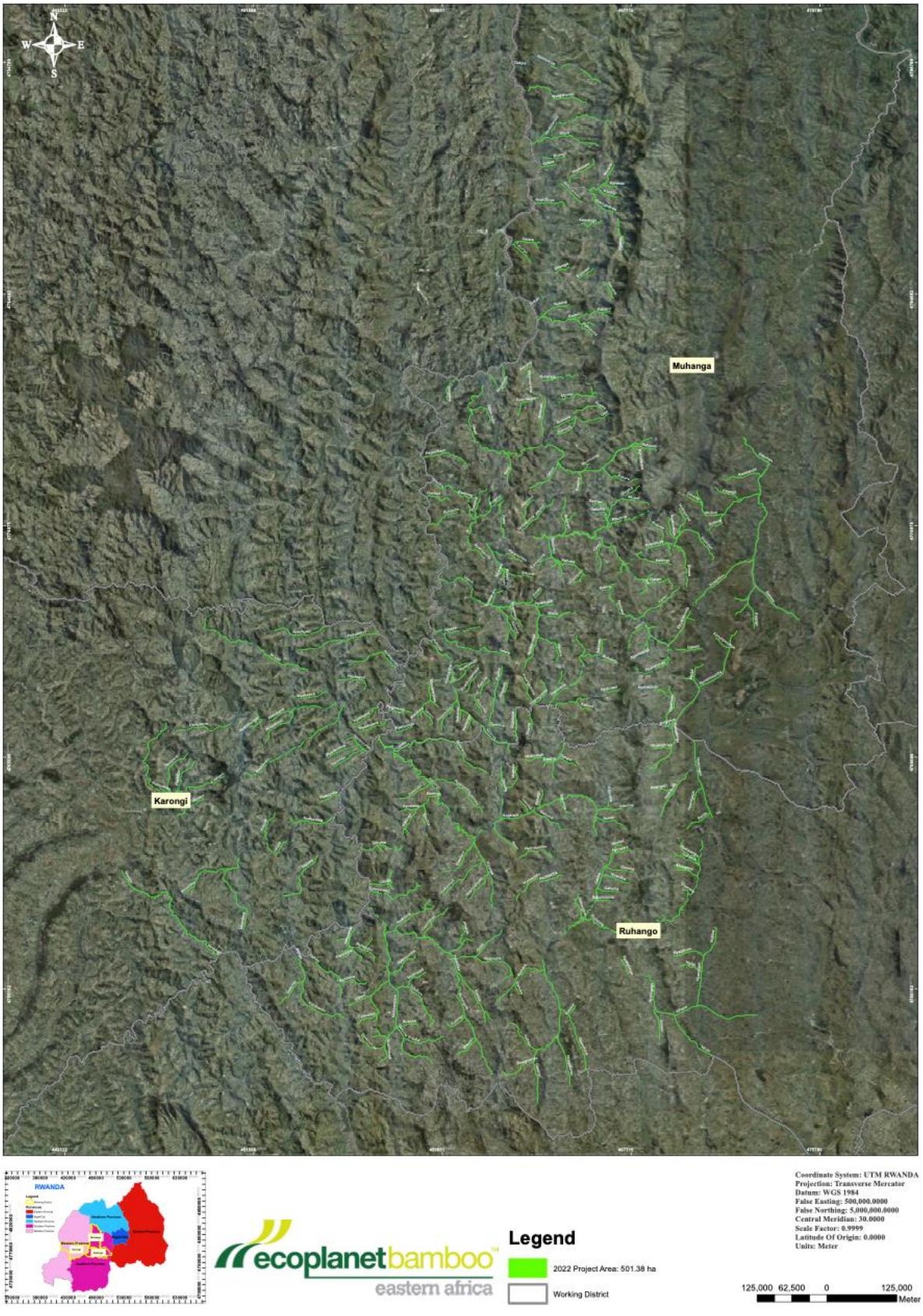
Table 4 Emission Sources and GHGs Selected for Accounting

Source		Gas	Included?	Justification/Explanation
	Above and Below Ground Biomass	CO_2	Yes	These are the major carbon pools for both the baseline and project scenario.
	Soil Organic Carbon (SOC	CO_2	Yes	The project activities are expected to trigger an increase in SOC over time as assessed using the applicable tool.
	Dead Wood	CO_2	No	The ecological growth patterns of clumping bamboo means that there is a constant number of culms that die, as new culms emerge during each annual growing season. Exclusion of this carbon pool represents a conservative scenario.
	Litter	CO_2	Yes	The bamboo clumps drop significant volumes of leafy material each year, resulting in an increase in this carbon pool.

The project boundary, representing the national boundaries of the country of Rwanda, along with detailed maps of the Project Area of the 1st planting instance, have been provided in Section 1.12 above.

The physical location of the riparian buffer zones planted in the 1st project instance are provided again below. Such plantings comprise of a large number of individual polygons. A file detailing the individual polygons associated with the below KML image of the 1st project instance have been provided as supplementary information to the VVB.

Figure 14 Project Area 1st Planting Instance



3.4 Baseline Scenario

The chosen methodology requires the use of the following tool for the demonstration of *the baseline scenario: "*A/R Methodological tool "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities" (Version 01").

The project proponent has used the VCS adapted version of this tool: "*Tool for the demonstration and assessment of additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) project activities" (Version 3.0, 2012).*

This tool includes a 4 step process, which is undertaken below. Step 1 of the aforementioned tool refers to the identification of the Baseline Scenario.

STEP 1. Identification of alternative land use scenarios to the proposed VCS AFOLU project activity

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

Rwanda is a small land locked nation, with a rolling topography. The majority of the country's landscapes are dominated by smallholder farming plots. There are few standing forests or native vegetation remaining, outside of clearly designated protected areas and reserves.

The proposed project activities are occurring on narrow strips of land classified as riparian buffer zones, representing those lands that are directly adjacent to various water resources, both lakes and rivers of varying sizes. These lands were designated as state lands in 2010 and relevant laws implemented to managed their use and restrict uses to those that protect or conserve these fragile lands. The project areas are defined by the type and size of the water body they buffer and are classified as follows:

- 50m buffer zones for lakeshores
- 10m buffer zones for big rivers
- 5m buffer zones for small rivers
- 2m buffer zones for unclassified rivers.

These water resources typically occur at lower elevations and are flanked by hills and mountains of rising elevation. As a result, and within the context of this land classification, as well as evidenced from these lands, the following alternative land use scenarios have therefore been identified:

i. Alternative Scenario 1: Continuation of the pre-project land use;

The pre-project land use is shown in the photos and google earth images below. It comprises predominantly of un-used lands, covered with grasses and a few scattered trees within certain sections. These areas have been set aside as "state land" riparian buffer zones, with no active land use, but no management of them beyond this designation have occurred.

Photo 6 Pre Project Land Use of Rwanda's Riparian Buffer Zones

ii. Alternative Scenario 2: Small scale agricultural activities

Smallholder agriculture may occur within these areas. Rwanda's land base is small, and with a subsistence based population, farming activities are common. Therefore the scenario whereby these lands are being used either for the small scale production of crops such as corn, or for the uncontrolled grazing of livestock (cows, goats and sheep) is a realistic alternative scenario.

iii. Alternative Scenario 3: The current project activity without being registered as an AFOLU project.

It is possible that bamboo would be planted within these riparian buffer zones, without being registered as an AFOLU project.

Outcome of Sub-step 1a:

The following alternative land use scenarios have therefore been identified as being credible:

- Continuation of the pre-project land use;
- Small scale agricultural activities;
- The current project activity without being registered as an AFOLU project

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

The proposed project is occurring on land that is legally classified as Riparian Buffer Zones (lands immediately adjacent to lakes and rivers), which significantly limits the type of activities that could realistically occur in the absence of the project.

In 2010 the Government of Rwanda recognized that such riparian lands represent ecologically sensitive environments and since then has been working towards determining potential mechanisms for their protection. These riparian buffer zones are defined, as per Ministerial Order No. 007/16.01 of 15/07/2010, as being public property, or designated State Land, whose use can only be authorized by the Minister in charge of the Environment.

This land classification is aimed at protecting these fragile ecosystems, both the upland lands and the water bodies and water resources they border, and setting them aside purely for environmental and conservation purposes. The Government of Rwanda legalities define what activities cannot be carried out within these defined riparian buffer zones. All agricultural and livestock activities are prohibited in such riparian buffer zones, as determined by law No. 48/2018 of 13/08/2018. This law further determines that such lands are "reserved as natural vegetation. Artificial vegetation can be grown on this land in the case of restoring that land, or if that vegetation is responsible for protecting the environment by stopping soil erosion, or being habitats for living organisms.

The Government of Rwanda has published numerous public announcements regarding the above designation of public riparian lands. As a result, any small scale agricultural activities that might occur, will be short term, and are not deemed to be a credible alternative.

As a result this alternative land use scenario has been removed, and the credible alternative land use scenarios are limited to those described below.

Outcome of Sub-step 1b:

a) Continuation of the pre-project land use
b) The current project activity without being registered as an AFOLU project.

Sub-step 1c. Selection of the baseline scenario

The Government of Rwanda has made the restoration of riparian buffer zones an environmental priority for the country, and over the past few years there have been a number of pilot projects aimed at planting bamboo within such buffer zones, as depicted in the images below. However, these pilot plantings have been small in scale, and with limited success. In 2017 the project proponent was engaged to carry out an extensive study to consider why such pilot projects were having limited success, with the following findings:

- Lack of maintenance activities – it was found that bamboo was planted in pilot projects however there was no maintenance of the bamboo post planting. As a result there was high mortality, and the planted bamboo failed to provide the contiguous buffer zone around the riparian areas. It

was determined that a minimum of two years after planting (three years of activity in total) was required in order to ensure survivability of the bamboo clumps and the benefits they provide.

- Lack of long term funding – the ability to carry out active maintenance activities associated with revegetation activities is limited by project funding. Typically such projects are focused solely on putting seedlings in the ground, with limited funding available for on-going maintenance.
- Lack of clear ownership – without a longer term maintenance period, and with bamboo being only planted and then left, there is no clear ownership of the resource, and therefore these pilot revegetation projects were found to have limited success.

The above factors limit the scalability of the pilot projects that have occurred to date. Furthermore, the extensive barriers faced by the project, as described in Section 3.5, Additionality, result in a scenario whereby the proposed project activity would be prevented by the absence of the sale of the GHG credits. These barriers are limited to alternative scenario b from the outcome of sub-step 1 above – ie they would limit the current project activity without being registered as an AFOLU project.

The below mentioned barriers would not prevent the implementation of alternative scenario a, or the continuation of pre-project land use, whereby these riparian buffer zones are set aside with no activity.

It can therefore be concluded that the most plausible baseline scenario is "Continuation of the pre-project land use" – these riparian buffer zones would be left as unused, unforested land, with little environmental benefit in their role as a buffer zone.

3.5 Additionality

Adhering to the: "*Tool for the demonstration and assessment of additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) project activities" (Version 3.0, 2012),* the subsequent steps for the determination of additionality are carried out below.

STEP 2. Investment analysis

The proposed project activity is for environmental protection purposes. There is an MoU in place between the Rwanda Water Board and the project proponent, which clearly defines the project as a purely conservation endeavor – there is no harvesting and no economic returns expected from these riparian bamboo plantings. The project is carried out purely for its high environmental impact, and potential to protect both the upland agricultural lands, and the water resources.

The proposed project activity is a voluntary endeavor undertaken by the project proponent. Although these riparian buffer zones have legislation that prohibits activities such as agriculture or development on them, due to the negative effects of such activities, neither the planting of bamboo, nor any form of afforestation, reforestation or revegetation is a mandated or required activity.

In 2010 legislation was released defining such riparian buffer zones as public property[8]. In 2011, following the definition of riparian buffer zones as being under the jurisdiction of the Rwanda Water Resources Board, the Ministry of Natural Resources published a National Policy for Water Resources Management[9]. Within this National Policy there is no description of the planting of bamboo as a regulatory requirement within such buffer zones. In contrast, all legislation regarding the management of such riparian buffer zones refers only to the prevention of certain activities such as agriculture or infrastructure, within these lands, with no regulation or mandating of any active actions to be taken on such lands.

In 2020, the Rwanda Ministry of the Environment carried out a mapping exercise in in partnership with IUCN and the Kingdom of the Netherlands that assessed levels of erosion within key watershed catchment areas. The Ministry issued a report[10] regarding "recommended erosion control practices" within catchment areas, which stated: "*Bamboos are recommended to close gullies or for riverside buffers*". By definition if an activity is "recommended" it cannot also be "regulatory".

In short, although the Government of Rwanda recommends and is in favor afforestation and reforestation activities from being carried out within the targeted riparian buffer zones, there is no requirement, no mandate, and no government funding available for such an activity.

As a result, without carbon financing in return for the GHG credits, this project would be extremely unlikely to occur. The riparian revegetation activity carries a high cost, particularly given the extremely wide distribution of planting sites spatially. Costs incurred include the cost of developing the bamboo seedlings, land preparation and transport to planting sites, post planting maintenance, and on-going care and maintenance of the bamboo seedlings until maturity.

As a grass, bamboo clumps benefit from regular thinning, as this stimulates further growth and maintains the health of the clumps. However the landscape included within the project area does not allow for any justifiable level of biomass removal from a commercial perspective, and therefore future thinning by adjacent communities is limited to what is required from a maintenance perspective and is not a commercial activity as there are no associated returns.

[8] Rwanda Ministerial Order No. 00716.01 of 15.07.2010

[9] Republic of Rwanda, Ministry of Natural Resources; 2011. National Policy for Water Resources Management

[10] Republic of Rwanda, Ministry of Environment; 2020. Erosion Control Mapping Report

As a result, it can be concluded that the project activity is less economically attractive than the baseline scenario, in which the riparian buffer zones are set aside but no active management occurs, as this baseline scenario carries no investment cost.

It can further be concluded that the proposed VCS project produces no financial benefits other than VCS related income and therefore additionality is clear.

STEP 4. Common Practice Analysis

In 2017 the project proponent was engaged by the Government of Rwanda to undertake an extended analysis of the status and success of bamboo initiatives in Rwanda. This study[11] found that a total of 523 hectares of riparian bamboo plantings had occurred across the country in the 10 year period between 2007 and 2017, however that these plantings had had low rates of success with >40% of these plantings no longer existing. The analysis determined that these plantings, which were carried out by either government funds, or NGOs, had a low rate of success due to the following key reasons:

1. To date bamboo riparian planting projects were structured with funds to plant but with no subsequent maintenance of the bamboo;
2. Poor species choice with bamboo planted only from cuttings of *Bambusa vulgaris*, a low quality, bamboo.
3. Where projects were carried out by NGOs there was a disconnect between their objectives, the Rwanda Water Resources Board and the Districts in which the bamboo was planted.

As a result of these findings, the project proponent undertook the 150km pilot project as detailed above in 2019, with the objective of determining a structure and project framework that could overcome the above issues and causes of low success. This pilot project was designed to provide the structure for a scaling (for the project activities detailed in this Project Description), with key frameworks different from previous attempts at bamboo:

1. Project timeframes –
    a. Minimum 3 years of full maintenance activities of the planted bamboo, to ensure its successful establishment and canopy closure;
    b. Protection of the planted bamboo by ranger teams from surrounding communities until the clumps are fully established;

[11] A Feasibility Study for a Bamboo Based Bio-economy for Rwanda; 2017. A study for the Ministry of Lands and Forestry, republic of Rwanda

c. Thereafter minimum 20 year on-going maintenance and monitoring activities of the planted bamboo;

Such project timeframes are only realistic due to the availability of carbon financing to cover ongoing project costs.

2. Clear ownership and governance structures;
3. Community engagement – although the project is carried out on government lands, the riparian buffer zones border smallholder farmer lands. Therefore positive relationships between the project and surrounding farmers are a key focus of the design of the proposed project activity.

With the above project structure and the longevity offered by carbon financing, the project proponent has proven that the planting of bamboo as a riparian buffer zone can be a positive activity with high rates of success.

3.6 Methodology Deviations

As described in Section 4.2, the project proponent has utilized independently developed species-specific allometric equations for the ex ante estimations of the project's GHG emission removals.

This method of ex ante estimations represents a methodology deviation, required due to the absence of existing data.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

The procedure for the calculation of *ex ante* baseline net GHG removals by sinks is as per the applied methodology (AR-ACM0003 v2), section 5.4 "Baseline net GHG removals by sinks".

The baseline emissions for the project areas are those associated with negative land use change as the project areas undergo continued forest degradation and deforestation, as indicated in the historical mapping in Section 3 above.

The baseline net GHG removals by sinks is the sum of the changes in carbon stocks of the selected carbon pools within the project boundary that would have occurred in the absence of the project activity. Under the conditions of the applied methodology, changes in carbon stock of above-ground and below-ground biomass of non-tree vegetation, dead wood, litter and soil organic pools may be conservatively assumed to be zero for all strata in the baseline scenario.

Therefore, the baseline net GHG removals by sinks will be determined as:

$$\Delta C_{BSL,t} = \Delta C_{TREE\_BSL,t} + \Delta C_{SHRUB\_BSL,t} + \Delta C_{DW\_BSL,t} + \Delta C_{LI\_BSL,t} \quad \text{Equation 1}$$

Where:

$\Delta C_{BSL,t}$	= Baseline net GHG removals by sinks in year t; tCO_2-e
$\Delta C_{TREE\_BSL,t}$	= Change in carbon stock in baseline tree biomass within the project boundary in year *t*, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"; t CO2-e
$\Delta C_{SHRUB\_BSL,t}$	= Change in carbon stock in baseline shrub biomass within the project boundary in year *t*, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities; t CO2-e
$\Delta C_{DW\_BSL,t}$	= Change in carbon stock in baseline dead wood biomass within the project boundary in year *t*, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities; t CO2-e

$\Delta C_{LI\_BSL,t}$ = Change in carbon stock in baseline litter biomass within the project boundary in year t, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities; t CO2-e

Section 3.4 above determines the baseline scenario – or the most likely scenario in the absence of the project activity – as the continuation of the pre-project land use (unused, unforested land).

A comparison of land cover within the riparian buffer zones targeted for planting was carried out, using satellite data from ten years prior to the project start date (August 2012) and from the most recent available data, taken from March 2022, representing a few months before the project start date.

This analysis, shown in Figures 12 and 13 below, indicates that there is a decrease in areas of standing trees – from a conglomerated 55.9ha in 2012 to 49.2ha in 2022. Figure 14 shows the locations of such tree cover loss.

Therefore, in the baseline scenario the change in carbon stock in baseline tree biomass within the project boundary will be a negative value due to the associated loss of standing trees. As a result, the changes in carbon stock of above-ground and below-ground biomass of shrub vegetation may be conservatively assumed to be zero for all strata in the baseline scenario.

Therefore:

$\Delta C_{BSL,t} = 0$

Where individual standing trees may occur within the project area, these trees are not touched or affected by the project activities. Furthermore, the presence of such trees does not affect the accounting of biomass sequestration related directly to the project activities, due to the clear difference between trees and bamboo clumps. During the implementation of the project activity, no trees within the project boundary are removed. Any existing tree is mapped during project development, and the planting of the buffer zone resumes on the other side. Therefore, in the absence of the project, changes in tree biomass would be expected to decrease in above ground and below ground carbon stock due to biomass loss and therefore may be conservatively assumed to be zero.

Figure 15 Historical Land Cover of Project Area, 2012

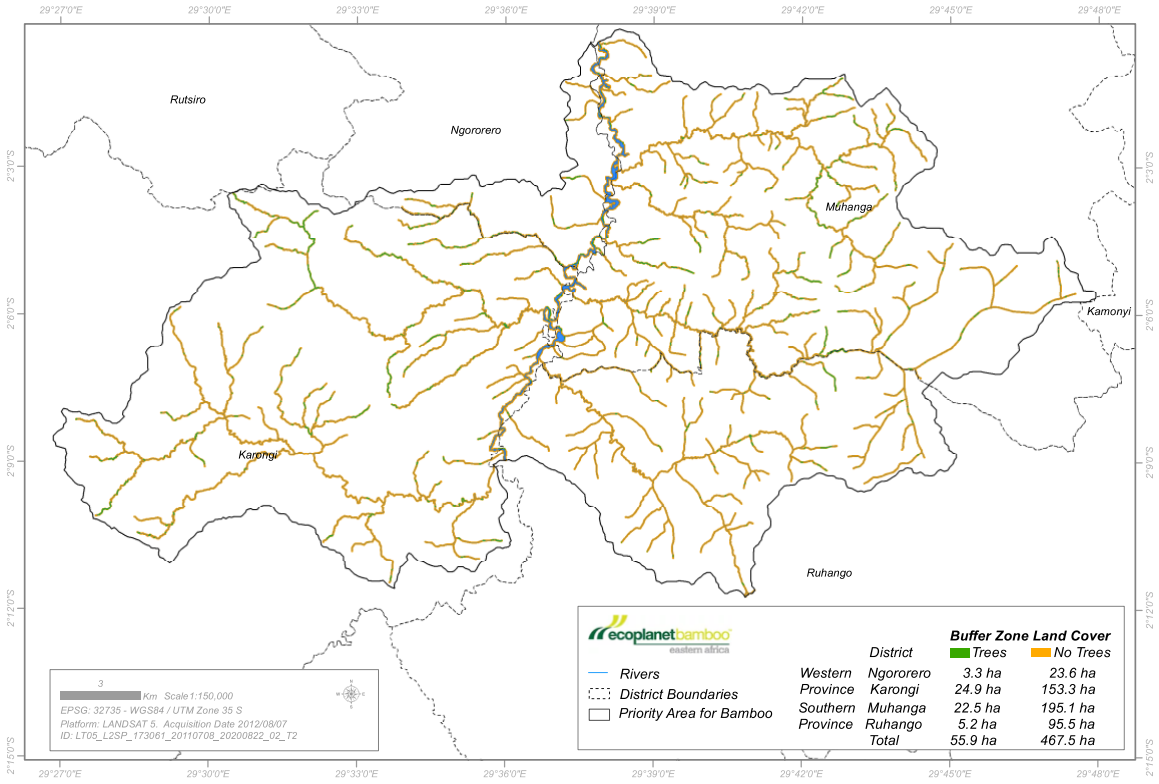


Figure 16 Land Cover of Project Area at Project Start, 2022

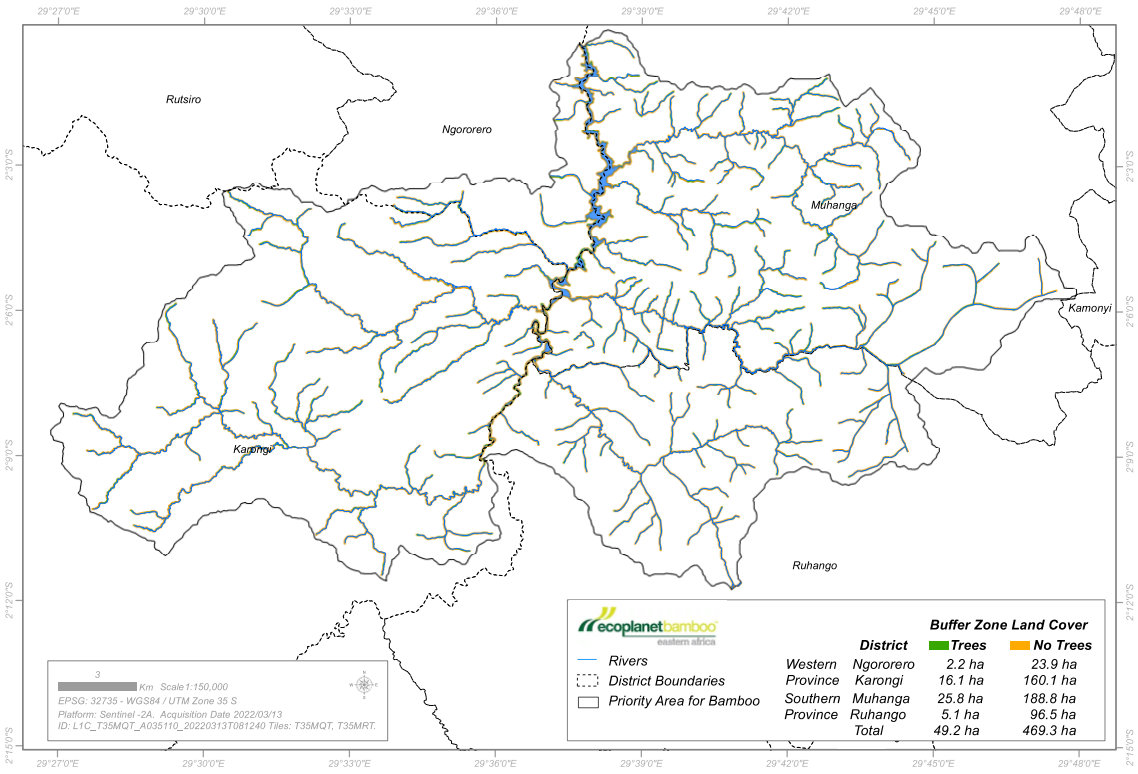
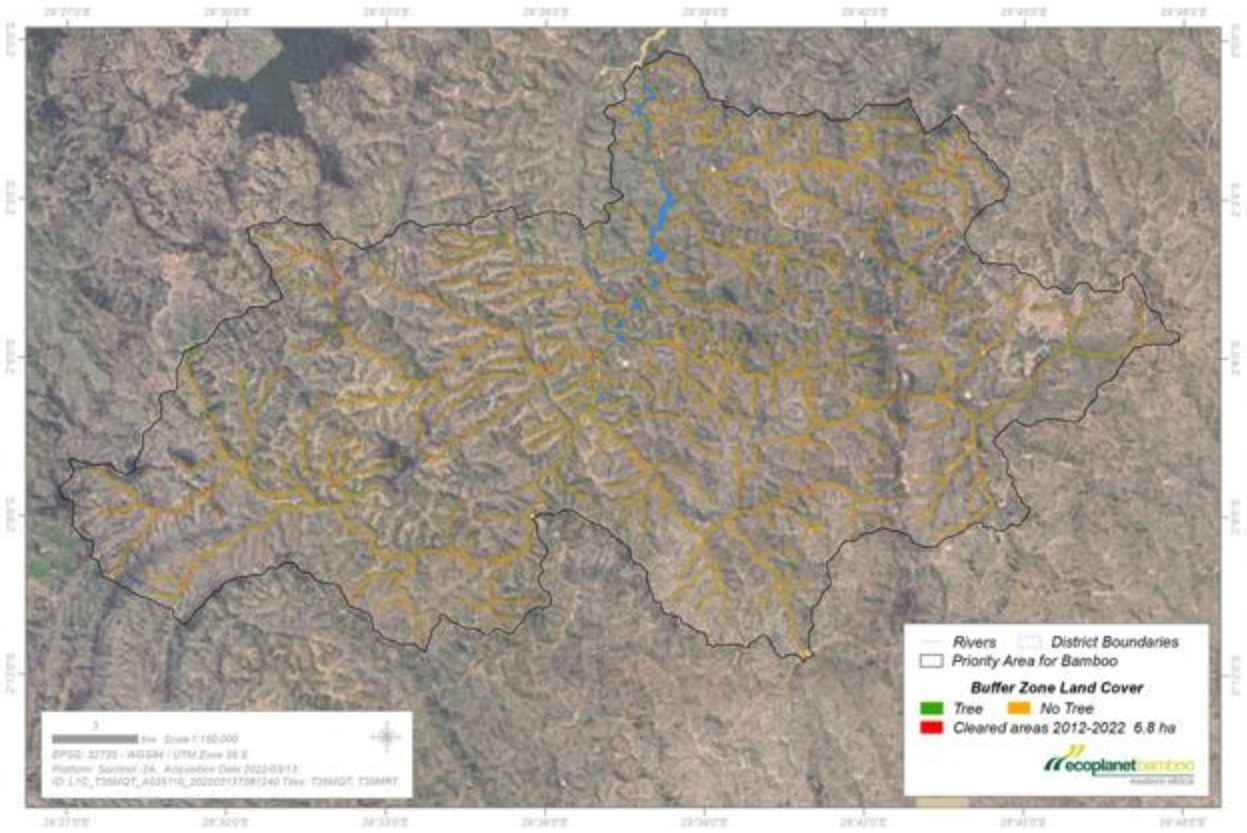


Figure 17 Tree Cover Loss, Baseline Scenario



4.2 Project Emissions

Procedures for the calculation of ex ante actual net GHG removals by sinks are detailed in the applied methodology (AR-ACM0003 v2), section 5.5 “Actual net GHG removals by sinks”.

Ex Ante Stratification

The chosen methodology requires that if biomass distribution over the project area is not homogenous, that stratification should be carried out in order to improve the precision of biomass estimation. For the actual net GHG removals by sinks, the ex ante estimations is based on the project planting and management plan.

In this scenario, such ex ante stratification is determined by two key factors:

- Year of Planting – planting is scheduled to occur over a 2 year period. The year in which planting of a specific area with bamboo occurs is expected to be a significant determining factor of the project removals during any monitoring event;
- Species – the project aims to plant species within two genus. Both Genus and targeted species are considered giant sympodial (clumping bamboos) with similar growth patterns and therefore

biomass accumulation. However it is conceivable that each planted species might have differing biomass accumulation rates, and therefore this factor is considered to be a potential determining factor of the project removals during any monitoring event.

Stratification at the time of validation is therefore estimated to result in 4 strata, as depicted in the below table. As additional project areas are added, and planting continues past 2023-2024, additional strata will also be added.

Table 5 Ex Ante Stratification of the Project Area

Year of Planting	Bambusa polymorpha	Bambusa textilis
2022-2023	Strata 1a	Strata 1b
2023-2024	Strata 2a	Strata 2b

If any natural or anthropogenic impacts such as altitude, or other factors such as soil types that are to be found during the course of monitoring that significantly alter the biomass distribution within the project area, then the project proponent will revise the ex post stratification accordingly.

Actual Net GHG Removals by Sinks

The methodology states that "GHG emissions resulting from the removal of herbaceous vegetation, combustion of fuel, fertilizer application, use of wood, decomposition of litter and fine roots of N-fixing trees, construction of access roads within the project boundary and transportation attributable to the project activity shall be considered insignificant and therefore accounted as zero". As such none of these described activities are described or included in the below calculations.

Therefore, the actual net GHG removals by sinks is limited to changes in the carbon stock attributed to the planted bamboo clumps within the project areas.

These actual net GHG removals by the bamboo clump sinks have been calculated as:

$$\Delta C_{ACTUAL,t} = \Delta C_{P,t} - GHG_{E,t} \quad \text{Equation 2}$$

Where:

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

$\Delta C_{P,t}$ = Change in the carbon stocks in project, occurring in the selected carbon pools, in year *t*; tCO_2-e

$GHG_{E,t}$ = Increase in non–CO_2 GHG emissions within the project boundary as a result of the implementation of the A/R project activity, in year *t*, as estimated in the tool "Estimation of non–CO_2 GHG emissions resulting from burning of biomass attributable to an A/R project activity; tCO_2-e

The increase in non-CO_2 GHG emissions within the project boundary, as a result of the implementation of the A/R project activities $GHG_{E,t}$ is accounted as zero, due to the fact that the project activities do not include the use of fire for any of the activities highlighted in the relevant tool:

- Fire is not used as a land preparation activity;
- Fire is not used for the clearance of harvest residue prior to replanting;

Furthermore, the impact of wild fires on the project activities is estimated to be insignificant, as described within the Non Permanence Risk Assessment. Therefore:

$GHG_{E,t} = 0$

The change in the carbon stocks in the project, occurring in the selected carbon pools in year *t*, are calculated utilizing equation 3 of the methodology, where bamboo has been used in clarification of "trees" within this equation.

$$\Delta C_{P,t} = \Delta C_{BAMBOO\_PROJ,t} + \Delta C_{SHRUB\_PROJ,t} + \Delta C_{DW\_PROJ,t} + \Delta C_{LI\_PROJ,t} + \Delta SOC_{AL,t} \quad \text{Eq. 3}$$

Where:

$\Delta C_{P,t}$ = Change in the carbon stocks in project, occurring in the selected carbon pools, in year *t*; tCO_2-e

$\Delta C_{BAMBOO\_PROJ,t}$ = Change in carbon stock in bamboo biomass in project in year *t* as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R project activities"; tCO_2-e

$\Delta C_{SHRUB\_PROJ,t}$ = Change in carbon stock in shrub biomass in project in year *t* as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R project activities"; tCO_2-e

$\Delta C_{DW\_PROJ,t}$ = Change in carbon stock in dead wood biomass in project in year *t* as estimated in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R project activities"; tCO_2-e

$\Delta C_{LI\_PROJ,t}$ = Change in carbon stock in litter biomass in project in year *t* as estimated in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R project activities"; tCO_2-e

$\Delta SOC_{AL,t}$ = Change in carbon stock in SOC in project in year *t,* in areas of land meeting the applicability conditions of the tool "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R project activities" as estimated in the same tool; tCO_2-e

Due to the specific characteristics of the project activities and the growth pattern of the sympodial bamboo species being grown, as well as the conditions of the methodology, $\Delta C_{SHRUB\_PROJ,t}$ and $\Delta C_{DW\_PROJ,t}$ can be conservatively assumed to be zero.

Therefore

$$\Delta C_{P,t} = \Delta C_{BAMBOO\_PROJ,t} + \Delta C_{LI\_PROJ,t} + \Delta SOC_{AL,t}$$

Changes in Carbon Stock in Bamboo Biomass due to Project Activities

The change in the carbon stock of the bamboo planted as a direct result of project activities is estimated as follows:

$$\Delta C_{BAMBOO\_t} = (\Delta C_{BAMBOO,t2} - (\Delta C_{BAMBOO,t1}) / T \quad \text{Equation 11}$$

Where:

ΔC_{BAMBOO_t} = Change in the carbon stocks in bamboo, in year *t*; tCO_2-e

$\Delta C_{BAMBOO,t2}$ = The carbon stocks in bamboo, in year *t2*; tCO_2-e

$\Delta C_{BAMBOO,t1}$ = The carbon stocks in bamboo, in year *t1*; tCO_2-e

T = The time elapsed between year *t2* and year *t1*; yr

Calculation of Bamboo Carbon Stock

The bamboo clumps being grown represent two carbon pools which are included in the project's GHG emission removals. These are:

1. Bamboo Above Ground Biomass (AGB) – this pool consists of bamboo culms, branches and auxiliary leafy material as described in more detail below;
2. Bamboo Below Ground Biomass (BGB) – this pool consists of bamboo rhizomes and extensive root networks as described in more detail below;

The changes in carbon stock as a direct result of the project activities are being calculated at the clump level. There are two different species being grown with different capacities for changes in biomass and associated carbon removals. For each species under consideration, the bamboo carbon stock at any point in time is calculated by the following equation:

$$C_{BAMBOO\_CLUMP} = AGB_{CLUMP} * RS * CF$$

Where:

C_{BAMBOO_CLUMP}	= Carbon stocks in a bamboo clump, in year *t*; tC;
AGB_{CLUMP}	= The bone dry above ground biomass included in a bamboo clump, including all bamboo culms, branches and leafy material, in year *t*; tons
RS	= The Root to Shoot ratio of a bamboo clump, used to calculate the below ground biomass represented by bamboo rhizomes and roots, in year *t*; tons
CF	= The carbon fraction of woody biomass, given as 0.47

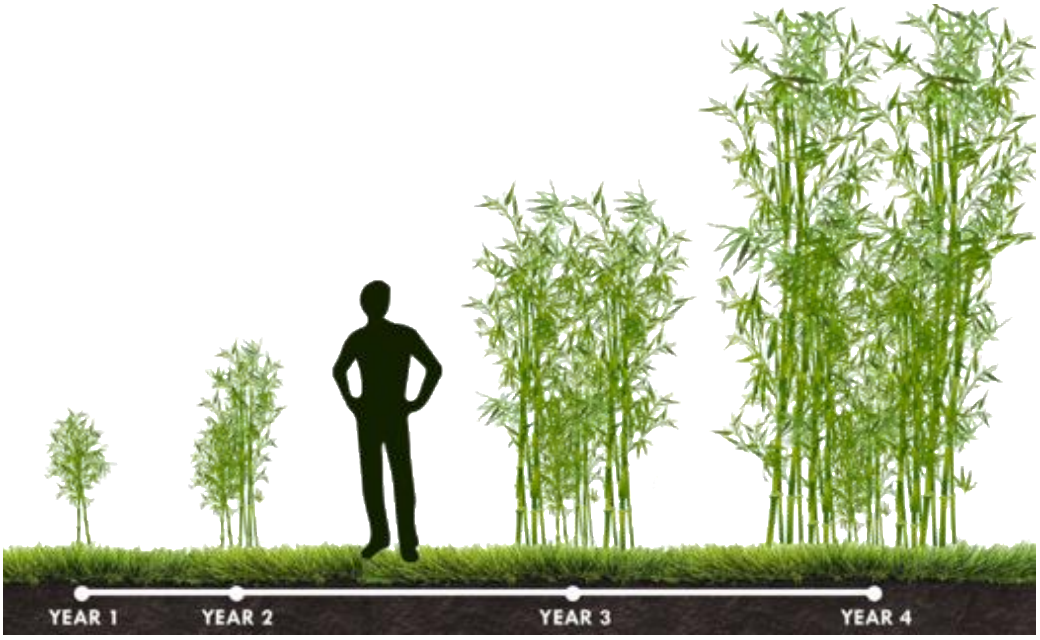
Bamboo clumps have a different growth pattern to trees and therefore they represent unique variables to be considered. Such variables need to be determined for each individual species for which the GHG emission removals are being calculated. The below section describes the factors that need to be taken into consideration when determining the Above Ground Biomass of a bamboo clump, and the subsequent equations.

Above Ground Biomass: AGB_{BAMBOO}

The Above Ground Biomass of a bamboo clump comprises of three distinct sources of biomass: culms (or poles), branches, and leafy material.

Each bamboo clump will have many individual culms. In the early years of growth and development there are multiple factors for consideration. During the first 6-10 years after planting – with the exact timeframe being dependent upon climate, soils, and management regimes - each clump will exhibit the following unique ecology depicted in the below graphic.

Figure 18 Early Year Growth & Development of a Bamboo Clump[12]



Each year the culms will increase in number, height and diameter, until the clump achieves maturity. Thereafter the clump will achieve a steady state of biomass, with new culms emerging year on year, and older ones dying. Bamboo culms do not increase in size year on year, but rather achieve their maximum biomass accumulation within just one growing season.

However, as per the above depiction, each year that the bamboo clump grows, additional culms emerge representing an increase in the AGB pool. Therefore, the first variable that requires measurement in order to report on changes in biomass due to the project planting activities, is the total number of culms in the clump, and the average biomass within those culms. This can be calculated using allometric equations where the total biomass of the culm, inclusive of branches and leafy material is a factor of the diameter of that culm.

Development of Species Specific Allometric Equations

The methodology requires the use of the "Tool for the Estimation of carbon stocks and changes in carbon stocks of trees and shrubs in A/R CDM project activities". Annex 1, paragraph 6 of this tool states:

[12] Image taken from Lewis Bamboo, accessed Sept 1st 2021. www.lewisbamboo.com

For ex-ante estimation the allometric equation, or volume table or volume equation applied to a tree species is selected from the following sources (the most preferred source being listed first):

(a) Existing data applicable to local situation (e.g. represented by similar ecological conditions);

(b) National data (e.g. from national forest inventory or national greenhouse gas (GHG) inventory);

(c) Data from neighbouring countries with similar conditions;

(d) Globally applicable data.

The project is the first of its kind in the local situation, nationally within Ghana, and within neighbouring countries. As a result, there are no existing allometric equations or volume data that meets sources a, b, or c above. A literature assessment shows that no comparable allometric equations or volume data for either species under the project context exist.

As a result, the project proponent has taken the route of developing species-specific allometric equations for the two bamboo species being planted, adhering to the requirements of AR Tool 17. The use of such an allomteric equation for the purpose of ex ante estimations of the carbon removal benefits therefore represents a methodology deviation, as described in Section 3.6 above.

In order to develop the species-specific allometric equations, the following steps were undertaken:

Destructive Sampling of Parent Plants

1. Destructive sampling of more than 50 culms for each species was carried out, across all diameter classes, with a minimum of 5 culms sampled in any one diameter class. Culms were harvested at the first node.

2. For each culm sampled the leaves and branches were removed, and the following measurements were taken and recorded directly :

    a. Diameter at breast height

    b. Culm length

    c. Culm weight

    d. Weight of branches and leaves

Photo 7 Destructive Sampling for Allometric Equation Development

Allometric Equation Development

The above data was utilized by an experienced forest statistician with experience in bamboo, in order to develop species specific allometric equations, following the A/R Methodological Tool for "Demonstrating appropriateness of allometric equations for estimation of aboveground tree biomass in A/R CDM project activities (V01). The process for fitting of the most appropriate model included a phase for checking data quality and consistence. Then, through regression analyses the performance of the models was assessed considering the precision, error, and graphical analysis of residues.

For each bamboo species the models with the best performance and the lowest margin of error was selected for predicting aboveground fresh biomass (*AGB*). The reports detailing the step by step process are available to auditors, and the allometric equations have been detailed in Section 5.1 below.

Analysis of Bamboo Clump Biomass

Given that each bamboo clump is comprised of multiple individual culms, the total above ground biomass of a single clump is a factor of the number of culms within that clump.

$$AGB_{CLUMP} = (AGB_{CULM} * MC * N_{CULM})$$

Where:

AGB_{CLUMP}	= Above ground biomass of the bamboo clump at time t; tons
AGB_{CULM}	= The above ground biomass of an individual culm, calculated using the allometric equation as described above; tons
MC	= The moisture content of the bamboo biomass; %
N_{CULM}	= The number of culms found within the bamboo clump at time t; #

Dendrometric Variables

The determination of bamboo biomass requires projections for the number of culms, and the average diameters of those culms based on clump age. Although literature on mature clumps is available, peer reviewed data on young clumps is sparse, as the majority of data on clumping bamboo species comes from naturally occurring stands and bamboo forests, and therefore does not provide for the early year growth and development of new clumps. As a result, the data on the projected growth of the clumps of the two species being grown comes from two sources:

Research Plots: EcoPlanet has been working on bamboo research since 2013 with a focus on the species being grown. A number of research projects have been undertaken to provide data on average biomass production of both species being grown including in China where the parent material is sourced.

Pilot Project: a pilot project was undertaken in the project area between 2019-2021 utilizing the same two species as the proposed project activity, from which conservative growth and development data has been drawn.

As described above, no allometric equations exist for the species and project context. In order to ensure that the ex-ante GHG emission removal estimates are realistic, these were compared against published data[13] for a similar clumping species *Dendrocalamus asper*. This study undertook destructive sampling to determine the bamboo biomass and associated carbon content of a hectare of five year old clumps. This study shows the similar value delivered by the species specific allometric equations developed by the project proponent, at 41tC/ha, although the number of planted clumps and associated number of culms per clump differ.

Below Ground Biomass: BGB_{BAMBOO}

The second unique variable for consideration for a bamboo clump is the underground rhizome structure that forms the basis of the fast growth and emergence of bamboo shoots which turn into bamboo culms.

[13] Sujarwo, W. 2015 Bio*mass content of black petung bamboo (Dendrocalamus asper);* Bamboo Journal

The unique biological characteristics of the rhizome mean that when a bamboo culm is harvested, although that above ground biomass is removed, the underground rhizome system remains still alive and continues to produce shoots, rapidly replacing the biomass that has been removed, so long as it is within a limit of sustainability.

For clumping bamboo species destructive sampling to determine the below ground biomass is unrealistic both in terms of time, resources and funds, as well as the fact that such sampling results in the death of the clump. As such, it is recommended that a below ground bamboo biomass expansion factors, (also known as root to shoot ratios) from available literature is used.

Literature sources as detailed in the parameter section below confirm the root to shoot factor across a range of clumping bamboo species to have a value of 1:0.25

Total GHG Removals per Bamboo Clump

Using the above approach, the changes in total biomass and associated carbon stock of an individual clump was calculated on a temporal basis.

Calculation of Changes in Soil Organic Carbon

The chosen methodology requires the application of the "Took for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities" Version 01.1.0. This tool is applied to the project as follows.

The project meets the required applicability conditions, as per the areas of land, the baseline scenario, and the project activity. These have been defined in Section 3.4 above and are summarized as:

a) The area of land on which the project activities are occurring:

(i) Are not wetlands;

(ii) Do not contain organic soils

(iii) Are not subject to the land management practices detailed in Tables 1 or 2 of the tool.

i. Table 1 - The baseline scenario is not cropland.

ii. Table 2 – The project is not located in a grassland agro-ecological zone.

b) The project activity meets the following applicability conditions:

(i) All litter remains on site with no removals;

(ii) Soil disturbance associated with the A/R CDM project activity is carried out to meet the following best practices:

i. All planting follows the natural contours of the land by the nature of the plantings being a single or double line adjacent to riparian areas.

ii. Soil disturbance associated with site preparation is limited only to the planting pits which is carried out before planting, with no subsequent disturbance over a more than 20 year period.

Furthermore, the assumptions of the tool are in line with the project activities:

a) Site preparation and planting activities take place within a year of each other – under the project's management plan such activities occur within a maximum of 2-3 months of each other;

b) The littler levels of the degraded ecosystem are extremely low in the pre-project scenario to the high levels of soil erosion on the steep slopes. In contrast the implementation of the revegetation activity increased the SOC content of the lands from the pre-project level to a steady state, assumed to be equal to the SOC content under native vegetation.

c) The increase in SOC content is assumed to take place at a steady and constant rate over a 20 year period.

The SOC stock at the start of the project is estimated using the following equation, assuming the Temperature/Regime of the project area as Tropical Montane as per the climatic conditions described in Section 1.4 above, and the soils being Low Activity Clay (LAC) soils.

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

Where:

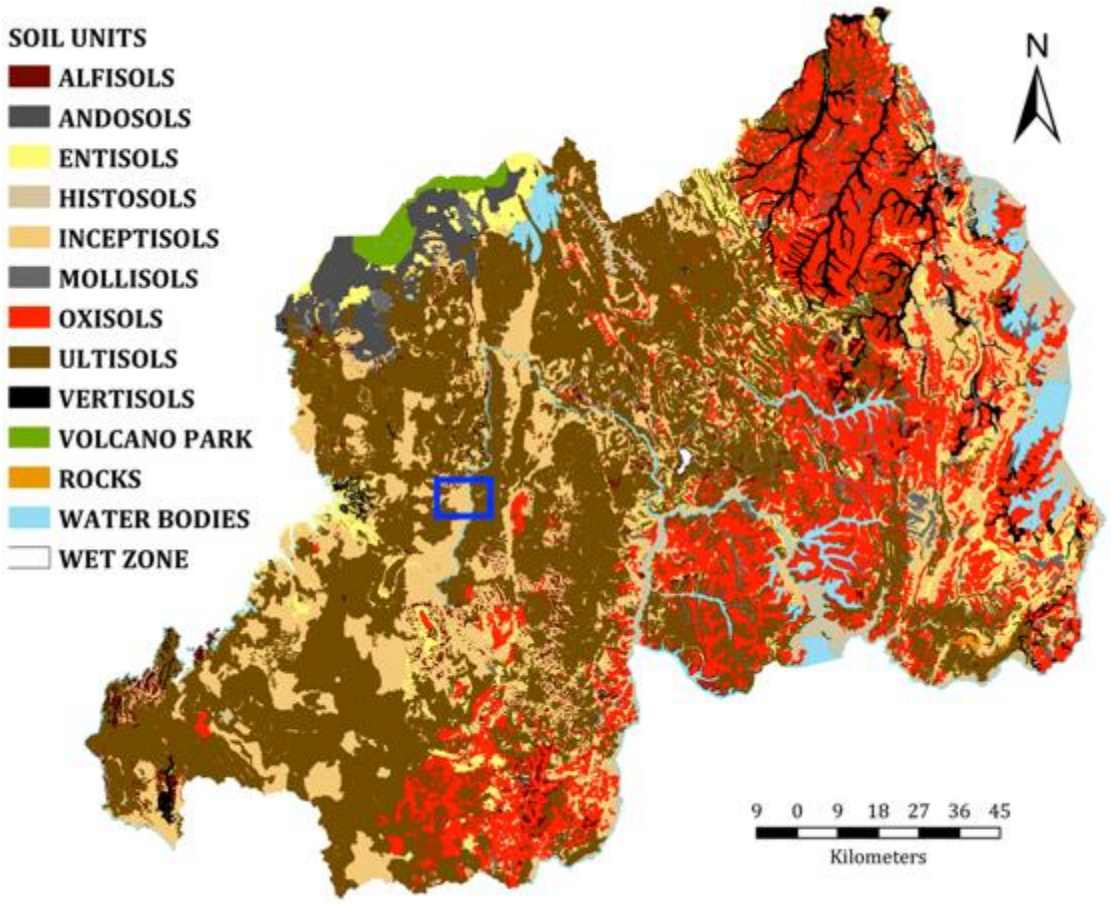
$SOC_{INITIAL,i}$	= SOC stock at the beginning of the A/R CDM project activity, in stratum i of the area of land; tC ha^{-1}
$SOC_{REF,i}$	= Reference SOC stock corresponding to the reference condition of tropical-moist climate, low activity clay soils, applicable to stratum i of the area of land;
$f_{LU,i}$	= Relative stock change factor for baseline land-use of "not applicable" in stratum i of the areas of land; dimensionless
$f_{MG,i}$	= Relative stock change factor for baseline management regime of "not applicable" for the relevant temperature/climate regime in stratum I of the areas of land; dimensionless
$f_{IN,i}$	= Relative stock change factor for a baseline nutrient input regime of "low" in stratum I of the areas of land; dimensionless

The project area is unified from a baseline, management and input scenario, and therefore for the purpose of this tool, there is only a single stratum.

Reference SOC stock:

- The project area is classified as topical-montane climate, with full details on the altitude, climate and associated rainfall provided in Section 1.13 above.
- The soils of the project area fall into both categories of low clay activity (LAC) due to the presence of Inceptisols across large areas of the project area and high clay activity (HAC) due to the presence of Ultisols across an equally large area. This distribution is shown in the map below. Therefore the selection of low clay activity soils is considered to be conservative.
- Therefore the reference SOC stock for the project area is 63.

Figure 19 Rwanda Soil Map Using USDA Soil Taxonomy[14]



[14] Nzeyimana, I and Geissen, V. GIS-Based Multi-Criteria Analysis for Arabica Coffee Expansion in Rwanda. (2014). PLoS ONE. 9(10): e107449. 10.1371/journal.pone.0107449.

The baseline land use is not cropland. Therefore table 6 of the tool is applied, and the baseline land use scenario is assigned a relative stock change factor of 1.

The baseline management regime of the project area can therefore be described as “Severely Degraded”, resulting in a relative stock change factor of 0.70.

The baseline land use scenario does not receive any fertilizer inputs. Therefore the input regime of the project area can best be described as “Low/Medium”, resulting in a relative stock change factor of 1.00

Therefore

$SOC_{INITIAL,i}$ = 63 * 1 * 0.7 * 1 = 44.1

The rate of change in SOC stock in project scenario until the steady state SOC is reached is calculated with the following equation:

$$dSOC_{t,i} = \left(\frac{SOC_{REF,i} - SOC_{INITIAL,i} - SOC_{LOSS,i}}{20\ years}\right)^2 for\ t_{PREP,i} < t \leq t_{PREP,i} + 20$$

Where:

$dSOC_{t,i}$	= the rate of change of SOC stock in stratum i of the areas of land, in year t; tC ha^{-1}
$t_{PREP,i}$	= the year in which first soil disturbance takes place in stratum i of the areas of land
$SOC_{LOSS,i}$	= the loss of SOC caused by soil disturbance attributable to the A/R CDM project activity in stratum i of the areas of land;
$SOC_{REF,i}$	= Reference SOC stock corresponding to the reference condition of tropical-montane climate, low activity clay soils, applicable to stratum i of the area of land;
$SOC_{INITIAL,i}$	= SOC stock at the beginning of the A/R CDM project activity, in stratum i of the area of land;
i	= 1, 2, 3,… biomass estimation strata within the project boundary

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

The project activities that result in soil disturbance are limited to the manual digging of planting pits. At a size of 30cm x 30cm, and a frequency of 500 pits per hectare, such disturbance relates to less than 0.5% of the area on which project activities are occurring.

Therefore

$SOC_{LOSS,i}$ = 0

Therefore

$$dSOC_{t,i} = (63 - 44.1 - 0) / 20 = 0.945$$

The project scenario results in the rate of change of SOC being >0.8. Therefore, as per the specifications of the tool, if:

$dSOC_{t,i} > 0.8$ **then** $dSOC_{t,i}$ **= 0.8 tC ha^{-1} yr^{-1}**

Calculation of Changes in Litter Carbon

The chosen methodology in requires application of the "Tool for estimation of carbon stocks and change in carbon stocks in dead wood and litter in due A/R CDM project activities" Version 03.

The project activities do not remove any litter from the project boundary and all litter therefore remains in situ.

The project proponents have chosen to make use of the default factor based methodology for the conservative calculation of changes in litter carbon stock as the result of the project activities. Therefore, the below equation has been applied:

$$C_{LI,i,t} = C_{TREE,i,t} \times DF_{LI} \quad \text{Equation 10}$$

Where:

$C_{LI,i,t}$ = carbon stock in litter in stratum *i* at a given point in time in year *t;* tCO_2e

$C_{TREE,i,t}$ = carbon stock in bamboo biomass in stratum *i* at a given point in time in year *t* as calculated in "estimation of carbon stocks and changes on carbon stocks of trees and shrubs in A/R CDM project activities"*;* tCO_2e

DF_{LI} = conservative default factors expressing carbon stock in litter as a percentage of carbon stock in bamboo biomass; 1%

i = 1, 2, 3,... biomass estimation strata within the project boundary

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

The project area biome is described as tropical with elevations of <2,000m, with annual rainfall amounts in the 1,000 mm/yr range, resulting in a 1% default factor which has been applied by strata.

Calculation of Changes in Carbon Stock Across All Pool

The project assumes an equal number of clumps of each species are being planted each year. Therefore, the estimation of GHG Emission Removals by all pools is calculated as shown in the tables below.

Table 6 GHG Emission Removals All Pools, By Year of Planting, Bambusa textilis

Year	2022 Planting (Hectares)	2023 Planting (Hectares)	TOTAL
t	250	250	tCO2e
2023	977.11	-	977.11
2024	2,742.06	977.11	3,719.17
2025	5,731.46	2,742.06	8,473.51
2026	14,795.47	5,731.46	20,526.93
2027	30,268.83	14,795.47	45,064.31
2028	53,668.06	30,268.83	83,936.90
2029	108,565.32	53,668.06	162,233.38
2030	191,432.82	108,565.32	299,998.13
2031	285,835.51	191,432.82	477,268.33
2032	308,048.50	285,835.51	593,884.01
2033	308,781.83	308,048.50	616,830.33
2034	309,515.17	308,781.83	618,297.00
2035	310,248.50	309,515.17	619,763.67
2036	310,981.83	310,248.50	621,230.33
2037	311,715.17	310,981.83	622,697.00
2038	312,448.50	311,715.17	624,163.67

2039	313,181.83	312,448.50	625,630.33
2040	313,915.17	313,181.83	627,097.00
2041	314,648.50	313,915.17	628,563.67
2042	315,381.83	314,648.50	630,030.33

Table 7 GHG Emission Removals All Pools, By Year of Planting, Bambusa polymorpha

Year	2022 Planting (Hectares)	2023 Planting (Hectares)	TOTAL
t	250	250	tCO2e
2023	1,303.39	-	1,303.39
2024	3,537.93	1,303.39	4,841.32
2025	6,833.76	3,537.93	10,371.69
2026	16,312.59	6,833.76	23,146.35
2027	30,348.58	16,312.59	46,661.17
2028	49,297.34	30,348.58	79,645.91
2029	86,154.65	49,297.34	135,451.99
2030	118,864.56	86,154.65	205,019.21
2031	146,634.86	118,864.56	265,499.42
2032	197,653.94	146,634.86	344,288.80
2033	198,387.27	197,653.94	396,041.21
2034	199,120.61	198,387.27	397,507.88
2035	199,853.94	199,120.61	398,974.55
2036	200,587.27	199,853.94	400,441.21
2037	201,320.61	200,587.27	401,907.88
2038	202,053.94	201,320.61	403,374.55
2039	202,787.27	202,053.94	404,841.21
2040	203,520.61	202,787.27	406,307.88
2041	204,253.94	203,520.61	407,774.55
2042	204,987.27	204,253.94	409,241.21

Subsequently, the projected planting timelines was applied to determine to estimate the total GHG removals across the full project activity.

Table 8 GHG Emission Removals All Pools

Year	Estimated Project Removals (tCo2e)
2023	2,280.50
2024	8,560.49
2025	18,845.20
2026	43,673.28
2027	91,725.48
2028	163,582.81
2029	297,685.37
2030	505,017.34
2031	742,767.75
2032	938,172.81
2033	1,012,871.55
2034	1,015,804.88
2035	1,018,738.21
2036	1,021,671.55
2037	1,024,604.88
2038	1,027,538.21
2039	1,030,471.55
2040	1,033,404.88
2041	1,036,338.21
2042	1,039,271.55
TOTAL	1,039,272

4.3 Leakage

As per the methodology, any increase in GHG emissions that results from the displacement of pre-project agricultural activities, due to the project activities, should be calculated utilizing A/R Tool “Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in the A/R project activity.

This tool defines such potential leakage as originating from the displacement of agricultural activities, crop cultivation and / or grazing activities, should such displacement result in an increase in GHG emissions.

The land included within the project boundary is legally designated as a state land, with the legislation detailing the management of such lands and legally allowed activities, described earlier on in this project document.

There is no movement of agricultural activities as a result of the project activity.

There is no movement of grazing activities as a result of the project activity.

$$LK_t = LK_{AGRIC,t} \quad \text{Equation 4}$$

Where:

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

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

It is determined that for all project areas:

$LK_{AGRIC,t}$ = 0

Therefore:

LK_t = 0

4.4 Net GHG Emission Reductions and Removals

According to the applied methodology, the net anthropogenic GHG removals by sinks shall be calculated as follows:

$$\Delta C_{AR-CDM,t} = \Delta C_{ACTUAL,t} - \Delta C_{BSL,t} - LK_t \quad \text{Equation 5}$$

Where

$\Delta C_{AR-CDM,t}$ = Net anthropogenic GHG removals by sinks, in year *t*; t CO2-e

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

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

LK_t = GHG emissions due to leakage; in year *t*; t CO2-e

Table 9 Estimated GHG Emission Removals Over the Project Crediting Period

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
2023	0	2,280.50	0	2,280.50
2024	0	8,560.49	0	8,560.49
2025	0	18,845.20	0	18,845.20
2026	0	43,673.28	0	43,673.28
2027	0	91,725.48	0	91,725.48
2028	0	163,582.81	0	163,582.81
2029	0	297,685.37	0	297,685.37
2030	0	505,017.34	0	505,017.34
2031	0	742,767.75	0	742,767.75
2032	0	938,172.81	0	938,172.81
2033	0	1,012,871.55	0	1,012,871.55
2034	0	1,015,804.88	0	1,015,804.88
2035	0	1,018,738.21	0	1,018,738.21
2036	0	1,021,671.55	0	1,021,671.55
2037	0	1,024,604.88	0	1,024,604.88
2038	0	1,027,538.21	0	1,027,538.21
2039	0	1,030,471.55	0	1,030,471.55
2040	0	1,033,404.88	0	1,033,404.88
2041	0	1,036,338.21	0	1,036,338.21
2042	0	1,039,271.55	0	1,039,271.55
TOTAL				**1,039,271.55**

5 MONITORING

5.1 Data and Parameters Available at Validation

The project monitoring plan has been developed according to the Monitoring Procedure included within the approved methodology, AR-ACM0003.

The following data and parameters are determined or available at validation, and remain fixed throughout the project crediting period – ie no monitoring of the below parameters exists. All data and parameters monitored during the project lifetime are detailed in Section 5.2 below.

Data / Parameter	$AGB_{CULM\_POLYMORPHA}$
Data unit	Kg
Description	Allometric equation for the calculation of above ground biomass of a single culm of *Bambusa polymorpha*
Source of data	Destructive Sampling & Subsequent Analysis[15]
Value applied	AGB = 2.183413 x D^1.276375
Justification of choice of data or description of measurement methods and procedures applied	The project proponent has followed the guidance provided by the CDM tool, which states that "for ex ante estimation of aboveground tree biomass in the project scenario any allometric equation can be used. No verifiable allometric equations exist for this bamboo species, Therefore the project proponent engaged a qualified 3rd party to develop a species specific allometric equation following the AR Methodological Tool "demonstrating appropriateness of allometric equations for estimation of aboveground tree biomass in A/R CDM project activities" V01, for the quantification of changes in above ground biomass of the planted *Bambusa polymorpha* from measurements of culm diameter. The equation was derived adhering to a conservative approach, and was derived from a data set of at least 30 samples of the parent material from which the planting material has been obtained,

[15] *Development of Allometric Equations for Bambusa polymorpha from Destructive Sampling; March 2022.*

	with the value of coefficient of determination (R^2) being not less than 0.85. A Reference document has been provided to the VVB detailing the steps taken including a detailed description if why this equation is the most scientifically rigorous.
Purpose of Data	Calculation of project emissions
Comments	None

Data / Parameter	$AGB_{CULM\_TEXTILIS}$
Data unit	Kg
Description	Allometric equation for the calculation of above ground biomass of a single culm of *Bambusa textilis*
Source of data	Destructive Sampling & Subsequent Analysis[16]
Value applied	AGB = 0.933722 x D^1.802318
Justification of choice of data or description of measurement methods and procedures applied	The project proponent has followed the guidance provided by the CDM tool, which states that "for ex ante estimation of aboveground tree biomass in the project scenario any allometric equation can be used. No verifiable allometric equations exist for this bamboo species, Therefore the project proponent engaged a qualified 3rd party to develop a species specific allometric equation following the AR Methodological Tool "demonstrating appropriateness of allometric equations for estimation of aboveground tree biomass in A/R CDM project activities" V01, for the quantification of changes in above ground biomass of the planted *Bambusa textilis spp* from measurements of culm diameter. The equation was derived adhering to a conservative approach, and was derived from a data set of at least 30 samples of the parent material from which the planting material has been obtained, with the value of coefficient of determination (R^2) being not less than 0.85. A Reference document has been provided to the VVB detailing the steps taken including a detailed description if why this equation is the most scientifically rigorous.

[16] *Development of Allometric Equations for Bambusa textilis spp from Destructive Sampling; March 2022.*

Purpose of Data	Calculation of project emissions
Comments	None

Data / Parameter	Litter Carbon
Data unit	tCO_2 / ha
Description	This variable represents the tCO_2 / ha contained within the litter carbon pool within the bamboo plantation
Source of data	IPCC Guidelines
Value applied	1% of the total bamboo biomass for each strata
Justification of choice of data or description of measurement methods and procedures applied	The project has chosen to utilize the default factor for the relationship between carbon stock in litter and carbon stock in living trees (bamboo), for a tropical biome with rainfall of between >1,600 mm/yr.
Purpose of Data	Calculation of project removals
Comments	NA

Data / Parameter	Soil Organic Carbon (SOC)
Data unit	tCO_2 / ha
Description	This variable represents the annual increase of SOC within the bamboo plantation
Source of data	IPCC Guidelines
Value applied	0.8 tCO_2 / ha / yr
Justification of choice of data or description of measurement methods and procedures applied	This value was estimated according to the IPCC guidelines (UNFCC/CCNUCC 2010 a), which recommends that a value of 0.8 tCO_2 can be used as a default value for the stock change per hear.
Purpose of Data	Calculation of project removals
Comments	NA

Data / Parameter	RS
Data unit	Dimensionless

Description	The root to shoot ratio is the ratio of above to ground biomass applied to calculate the below ground biomass of sympodial bamboo species
Source of data	Peer Reviewed Literature[17][18]
Value applied	1:0.25
Justification of choice of data or description of measurement methods and procedures applied	Destructive sampling of a bamboo clump is extremely expensive and time consuming, and results in the death of the clump. As a result, destructive sampling to determine the below ground biomass held in the intricate root and rhizome system of sympodial bamboo is not realistic, and it is necessary to rely on literature and where necessary results from similar species for the calculation of this parameter.
Purpose of Data	Calculation of project emissions
Comments	None

Data / Parameter	CF_{BAMBOO}
Data unit	tC(t d.m)-1
Description	The fraction of dry bamboo biomass that can be attributed to being carbon.
Source of data	IPCC Guidelines
Value applied	0.47
Justification of choice of data or description of measurement methods and procedures applied	IPCC default factor for the traction of woody biomass that represents carbon.
Purpose of Data	Calculation of project emissions
Comments	None

[17] *Arango & Camargo 2012*

[18] *Gurmessa et al. 2016. Allometric Equations to Estimate the Biomass of Oxytenanthera Abyssinica (A. Rich.) Munro. (Ethiopian Lowland Bamboo) in Dicho Forest, Oromia Region, Western Ethiopia. International Journal of Research Studies in Biosciences (IJRSB), Volume 4, Issue 12.*

Data / Parameter	CO_2e
Data unit	Carbon dioxide equivalent
Description	Conversion of Carbon to Carbon Dioxide Equivalent
Source of data	IPCC
Value applied	44/12
Justification of choice of data or description of measurement methods and procedures applied	Standard conversion factor
Purpose of Data	Calculation of project emissions
Comments	None

Data / Parameter	t_{VAL}
Data unit	Dimensionless
Description	Two-sided Student's t-value, at infinite degrees of freedom, for 90% confidence level
Source of data	Tool for the "Calculation of the number of sample plots for measurements within A/R CDM project activities" (Version 02.1.0)[19]
Value applied	1.645
Justification of choice of data or description of measurement methods and procedures applied	Confidence level of 90%, degree of freedom "infinite"
Purpose of Data	Calculation of project emissions
Comments	None

Data / Parameter	s_i

[19] EB 58 Annex 15. Calculation of the number of sample plots for measurement within A/R CDM project activities (Version 02.1.0) https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-03-v2.1.0.pdf/history_view

Data unit	t.d.m
Description	Estimated standard deviation of biomass stock in stratum *i.*
Source of data	Tool for the "Calculation of the number of sample plots for measurements within A/R CDM project activities" (Version 02.1.0)
Value applied	35%
Justification of choice of data or description of measurement methods and procedures applied	For areas where no pre-measurements are conducted, a conservative value of 35% of the mean biomass stock is applied.
Purpose of Data	Calculation of project emissions
Comments	None

Data / Parameter	*E*
Data unit	t.d.m
Description	Acceptable margin of error (i.e. one-half the confidence interval) in estimation of the biomass stock within the project boundary
Source of data	Tool for the "Calculation of the number of sample plots for measurements within A/R CDM project activities" (Version 02.1.0)[20]
Value applied	10%
Justification of choice of data or description of measurement methods and procedures applied	A default value of 10% of the mean biomass stock within the project boundary may be used unless a different value is prescribed in the methodology.
Purpose of Data	Calculation of project emissions
Comments	None

[20] EB 58 Annex 15. Calculation of the number of sample plots for measurement within A/R CDM project activities (Version 02.1.0) https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-03-v2.1.0.pdf/history_view

5.2 Data and Parameters Monitored

All parameters and variables included within the monitoring plan correspond to those used specifically for assessing the growth, productivity, carbon stock and changes in carbon stock of sympodial (clumping) bamboo species, and take into account the unique growth and development patterns of this group of plants.

Data / Parameter	$N_{CLUMP\_SPECIES\_t}$
Data unit	Dimensionless
Description	The total number of clumps of each species planted by year as the result of the project activities
Source of data	Project Records
Description of measurement methods and procedures to be applied	Counting of all clumps planted by species, as a result of the project activities
Frequency of monitoring/recording	Annually, one year after each planting season
Value applied	Determined ex post
Monitoring equipment	NA
QA/QC procedures to be applied	The following QA/QC procedures are applied: • All data is uploaded onto tablets directly in the field by a team of trained technicians. This reduces data entry errors; • Seedling inventory: an inventory is maintained to reconcile the number of seedling leaving the nursery each day during planting season and field planting data; • GIS mapping: individual polygons are mapped and reconciled against the total number of clumps planted within any area; • Randomized sampling: carried out by senior managers to provide QC on field data.
Purpose of data	Calculation of project emissions
Calculation method	NA
Comments	None

Data / Parameter	N_{CULM}
Data unit	Dimensionless
Description	The number of culms found in each of the bamboo clumps sampled during the monitoring event and counted numerically.
Source of data	Field sampling / monitoring from permanent sample plots.
Description of measurement methods and procedures to be applied	For each bamboo clump within a permanent sample plot, the total number of culms is manually counted by the field team and recorded numerically.
Frequency of monitoring/recording	During monitoring events
Value applied	Determined ex post
Monitoring equipment	NA
QA/QC procedures to be applied	The field monitoring team is fully trained in an understanding of clump growth and in field data collection and led by an experienced manager. All field data is input directly into tablets in the field. Videos are taken of sampling to provide QC measures with random checks carried out by a senior manager and the project proponent's corporate team.
Purpose of data	Calculation of project emissions
Calculation method	NA
Comments	None

Data / Parameter	D_{CULM}
Data unit	Dimensionless
Description	The diameter at breast height of a bamboo culm
Source of data	Field sampling / monitoring from permanent sample plots.
Description of measurement methods and procedures to be applied	Measured using a calliper, with measurements taken at the middle of an internode closest to breast height (1.3m) of each bamboo culm within the bamboo clump being monitored. For each culm recorded a unique number is given.

Frequency of monitoring/recording	Each time a verification event occurs
Value applied	Determined ex post
Monitoring equipment	Caliper
QA/QC procedures to be applied	The field monitoring team is fully trained in an understanding of clump growth and in field data collection and led by an experienced manager. All field data is input directly into tablets in the field. Videos are taken of sampling to provide QC measures with random checks carried out by a senior manager and the project proponent's corporate team.
Purpose of data	Calculation of project emissions
Calculation method	NA
Comments	None

Data / Parameter	AGB_{CULM}
Data unit	t
Description	The tool for the development of allometric equations will be followed in order to develop site and species specific allometric equations for the bamboo planted by the project.
Source of data	Destructive sampling of bamboo planted as part of the project activities.
Description of measurement methods and procedures to be applied	Destructive sampling of culms to develop the required allometric equation in order to determine the total above ground biomass for a bamboo culm.
Frequency of monitoring/recording	Years 5, 10 & 15
Value applied	Determined ex post
Monitoring equipment	NA
QA/QC procedures to be applied	Assessment of this parameter is carried out using excel spreadsheets with input equations. Therefore no QA/QC procedures are required.

Purpose of data	Calculation of project emissions
Calculation method	NA
Comments	None

Data / Parameter	T
Data unit	Year
Description	The time period in years between estimations of the change in carbon stock of bamboo biomass
Source of data	Monitoring records
Description of measurement methods and procedures to be applied	NA
Frequency of monitoring/recording	Annual
Value applied	NA
Monitoring equipment	NA
QA/QC procedures to be applied	NA
Purpose of data	Calculation of project emissions
Calculation method	$T = t_2 - t_1$
Comments	If calculations in the change in bamboo carbon stock are carried out in different months of the year, then a fractional value (number of months / 12) is applied.

Data / Parameter	n
Data unit	Dimensionless
Description	The number of sample plots (clumps) by stratum (species and year of planting) required for the estimation of biomass stocks within the project boundary.
Source of data	Calculation
Description of measurement methods	NA

and procedures to be applied	
Frequency of monitoring/recording	Calculated for each monitoring event.
Value applied	Determined ex post
Monitoring equipment	NA
QA/QC procedures to be applied	NA
Purpose of data	Calculation of project emissions
Calculation method	As described in the tool "Calculation of the number of sample plots for measurements within A/R CDM project activities"
Comments	None

Data / Parameter	i
Data unit	Dimensionless
Description	Ex post strata within the project boundaries
Source of data	Monitoring data
Description of measurement methods and procedures to be applied	Ex post strata are determined based upon the actual achieved project activities, with strata determined as a combination of species planted and year of planting
Frequency of monitoring/recording	Calculated for each monitoring event
Value applied	Determined ex post
Monitoring equipment	NA
QA/QC procedures to be applied	The project records will determine the actual number of bamboo clumps of each targeted species, planted each year. QC measures are incorporated into the determination of the area and the number of clumps as described in the relevant parameters above.
Purpose of data	Calculation of project emissions
Calculation method	NA

Comments	None

5.3 Monitoring Plan

In accordance with the applied approved methodology, the monitoring plan shall provide for collection of all relevant data necessary for:

a) Verification that the applicability conditions listed under paragraphs 3 and 4 have been met;

b) Verification of changes in carbon stocks in the pools selected;

c) Verification of project emissions and leakage emissions.

The data collected shall be archived within the project proponent's database for a period of at least two years after the end of the last crediting period of the project activity.

The methodology requires that commonly accepted principles and practices of forest inventory and forest management in the host country are implemented. Given that there are no such commonly accepted practices with regards to bamboo in the host country, the project utilizes standard operating procedures (SOPs) specifically for the collection of data relevant for sympodial bamboo.

a) Verification of Methodology Applicability Conditions

Monitoring of project boundaries: given the linear and spread out nature of the riparian buffer zones monitoring of the project boundaries is required. Each year the Rwanda Water Board provides a "priority" area for the bamboo to be planted within the framework of the proposed project activities. For each area there are factors on the ground that affect the actual planting area, such as access, and as a result the final project boundary for each planting instance can only be determined post planting.

At the same time, there are areas within the priority planting area where standing trees exist, which requires ground truthing at the time of planting. The GHG removals associated with the project are limited to the specific areas within which bamboo planting has occurred.

Therefore, monitoring of the actual planted bamboo and the resulting boundaries of the riparian buffer zones included within the GHG assessment will be monitored, through either GIS/remote sensing, or utilizing drone photography. This monitoring aspect includes the identification and monitoring of ex post strata, based upon the actual date of planting and species planted within each planted area.

At the end of each planting season the boundaries of the areas under which the revegetation activities occurred is uploaded in the form of shape files into the project's forestry software platform[21], Micro Forest. Such annual monitoring of the boundaries is carried out in order to demonstrate that the actual area afforested conforms to the bamboo planting activities as outlined in the overall project plan and each annual operational plan.

Monitoring of bamboo establishment: as above, in addition to monitoring of project boundaries it is necessary to monitor the actual bamboo establishment against planned rates. For each riparian buffer zone that undergoes revegetation activities the exact length and the exact number of bamboo clumps planted is uploaded into the Micro Forest platform. Any deviation from the planned bamboo establishment will be documented.

b) Verification of Changes in Carbon Stocks in Selected Pools

The below monitoring parameters are those required for the determination of bamboo growth and therefore for the determination of changes in bamboo carbon stock. These parameters will be gathered from permanent sample plots, established for each ex post strata.

All data and information collected will be stored in project databases, and the Micro Forest platform. This software allows for the gathering of spatial data via its app on cell phones or tablets during the daily operations of the revegetation project. Such data is automatically synced with the project's master database whenever individual devices come into connectivity.

Such spatial data is then used for the development of stratification maps and clear delineation of the number of planted bamboo clumps for each Field, as the unit of revegetation.

Bamboo Clump Mortality

Bamboo clumps are most susceptible within 6 months post planting. After this initial establishment period, mortality rates are expected to be extremely low, as once the bamboo clump has achieved the production of an established below ground rhizome system, and the above ground biomass is emerging as woody biomass, the clumps are not highly susceptible to external factors.

Mortality monitoring occurs after the onset of the second raining season, known as the short rains. At this time the operational team can easily determine any clumps that have suffered mortality. Such

[21] *The project is in the process of implementing the Micro Forest software platform for the spatial management of project activities. See www.microforest.co.za for more information.*

monitoring co-incides with maintenance activities of the previous year's plantings, including ring weeding around each clump and the control of inter-row grasses.

Following mortality monitoring, re-stocking occurs to maximize the stocking density to the targeted 400 clumps per km/hectare.

Ex Post Stratification

If biomass distribution over the project area is not homogeneous, stratification should be carried out to improve the precision of biomass estimation. Different stratifications may be appropriate for the baseline and project scenarios in order to achieve optimal precision of estimation of net GHG removals by sinks. In the context of the project activities:

(a) For baseline net GHG removals by sinks – the project areas represent a homogenous strata as planting occurs on an individual clump basis with each linear km (representing 1 hectare) measured comprising of 400 bamboo clumps, and no removal of trees or woody vegetation is undertaken for the planting of bamboo.

(b) For actual net GHG removals by sinks – no ex ante stratification of the project area is necessary. However, the *ex post* estimations is based on the actual implementation of the project planting and management plan. Ex post stratification is dependent upon two factors;

- Year of planting
- Species

Table 10 Ex Post Stratification By Year of Planting and Species

Year of Planting	Bambusa polymorpha	Bambusa textilis
2022	Strata 1a	Strata 1b
2023	Strata 2a	Strata 2b
Etc		

The changes in the biomass within the project area during the crediting period of the project will be monitored through the sampling design based on the number and area of each strata. Each strata will consist of the set of blocks in the project area based on the planting date and species of bamboo.

Sampling

Sampling is carried out in accordance with the stratification as defined above. Permanent sample plots will be developed for each project instance, with new permanent sample plots identified for teach new

year of planting. The specific sampling design that was applied is stratified random sampling with new PSP locations added as per the methodology defined in the project document. The maximum allowable margin of error for the estimation of the bamboo biomass assessed in the monitoring plan is 10% at 90% confidence level.

Development of Permanent Sample Plots

Some studies (Camargo 2006, Schumacher 2006, Rijal 2006 and Camargo et al. 2008) have been carried out to in order to define an optimal plot design for bamboo inventory of giant sympodial species. As a result, the size of permanent sample plots will be of 75 m^2 for all strata. Limitations associated with the nature of the riparian plantings result in sample plots that have to be linear in nature. Within the sample plots three bamboo clumps will be monitored and measured at each verification event, as depicted in the image below, with the first clump representing the center point of the sample plot, and the subsequent clumps moving east along the flow of the river.

Figure 20 Permanent Sample Plot Design

The location of permanent sample plots will be determined through a random selection process. A grid with the size of plots will be overlaid on the digital map of the bamboo planted area, excluding areas of conserved forest. Using Hawth's extension of the software ArcMap 9.2 randomly selected plots are defined and the co-ordinates of the center point the plot will be registered and marked.

Calculation of Sample Size

The total number of permanent sampling plots to be monitored will be estimated in line with the tool "Calculation of the number of sample plots for measurements within A/R CDM project activities" (version 02.1.0). Sample plots will be located randomly inside each stratum and measured at least every five years, or at shorter intervals depending on the desire frequency of verification events. SEP

The tool allows for a simplified equation for the estimation of the number of sample plots where the total sampling is less than 5% of the total project.

Application of the Tool

The maximum number of sample plots by stratum is calculated as:

$$N = \frac{A}{AP}$$

The number of sample plots for the project area is thereafter calculated using the following equation, establishing a confidence interval of 95% and a margin of error of 10%.

$$n = \frac{N * t_{VAL}^2 . \left[\sum_{i=1}^{L} Wi.S_{ti} \right]^2}{\left(N.E^2 \right) + t_{VAL}^2 * \sum_{i=1}^{L} w_t . (S_{ti})^2}$$

n	Number of sample plots required for estimation of biomass stocks within the project boundary; dimensionless
N	Total number of possible sample plots within the project boundary being as calculated as above;
t_{VAL}	Two-sided Student's t-value, at infinite degrees of freedom, for the required confidence level; calculated as 1.960
W_i	Relative weight of the area of stratum i (i.e., the area of the stratum i divided by the project area); as defined in the assumptions above
S_i	Estimated standard deviation of biomass stock in stratum i; t d.m. ha-1
E	Acceptable margin of error (i.e., one-half the confidence interval) in estimation of culm diameter, defined as <10%.

The tool defines that for a small sampling fraction (that is, when area sampled is less than 5% of the project area), the following simplified equation can be used for estimating the number of sample plots:

$$n = \left(\frac{t_{VAL}}{E} \right)^2 * \left(\sum_i w_i * s_i \right)^2$$

n = Number of sample plots required for estimation of biomass stocks within the project boundary; dimensionless

t_{VAL} = Two-sided Student's t-value, at infinite degrees of freedom, for the required confidence level; dimensionless

E = Acceptable margin of error (i.e., one half the confidence interval) in estimation of biomass stock within the project boundary; t d.m. (units used for s_i)

w_i = Relative weight of the stratum *i* (i.e., the number of clumps of the stratum *I* divided by the total project planted clumps; t d.m.

s_i = Estimated standard deviation of biomass stock in stratum *i*; dimensionless

i = 1a; 1b; 1c; 2a… biomass stock estimation strata within project boundary

Given that the project has multiple strata, the allocation of the total number of sample plots to different strata is calculated as:

$$n_i = n * \frac{w_i * s_i}{\sum_i w_i * s_i}$$

Where:

n_i = Number of sample plots allocated to stratum *i*; dimensionless

n = Number of sample plots required for estimation of biomass stocks within the project boundary; dimensionless

w_i = Relative weight of the stratum *i* (i.e., the number of clumps of the stratum *I* divided by the total project planted clumps; t d.m.

s_i = Estimated standard deviation of biomass stock in stratum *i*; dimensionless

i = 1a; 1b; 1c; 2a… biomass stock estimation strata within the project boundary

The project will utilize a 90% confidence level, as prescribed by the tool, for the determination of biomass stock in A/R projects.

After calculating the sample size, the plots selected within each stratum will be permanent and monitoring shall always will be conducted out on these throughout the project life. New plots will be added for each strata as applicable.

Monitoring of Bamboo Clump Parameters

The species being grown have similar growth and ecological patterns. Both are sympodial (clumping) bamboo species. Such bamboos have a tight knit rhizome system with above ground culms emerging within a compact "clump", giving this group of bamboos the common name "clumping" bamboo. Each bamboo clump that is planted will consist of multiple culms (or poles), with these culms growing in number and size over a number of years after planting, until the clump achieves its maximum productive biomass, and therefore carbon removals.

The growth of individual clumps and their culms within sample plots will be measured at each monitoring event for the estimation of above-ground bamboo biomass. For each clump included within permanent sample plots, the following monitoring will be carried out:

Step 1:

- Use of a GPS to record the clump location, and the number of the clump within the permanent sample plot as Clump 1, Clump 2, Clump 3.
- Confirmation of bamboo species.
- Counting of the total number of culms within the clump including all culms that are taller than breast height, measured at 1.3m.

Step 2:

Culms will be recorded as Culm 1, Culm 2, Culm 3 etc. Individual culm measurements will be taken for all culms within the clump, using a caliper:

- Culm diameter at breast height (cm)

Step 3:

The appropriate allometric model is fitted from culm diameter to determine the total Above Ground Biomass of each individual culm, for all culms identified in the clump and the associated Total Above Ground Biomass of the clump.

The below ground biomass will be extrapolated from above-ground biomass using the Root to Shoot ratio for clumping bamboo.

Litter & Soil Carbon Pools

The changes in carbon content in the litter and soil attributable to project activities are not measured as part of the monitoring plan, as these are calculated using default factors following IPCC guidelines. This represents a conservative approach.

Pre-existing Trees

Pre-existing trees and non-tree vegetation will not be measured and accounted for. This represents a conservative approach, as the baseline scenario assumes the removal and reduction of these trees. Given the clear differences between trees and bamboo monitoring of only bamboo clumps does not represent a challenge.

Monitoring Frequency of Clump Parameters

The monitoring of information critical for achieving the project management plan will be recorded and monitored annually. This includes the actual planted bamboo clumps by species each year, and the subsequent determination of clump mortality.

For the estimation of changes in biomass stock in the planted bamboo, monitoring of clump parameters will occur either every five years, or at each verification event, depending on the frequency of such events.

Quality Assurance / Quality Control

The project provides the following quality assurance and quality control (QA/AC) measures for all aspects of project implementation and monitoring.

- A qualified team member for each activity, with the relevant experience and an adequate management support structure;
- On-going training of field personnel (team leaders, supervisors and managers) in bamboo clump management and inventory;
- Use of tablets in field to input data directly thereby reducing errors;
- The use of GIS & remote sensing techniques for reconciling field data with spatial data;
- Randomized monitoring – the project operates a system of randomized monitoring between its in country and corporate teams. Random GPS points are selected on a weekly basis on recorded activities, and photographic evidence provided within a set time frame.
- This includes the necessary training of all field personnel in bamboo clump inventory.

In all aspects of project development and reporting, a conservative approach will be maintained.

Structure and Responsibility

Three levels of responsibility exist within the project proponent's team for the analysis and reporting of the monitoring event:

Camille Rebelo: EcoPlanet Bamboo Chief Operating Officer and carbon specialist, Camille has 15 years of experience in AFOLU project implementation, as well as 10 years of experience in the development and management of bamboo. Camille is responsible for the development of the monitoring plan, oversight of fieldwork, analysis of all data collected during the monitoring event and the delivery of monitoring reports and documentation.

Samantha Wilde, VP of Forestry: EcoPlanet's VP of Forestry oversees all revegetation projects, manages the Micro Forest platform and associated database of information, and provides support to the in country operational teams. She is responsible for the training of teams to ensure consistency and credibility of data collection across all projects. Samantha spent five years living in Rwanda managing the country's targets for the expansion of bamboo as a solution for riparian buffer zone protection.

Project Manager, Rwanda EcoPlanet has an experienced project management professional who serves as the General Manager of the Rwanda Riparian Restoration Project. This senior position has experience of development of projects in Rwanda and is responsible for all day to day operations, including the collection of data during monitoring events.

Data Collection, Storage and Reporting

In order to guarantee the quality of the information collected during the monitoring event the standard operating procedures described in the monitoring plan ware adhered to. All inventory and field work is carried out in accordance with the requirements established in the IPCC GPG LULUCF guidelines, where applicable to bamboo plantations. Statistical criteria and the principals of forest inventory are utilized as a quality control / quality assurance procedure for inventory operations, including field data collection and data management.

Once the infield sampling portion of each monitoring event is completed the data will be aggregated, collated and sent to EcoPlanet Bamboo's management team for analysis.

Data collected during the monitoring event has been archived electronically and shall be kept for a minimum of two years. Data is stored online in company Dropbox accounts.

The project database will include all information related to the monitoring of project activities: forest management unit and / or PSP identification codes and coordinates for each sampling plot, dates when sampling has been made, the person responsible for the sampling and the sampling results.

c) Verification of Project Emissions and Leakage Emissions.

Project Emissions: according the applied methodology the only increase in GHG emissions within the project boundary that requires being accounted for is the non-CO2 GHG emissions from burning of woody biomass for site preparation and/or forest management. The monitoring of emissions is required only if the emissions are considered significant; if insignificant, evidence should be provided (e.g., in the relative part of the monitoring plan of each project instances that the assumption for the exclusion made in the ex-ante assessment still hold in the ex post situation.

The project activities do not result in any burning of biomass, whether for land preparation or as part of the forest management. However, under the scenario where wild or uncontrolled fires occur within the project areas, the monitoring and estimation of GHG emissions associated with such an occurrence will be done in accordance with the latest version of the tool "Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity".

Leakage Emissions: under the applicability conditions of the applied methodology, no leakage emissions are expected. Monitoring activities will ensure that this assumption is accurate in the observations of the ex post project scenario.

Procedure for Addressing Non Conformities

Any non-conformities associated with documentation and reporting are dealt with by EcoPlanet Bamboo Group's management team, while non conformities in the field are dealt with by instruction to the Project Manager.

APPENDIX

This appendix is left empty intentionally.