



CONSERVATION AND RESTORATION OF THE MANGROVE ECOSYSTEM IN THE GAMBIA THROUGH THE REDD+ MECHANISM

Document Prepared by Ørsted with support from Department of Parks and Wildlife Management Gambia (DPWM), Sahel Wetlands Concern (SWC), Kombo Foni Forestry Association (KOMFFORA) and West African Bird Study Association (WABSA).

Project Title	CONSERVATION AND RESTORATION OF THE MANGROVE ECOSYSTEM IN THE GAMBIA THROUGH THE REDD+ MECHANISM
Version	V1.3
Date of Issue	11.07.2024 this version of the document issued
Prepared By	Prepared by Ørsted (lstch@orsted.com , +45 99 55 27 32) with support from Department of Parks and Wildlife Management Gambia (DPWM), Sahel Wetlands Concern (SWC), Kombo Foni Forestry Association (KOMFFORA) and West African Bird Study Association (WABSA).
Contact	Lærke Stürup Chrintz, Climate Advisor at Ørsted, lstch@orsted.com , +45 99 55 27 32 Ørsted Headquarters: Nesa Allé 1, 2820 Gentofte, Denmark

CONTENTS

1	PROJECT DETAILS.....	4
1.1	Description of the Project.....	4
1.1.1	Audit History.....	5
1.2	Sectoral Scope and Project Type	5
1.3	Project Eligibility	5
1.4	Project Design	7
1.4.1	Eligibility Criteria	7
1.5	Project Proponent.....	10
1.6	Other Entities Involved in the Project.....	10
1.7	Project Ownership.....	11
1.8	Project Start Date	12
1.9	Project Crediting Period	12
1.10	Project Scale and Estimated GHG Emission Reductions or Removals	12
1.11	Description of the Project Activity.....	14
1.12	Project Location.....	17
1.13	Conditions Prior to Project Initiation	19
1.14	Compliance with Laws, Statutes and Other Regulatory Frameworks.....	25
1.15	Participation under Other GHG Programs	27
1.15.1	Projects Registered (or seeking registration) under Other GHG Program(s)	28
1.15.2	Projects Rejected by Other GHG Programs	28
1.16	Other Forms of Credit	28
1.16.1	Emissions Trading Programs and Other Binding Limits.....	28
1.16.2	Other Forms of Environmental Credit.....	28
1.16.3	Supply Chain (Scope 3) Emissions.....	28
1.17	Sustainable Development Contributions	28
1.18	Additional Information Relevant to the Project.....	30
1.18.1	Leakage Management.....	30
1.18.2	Commercially Sensitive Information.....	30
1.18.3	Further Information.....	31

2	SAFEGUARDS.....	31
2.1	No Net Harm	31
2.2	Local Stakeholder Consultation	31
2.3	Environmental Impact.....	39
2.4	Public Comments	39
2.5	AFOLU-Specific Safeguards	39
3	APPLICATION OF METHODOLOGY	41
3.1	Title and Reference of Methodology	41
3.2	Applicability of Methodology.....	42
3.3	Project Boundary	53
3.4	Baseline Scenario.....	57
3.5	Additionality.....	64
3.6	Methodology Deviations.....	66
4	QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS	66
4.1	Baseline Emissions.....	66
4.2	Project Emissions	76
4.3	Leakage	96
4.4	Net GHG Emission Reductions and Removals	98
5	MONITORING	114
5.1	Data and Parameters Available at Validation	114
5.2	Data and Parameters Monitored	117
5.3	Monitoring Plan	130
	APPENDIX.....	143

1 PROJECT DETAILS

1.1 Description of the Project

The project is initiated by the Government of The Gambia to secure the long-term sustainability and maintenance of the mangrove restoration and avoided degradation activities through the certification and selling of carbon credits. The main project proponent and project owner is the Government of The Gambia represented through the Ministry of Environment, Climate Change and Natural Resources. The Department of Parks and Wildlife Management (DPWM) is responsible for project implementation with support from the three Gambian NGO's; Sahel Wetlands Concern (SWC), West African Bird Study Association (WABSA) and Kombo Foni Forestry Association (KOMFFORA). Ørsted Nature Based Solutions (Ørsted) is also a project proponent and is responsible for the development of the VCS project documentation and processes. This document is prepared by Ørsted with support from DPWM, SWC, KOMFFORA and WABSA. In the initial stages of project development contributions were made by S2 Services Limited (S2 Services) and Forests & Wetlands Consulting (FWC).

The project is a grouped project that aims to generate greenhouse gas emission removals and reductions through mangrove restoration (removal credits) (henceforth considered to include mangrove reforestation, mangrove afforestation and hydrological restoration) and avoided degradation, including wetland restoration and conservation activities (reduction credits).

The project area covers the entire mangrove and potential mangrove landscape (both intact mangrove areas, degraded mangrove areas and degraded wetland areas environmentally suitable for mangrove planting) of The Gambia. Project activities will be gradually included on basis of among others environmental appropriateness for restoration, and available community- and financial resources. The restoration project activities (removal credits) are estimated to have an average annual amount of emission reductions (ER's) of 109,997.1, assuming that 10,000 hectares will be restored over four years and accounting for 30 years. The first project activity instance covering 235.46 ha of mangrove restoration (removal credits) is expected to generate approximately 2790.4 ERs on average/year over a 30-year period.

Initially, restoration is the main project component. Restoration of degraded mangrove areas will take place in selected locations considering the ecological conditions and with the involvement of local communities, government, departments, and NGO's. The project is designed to actively engage communities in the project activities to ensure ownership and alignment with community preferences as well as contributing to community development. The project also seeks to improve biodiversity.

The grouped project area is characterized by both degraded wetland areas and natural intact mangroves. Within this project's first project activity instance (PAI#1), the project area is characterized as degraded mangrove areas, and project activities entails hydrological engineering in a smaller part of the area and restoration of 235.46 ha mangrove in the area around Bintang Bolon. Communities within this area have been actively engaged in the project activities such as through stakeholder meetings, selection of restoration sites, hydrological engineering and planting of the mangrove.

1.1.1 Audit History

Audit type	Period	Program	Validation/verification body name	Number of years
Validation	16 August 2023 (Date that project received final validation approval and approved documents. Evidence in the form of email can be provided upon request)	VCS	KBS Certification Services Ltd.	NA

1.2 Sectoral Scope and Project Type

This project is a grouped project that falls within sectoral scope 14; Agriculture, Forestry and Land Use.

The project category applied in PAI#1 included in this Project Description (henceforth referred to as PD) is the combined category of RWE (Restoration of Wetlands Ecosystems) + ARR (Afforestation, Reforestation, and Revegetation).

1.3 Project Eligibility

The scope of the VCS program is defined in the VCS standard V4.4 in Section 2.1 “Scope of VCS program”. As justified in Table 1 below, this grouped project falls within the scope.

Table 1: Justification of project eligibility under the VCS program

The scope of the VCS program, as stated in the VCS standard V4.4	Justification that the project is within the scope
Inclusions in the scope of the VCS program	
The seven Kyoto Protocol greenhouse gases.	The project takes into consideration the emission reductions of CO ₂ , N ₂ O and CH ₄ . All three gasses are counted as a Kyoto protocol greenhouse gas.
Ozone-depleting substances (ODS).	Not part of the project scope.
Project activities supported by a methodology approved under the VCS Program through the methodology development and review process.	All applied project activities are supported under the chosen Verra methodology VM0007 V1.6. The area has not been cleared, drained, or converted native ecosystems to create GHG credits.

	Details and evidence are demonstrated in the “Historical analysis of land cover” report. There, the lack of forests remains today. In healthy mangrove ecosystems, mangroves-mudflat dynamics can create increased flow resistance due to increased mangrove presence, and thereby can establish more mudflats. ¹² Additionally, the project budget lacks funding for such drainage, clearing, or conversion activities. The budget is available upon request.
Project activities supported by a methodology approved under an approved GHG program, unless explicitly excluded (see the Verra website for exclusions).	Not part of the project scope, as all applied project activities are supported under the chosen Verra methodology VM0007 V1.6.
Jurisdictional REDD+ programs and nested REDD+ projects as set out in the VCS Program document <i>Jurisdictional and Nested REDD+ (JNR) Requirements</i> .	REDD project instances are not part of PAI#1 and will not be part of any future instances.
Exclusions in the scope of the VCS program	
The scope of the VCS Program excludes projects that can reasonably be assumed to have generated GHG emissions primarily for the purpose of their subsequent reduction, removal, or destruction.	In the project area, no GHG emissions has been generated for the purpose of their subsequent reduction, removal or destruction.
Grid-connected electricity generation activities using hydroelectric power plants. Grid-connected electricity generation activities using wind, geothermal, or solar photovoltaic (PV) power plants.	The project does not include any of the listed project activities.

¹ Beselly SM, van der Wegen M, Grueters U, Reyns J, Dijkstra J, Roelvink D. Eleven Years of Mangrove–Mudflat Dynamics on the Mud Volcano-Induced Prograding Delta in East Java, Indonesia: Integrating UAV and Satellite Imagery. Remote Sensing. 2021; 13(6):1084. <https://doi.org/10.3390/rs13061084>

² Anthony, E. J. (2004). Sediment dynamics and morphological stability of estuarine mangrove swamps in Sherbro Bay, West Africa. Marine Geology, 208(2–4), 207–224. <https://doi.org/10.1016/j.margeo.2004.04.009>

Activities recovering waste heat for combined cycle electricity generation, or to heat/cool via cogeneration or trigeneration. Activities generating electricity and/or thermal energy for industrial use from the combustion of non-renewable biomass, agro-residue biomass, or forest residue biomass. Activities generating electricity and/or thermal energy using fossil fuels, and activities that involve switching from a higher to a lower carbon content fossil fuel. Activities replacing electric lighting with more energy-efficient electric lighting, such as the replacement of incandescent electrical bulbs with compact fluorescent lights (CFLs) or light emitting diodes (LEDs). Activities installing and/or replacing electricity transmission lines and/or energy-efficient transformers. Activities that reduce hydrofluorocarbon-23 (HFC-23) emissions.	
---	--

For details on the project location, including definition of wetlands, see Section 1.12. For applicability of methodology, see Section 3.2.

1.4 Project Design

The project is a grouped project.

1.4.1 Eligibility Criteria

As this project is a grouped project, any instance implemented after validation must comply with Section 3.6.16 and 3.6.17 of the VCS standard 4.4. Therefore, a set of eligibility criteria is defined for each project activity category combination. Any future instances shall meet the applicable set of eligibility criteria. As the project instance covered by this PD consists of only one combined project activity category of ARR+RWE, one set of eligibility criteria is defined here.

Eligibility criteria of the combined project activity category ARR+RWE:

- 1) Meet the applicability conditions set out in the VM0007 Methodology version 1.6.
- 2) Use technologies or measures like those specified in this PD for the first instance and apply them in the same manner. New instances will consist of mangrove restoration and, when deemed necessary, alteration of hydrology to restore the natural hydrology of the area.
- 3) Be subject to the baseline scenario determined in Section 3.4 of this PD, covering the project activity ARR+RWE within the geographical boundaries of this grouped project.
- 4) Have characteristics with respect to additionality that are consistent with that of the first instance, as described in Section 3.5 “*additionality*”.

Table 2: Justification of criteria for inclusion of all new project activities

Criteria for New Inclusion of Project Activities	Justification and Assessment
1) Occur within the designated geographic area of this grouped project.	Requirement of VCS Standard 4.4. This will be monitored using GPS and drone ground truthing.
2) Comply with at least one complete set of eligibility criteria for the inclusion of new project activity instances. Partial compliance with multiple sets of eligibility criteria is insufficient.	Requirement of VCS Standard 4.4. This will be assessed using documentation throughout Table 2.
3) Be included in the monitoring report with sufficient technical, financial, geographic and other relevant information to demonstrate compliance with the applicable set of eligibility criteria and enable sampling by the validation/verification body.	Requirement of VCS Standard 4.4. This will be assessed through a combination of GPS, drone, and satellite imagery as well as relevant receipt and other financial documentation.

4) Be included in an updated project description, with updated project location information, which shall be validated at the time of verification against the applicable set of eligibility criteria.	Requirement of VCS Standard 4.4. This will be assessed through updated PD and location.
5) Have evidence of project ownership, in respect of each project activity instance, held by the project proponent from the respective start date of each project activity instance	Requirement of VCS Standard 4.4. Evidence of project ownership is defined in Section 1.7. In alignment with Section 1.7, agreements evidencing project ownership will be created for all future instances,
6) Have a start date that is the same as or later than the grouped project start date.	Requirement of VCS Standard 4.4. This will be documented with receipts of project activities in alignment with Section 1.8. All start dates of new instances will be the same and/or later than the start date of the grouped project.
7) Be eligible for crediting from the start date of the instance through to the end of the project crediting period only.	Requirement of VCS Standard 4.4. This will be assessed through the methods laid out in Section 5.
8) Only eligible for crediting from the start of the verification period in which they were added to the grouped project.	Requirement of VCS Standard 4.4. This will be documented with verification documents.
9) Not be or have been enrolled in another VCS project.	Requirement of VCS Standard 4.4. This will be assessed by checking VCS project database.
10) Adhere to the clustering and capacity limit requirements for multiple project activity instances set out in Section 3.6.8 and 3.6.9 in the VCS standard 4.4.	Requirement of VCS Standard 4.4. This will be proved by project KML files.
11) Have maximum 5% crown cover and no forest coverage over at least the last 10 years.	Lack of historical forest present is determined through appliance of satellite imagery in the form of Landsat and/or Sentinel, while crown cover percentage is determined through drone imagery or VHR satellite imagery.
12) Consult with respective community landowners and sign contract of participation.	Documented with receipt of consultation and partnership agreements with community landowners.

1.5 Project Proponent

Organization name	Department of Parks and Wildlife Management under the Ministry of Environment, Climate Change and Natural Resources (MECCNR) representing The Government of The Gambia.
Contact person	Mohamed Lamin Kassama
Title	Director
Address	Abuko Nature Reserve, Serrekunda, Kanifing Municipality
Telephone	(+220) 390 3511
Email	mlkassama2@gmail.com

Organization name	Ørsted Nature Based Solutions A/S (Ørsted)
Contact person	Lærke Stürup Chrintz (primary contact)
Title	Climate Advisor
Address	Kraftværksvej 53, 7000 Fredericia, Denmark
Telephone	+45 99 55 27 32
Email	lstch@orsted.com

1.6 Other Entities Involved in the Project

Organization name	Sahel Wetlands Concern (SWC)
Role in the project	Support to project development and implementing partner
Contact person	Kawsu Jammeh
Title	Chairman Board of Director
Address	Abuko Nature Reserve, West Coast Region, The Gambia
Telephone	(+220) 277 9223

Email	biodiversity.peace@gmail.com ; sahelwet2007@gmail.com ; jammeh.kawsu@gmail.com
--------------	--

Organization name	Kombo Foni Forestry Association (KOMFFORA)
Role in the project	Support to project development and implementing partner
Contact person	Seeku Janko
Title	Project Coordinator
Address	Kafuta village, Kombo East, West Coast Region, The Gambia
Telephone	(+220) 515 4197
Email	komffora@yahoo.com

Organization name	West African Bird Study Association (WABSA)
Role in the project	Support to project development and implementing partner
Contact person	Lamin Jobaate
Title	Executive Director
Address	Abuko Nature Reserve, Department of Parks & Wildlife Management, The Gambia
Telephone	(+220) 937 4734 ; (+220) 764 0262
Email	kunowabsa@yahoo.com

1.7 Project Ownership

The project is set up in such that the Gambia Mangrove REDD+ Project is a registered nonprofit group in The Gambia consisting of The Department of Parks and Wildlife Management (DPWM), Sahel Wetlands Concern, Kombo Foni Forestry Association, and West African Birds Study Association (the three NGOs are also known as the consortium). The DPWM represents The Gambia Mangrove REDD+ Project as well as the Project Proponents. According to VCS Standard v4.4, Section 3.7.1, evidence establishing project ownership can include legal agreements with the land rights owner. Gambia Mangrove REDD+ Project led by DPWM have made agreements with each participating community (customary landowners of land planted in this project) specifying the agreement to participate in the project and to protect the planted mangroves for at least 100 years. This agreement is administered by the project and signed by the Village Chief (representing the

village). Agreements will be made with any new participating villages for all future instances. These agreements between the Project Proponent and each participating community are legally recognized by The Gambian government.

Landownership: Landownership rights belongs to the villages through their customary rights as dictated by the Lands (Provinces) Act of 1990 and 1995. This ownership will not be transferred or affected by the project activities.

Project ownership: As described above, DPWM is representing the project ownership and leads the project implementation and maintenance of the project activities.

Additionally, the Government of The Gambia, represented by represented by DPWM of The Ministry of Environment, Climate Change and Natural Resources has the overall responsibility of overseeing and coordinating the development and implementation of policies and programs relevant to the environment, climate change, and natural resources management in the Gambia.³.

1.8 Project Start Date

The project start date of PAI#1 of RWE activities is set to 09 April 2022, as this was the day on which the first canal excavation was being performed. The project start date of PAI#1 of ARR activities is set to 05 August 2022 as this was the day on which the first planting was performed. Evidence in the form of receipts documenting the payment to the local community members performing the task with dates is available to the auditor upon request. Thus, the start date of the combined ARR+RWE activities in PAI#1 is the earlier of the two dates, set on 09 April 2022. The start date of future PAIs will be the same and/or later than the start date of the grouped project and will be evidence in the same manner through documenting receipts of the first activities, regardless of if ARR or RWE and considering whichever comes first, of that instance.

1.9 Project Crediting Period

The project crediting period will run from April 09 2022 to April 09 2052 equalling a crediting period of 30 years. However, in the VCUPA between the two project proponents, the possibility of extending the crediting period to 100 years in total has been agreed.

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale

³ MECCNAR: Mandate. Webpage: <https://meccnar.gov.gm/mandate>, Accessed 21st of October 2022

Project	x
Large project	

Table 3: Estimated GHG emission reductions or removals from PAI#1 and the grouped project

Year	Estimated yearly GHG emission reductions or removals (tCO ₂ e) from PAI#1 (235.46 ha)	Estimated yearly GHG emission reductions or removals (tCO ₂ e) from the grouped project (in this estimate only including ARR+RWE project activities) (10,000 ha)
2023	106.7	106.7
2024	314.6	1674.4
2025	1688.6	7282.9
2026	1710.5	29,380.5
2027	1711.6	52,966.2
2028	2102.2	72,747.2
2029	2286.7	78,228.1
2030	2451.6	86,565.2
2031	2608.1	96,979.8
2032	2754.8	104,130.0
2033	2890.4	110,747.5
2034	3014.0	116,949.3
2035	3124.8	122,683.9
2036	3222.4	127,911.0
2037	3306.4	132,600.0
2038	3376.5	136,727.8
2039	3432.5	140,278.0
2040	3474.5	143,239.8
2041	3502.5	145,607.6
2042	3516.6	147,379.6

2043	3517.1	148,558.3
2044	3504.2	149,149.3
2045	3478.2	149,161.5
2046	3439.6	148,606.4
2047	3388.7	147,498.1
2048	3326.1	145,852.9
2049	3252.2	143,689.1
2050	3167.6	141,026.9
2051	3073.0	137,888.3
2052	2968.8	134,296.8
Total estimated ERs	83,711.4	3,299,213.0
Total number of crediting years	30	30
Average annual ERs	2790.4	109997.1

1.11 Description of the Project Activity

Project activity ARR

In the grouped project, the ARR project activity consists of planting mangrove trees in degraded wetland areas applicable for mangrove planting already, or applicable once the natural hydrology of the area has been restored. The areas are predominately either partly degraded or completely deforested previous mangrove sites. However, some restored areas can be areas that historically may not have been mangrove but would be suitable areas today due to changing environmental conditions such as rising sea levels and degraded landscapes through anthropogenic influences. The baseline situation in restored areas will in all cases be degraded and restoration will not take place in areas where the baseline is a healthy alternative native ecosystem.

The species of mangrove trees to be planted depends on availability and the ecological conditions in the specific PAI area (salinity, tidal regime, mangrove species already present and so forth). The species chosen will always consist of species native to The Gambia. The species to be planted will be *Rhizophora mangle* (Figure 1). This species is native to the Gambia, and no invasive mangrove species are planted or introduced throughout the life cycle of this project. All propagules collected will originate from mangrove forests within the Gambia. Further, the planting

activities performed are closely planned and supervised by DPWM who has extensive experience within mangrove restoration in the Gambia, ensuring that only the species agreed upon are planted.

As the degraded mangrove areas included in this project are restored to their natural state, they will get pollinated and germinate on a continuous basis, as is the case in naturally functioning ecosystems. Because of this, the amount of carbon stored in the system during the project crediting period will remain in the system, as new trees are to naturally grow up once another tree is dying.

In PAI#1, the whole area consists of degraded mangrove habitat with only few scattered mangrove trees present. The species planted is *Rhizophora mangle*. In PAI#1, the trees will be planted with a density of approximately 10,000 propagules per hectare since planting with this density in previous mangrove restoration initiatives within The Gambia have proven successful.

For this activity, Ørsted funds project development and provides technical assistance such as GIS assistance and remote sensing analyses, and DPWM takes project lead with SWC, KOMFORRA, and WABSA assisting in project management. DPWM, SWC, KOMFORRA, and WABSA also take salinity measurements, The communities are hired to execute the planting, which are technically advised by Ørsted and DPWM and managed by DPWM, SWC, KOMFORRA, and WABSA.

This project is not within a jurisdiction covered by a jurisdictional REDD+ program.⁴

⁴ Atmadja, S.; Komalasari, M.; Alusiola, R.; Barboza, I.; Sartika; L.; Theresia, V.; Simonet; G. 2023. The International Database on REDD+ projects and programs Linking Economics, Carbon and Communities (ID-RECCO) - Project tables, V.5.0. URL: <https://www.reddprojectsdatabase.org>



Figure 1: *Rhizophora mangle*

Project activity RWE

In this project, the restoration of wetlands ecosystems (RWE) activity consists of restoring degraded wetlands ecosystems through planting mangrove (covered by the ARR activity) and, where necessary, restoring the hydrology to re-establish the natural hydrology of the degraded wetland area. This can include activities such as hydrological engineering (digging canals that results in an improved flow of tidal water from the adjacent river and into the project area) and altering roads and dams.

In PAI#1, hydrological engineering has been performed in some of the areas, where deemed necessary. Areas of PAI#1 where the hydrological engineering has been performed and areas where it was not deemed necessary are divided into two different strata. Areas without hydrological engineering are classified as strata 1, and areas with hydrological engineering are classified as strata 2. See Table 4 for information regarding which polygons are classified under each stratum.

For this activity, Ørsted funds project development and provides remote sensing analyses, and DPWM takes project lead with SWC, KOMFORRA, and WABSA assisting in project management. Technical decision making is fulfilled by DPWM. Where hydrological engineering takes place, community members are hired to perform the work. This project is not within a jurisdiction covered by a jurisdictional REDD+ program.

1.12 Project Location

The grouped project geographic boundary corresponds to all intact, degraded and deforested wetland areas within the mangrove regions of The Gambia (Figure 2).

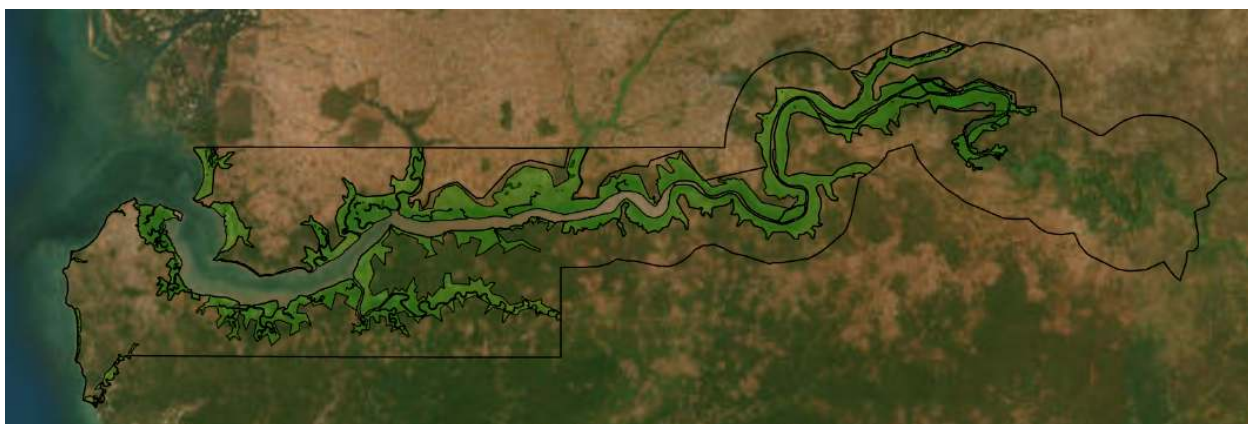


Figure 2: Grouped Project boundary

A shapefile with the geodetic coordinates of the grouped project boundary has been submitted to Verra and is available to the auditor upon request.

See Table 4 and Figure 3 for the exact location of the first project activity instance, PAI#1.

A shapefile file with the geodetic coordinates of PAI#1 is available to the auditor upon request.

Table 4: Location and hectares of the first project activity instance PAI#1

Region	Rural community	Strata	Unique ID for each discrete parcel of land	Total planted area for each community (ha)
West Coast Region (WCR)	Joreng	2	P5, P6, P7	56.40
Lower River Region (LRR)	Keneba	1	P16, P17, P18, P19, P20, P21	75.10
	Kantong Kunda	1	P8, P9, P10, P11, P12, P13, P14, P15	51.09
	Bajana	1	P1	22.51
	Jiffarong	1	P2, P3, P4	30.36

Region	Rural community	Strata	Unique ID for each discrete parcel of land	Total planted area for each community (ha)
Total				235.46

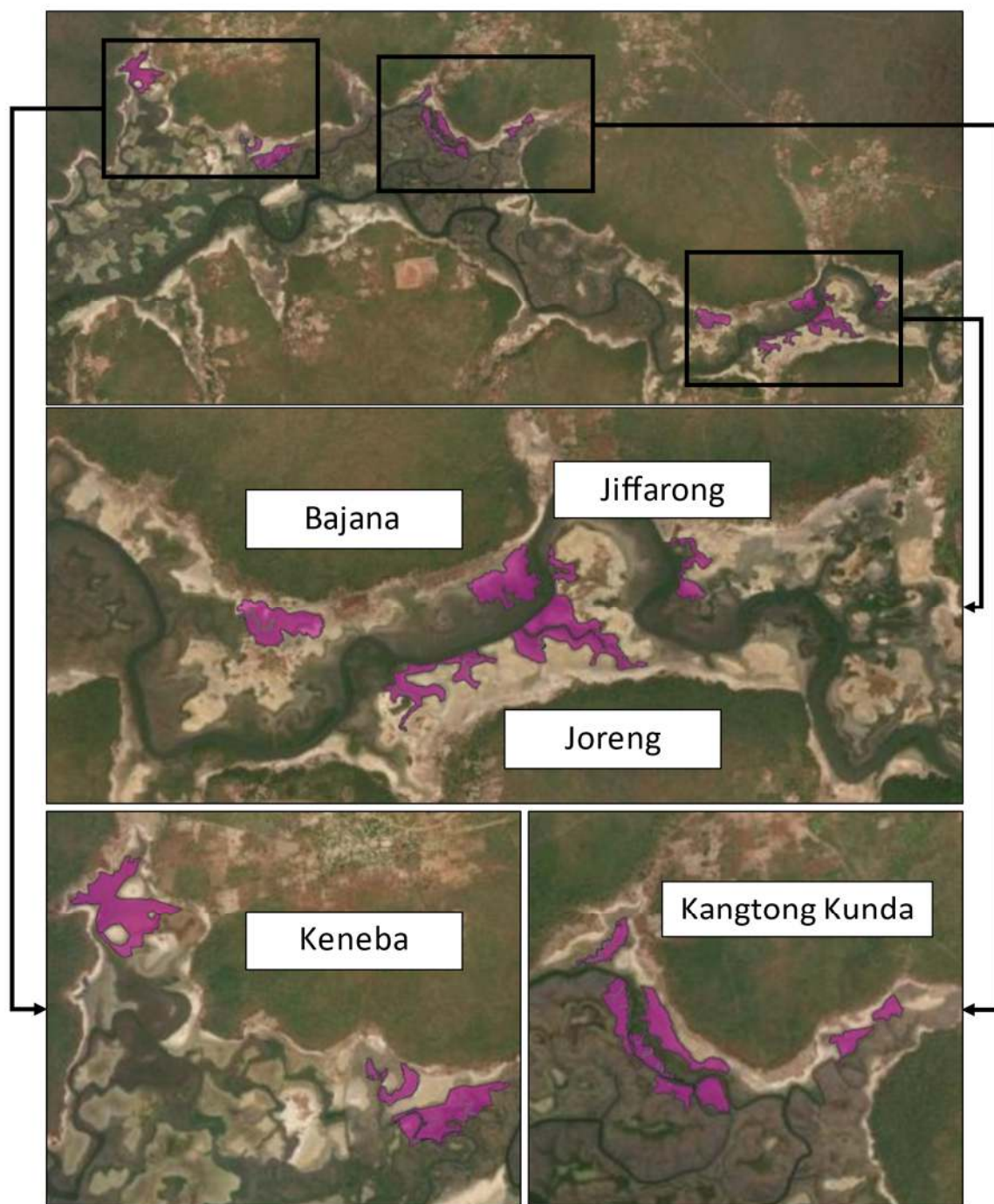


Figure 3: Map showing the locations of the first project activity instance PAI#1

The applied methodology VM0007 v1.6 requires an eligibility assessment of the project area according to its requirements, which has been performed below:

ARR: Neither the project area of PAI#1 nor any future added PAIs has been cleared of native ecosystems to create GHG emissions reductions/removals. The reasons behind the degradation of the mangrove ecosystem in PAI#1 are presented in section 1.13.

WRC: The project area of PAI#1 and all future added PAIs meets the definition as provided in the VCS standard, as the areas meet the internationally accepted definition of wetland defined in the Ramsar Convention on wetlands. In article 1.1 of the convention, wetlands are defined as follows: *For the purpose of this Convention wetlands are areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters⁵.* As the project area of PAI#1 and all future added PAIs are areas that in their natural state is temporarily covered by saline water that does not exceed six meters of depth, the areas are classified as wetland.

No intact wetland areas have been nor will be converted to create GHG emissions reductions/removals in this project. The effects of sea-level rise on project boundaries are considered in Section 4.2 of this PD.

1.13 Conditions Prior to Project Initiation

Climate

The Gambia has a Sahelian climate, characterized by a long, dry season (November to May) and a short, wet season (June to October). Average temperatures in Gambia range from 18°C to 30°C during the dry season and 23°C to 33°C during the wet season. Average rainfall in a year within The Gambia varies from 1,000 mm in the South and Southeast to 700 mm in the most northern part of the country. The West African monsoon brings rain to the country between June and October. See Figure 4 for a graph illustrating the minimum temperature, mean temperature, max temperature and precipitation in The Gambia between 1991 and 2020.

⁵ Ramsar (1971): The Ramsar Convention Article 1.1

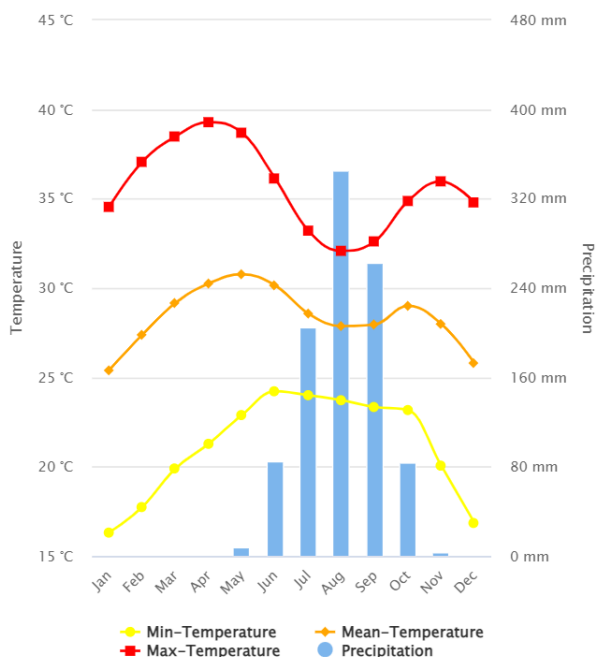


Figure 4: Graph illustrating the minimum temperature, mean temperature, max temperature and precipitation in The Gambia between 1991 and 2020.⁶

Hydrology and topography

With The Gambia lying entirely within the drainage basin of the Gambia River, The Gambia has plentiful of surface water. The water in River Gambia is generally of brackish quality with a varying salinity content dependent on the location in the river delta and the time of season. The highest salinity content is found at the river mouth from where it gradually drops further inland. During the wet season, the salinity content is due to the additional fresh water less saline than during the dry season. The Gambia also has plentiful of ground water. Due to the salinity content of the surface water in the country, all potable water is met by groundwater.

The Gambia is characterized as a very flat country, especially in its western half. The highest point within The Gambia is Red Rock measuring only 53 m above sea level.

During field missions performed on the 23rd of September 2022 and on the 6th of October 2022 the salinity content of the water present in PAI#1 was determined. As both field missions were conducted during the end of the rainy season where the water is expected to be less saline when compared to the dry season, the salinity measured is expected to be lower than the salinity average over the entire year. As the salinity measurements in this project are used for determining the methane and nitrous dioxide emissions from the project area, the wet season salinity

⁶ World Bank Group: Climatology of the Gambia. Webpage: <https://climateknowledgeportal.worldbank.org/country/gambia/climate-data-historical>, Accessed 21st of October 2022

measurements are appropriate as they result in a more conservative estimate of emissions. See Section 4.1 and 4.2 of this PD for more information on the methane and nitrous dioxide estimations. See Table 5 below for salinity measurements.

Table 5: Salinity measurements in PAI#1

Community	Date	Coordinates	Description	Salinity, %
Joreng	23-09-2022	E -15.888003, N 13.265014	Water edge Bintang Bolon	2.5
Joreng	23-09-2022	E -15.890779, N 13.264907	Water edge Bintang Bolon	2.1
Joreng	23-09-2022	E -15.888812, N 13.264773	Water edge Bintang Bolon	2.3
Joreng	23-09-2022	E -15.885291, N 13.263751	Pore water	4.6
Joreng	23-09-2022	E -15.888003, N 13.264854	Pore water	4.7
Joreng	23-09-2022	E -15.890715, N 13.262984	Pore water	3.7
Joreng	23-09-2022	E -15.891081, N 13.259876	Pore water	3.9
Joreng	23-09-2022	E -15.888812, N 13.264734	Pore water	3.5
Joreng	06-10-2022	E -15.879803, N 13.265527	Tidal water above planted area	2.1
Joreng	06-10-2022	E -15.880203, N 13.265622	Tidal water above planted area	2.1
Kantong Kunda	06-10-2022	E -15.968409, N 13.318455	Tidal water above planted area	2.2
Kantong Kunda	06-10-2022	E -15.965073, N 13.315919	Tidal water above planted area	2.3
Keneba	06-10-2022	E -16.030164, N 13.325479	Pore water	3.7
Keneba	06-10-2022	E -16.030163, N 13.325480	Pore water	4.4

Soil type

According to the Soil Atlas of Africa produced by ESDAC ⁷, The soil of terrestrial Gambia consists of Ferric Acrisols (ACfr) and Dystric Regosols (RGdy), while the wetland soil consists of mainly Umbric Gleysols (GLum) and to a lesser degree Gleyic Solonchaks (SCgl). Umbric Gleysols are categorized as soils that are saturated by groundwater for long periods and with a thick, dark coloured acid surface horizon rich in organic matter. Gleyic Solonchaks are categorized as soils that have an accumulation of salt and which shows waterlogged conditions. See Figure 5 for soil map of the Gambia.

According to the IPCC wetlands supplement (2013)⁸, a soil classifies as organic if it lives up to either 1. and 2. or 1. and 3. below:

1. *Thickness of organic horizon greater than or equal to 10 cm. A horizon of less than 20 cm must have 12 percent or more organic carbon when mixed to a depth of 20 cm.*

2. *Soils that are never saturated with water for more than a few days must contain more than 20 percent organic carbon by weight (i.e., about 35 percent organic matter).*

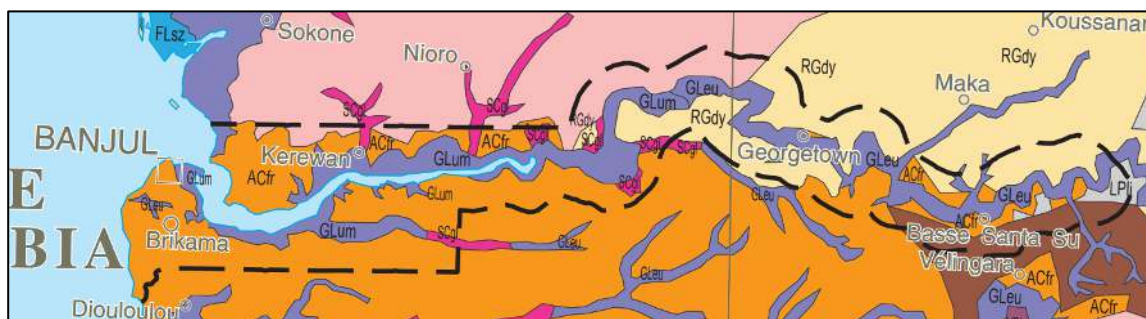
3. *Soils are subject to water saturation episodes and has either:*

a. *At least 12 percent organic carbon by weight (i.e., about 20 percent organic matter) if the soil has no clay; or*

b. *At least 18 percent organic carbon by weight (i.e., about 30 percent organic matter) if the soil has 60% or more clay; or*

c. *An intermediate proportional amount of organic carbon for intermediate amounts of clay.*

The top layer of soil within PAI#1 has been inspected through several field missions and is determined to have muddy and mineral characteristics with no organic horizon present. As the thickness of the organic horizon is therefore below 10 cm, the soil does not live up to point 1 above and therefore does not classify as organic. Consequently, the soil is classified as mineral.



⁷ ESDAC (2013): Soil Atlas of Africa and its associated Soil map

⁸ IPCC (2013): Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands

Figure 5: Soil map of The Gambia

Current and historical land use/land cover

Prior to project initiation the project ecosystem type covered by the grouped project is characterized as degraded wetland areas (ARR and RWE project activities). For PAI#1 specifically, the pre-project ecosystem type was classified as degraded mangrove areas that are practically bare land with only few scattered mangrove trees of primarily the genus *Avicennia* within it. The project area was abandoned and not used for any kind of agricultural or anthropogenic activities. See Picture 1 for land cover prior to mangrove planting in PAI#1.

The historical land cover in the project area of PAI#1 can be found in the below Figure 6, illustrating that the project area is wetlands that has historically been covered by mangrove habitats. Mangrove species native to The Gambia include *Rhizophora mangle*, *Rhizophora racemosa*, *Rhizophora harisonii*, *Avicennia germinans*, *Avicennia africana* and *Laguncularia racemosa*.

The land has not been cleared of its native ecosystems within 10 years of the project start date. The main reason behind the degradation in PAI#1 is by DPWM identified as the construction of a dam further upstream of the river Bintang Bolon in Senegal that severely altered the natural hydrology of the area. In 2005/2006, the blockade was removed, but the mangrove habitat has, apart from the emergence of a few scattered *Avicennia* trees, not been able to recover naturally according to DPWM.

In general, the overall historical degradation of the mangrove ecosystem within The Gambia has by DPWM been attributed to a mix of dam and road constructions altering natural hydrology, anthropogenic overexploitation due to for example the collection of fuelwoods and building materials, rice cultivation and drought.

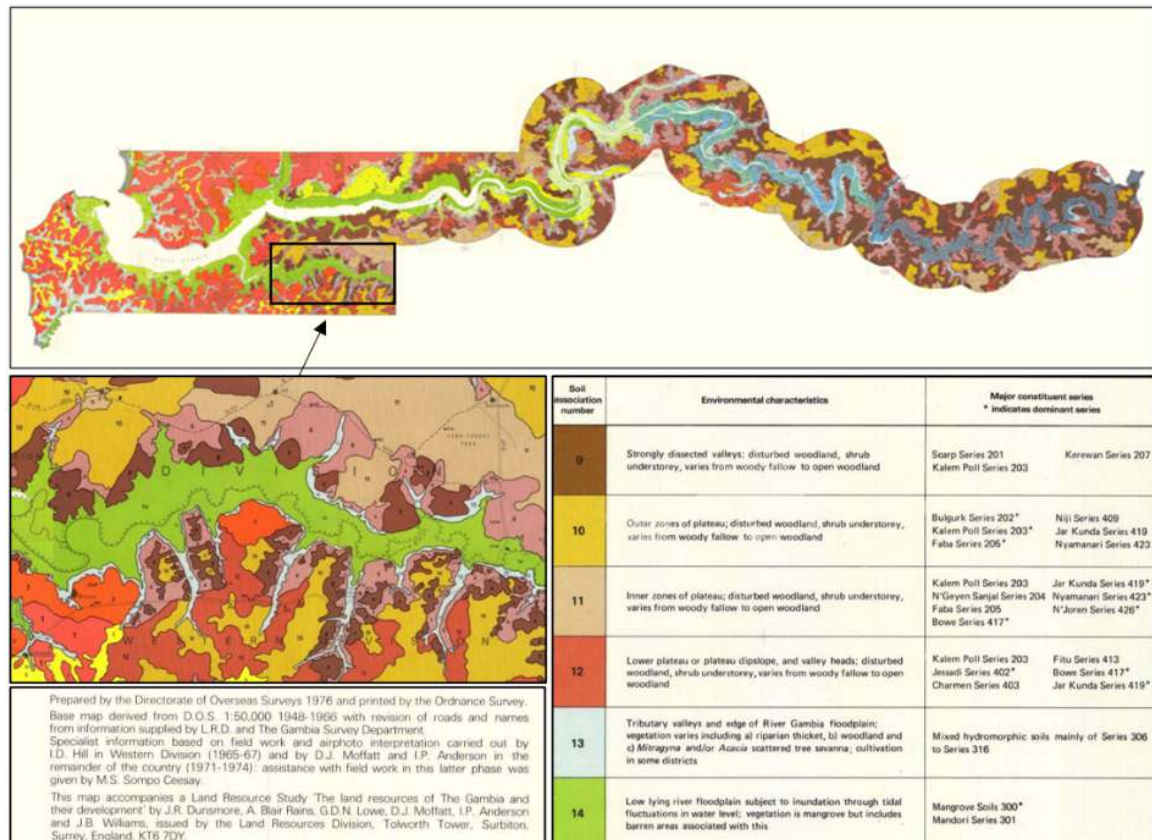


Figure 6: Historical land cover of The Gambia (map published in 1976)



Picture 1: Land cover prior to mangrove planting in Joreng in PAI#1, but after hydrological engineering has been performed

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

Several policies and acts are in place in The Gambia to regulate the use and management of natural resources in The Gambia⁹. Two of the main environmental acts and regulations in place that are especially relevant for this project is The Biodiversity Act (2003) and The Forest Act (1998).

The Biodiversity Act 2003 concerns the preservation of flora and fauna and have related regulations in place to implement the act. It established the National Biodiversity and Wildlife Trust Fund to promote the protection, development and sustainable use of biological resources and established procedures for management and establishment of protected areas. The Act also designates the responsibility to The Department of Parks and Wildlife to manage national protected areas and encourage community participation^{10, 11}.

⁹ UNEP (2021): Large scale ecosystem-based adaptation in the Gambia: Developing a climate-resilient, natural resource-based economy, volume 1: Environmental and Social Impact Assessment

¹⁰ MECCNAR (2003): Biodiversity and Wildlife Act

¹¹ FAO: FOSA Country Report, The Gambia

The Forest Act (1998) sets out the maintenance and development of the forest resources of The Gambia to enhance the contribution of forestry sector to socio-economic development. The Forest Act remains the most recent and relevant piece of legislation detailing how community forests are formed and managed (Part VII: Declaration of reserved forest. Creation of community forest. Designation of community-controlled state forest)¹².

The National Environment Act 1994 is the legal framework for the control and management of the environment and for the related matters. Additional acts such as The Lands Act (1990) and (1995), The Labour Act (2007), The Local Government Act (1990) and Environmental Discharge Permitting Regulations (2001) also cover the spheres of this project but will not be elaborated further¹³.

Supplementary, a list of environmental policies and frameworks are in place, including:

The Supplementary Agricultural and Natural Resource (ANR)¹⁴ Policy Final Validated Policy from December 2017 which is supplementary and aligned to the Agriculture and Natural Resource Policy (2017-2026). The ANR aims to address the policy guidelines for decision making and implementation within agriculture and natural resources. It is scoped towards the needs and aspirations of resource-users through implementing long-term natural resource protection, development, and inclusion programmes. It is closely aligned with the national development and poverty reductions frameworks and focuses on building capabilities of citizens and capacities of the sub-sectors.

The Forestry sub-sector policy (2010–2019) aims to reserve, maintain and develop forest resources to provide environmental protection through a list of means, and for instance through ensuring that 75% of forest lands are managed and protected according to forest management principles and plans. This for instance includes engaging local communities in forest resource management, strengthening local structures such as community forest committees, devolving authority and management responsibilities to local communities and introducing participatory techniques for local empowerment. Further, it encourages the involvement of the local communities and the private sector in the management and development of forest.

Additionally, The Agriculture and Natural Resources (ANR) policy document (2009-2015), The Nationally Determined Contributions, The National Biodiversity Strategy and Action Plan (NBSAP) and the National Action Plan (NAP for UNCCD) are relevant policies in place. Gambia has also signed several relevant regional and international conventions and treaties related to environmental issues that offer protection to the forest ecosystems and related to human rights. Treaties related to environmental issues include among others the Convention on Biological Diversity, United Nations Framework Convention on Climate Change, Convention on International Trade Endangered Species of Wild Fauna and Flora (CITES), Convention on Water of International

12 UNEP (2021): Large scale ecosystem-based adaptation in the Gambia: Developing a climate-resilient, natural resource-based economy, volume 1: Environmental and Social Impact Assessment

13 UNEP (2021): Large scale ecosystem-based adaptation in the Gambia: Developing a climate-resilient, natural resource-based economy, volume 1: Environmental and Social Impact Assessment

14 MECCNAR (2017): Supplementary Agriculture and Natural Resource (ANR) Policy – Final Validated Policy

Importance Especially as Water Fowl Habitat (RAMSAR), Convention Coverage the Protection of the World Cultural and Natural Heritage, United Nations Convention on the Law of the Sea, United Nations Convention to Combat Desertification, Development of the Marine and Coastal Environment of the West and Central African Region (WACAF), Protocol Concerning Co-operation in Combating Marine Pollution in cases of Emergency in West and Central African Region (WACAF). Treaties related to human rights issues include on a regional scale amongst others the African Charter on Human and Peoples' Rights and African Charter on the Rights and Welfare of the Child, and on a UN scale amongst others the International Covenant on Civil and Political Rights, International Covenant on Economic, Social and Cultural Rights, Convention on the Elimination of All Forms of Discrimination Against Women, Convention on the Rights of the Child and the International Convention on the Elimination of All Forms of Racial Discrimination¹⁵.

On the Community side, a list of women and children acts are also in place, including for instance The Women's Act 2010 that sets out the frameworks for the protection of Women's rights in additions to what is stated in Gambia's Constitution, The Child Protection Strategy (2016-2020), National Children Policy (2004-2008) and Programme for Accelerated Growth and Employment (2017-2020) that focuses on sustainable forest management and achieving food security for the country.

As such the project is fully aligned with the local, national and international laws as listed above.

Additionally, the Government of The Gambia through the Ministry of Environment, Climate Change and Natural Resources have signed the VCUPA with Ørsted and is actively involved in its execution. The ministry has delegated the responsibility for implementation to the Department of Parks and Wildlife Management, who, as stated above, is responsible for the management of national protected areas and encouragement of community participation. According to the VCUPA, The Ministry of Environment, Climate Change and Natural Resources through the Department of Parks and Wildlife Management has an obligation to comply with Ørsted's code of conducts, human rights standards and environmental and safety matters. Additionally, as a safeguard for this legal compliance Ørsted has the right to make site visits for the purpose of reviewing the compliance with the above. Additionally, according to the contract, The Gambia has an obligation to report any violation of any Environmental Laws, Human Rights Standards or Safety Noncompliance, and the DPWM and all other project proponents have signed to implement project activities in accordance with all relevant laws.

Above will be a safeguard for legal compliance, and considering the absence of clear climate, biodiversity laws and acts for the protection and improvement of natural resources, the project will contribute to enhancing the natural resources of The Gambia.

1.15 Participation under Other GHG Programs

¹⁵ International Justice Resource Center (2017): Gambia. Access: <https://ijrcenter.org/wp-content/uploads/2017/11/Gambia>

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

The project has neither been registered nor is it seeking registration under any other GHG programs.

1.15.2 Projects Rejected by Other GHG Programs

The project has not been rejected by any other GHG programs.

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

The project does not reduce GHG emissions from activities that are included in any emissions trading programs or any other mechanisms that includes GHG allowance trading.

1.16.2 Other Forms of Environmental Credit

The project has neither applied for nor received any other form of GHG-related credit, including renewable energy certificates.

1.16.3 Supply Chain (Scope 3) Emissions

This project does not impact emissions associated with a good or service, why this section is not applicable to this project.

1.17 Sustainable Development Contributions

Table 6: Overview of the SDGs that the project contributes to

SDGs	Justification	SDG Indicator	Total expected contribution from the already implemented PAI#1 over the next 30 years	Total expected contribution from the grouped project over the next 30 years	Monitoring of indicator

Goal 13 - Climate Action 13.0 - Take urgent action to combat climate change and its impacts	The project contributes to climate action by enhancing the carbon stocks of the mangrove ecosystem. The project enhances carbon stocks by restoring the degraded mangrove ecosystem mainly through the planting native mangrove trees.	Tons of greenhouse gas emissions removed	85,066.7 ERs	3,300,062.1 ERs	Monitored and third party verified throughout the project crediting period, per VCS requirements.
Goal 14 - Life below water 14.2 - Sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans	By restoring the mangrove habitats, the project is simultaneously restoring the below-water biodiversity dependent on and/or benefitting from the mangrove ecosystem. Amongst many things, the mangrove habitat acts as spawning, nursing, and living grounds for an abundance of species of fish, mollusks, crabs and other mangrove dependent underwater species of the area.	Hectares of degraded mangrove habitat replanted with native species	235.46 hectares	10.000 hectares	Monitored and third party verified throughout the project crediting period, per VCS requirements. See Section 5.3 of this PD for more information on the monitoring procedure.

Goal 15 - Life on land 15.2 - Promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally 15.3 - Combat desertification, restore degraded land and soil, including land affected by desertification, drought, and floods, and strive to achieve a land degradation-neutral world	By restoring the mangrove habitats, the project is simultaneously restoring biodiversity above water dependent on and/or benefitting from the mangrove ecosystem. The mangrove habitat supports an abundance of species of birds, mollusks, fungi, insects and lizards amongst many.	Hectares of degraded mangrove habitat replanted with native species	235.46 hectares	10.000 hectares	Monitored and third party verified throughout the project crediting period, per VCS requirements. See Section 5.3 of this PD for more information on the monitoring procedure.
--	--	---	-----------------	-----------------	--

1.18 Additional Information Relevant to the Project

1.18.1 Leakage Management

As there is no ecological leakage, there no leakage management plan. See Section 4.3 and 5.3 in this PD for additional details on the determination of leakage.

1.18.2 Commercially Sensitive Information

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

1.18.3 Further Information

No further information to be added.

2 SAFEGUARDS

2.1 No Net Harm

As argued throughout this PD, the project activities will only contribute positively to the environment and the local communities who are dependent of the mangrove ecosystems.

The areas planted were under no anthropogenic usage pre-planting, why no socio-economic benefits were generated from the area before the project. The locals have gotten an additional income from performing planting activities as a direct result of this project. This is proved through the signed contracted budgets shared with the auditor upon request and in the receipts shared with the auditor upon request, confirming the payments performed to the community members performing the planting. Furthermore, it is in countless literature (see for example this UNEP-DEPI report¹⁶) highlighted how mangrove ecosystems are contributing positively to local livelihoods through various ecosystem benefits such as resulting in the presence of more aquatic life such as oysters and fish which can be harvested and/or cached and either eaten by the locals or sold for generating additional income. The local communities are very aware that a healthy mangrove ecosystem means more aquatic life, and they are all looking forward to getting access to these benefits once again.

As justified in the *historical analysis of land cover* report shared with the auditor upon request, the original land cover in the project area is mangrove. As also justified in the report, the land cover of the project area is pre-project implementation heavily degraded mangrove areas. Restoring the original ecosystem will naturally therefore of course only result in a positive environmental impact.

2.2 Local Stakeholder Consultation

The stakeholder consultations can be divided in two overall processes, covering the official local stakeholder consultations that was performed during the project development phase, and the further ongoing local stakeholder engagements that has been and will further be performed in the ongoing implementation phases.

¹⁶ UNEP-DEPI (2017): Mangroves of Western and Central Africa

Official local stakeholder consultations for identification and engagement of relevant local stakeholders

From point zero, project stakeholders were identified following a participatory approach through consultation during the project concept development, project feasibility study and project design phases. The identification process started with the selection of the project consortium members who will assure the overall coordination and implementation of project activities. The international consultancy firms: S2 Services and FWC shortlisted consortium members based on their experience in the project area and conservation engagement at national and international scale.

Following the identification of the consortium members and development of the project concept note, field missions were carried out in The Gambia by S2 Services and FWC from November to December 2020. In collaboration with the consortium, a firsthand analysis of government institutions, community groups and organizations involved in the management of mangroves resources in The Gambia was done. Field missions were then undertaken in the five mangrove regions of The Gambia to evaluate pre-defined baseline situations from literature review and experiences of the consortium members (SWC, KOMFFORA and WABSA), and to exchange with key stakeholders in some of the pre-identified communities.

This instance was characterized by interactive face to-face discussions with actors in the field. The objectives of the project were communicated, and a bridge was generated between government institutions, organizations, and community groups and individuals with similar visions and interests in a healthy mangrove in The Gambia.

The identification process also permitted discussions with stakeholders on various aspects of the project, engaging them in decision making and determining the best ways to manage the present and future expectations of different stakeholders.

Defining methods for inviting relevant stakeholders

Following the identification of actors and stakeholders in the project, the convocation process was initiated in a formal way through a press release in the News Paper *The Progress*, invitation letters, phone calls, and WhatsApp messages, in line with Gambian normal practice and procedures. Aspects considered in the process includes:

- The rights, interests and relevance of the person, organization, or institution to which the invitation was sent
- Prior information about the project to accompany the call: background and objectives of the project, general context of the workshop and impacts of each stakeholder group

Stakeholders were contacted at least 2 days before the scheduled meeting date and contacts were followed up to confirm that they had received the invitations and to confirm their attendance.

Description of and outcomes from the local stakeholder consultations

Stakeholder consultations was carried out in the 5 mangrove regions of The Gambia bringing together the different stakeholders engaged in the project (see Table 7 for details on the consultations). The stakeholder consultation process aimed to reduce project implementation risks and to integrate the desires, aspirations, interest opinions and needs of community members at all stages of the project.

Communities are consisted of villages that have their own governance with an Alkalo or village chief and a council of elders. Discussions occurred with both parties held in the village center with open invite to all village residents.

The stakeholder consultation meetings were interactive with the opportunity for stakeholder groups to ask questions and giving their opinions and experiences. The information shared during the stakeholder consultation meetings included project concept and background, project partners, anticipated project impacts and benefits, current situation, and the steps to be followed from development of project through to issuance of carbon credits.

Stakeholders shared their input and generally expressed their interest in the project. The local consortium was helpful in assuring smooth communication in English and in the local languages.

Stakeholders generally expressed their readiness to participate in the project and willingness to change their perceptions and practices given that the project is promising a multitude of alternatives such as temporal and permanent jobs, improved tourism, good governance, capacity building, trainings, and more ecosystem benefits from the restored mangrove ecosystem.

Table 7: Information regarding the preliminary stakeholder consultations

Region	Date	Stakeholder category	Place	Time frame	Number of participants
Greater Banjul Meeting	Friday 24 th of September	Government Agencies (TAC), local authorities, women leaders, youth representatives, area councillors, education and research institutions, CBOs, and Vulnerable groups	Baobab Holiday Resort	9.30am to 14.00pm	23

Central River Region (CRR)	Wednesday the 29 th of September, 2021	Government Agencies (TAC), local authorities, women leaders, youth representatives, area councillors, CBOs, and Vulnerable groups	Governor's Office	9.30am to 14.00pm	22
North Bank Region (NBR)	Thursday the 28 th of September, 2021	Government Agencies (TAC), local authorities, women leaders, youth representatives, area councillors, education and research institutions, CBOs, and Vulnerable groups	Governor's Office	9.30am to 14.00pm	24
Lower River Region	Friday the 1 st of October, 2021	Government Agencies (TAC), local authorities, women leaders, youth representatives, area councillors, education and research institutions, CBOs, and Vulnerable groups	Governor's Office	9.30am to 14.00pm	19
West Coast Region (WCR)	Saturday the 25 th of October, 2021	Government Agencies (TAC), local authorities, women leaders, youth representatives, area councillors, education and research institutions, CBOs, and Vulnerable groups	Governor's Office	9.30am to 14.00pm	20

Documentation of the outcomes of the local stakeholder consultations during design phase

For each of the five stakeholder consultations, a summary report was conducted containing an attendance list and an overview of raised questions, comments and/or issues from the stakeholders and the responses and/or clarifications to such from the project developers. Furthermore, additional attendance lists including signatures from the attendees has been produced and kept.



Picture 2: Photograph taken at the initial stakeholder consultation in Lower River Region

Further engagement of local stakeholders during project implementation phase

It is a core approach of the project to engage local stakeholders in the implementation of the project, as this will ensure the long-term sustainability of the project through increased ownership feeling in the villages where activities take place.

The procedures for engaging the local stakeholders take basis in normal practice for Gambian stakeholder involvement and combines informal meetings and dialogue with more established channels. More specifically, the process includes that once a specific potential area for restoration has been identified, the project developers (typically DPWM) visit the village(s) with the customary ownership over that specific wetland area. During the visit, the Alkalo (village chief) or for instance members of the Village Development Committee is contacted to present the project, answer potential projects and start the dialogue. Often, this is an informal dialogue where there is a high degree of knowledge exchange, and where initial interest and issues can be clarified. In those cases (most cases) where there is an interest to participate in the project, the Alkalo will organize internal village gathering to discuss with the rest of the community members and the Village Development Committee (VDC). This process is determined by the villages' own

practices. If there is consensus that they want to participate in the project, they contact the project developers who initiate a project information and training day for the community members. For each community, a focal point person and a project committee typically consisting of five men and five women are selected. These people play an important role in the ongoing communication between the project developers and the community members and contribute to solving the various ongoing tasks related to the project, such as community organisation and logistical tasks.

As the project is designed to not result in any kind of harm to the local communities and their livelihood, but instead brings an abundance of positive benefits in the form of for example jobs and improved ecosystem benefits, local communities are very positive towards the project. The local communities have suffered due to the degradation of the ecosystem as fish stocks and the like has severely decreased because of such. The locals are aware of this, and therefore wants the healthy ecosystem back. So far, no communities have expressed disinterest to participate in the project, and all communities consulted so far for future PAIs has as well been positive and expressed their willingness to start planting as soon as possible.

For a village to participate, it is required that they an agreement is signed between the community and the project, headed by DPWM. These agreements have been shared with the VVB.

In regard to ensuring fair and humane working conditions, all contracts executed in relation to the project have a code of conduct included. Discrimination on the basis of race, gender, and religion, as well as harassment of any kind, is prohibited, and child labour is forbidden. These codes of conduct are in line with The Gambia's Labour Act. The contracts including the Codes of Conduct can be shared with the validator upon request.



Picture 4: Photographs of project community meetings with project staff in Kiang and Foni areas on 4th and 5th of February 2023, engaging and informing them about the upcoming 2023 plantings (PAI#2)

Mechanisms for ongoing communication with local stakeholders

Three main communication channels have been established for ongoing future communication related to the project:

1) WhatsApp

In the majority of communities, it is normal custom that WhatsApp groups acts as a main communication channel between community members. Following the customs of the

communities, WhatsApp groups including both NGO representatives, ministry representatives and local stakeholders and community focal points are established and used for ongoing communication, coordination, relevant information, and various updates related to the project are distributed out. In general, the DPWM has ongoing communication with the communities, whom they for most cases are very familiar with and hold informal dialogue with.

On Monday the 18th of July 2022, an official project WhatsApp group was established for future communication between local stakeholders consisting of representatives from the local communities and local NGOs, the DPWM and Ørsted.

Here, ongoing updates of project design, implementation, monitoring, and other significant milestones are communicated. These updates are shared both through WhatsApp and verbally, but also by re-sharing the Official Project Webpage which hosts the information in a clear and searchable manner (see below).

2) Regular village gatherings

In many communities, the main event of gathering is the Friday prayer, led by the Alkalo of each village. Following the prayer, it is customary to share various announcements. It is also customary in the region to share information orally. Therefore, the Friday gatherings (or similar regular village gatherings, depending on the specific customs of each village) acts as a natural communication channel where ongoing information related to the project can be orally announced, information can be distributed out on paper or made available on the local village information boards.

Additionally, each village has a mangrove committee and a focal point directly linked to the project team. This allows for clear, direct, and formalized flow of information through a specific representative. As milestones are accomplished, communications will be duplicated on the WhatsApp and through the mangrove focal point and committee members to share orally with the villages.

3) Official Project Webpage

To ensure that all members of the involved communities at all times has access to all relevant information related to the project, an official project webpage¹⁷ is established. Here, information be found related to:

- General description of the project and planting activities
- The project design and implementation, including the results of monitoring.
- The risks, costs and benefits the project may bring to local stakeholders.
- All relevant laws and regulations covering workers' rights in the host country.

¹⁷ www.gambiamangrove.com

- The process of VCS Program validation and verification processes and the validation/verification body's site visit.

Furthermore, grievance redress contact formula and contact details for all relevant project developers and stakeholders can be found on the webpage. The link to the grievance form is also distributed through the WhatsApp group and through QR codes provided by project team members.

The webpage address and information related to the contents of the webpage has been distributed out through the WhatsApp groups and will on a running basis be shared when appropriate.

The webpage also has a forum for questions and discussions to encourage dialogue with community members and to accommodate the wish to have a forum for this project specifically.

2.3 Environmental Impact

Not relevant.

2.4 Public Comments

No comments have been received during the public comment period of the listing of the Draft PD and since the draft PD was submitted before recent VCS rule changes (July 20th), no additional comment period is expected for the validation.

2.5 AFOLU-Specific Safeguards

Local stakeholder identification process

Please refer to Section 2.2 of this PD.

Risks to local stakeholders due to project implementation and the mitigation of such

In general, the implementation of the project activities is perceived as low risk, relating to minor incidents related to working in a wetland area, which for instance could cutting wounds from oyster shells or mangrove leftovers in the mud or in more rare circumstances leach bites and worm infections. As these are situations the local villagers are familiar with and used to navigate it and will be hard to avoid it is something that will be dealt with and mitigated locally. No entity

is involved in any form of discrimination or sexual harassment. All contracts related to project work have a code of conduct, which covers discrimination and sexual harassment, that all parties must adhere to. The contracts including code of conduct can be shared with the auditor upon request. Thus far no complaints have been received through the grievance mechanism or any other channels.

Risks to local stakeholder resources due to project implementation and the mitigation of such

Regarding local stakeholder' resources: In PAI#1, the area planted was prior to project implementation under no anthropogenic usage, and no resources were extracted from the area. As a result of the project implementation, the resource availability in the form of for example oysters which live on the mangrove roots and fish-stocks in the adjacent river dependent upon the mangrove ecosystem is expected to increase, creating a net-positive natural resource generation. Therefore, the implementation of the project has no negative influence on the local stakeholder resources.

Regarding local stakeholders' property rights: In the Gambia, the lands (Provinces) Act has historically been the principal land law of the Gambia. The act recognizes customary land tenure arrangements and states that the use of “*land by the indigenes shall be governed and regulated by the customary laws obtaining in the localities in which such lands are situated.*” District authorities, Alkalis (village chiefs), headmen, elders, and traditional advisors are given authority over customary tenure systems. Legal respect of both customary and Islamic laws is subject to caveats that say that these laws will be respected as long as they are not repugnant to such factors as equity, good conscience, and morality or inconsistent with other laws that may be in force¹⁸.

The degraded wetland areas eligible for replanting are typically customary land. As described in Section 2.2 the consent of the local communities situated along the project areas is crucial for project success. Without it, the project can simply not be implemented as the plantings are performed by the community members themselves. As further described in Section 2.2, prior to project implementation, the consent is obtained orally from the Alkalos in the relevant communities. As the project brings no negative consequences, the consent has so far been given by all Alkalos backed up by wide support from the community members within the community. Should some communities in potential future PAI's not wish to be part of the project, the land over which they hold a customary right will be excluded from the project. Project activity sites will always be assessed in the light of the impacts they will hold to the local communities and will only be chosen on areas where there is no risk of negative impacts environmentally and socially.

Process to ensure ongoing communication and consultation with local stakeholders

¹⁸ USAID (1994) Tenure and Natural Resources in the Gambia – Summary of research findings and policy options

As presented in Section 2.2 three main communication channels in the form of WhatsApp groups, regular village gatherings and the official project website has been identified and/or established. For more information on the purpose of each communication channel, refer to the subsection. As stated in the subsection, the official project webpage includes a grievance redress contact formula which can be accessed by all local stakeholders, should they wish to raise their voice to the project proponents on matters related to the project. Should the grieving party have troubles with accessing, understanding or completing the online formula, they can contact the project proponent DPWM, who shall then either assist them with drafting and sending the report themselves, or coordinate with relevant project staff who then assists with drafting and sending the report. Contact details of DPWM can be found on the official project webpage. The grievance procedures also provide a function for submitting inputs anonymously.

Once a report has been received through the webpage formula, the project proponents Ørsted and DPWM receiving the report shall within 7 working days coordinate with relevant project staff and contact and discuss with the community, community member(s) and/or other stakeholders involved in the report. Based on all collected information from relevant parties The project proponents and relevant project staff shall propose a solution and mediation within 14 working days. Finally, the complications or grievances shall be dealt with within 30 days. The grievance report, the process of responding to the grievance and its solution shall be uploaded to the official project webpage.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

The methodology to be applied in this project is the VM0007 REDD+ Methodology Framework (REDD+ MF), version 1.6.

The following methodological tools and modules (see Table 8), to which the selected methodology refers to, are used in this PD covering the ARR+RWE combined project activity on mineral soils. In case areas covering peat soils will be part of future PAI's, tools and modules relevant for these, these will also be added in a future updated PD.

Table 8: Applied tools and modules

Module	Full name	Version
M-ARR	VMD0045 Methods for monitoring greenhouse gas emissions and removals in ARR project activities	Version 1.1. Approved 09/03-2015. Latest revision 08/09-2020

Module	Full name	Version
T-ADD	CDM Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities	Version 1. Valid from 19/10-2007
T-BAR	AFOLU Non-Permanence Risk Tool	Version 4.0. Valid from 19/09-2019
X-STR	VMD0016 Methods for stratification of the project area	Version 1.2. Approved 03/12-2010. Latest revision 08/09-2020
BL-ARR	VMD0041 Estimation of baseline carbon stock changes and greenhouse gas emissions in ARR project activities	Version 1.1. Approved 09/03-2015. Latest revision 08/09-2020
LK-ARR	VMD0043 Estimation of emissions from displacement of pre-project agricultural activities	Version 1.0. Approved 09/03-2015
M-TW	VMD0051 Methods for Monitoring of Carbon Stock Changes and Greenhouse Gas Emissions and Removals in Tidal Wetland Restoration and Conservation Project Activities	Version 1.0. Approved 08/09-2020
ADD-AM	VMD0052 Demonstration of additionality of tidal wetland restoration and conservation project activities	Version 2.0. Approved 30/09-2021
BL-TW	VMD0050 Estimation of Baseline Carbon Stock Changes and Greenhouse Gas Emissions in Tidal Wetland Restoration and Conservation Project Activities	Version 1.0. Approved 08/09-2020
LK-ECO	VMD0044 Estimation of emissions from ecological leakage	Version 1.1. Approved 09/03-2015. Latest revision 08/09-2020
E-FFC	VMD0014 Estimation of emissions from fossil fuel combustion	Version 1.0. Approved 03/12-2010

3.2 Applicability of Methodology

In this section, the applicability conditions of the applied project activities of PAI#1 (ARR+RWE) listed in the methodology VM0007 v1.6, including applicability of used modules and tools referred to throughout the methodology, are presented and justified. When new instances of ARR+RWE are added in the future, their applicability are to be justified accordingly.

Table 9: Applicability conditions of project activities included in PAI#1 and of potential project activities of future PAI's of the applied methodology VM0007 v1.6. The applicability conditions for project activities included in PAI#1 has also been justified.

Project activity	Applicability conditions	Justification
Afforestation, reforestation and revegetation (ARR)	ARR activities are applicable under the following conditions:	
	1) The project area is non-forest land or land with degraded forest.	1) PAI#1 is degraded wetland and thus non-forest land (See the "Historical analysis of land cover" report for imagery that demonstrates historical prevalence of degraded wetland/non-forest land).
	2) In strata with drained organic soil, ARR activities must be combined with rewetting.	2) The soil of PAI#1 does neither classify as organic nor drained. Please refer to section 1.13 for further information.
	ARR activities are not eligible under the following conditions:	
	1) The project scenario involves the application of nitrogen fertilizers.	1) No nitrogen fertilizers are applied in the project scenario of PAI#1. Additionally, financing for nitrogen fertilizers is not available within the budget for project activities, which is available upon request.
	2) If ARR activities enhance peat oxidation. Therefore, on peatland, the project must include at least some degree of rewetting. In a tidal system where the tidal regime is restored or continues to be in place, ARR activities are considered not to enhance peat oxidation.	2) In PAI#1, the tidal regime is being restored as a part of the project activities, and the area does not have peat. Therefore, the ARR activities are considered not to enhance peat oxidation. Furthermore, the soil of PAI#1 is not classified as organic.
	Where project activities on wetlands are excluded by the applicability conditions of applied modules or tools, such applicability conditions can be disregarded for the purpose of their use within this methodology, as quantification procedures for peat and tidal	The relevant listed applicable soil modules are applied in this project.

Project activity	Applicability conditions	Justification
	wetland soils are provided in Modules BL-PEAT, M-PEAT, BL-TW and M-TW. Therefore, ARR activities on wetlands are regarded as combined ARR-RWE activities.	
All Wetland Restoration and Conservation (WRC) Activity types	<i>WRC activities are not eligible under the following conditions:</i>	
	1) Project activities lower the water table, unless the project converts open water to tidal wetlands, or improves the hydrological connection to impounded waters.	1) In PAI#1, part of the project activities is to improve the hydrological connectivity of some of the area, but such intervention will not lower the water table. In some cases, it is possible that the hydrological alteration improves the hydrological connection to impounded waters. However, this is according to the methodology approved of.
	2) Changes in hydrology do not result in the accumulation or maintenance of SOC stock, noting that a) this pertains to projects that intend to sequester carbon through sedimentation and/or vegetation development and b) this does not pertain to projects that increase salinity to reduce CH ₄ emissions. Projects that aim to decrease CH ₄ emissions through increased salinity must account for any changes in SOC stocks.	2) In PAI#1, the changes in hydrology due to the applied project activities will result in a net-accumulation of SOC compared with the baseline scenario. This can be justified for two reasons: 1) As mangrove trees are planted, additional organic material is added to the area in the project scenario compared with the baseline scenario, and 2) As the project area through the hydrological changes induced by project activities will become wetter compared to the baseline scenario, the SOC will, due to the more anaerobic environment, have better conditions for accumulating. Note that no sequestration will be claimed until crown coverage achieves thresholds put forth in VMD0051-M-TW.
	3) Hydrological connectivity of the project area with adjacent areas	3) The alteration of the hydrology in the project area will not result in a

Project activity	Applicability conditions	Justification
	leads to a significant increase in GHG emissions outside the project area.	lowered water table in areas outside of the project area as the altered hydrology is connected to the ocean, ensuring a constant water table in areas where the hydrology is not altered.
	4) Project activities include the burning of organic soil.	4) In PAI#1, none of the project activities include the burning of organic soil. Furthermore, no organic soil is present. Please refer to Section 1.13 for further information.
	5) Nitrogen fertilizer(s), such as chemical fertilizer or manure, are applied in the project area during the project crediting period.	5) in PAI#1, none of the project activities include the application of any type of nitrogen fertilizers. Additionally, financing for nitrogen fertilizers is not available within the budget for project activities, which is available upon request.
Restoration of Wetlands Ecosystems (RWE)	<i>For RWE project activities, prior to the project start date, the project area must meet the following conditions:</i>	
	a) The area is free of any land use that could be displaced outside the project area, as demonstrated by at least one of the following, where relevant: - The project area has been abandoned for two or more years prior to the project start date; or - Use of the project area for commercial purposes (i.e., trade) is not profitable as a result of salinity intrusion, market forces, or other factors. In addition, timber harvesting in the baseline scenario	PAI#1 lives up to the conditions set in option a) as the project area has been abandoned for at least two years prior to the project start date.

Project activity	Applicability conditions	Justification
	within the project area does not occur; or - Degradation of additional wetlands for new agricultural/aquacultural sites within the country will not occur or is prohibited by enforced law. OR b) The area is under a land use that could be displaced outside the project area, although in such case, baseline emissions from this land use must not be accounted for, and where degradation of additional wetlands for new agricultural/aquacultural sites within the country will not occur or is prohibited by enforced law. OR c) The area is under a land use that will continue at a similar or greater level of service or production during the project crediting period (e.g., reed or hay harvesting, collection of fuelwood, subsistence harvesting, commercial fishing). The project proponent must demonstrate (a), (b) or (c) above, based on verifiable information such as laws and bylaws, management plans, annual reports, annual accounts, market studies, government studies or land use planning reports and documents.	

Project activity	Applicability conditions	Justification
	<i>Project activities restoring tidal wetlands may include any of the following, or combinations of the following:</i>	
	1) Creating, restoring and/or managing hydrological conditions (e.g., removing tidal barriers, improving hydrological connectivity, restoring tidal flow to wetlands or lowering water levels on impounded wetlands) 2) Altering sediment supply (e.g., beneficial use of dredge material or diverting river sediments to sediment-starved areas) 3) Changing salinity characteristics (e.g., restoring tidal flow to tidally-restricted areas) 4) Improving water quality (e.g., reducing nutrient loads leading to improved water clarity to expand seagrass meadows, recovering tidal and other hydrologic flushing and exchange or reducing nutrient residence time) 5) (Re-)introducing native plant communities (e.g., reseeding or replanting) 6) Improving management practice(s) (e.g., removing invasive species, reduced grazing) 7) In RWE-ARR project activities, the prescribed burning of herbaceous and shrub aboveground biomass (cover burns) may occur	All activities presented in this subsection is optional, why PAI#1 shall not live up to anything here to be applicable. However, the activities described in bullet 1, 3 and 5 are relevant for the project.

Table 10: Applicability conditions and justification of tools and modules applied in PAI#1

Module	Applicability conditions	Justification
M-ARR	The applicability conditions are provided in AR-ACM0003. Applicability conditions included in AR-ACM0003 and corresponding tools that exclude project activities on wetlands can be neglected for the purpose of their use in this module, as accounting procedures for the peat soil are provided in Modules M-PEAT and M-TW. A project activity applying the methodology AR-ACM0003 shall also comply with the applicability conditions of the tools contained within the methodology and applied by the project activity.	
	<i>The methodology AR-ACM0003 is applicable under the following conditions:</i>	
	(a) The land subject to the project activity does not fall in wetland category	Applicability condition (a) of AR-ACM0003: Can be discarded as M-ARR allows for the inclusion of wetland areas.
	(b) Soil disturbance attributable to the project activity does not cover more than 10 per cent of area in each of the following types of land, when 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.	Applicability condition (b) of AR-ACM0003: Soil disturbances will not cover more than 10% of the area of PAI#1. Furthermore, the soil within PAI#1 does not classify as organic, and the baseline is not subject to any land-use and/or management practices.
	<i>Applicability conditions of tools contained within the methodology AR-ACM-0003</i>	
	c) Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities	c) See module T-ADD within this table for justification.
	d) Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity:	d) No fire is expected to occur as burning of biomass is not part of the project activities.

Module	Applicability conditions	Justification
	- The tool is applicable to all occurrence of fire within the project boundary. - Non-CO2 GHG emissions resulting from any occurrence of fire within the project boundary shall be accounted for each incidence of fire which affects an area greater than the minimum threshold area reported by the host Party for the purpose of defining forest, provided that the accumulated area affected by such fires in a given year is $\geq 5\%$ of the project area.	
	<i>e) Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities</i>	e) The tool has no internal applicability conditions.
	<i>f) Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities.</i>	f) The tool has no internal applicability conditions.
	<i>g) Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities</i>	g) The tool has no internal applicability conditions.
	<i>h) Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity</i> - This tool is not applicable if the displacement of agricultural activities is expected to cause, directly or indirectly, any drainage of wetlands or peat lands.	h) The project activities will not result in any displacement of agricultural activities as agricultural activities are not present in the baseline of PAI#1.
	<i>i) Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities</i>	i) This tool is not used for estimation of change in soil organic carbon stocks in this project (module M-TW and BL-TW is used instead, as required in the applied methodology), why the applicability conditions are not relevant.
T-ADD	1) 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	1) No violation of any applicable law (even when not enforced) is taking place because of the project.

Module	Applicability conditions	Justification
	violation of any applicable law even if the law is not enforced.	
	2) This tool is not applicable to small – scale afforestation and reforestation project activities.	2) The grouped project has a scope of reforesting 10.000 hectares of forest, classifying it as a large – scale reforestation project in CDM terminology.
T-BAR	This tool has no applicability conditions	This tool has no applicability conditions
X-UNC	1) Where an uncertainty value is not known or cannot be simply calculated, a project must justify that it is using an indisputably conservative number and an uncertainty of 0% may be used for this component.	1) Indisputably conservative numbers have been applied. See Section 4.4.
	2) Guidance on uncertainty – a precision target of a 95% confidence interval half-width equal to or less than 15% of the recorded value must be targeted. This is especially important in terms of project planning for measurement of carbon stocks; sufficient measurement plots should be included to achieve this precision level across the measured stocks.	2) As all parameters applied is deemed as being indisputably conservative, uncertainty estimations are not to be calculated. Please refer to Section 4.4 for further information.
X-STR	1) Any module referencing strata <i>i</i> must be used in combination with this module.	1) Any module referencing strata <i>i</i> has been used in combination with module X-STR.
	2) For peatland rewetting and conservation project activities this module must be used to delineate non-peat versus peat and to stratify the peat according to peat depth and soil emission characteristics, unless it can be demonstrated that the expected emissions from the soil organic carbon pool or change in the soil organic carbon pool in the project scenario is <i>de minimis</i> .	2) peatland rewetting and conservation is not part of the initial project instance PAI#1. If future project instances including such activities are to be added, this point will be justified in an updated PD.

Module	Applicability conditions	Justification
	3) In the case of WRC project activities, the project boundary must be designed such that the negative effect of drainage activities that occur outside the project area on the project GHG benefits are minimized.	3) No drainage activities outside the project area that would negatively affect the GHG benefits within the project area are projected to occur.
BL-ARR	<i>This module is applicable under the following conditions:</i>	
	1) The applicability conditions set out in AR-ACM0003 Afforestation and reforestation of lands except wetlands must be met.	1) See module M-ARR in this table for justification.
	2) Applicability conditions included in AR-ACM0003 Afforestation and reforestation of lands except wetlands and corresponding tools that exclude project activities on wetlands can be disregarded for the purpose of their use in this module, as accounting procedures for the peat soil are provided in Modules BL-PEAT and BL-TW.	2) The relevant listed applicable soil modules are applied in this project.
	3) Where the ARR project activity is implemented on peatland, the peatland must be degraded in the baseline scenario as identified by the presence of drainage infrastructure (ditches, canals) and associated lowered water tables below the surface. In the case of forested peatland, degradation may be identified by the removal or degradation of the tree cover before the project start date.	3) The soil in PAI#1 is not classified as peatland. If future project activity instances are to be implemented on peatland, this point will be justified once relevant in an updated PD.
	4) Where the ARR project activity is implemented on tidal wetlands, the wetland must be degraded, as defined in REDD+ MF.	4) The area within PAI#1 classify as degraded wetland.
LK-ARR	<i>This module is applicable under the following conditions:</i>	
	Applicability conditions set out in AR-ACM0003 must be met. Applicability conditions in AR-ACM0003 that exclude project activities on wetlands	1) See module M-ARR in this table for justification.

Module	Applicability conditions	Justification
	can be disregarded in the context of this module.	
M-TW	This module applies to tidal wetland restoration and conservation project activities, as defined in REDD+ MF. This module is applicable under the same applicability conditions outlined in REDD+ MF for WRC project activities.	See Table 9 for listing and justification of applicability conditions for WRC project activities in the REDD+MF methodology VM0007 v1.6.
ADD-AM	This module is applicable to tidal wetland restoration and conservation project activities as defined below.	
	<i>Project activities restoring tidal wetlands may include any of the following, or combinations of the following:</i>	
	1) Creating, restoring and/or managing hydrological conditions (e.g., removing tidal barriers, improving hydrological connectivity, restoring tidal flow to wetlands or lowering water levels on impounded wetlands) 2) Altering sediment supply (e.g., beneficial use of dredge material or diverting river sediments to sediment-starved areas) 3) Changing salinity characteristics (e.g., restoring tidal flow to tidally-restricted areas) 4) Improving water quality (e.g., reducing nutrient loads leading to improved water clarity to expand seagrass meadows, recovering tidal and other hydrologic flushing and exchange or reducing nutrient residence time) 5) (Re-)introducing native plant communities (e.g., reseeding or replanting) 6) Improving management practice(s) (e.g., removing invasive species, reduced grazing)	The project activities applied in PAI#1 includes the activities described in point 1), 3) and 5).

Module	Applicability conditions	Justification
	7) In RWE-ARR project activities, the prescribed burning of herbaceous and shrub aboveground biomass (cover burns) may occur.	
BL-TW	This module applies to tidal wetland restoration and conservation project activities, as defined in REDD+ MF. This module is applicable under the same applicability conditions outlined in REDD+ MF for WRC project activities.	See Table 9 for listing and justification of applicability conditions for WRC project activities in the REDD+MF methodology VM0007.
LK-ECO	This module is applicable under the following condition: Leakage caused by hydrological connectivity is avoided by project design and site selection.	Leakage caused by hydrological connectivity is avoided. Justification for can be found in Section 4.3.
E-BPB	This module is applicable to REDD project activities with emissions from biomass burning and REDD-WRC project activities with emissions from biomass and/or peat burning. This module is also applicable to RWE and ARR-RWE project activities with emissions from peat burning.	The module is applicable to ARR+RWE project activities with emissions from peat burning. Neither peat burning or biomass burning is expected in the baseline and neither is part of the project activities. However, should this occur or new information regarding such emerge, the module will be applied for estimation of GHG emissions related to such.
E-FFC	All fossil fuel combustion associated with a project may be accounted, including fossil fuel combustion of subcontractors that are conducting (parts of the) work to implement the project. Fossil fuel combustion in all situations is an optional emission source. Project proponents may, however, elect to include fossil fuel combustion if emissions are higher in the baseline than in the project case thus generating emission reductions through project activities. Where emissions from fossil fuel combustion are estimated in the baseline, monitoring and estimation must also occur in the with-project scenario.	In the applied methodology VM0007 v1.6, it is stated that fossil fuel combustion related to the implementation of RWE activities must be included in the GHG estimations (See Table 10 in VM0007 v1.6). Therefore, combustion of fossil fuels in the project scenario are included in the GHG estimations of this PD – however they are deemed <i>de minimis</i> , see Section 4.2.

3.3 Project Boundary

Geographic boundaries

See section 1.12 for Geographic boundaries.

Temporal boundaries

As described in section 1.9, The project plans for a crediting period of 30 years from 09/04/2022 to 09/04/2052, with the possibility of prolonging the crediting period for up to 100 years.

According to the methodology, the duration of the monitoring period can be from 1–10 years. An annual monitoring is expected to be performed in the project area. An official monitoring report for credit issuance is expected for submission every 1-5 years, depending on the growth of the mangrove trees and practical circumstances.

Carbon pools

No overall decreases in carbon stocks will take place in the project scenario because of project activities. Potential further decreases of carbon stocks in the baseline scenario are conservatively not accounted for, apart from a small amount of methane and nitrous dioxide emissions from the soil carbon pool which are also accounted for in the project scenario, equaling them out (see Section 4.1 and 4.2 for further information). Therefore, the only net-carbon stock changes accounted for in this project are the increases in the below listed (Table 11) carbon pools.

Table 11: Carbon pools in the Baseline and Project Scenario

Carbon pool		Included?	Justification/Explanation
Baseline	Aboveground biomass (tree and non-tree biomass)	Included	Major carbon pool subject to the project activities. Covered under ARR.
	Belowground biomass	Included	Carbon stock in this pool is expected to increase due to the implementation of the project activities. Covered under ARR.
	Litter	Excluded	This carbon pool is excluded. It is a conservative choice to exclude the pool as the project activities will not decrease the rate of accumulation of the litter.
	Dead wood	Included	Even though stock changes in dead wood in the baseline are not expected to increase, this carbon pool has been considered because the project activities are expected to lead to an increase of SOC. Covered under ARR.

Carbon pool		Included?	Justification/Explanation
	Soil Organic Carbon	Included	Even though the SOC stock in the baseline is not expected to increase (actually they are highly likely to decrease due to ongoing oxidation of C present in the soil – however this factor has conservatively been excluded from these calculations), this carbon pool has been considered because the project activities are expected to lead to an increase of SOC. Covered under RWE.
	Wood products	Excluded	This pool is optional as per VCS rules.
Project	Aboveground biomass (tree and non-tree biomass)	Included	Major carbon pool subject to the project activities. Covered under ARR.
	Belowground biomass	Included	Carbon stock in this pool is expected to increase due to the implementation of the project activities. Covered under ARR.
	Litter	Excluded	This carbon pool is excluded. It is a conservative choice to exclude the pool as the project activities will not decrease the rate of accumulation of the litter.
	Dead wood	Included	Carbon stock in this pool is expected to increase due to implementation of the project activities. The methodology provides a conservative default approach for accounting of increase in carbon stock in this pool. Covered under ARR.
	Soil Organic Carbon	Included	The applied methodology allows in module BL-TW and M-TW for the use of default values to account for the increase in carbon stock in the soil pool. Covered under RWE.
	Wood products	Excluded	This pool is optional as per VCS rules.

Sources of GHG emissions

Table 12: Project GHG emission sources

Source		Gas	Included?	Justification/Explanation
Baseline	Burning of biomass	CO2	Excluded	Carbon stock decreases due to burning are accounted as a carbon stock change. However, burning of biomass is not expected.
		CH4	Excluded	Conservatively excluded. Furthermore, burning of biomass is not expected.

Source		Gas	Included?	Justification/Explanation
		N2O	Excluded	Conservatively excluded. Furthermore, burning of biomass is not expected.
	Combustion of fossil fuels	CO2	Excluded	Conservatively excluded.
		CH4	Excluded	Conservatively excluded.
		N2O	Excluded	Conservatively excluded.
	Emissions from tidal wetlands mineral soil	CO2	Excluded	Conservatively excluded.
		CH4	Included	This emission source is accounted for through the usage of a standard value based on salinity content.
		N2O	Included	This emission source is accounted for through the usage of a standard value based on salinity content.
	Peat or biomass combustion	CO2	Excluded	Conservatively excluded.
		CH4	Excluded	Conservatively excluded.
		N2O	Excluded	Conservatively excluded.
Project	Burning of biomass	CO2	Included	Carbon stock decreases due to burning of biomass is accounted as a carbon stock change. However, no burning of biomass is expected in the grouped project, and it does not occur in the first project instance PAI#1.
		CH4	Included	Burning of biomass for the purpose of site preparation, or as part of forest management, is allowed. However, no burning of biomass is expected in the grouped project, and it does not occur in the first project instance PAI#1.
		N2O	Included	Burning of biomass for the purpose of site preparation, or as part of forest management, is allowed. However, no burning of biomass is expected in the grouped project, and it does not occur in the first project instance PAI#1.
	Combustion of fossil fuels	CO2	Included	This source may result in emissions. However, it is calculated to be <i>de minimis</i> .
		CH4	Included	This source may result in emissions. However, it is calculated to be <i>de minimis</i> .
		N2O	Included	This source may result in emissions. However, it is calculated to be <i>de minimis</i> .
	Emissions from tidal	CO2	Included	There will be no net CO2 emissions from the soil pool in the project scenario. The net-increase in the

Source		Gas	Included?	Justification/Explanation
	wetlands mineral soil			SOC pool is accounted for through the appliance of a standard value.
		CH4	Included	This emission source is accounted for through the usage of a standard value based on salinity content.
		N2O	Included	This emission source is accounted for through the usage of a standard value based on salinity content.
	Peat or biomass combustion	CO2	Included	This emission source is accounted for. However, no combustion of biomass or peat is expected in the grouped project, and it does not occur in the first project instance PAI#1.
		CH4	Included	This emission source is accounted for. However, no combustion of biomass or peat are expected in the grouped project, and it does not occur in the first project instance PAI#1.
		N2O	Included	This emission source is accounted for. However, no combustion of biomass or peat are expected in the grouped project, and it does not occur in the first project instance PAI#1.

3.4 Baseline Scenario

As set out in the applied methodology VM0007, the CDM combined tool T-ADD should be applied for the determination of the most plausible baseline scenario for each of the included categories. In this PD, the module is applied to the project activity category of RWE+ARR.

Determination of the most plausible baseline scenario for project activity category RWE+ARR

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

- The start date of the project is 09th of April 2022 and are therefore after 31st of December 1999. Please refer to section 1.8 for further information and evidence.
- This project was from the very beginning planned for generating VCUs and would not have taken place if not for these. This can be proved through the fact that Ørsted as of now has paid for most of the implementation activities (proof in the form of signed

contracts covering implementation of both PAI#1 and PAI#2 is shared with the validator upon request) and through the signed VCUPA agreement (also shared with the validator upon request) that gives Ørsted the right to all VCUs generated from the project. This contract was signed before the implementation of the first project activity. The contract has been shared with the validator as evidence.

STEP 1 Identification of alternative land use scenarios to the proposed project activity:

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

In this sub-step, the realistic and credible land-use scenarios that would have occurred on the land within the proposed project boundary in the absence of the project activity is identified. These scenarios shall at least include two scenarios consisting of **(1)** continuation of the pre-project land use and **(2)** reforestation of the land without being registered as a carbon project. Further, it shall be explored whether a third **(3)** land use scenario consisting of partly reforestation of the land in the absence of the project is realistic and credible. In this case, the project participant shall assess the baseline rate of forestation and shall provide justification that the project will lead to an increased rate of afforestation/reforestation that would not occur in the absence of the project activity and that this results from direct intervention by the project participants. To eliminate doubt, it is explored whether a fourth **(4)** potential land use scenario consisting of natural regeneration can be considered as realistic and credible. Additionally, the possibility for other alternative land use scenarios is explored.

Exploration of the potential third land use scenario consisting of partly reforestation in the absence of the project: According to existing literature exploring historical mangrove extent in the Gambia, it is evident that a net mangrove deforestation has been taking place. Examples of such literature is this report¹⁹ produced for UNEP which estimates a mangrove decline in the Gambia from 1980 to 2006 and this study²⁰ by Judith Carney et al which estimates a mangrove decline of 12% along the south bank of the lower Gambia river between 1986 and 2010. As argued later in this analysis, various initiatives for replanting mangrove are under implementation in the Gambia. However, these initiatives are far from sufficient for restoring all the degraded mangrove habitat which constitutes more than 20.000 hectares. This carbon project provides substantial additional funding with a target to restore the Gambian mangrove habitat which is not restored through other restoration initiatives.

Exploration of the potential fourth land use scenario consisting of natural regeneration in the absence of the project: as proved in the historical report covering PAI#1, the area is not covered

¹⁹ Report produced for UNEP-DEPI (2007): Mangroves of Central and Western Africa. Report access: <https://wedocs.unep.org/bitstream/handle/20.500.11822/7768/-Mangroves%20of%20West%20Africa-20073922.pdf?sequence=3>, Accessed 02/02-2023

²⁰ Carney, J., Gillespie, T. W., Rosomoff, R. (2014): Assessing forest change in a priority West African mangrove ecosystem: 1986-2010

by forest and has not been for at least the last 13 years which is the timespan covered by the report and that the current crown cover within the instance is below 5%. This is to be noted as *Rhizophora* has been documented to reestablish themselves after clearings within 3 years.²¹ Thus, it is not deemed realistic or credible that the areas would naturally regenerate in the absence of the project, as there is evidence that if that was the case, project areas would already see natural regeneration. To ensure that future added instances are neither subject to natural regeneration, it is a requirement that future added instances as subject to a historical satellite imagery analysis proving that the area has not been forested for at least the last 10 years and that the current crown cover within the instance is not above 5% (refer to Section 1.4.1).

Exploration of potential other credible and realistic land use scenarios: The areas planted and areas to be planted in the future through this project are pre- project implementation not under any anthropogenic usage, and neither is it realistic that they would be over time in the absence of the project. The reason for this is that the salinity is too high for the local communities to grow anything that would produce a satisfactory yield. This is confirmed by both all involved communities and the DPWM. It is the local communities who approves of areas to be planted and who performs the plantings, and they would not plant in areas that they in other ways could use for generating a meaningful amount of food or income. Therefore, it is not deemed realistic or credible that the areas to be restored through this project would in the absence of the project fall under any other usages.

Outcome of Sub-step 1a:

Based on the above explorations, a total of two alternative land use scenarios are deemed credible and realistic:

- Baseline scenario 1: Status Quo: Continuation of the pre-project land-use, remaining as degraded wetlands.
- Baseline scenario 2: Reforestation of the land within the boundaries of the project activities performed without being registered as a VCS project activity.

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

As described in Section 1.14, the project will be implemented in compliance with all relevant local, state and national, applicable legal and regulatory requirements (local, regional and national laws, statutes and regulatory frameworks). This will be enforced by the Department of

²¹ Sukardjo, S. (1987). Natural regeneration status of commercial mangrove species (*Rhizophora apiculata* and *Bruguiera gymnorhiza*) in the mangrove forest of Tanjung Bungin, Banyuasin District, South Sumatra. *Forest Ecology and Management*, 20(3–4), 233–252. [https://doi.org/10.1016/0378-1127\(87\)90082-x](https://doi.org/10.1016/0378-1127(87)90082-x)

Parks and Wildlife Management. Further, the alternative land use scenarios identified are all in compliance with all mandatory applicable legal and regulatory requirements.

Outcome of Sub-step 1b:

The plausible alternative land use scenarios that are in compliance with the mandatory legislation and regulations taking into account enforcement within The Gambia is as follows:

- Baseline scenario 1: Status Quo: Continuation of the pre-project land-use, remaining as degraded wetlands.
- Baseline scenario 2: Reforestation of the land within the boundaries of the project activities performed without being registered as a VCS project activity.

STEP 2 Barrier analysis:

Sub-step 2a: Identification of barriers that would prevent the implementation of baseline scenario two:

a) Investment barriers

All ARR+RWE activities are to be implemented on degraded mangrove habitat areas with the purpose of restoring well-functioning natural mangrove ecosystems. No direct income is expected because of the restoration as neither thinning or harvesting activities (and therefore no timber harvest) are part of the project activities within the project areas. However, the communities are expected to benefit indirectly as the project activities are expected to result in an increased ecosystem productivity of fish, oyster and the like, as well as from the revenue gained from carbon credits to be issued.²²

As the ecosystem restoration does not result in a direct product that can be sold to create a profit, the economic incentive for investing in the restoration would be lacking if not for the payments performed for plantings and the carbon credit revenues facilitated through this project.

Smaller mangrove restoration activities funded by other entities have previously taken place in the Gambia, but the scope of these projects have been local, and the funding provided not sufficient for implementing a larger scale restoration of mangrove habitats in The Gambia at the scale targeted by this project.²³ Furthermore, this carbon project covers the financing and support related to the entire project period, guaranteeing full implementation and long-term management of the restored areas.

²² Albert, J.A. & Warren-Rhodes, K. & Schwarz, Anne-Maree & Duke, Norman. (2012). Mangrove ecosystem services and payments for blue carbon in Solomon Islands. 10.13140/RG.2.1.2301.2081.

²³ Personal communications with the Department of Parks and Wildlife Management, The Gambia.

b) Technological, logistical, and social barriers

Historically, The Gambia has relied heavily on external project-based funding, and significant gaps in long-term funding for climate action remain.²⁴²⁵ Without the carbon project, sufficient funding related to acquiring the necessary materials (boats, shovels, cars, equipment related to monitoring the health of the ecosystem, laboratories for analysis of soil etc.) for a successful implementation of the restoration and the continued monitoring securing long-term success is lacking.

Local communities are committed to restoring degraded mangrove habitat, but if not for this carbon project, local communities would not have access to sufficient technical and organizational guidance for establishing and managing a large-scale mangrove restoration project. Education is still limited in The Gambia, with only 29% of students completing upper secondary education, and leaves most local communities lacking in professional skills.²⁶ For example, technical knowledge is required to successfully alter the hydrology in areas where the degradation has resulted in alterations of the previous natural hydrology, and for identifying areas in which the restoration would prove successful. Likewise, the locals do not have the logistical skills, contacts, knowledge nor funds to secure a sufficient supply of high-quality propagules. Furthermore, the local communities do not have sufficient incentive nor time to plant voluntarily without getting a salary as they do in the carbon project. 76% of the rural population in The Gambia live in poverty and has trended upwards.²⁷

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

Baseline scenario 1 does not face any of the barriers described in sub-step 2a, while baseline scenario 2 faces all of the above listed barriers. As a result of such, baseline scenario 2 is eliminated.

Sub-step 2c: Determination of baseline scenario

²⁴ Urquhart, P., GCCA Component 2 Project Team, National Climate Committee, Technical Working Group, Karani, P., Osuteye, E. Abeyasinghe, A., Sharma, A., Ferreira, T., Njie, M., Yade, S., Nyass, M., Feys, F., Watson, D., Sowe, M., & Yaffa, S. (2016). National Climate Change Policy of the Gambia.

²⁵ African Development Bank. (2023). Country Focus Report 2023 - Gambia - Mobilizing Private Sector Financing for Climate and Green Growth.

²⁶ UNICEF Gambia. (2020). The Gambia Education Fact Sheets.

²⁷ World Bank. (2023). The Gambia. Poverty & Equity Brief.

By applying the decision tree presented in the applicable tool, The baseline scenario is identified as baseline scenario 1: Status Quo: Continuation of the pre-project land-use, remaining as degraded wetlands.

Outcome of Step 2:

The baseline scenario is identified as baseline scenario 1: Status Quo: Continuation of the pre-project land-use, remaining as degraded wetlands.

STEP 4 Common practice analysis:

As required in the applicable tool, the baseline analysis is complemented by an analysis of the extent to which forestation activities has already been implemented within the project area. In the specific area of PAI#1, no forestry activities have been implemented or planned for which is also the expectations for future PAIs. However, in the Gambia as a whole, some restoration of the mangrove ecosystem has taken place through various programs.

Below is a list of ongoing and finalized mangrove restoration projects within the wetlands ecosystem of the Gambia:

GCF project FP011 “Large-scale Ecosystem-based Adaptation in The Gambia: developing a climate-resilient, natural resource-based economy: Implementing Ecosystem-based Adaptation (EbA)”

The goal of the EbA project is to restore degraded forests and agricultural landscapes in The Gambia with climate-resilient plants, establishing natural resource-based businesses, and strengthening capacity and policies to implement ecobased adaptation systems. The duration of the project is 6 years. As part of the project indicated by EbA, the West African Bird Study Association (WABSA) has planted 34.3 ha of degraded mangrove areas identified for the 2021 mangrove restoration action plan. This includes mangrove areas of the Central River Region (CRR) North bank and Lower River Region (LRR) South bank of the River Gambia.

“National Agricultural Land and Water Management Development Project” (NEMA-CHOSSO)²⁸

The program development objective was to reduce poverty of rural women and youth by increasing incomes from improved productivity based on sustainable land and water management practices. The program was funded by various grants and loans (primarily through IFAD) and lasted from 2013 to 2019. As part of the program, mangrove was to be restored in various areas in The Gambia. According to plan, approx. 1800 hectares

²⁸ Some documents name the project: “Strengthening Climate Resilience of the National Agricultural Land and Water Management Development Project” to mean the same project “National Agricultural Land and Water Management Development Project”

were to be restored, though exact areas and shapefiles are not available and the actual planting sites have not been identified.

“Resilience of Organizations for Transformative Smallholder Agriculture Project” (ROOTS)

The program, a successor of the NEMA-CHOSSO project, was launched on 09 February 2021 and will run until 2025, with funding from the International Fund for Agricultural Development (IFAD), the OPEC Fund for International Development (OFID), the GEF Least Developed Countries Fund (LDCF), the French Development Agency (AFD), the Government of the Gambia and the Project’s beneficiaries. The main goal of ROOTS is to improve food security, nutrition and resilience of smallholder farmers to climate change in The Gambia. To achieve this, the ambition is to restore 1,300 hectares of mangroves.

Project of Mangrove Ecosystem Restoration in the Gambia by the French Development Agency

On 17 February 2022, the Ministry of Finance and Economic Affairs and French Development Agency has signed agreement to support the mangrove restoration in the Gambia with a total amount of 6.9 million EURO as a five-year program.

The global objective of the project is to provide a strategic, scientific and technical support to Gambia for the large-scale restoration of the mangrove ecosystems, and the improvement of the coastal communities’ conditions, in a context of climate change. The project’s framework corresponds to the four following specific objectives: 1) Strengthen the national legal and policy framework for enhanced climate adaptation and coastal resilience, 2) Test restoration technics on 800 ha of mangrove in different contexts and develop a national strategy and action plans for large-scale restoration of mangrove ecosystems in The Gambia. 3) Improve governance and management effectiveness of marine protected areas in key mangrove areas and 4) Support the development of sustainable value chains and alternative income for grassroots women's and youth organizations in the project's pilot sites.

There are several essential distinctions between the above listed restoration initiatives and this carbon project;

Essentially, the above listed restoration activities differ fundamentally from this project as they are based on different financing strategies, where the existing restoration projects are donor projects financed primarily by grants, and this project is a carbon project where financing is based on a mix of grant and carbon credit incomes. It is the analysis of the project proponents that one of the reasons the above projects have not reached their restoration goals is because grants have not been success-based, and no documentation or long-term maintenance and monitoring

has been integrated as a part of the projects. This project has ensured to integrate these aspects diligently to ensure not only the long-term sustainability of the project but also to ensure a long-term revenue to The Gambia through the sale of carbon credits for new environmental projects and through this to provide an incentive to implement the best possible restoration practices and to secure the long-term success of the project, as the amount of restored areas will increase the revenue gained from carbon credits. In other words, the existing projects have faced barriers with the actual restoration and maintenance on a longer term for the restoration activities, which with this project is mitigated through the carbon financing mechanism.

It should however be noted that this project seeks to embrace other restoration activities as the areas of degraded mangrove in The Gambia is too extensive for one project to cover, and many efforts to restore mangrove in The Gambia one way or the other would be available. As the DPWM are overall responsible for wetlands and mangrove restoration it is also ensured that all potential activities are coordinated to avoid overlapping in project areas. DPWM confirm that nothing near enough finance would be available for mangrove restoration in The Gambia was it not for this carbon project, and they see this project as a game changer for restoring The Gambian mangrove habitat at large scale.

This project moreover differs from the other projects as it will be done with a streamlined planting strategy, which is a relatively new approach in The Gambia. Moreover, the restoration activities of the carbon project are based on relevant scientific literature and studies and the extensive experience built up by the DPWM. The long-term monitoring and maintenance of the PAI's is assured by utilizing some of the revenue from the sales of the carbon credits, contributing to the assurance of the long-term project success. Furthermore, the management of the carbon project is well organized, with the MECCNAR overseeing the implementation of activities through the director of the DPWM. Then, a consortium of local NGOs and experts within DPWM experienced with mangrove planting and supported by international experts actively conduct and supervise activities.

Lastly, the existing restoration activities differ from the carbon project as their scope is limited by the available amount of funds being directed towards the restoration. Even if assumed that all the above-mentioned existing restoration activities succeeded with reaching their restoration goals, vast areas of degraded mangrove habitat would still be present in the Gambia. With this carbon project, degraded mangrove areas within the Gambia that has not yet been restored are targeted and restored by utilizing additional finance through the carbon credit scheme.

Outcome of Step 4:

While some restoration of the mangrove ecosystem has taken place through various programs in The Gambia, these restoration efforts are far from sufficient for restoring the majority of the Gambian mangrove ecosystem. Further, the project activities are distinct from previous restoration initiatives in both its approach and financing.

3.5 [Additionality](#)

As the project activity in PAI#1 is of the combined category ARR+RWE, additionality is determined through both the project method (as required for all project activities other than tidal wetland restoration and conservation) and the activity method (as required for all tidal wetlands conservation and restoration project activities).

Project method additionality

According to the applied methodology, the latest version of the tool *CDM Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities (T-ADD)* must be applied to determine additionality. This has already been done in Section 3.4 above, why the demonstration of additionality according to the project method is completed.

Activity method additionality

According to the applied methodology, the module *ADD-AM Demonstration of Additionality of Tidal Wetland Restoration and Conservation Project Activities* must be applied to determine additionality:

STEP 1: Regulatory surplus

To live up to the regulatory surplus, the project shall:

“not be mandated by any law, statute or other regulatory framework, or for UNFCCC non-Annex I countries, any systematically enforced law, statute or other regulatory framework.”

As the project is not mandated by any law, statute or other regulatory framework, and neither any systematically enforced law, statute or other regulatory framework, the project passes STEP 1.

STEP 2: Positive list

The applicability conditions of the module ADD-AM represent the positive list. The project must demonstrate that it lives up to all the applicability conditions to comply with the positive list and be deemed additional.

As this project complies with all applicability conditions listed in the module (see Table 10), the project is deemed additional.

3.6 Methodology Deviations

In this project, there are no methodology deviations.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

As required in the applied methodology, individual baselines are to be calculated for each activity type in the project. As PAI#1 consists of only ARR+RWE on mineral soils (see section 1.13 of this PD), one baseline is calculated.

As required in the applied methodology of VM0047 v1.0, the module BL-ARR VMD0041 v1.1 is used for estimating the GHG removals in the baseline scenario. As the soil in PAI#1 qualifies as mineral, the module BL-TW is used for calculating the baseline net emissions from the SOC pool. The fossil fuel combustion is conservatively excluded from the baseline emissions calculations, why module E-FFC is not applied.

Additionally, no stratification is applied as there is no difference in vegetation types. A maximum of 5% tree covered is allowed in pre-project areas as scattered individuals, and only one species of mangroves is planted.

All calculations are performed in an excel file available to the auditor upon request.

Estimation of baseline net GHG removals from the ARR component

In the applicable module BL-ARR, it is stated that baseline net GHG removals under the ARR baseline scenario is estimated as follows:

$$\Delta C_{BSL-ARR} = \sum_{t=1}^{t*} \Delta C_{BSL,t} + \Delta C_{BSL-herb}$$

Where:

$\Delta C_{BSL-ARR}$	=	Net GHG removals under the ARR baseline scenario up to time t^* ; t CO ₂ e
$\Delta C_{BSL,t}$	=	Baseline net GHG removals by sinks in year t (from AR-ACM0003); t CO ₂ e
$\Delta C_{BSL-herb}$	=	Net GHG removals under the ARR baseline scenario in herbaceous vegetation up to time t^* ; t CO ₂ e
t	=	1,2,3 ... t^* time since project start; years

Estimation of baseline net GHG removals by sinks ($\Delta C_{BSL,t}$):

In the applicable module BL-ARR, it is stated that the CDM methodology AR-ACM0003 shall be applied for estimating the net GHG removals under the ARR project baseline. In AR-ACM0003, it is stated that the baseline net GHG removals by sinks ($\Delta C_{BSL,t}$) shall be calculated as follows:

$$\Delta C_{BSL,t} = \Delta C_{TREE_BSL,t} + \Delta C_{SHRUB_BSL,t} + \Delta C_{DW_BSL,t} + \Delta C_{LI_BSL,t}$$

Where:

$\Delta C_{BSL,t}$	=	Baseline net GHG removals by sinks in year t ; t CO 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 “ <i>Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities</i> ”; t CO ₂ -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 “ <i>Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities</i> ”; t CO ₂ -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 “ <i>Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities</i> ”; t CO ₂ -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 “ <i>Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities</i> ”; t CO ₂ -e

Estimation of carbon stock change in baseline tree biomass ($\Delta C_{TREE_BSL,t}$) and baseline shrub biomass ($\Delta C_{SHRUB_BSL,t}$):

According to AR-ACM0003, these parameters shall be calculated using the CDM tool AR-TOOL14 v4.2.

In this CDM tool, it is stated that baseline carbon stock and baseline carbon stock change in trees and shrubs can be estimated as zero if certain conditions are met.

For carbon stock in trees in the baseline to be accounted as zero, all of the following conditions must be met:

- (a) The pre-project trees are neither harvested, nor cleared, nor removed throughout the crediting period of the project activity;*
- (b) The pre-project trees do not suffer mortality because of competition from trees planted in the project, or damage because of implementation of the project activity, at any time during the crediting period of the project activity;*
- (c) The pre-project trees are not inventoried along with the project trees in monitoring of carbon stocks but their continued existence, consistent with the baseline scenario, is monitored throughout the crediting period of the project activity.*

These conditions have been documented and will be continually monitored with drones or VHR satellite imagery (Picture 5) to ensure that the pre-project trees do not reduce or die-off throughout the crediting period of the project activity.



Picture 5. Example of drone imagery in which pre-project trees are documented for monitoring.

As all the above conditions are fulfilled in the project, the carbon stock in trees in the baseline are accounted as zero.

For changes in carbon stocks in trees and shrubs in the baseline to be accounted as zero, one of the below conditions must be met and documented:

- (a) Observed reduction in topsoil depth (e.g. as shown by root exposure, presence of pedestals, exposed sub-soil horizons);*
- (b) Presence of gully, sheet or rill erosion; or landslides, or other forms of mass-movement erosion;*

- (c) Presence of plant species locally known to be indicators of infertile land;
- (d) Land comprises of bare sand dunes, or other bare lands;
- (e) Land contains contaminated soils, mine spoils, or highly alkaline or saline soils;
- (f) Land is subjected to periodic cycles (e.g. slash-and-burn, or clearing-regrowing cycles) so that the biomass oscillates between a minimum and a maximum value in the baseline;
- (g) Conditions (a), (b) and (c) under paragraph 11 apply.

As condition (g) listed above is met, changes in carbon stocks in trees and shrubs in the baseline is set to zero. For a description of the method applied for mapping existing pre-project trees in PAI#1, see Section 5.3 of this PD.

Estimation of carbon stock change in baseline dead wood biomass, ($\Delta C_{DW_BSL,t}$):

According to AR-ACM0003, this parameter shall be calculated using the CDM tool AR-TOOL12. According to this tool, it is, if dead wood remains in situ and is not removed from the project boundary through any type of anthropogenic activities, allowed to use a default factor for the estimation of dead wood. As no deadwood are expected to be removed in the baseline scenario, the usage of the default factor is applicable to the project and is selected.

The carbon stock in dead wood ($\Delta C_{DW,i,t}$) is through the usage of the default factor (DF_{DW}) estimated as:

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

Where:

$\Delta C_{DW,i,t}$	=	Carbon stock in dead wood in stratum i at a given point of time in year t ; t CO ₂ e
$C_{TREE,i,t}$	=	Carbon stock in trees biomass in stratum i at a point of time in year t , as calculated in the tool “ <i>Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities</i> ”; t CO ₂ e
DF_{DW}	=	Conservative default factor expressing carbon stock in dead wood as a percentage of carbon stock in tree biomass; per cent
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

As the carbon stock in dead wood is calculated based on a percentage of the carbon stock in tree biomass which in the baseline is set to zero (see above section), the carbon stock in dead wood in the baseline scenario is as well set to zero.

Estimation of carbon stock change in baseline litter biomass ($\Delta C_{LI_BSL,t}$):

The litter biomass pool is conservatively excluded from both the baseline and the project scenario calculations.

Estimation of uncertainty for ARR project activities:

As the baseline carbon stock and baseline carbon stock change for trees and shrubs are set to zero, uncertainty estimations are not applicable.

Long term average in case of harvesting

As harvesting is not expected to be carried out in the baseline scenario, calculating the long-term average GHG-benefit is not relevant.

Herbaceous vegetation ($\Delta C_{BSL-herb}$)

The carbon pool of herbaceous vegetation is conservatively excluded in both the baseline and the project scenario.

Table 13: overview of the projected change in carbon stock in tree biomass ($\Delta C_{TREE_BSL,t}$), shrub biomass ($\Delta C_{SHRUB_BSL,t}$), dead wood ($\Delta C_{DW_BSL,t}$), litter ($\Delta C_{LI_BSL,t}$) and summarized for the overall ARR baseline scenario ($\Delta C_{BSL-ARR}$) in PAI#1 over the 30-year project crediting period

Year	$\Delta C_{TREE_BSL,t}$	$\Delta C_{SHRUB_BSL,t}$	$\Delta C_{DW_BSL,t}$	$\Delta C_{LI_BSL,t}$	$\Delta C_{BSL-ARR}$
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0
10	0	0	0	0	0

11	0	0	0	0	0
12	0	0	0	0	0
13	0	0	0	0	0
14	0	0	0	0	0
15	0	0	0	0	0
16	0	0	0	0	0
17	0	0	0	0	0
18	0	0	0	0	0
19	0	0	0	0	0
20	0	0	0	0	0
21	0	0	0	0	0
22	0	0	0	0	0
23	0	0	0	0	0
24	0	0	0	0	0
25	0	0	0	0	0
26	0	0	0	0	0
27	0	0	0	0	0
28	0	0	0	0	0
29	0	0	0	0	0
30	0	0	0	0	0

Estimation of baseline net GHG removals from the RWE component

As stated in the applied methodology VM0007 v1.6, the module VMD0050 v1.0 BL-TW shall when the soils classify as mineral be used for calculating the net-emissions from the baseline soil pool of RWE-ARR project activities. In module BL-TW, it is stated that the net GHG emissions from soil in the baseline scenario is calculated as follows:

$$GHG_{BSL-TW,i,t} = GHG_{BSL-soil-CO2,i,t} - Deduction_{alloc} + GHG_{BSL-soil-CH4,i,t} + GHG_{BSL-soil-N2O,i,t}$$

Where:

$GHG_{BSL-TW,i,t}$	=	GHG emissions from the tidal wetland SOC pool in the baseline scenario in stratum i in year t ; t CO ₂ e ha/yr
$GHG_{BSL-soil-CO2,i,t}$	=	CO ₂ emissions from the tidal wetland SOC pool in the baseline scenario in stratum i in year t ; t CO ₂ e ha/yr
$Deduction_{alloch}$	=	Deduction from CO ₂ emissions from the SOC pool to account for the percentage of the carbon stock that is derived from allochthonous soil organic carbon; t CO ₂ e ha/yr
$GHG_{BSL-soil-CH4,i,t}$	=	CH ₄ emissions from the tidal wetland SOC pool in the baseline scenario in stratum i in year t ; t CO ₂ e ha/yr
$GHG_{BSL-soil-N2O,i,t}$	=	N ₂ O emissions from the tidal wetland SOC pool in the baseline scenario in stratum i in year t ; t CO ₂ e ha/yr
i	=	1, 2, 3 ... M_{BSL} strata in the baseline scenario
t	=	1, 2, 3, ... t^* years elapsed since the project start date

Estimation of baseline CO₂ emissions from the SOC pool ($GHG_{BSL-soil-CO2,i,t}$):

$$GHG_{BSL-soil-CO2,i,t} = GHG_{BSL-insitu-CO2,i,t} + GHG_{BSL-eroded-CO2,i,t} + GHG_{BSL-exav-CO2,i,t}$$

Where:

$GHG_{BSL-soil-CO2,i,t}$	=	CO ₂ emissions from the tidal wetland SOC pool in the baseline scenario in stratum i in year t ; t CO ₂ e ha/yr
$GHG_{BSL-insitu-CO2,i,t}$	=	CO ₂ emissions from the tidal wetland SOC pool of in-situ soils in the baseline scenario in stratum i in year t ; t CO ₂ e ha/yr
$GHG_{BSL-eroded-CO2,i,t}$	=	CO ₂ emissions from the eroded tidal wetland SOC pool in the baseline scenario in stratum i in year t ; t CO ₂ e ha/yr
$GHG_{BSL-exav-CO2,i,t}$	=	CO ₂ emissions from the tidal wetland SOC pool of soil exposed to an aerobic environment through excavation in the baseline scenario in stratum i in year t ; t CO ₂ e ha/yr

Calculation of $GHG_{BSL-insitu-CO2,i,t}$:

In module BL-TW, it is stated that $GHG_{BSL-insitu-CO2,i,t}$ can be estimated using a default value. If the crown cover is estimated to be 15% or less, the value may be assumed to be insignificant and accounted for as zero. As the crown cover in the project area prior to planting has a crown cover below 15% and as the crown cover is not expected to grow in the baseline scenario (see Section 3.4), $GHG_{BSL-insitu-CO2,i,t}$ is set to zero.

Calculation of $GHG_{BSL-eroded-CO2,i,t}$:

In BL-TW, it is stated that for each stratum it must be determined whether soil erosion occurs. The planting of mangrove trees will because of the establishment of a root system and because of the trees acting as protection against waves, result in less erosion when compared to the amount of erosion in the baseline scenario. To be conservative, erosion is set to zero in both the project and the baseline scenario.

Calculation of $GHG_{BSL-exav-CO2,i,t}$:

In BL-TW, it is stated that for each stratum, it shall for the baseline scenario be determined whether piled up soil exposed to an aerobic environment is present. As excavation of soil is not expected to take place in the baseline scenario, $GHG_{BSL-exav-CO2,i,t}$ is conservatively set to zero.

Calculation of $Deduction_{alloch}$:

As allowed in module BL-TW, $Deduction_{alloch}$ is in this project conservatively set to zero.

Calculation of $GHG_{BSL-soil-CH4,i,t}$:

In module BL-TW, it is stated that if the salinity level (either salinity average or salinity low point) equals or is above 20 ppt, a default factor for $GHG_{BSL-soil-CH4,i,t}$ can be calculated as follows:

$$GHG_{BSL-soil-CH4,i,t} = 0.0056 \text{ t CH}_4 \text{ ha yr} \times CH4_GWP,$$

Where $CH4_GWP$ is the global warming potential of CH_4 as defined by IPCC in their fifth assessment report (AR5). In this report, CH_4 -GWP is defined as being 28.

In module M-TW, it is stated that salinity can be measured directly in the shallow pore water (within 30 cm from soil surface). It is further stated that salinity can be measured in the main floodwater source which can then act as a proxy for the salinity level of the pore water in the project area, if measurements are performed in the wet season and if the source floods the wetland at least on 20% of high tides. If the number of measurements is small, the salinity low point shall be applied. As the floodwater source proxy method for estimating salinity is allowed for usage in the project scenario, it is assumed that it is also an appropriate method for usage in the baseline scenario.

For estimating the salinity content in PAI#1, measurements have been performed in both pore water, in the water covering the project area during high tide and at the river edge in the Bintang Bolon river adjacent to the project area. Please see section 1.13 for more information on the measurements. As all the performed measurements is above 20 ppm, the default factor can be applied.

As described in Section 4.2 *Project emissions* of this Project Document, the methane emissions in the baseline scenario are the same as the methane emissions in the project scenario, meaning that they cancel each other out and results in net zero methane emissions in the project scenario.

Calculation of $GHG_{BSL-soil-N_2O,i,t}$:

In module BL-TW, it is stated that a default factor can be used for estimating $GHG_{BSL-soil-N_2O,i,t}$, if the project area does not receive hydrologically direct input from a point or non-point source of nitrogen. For non-seagrass wetland systems where the salinity average or salinity low point is above 18 ppt, $GHG_{BSL-soil-N_2O,i,t}$ can be calculated as follows:

$$GHG_{BSL-soil-N_2O,i,t} = 0.000487 \text{ t N}_2\text{O ha yr} \times N_2O_GWP,$$

where N_2O_GWP is the global warming potential of N_2O as defined by IPCC in their fifth assessment report (AR5). In this report, N_2O_GWP is defined as being 265.

In module M-TW, it is stated that salinity can be measured directly in the shallow pore water (within 30 cm from soil surface). It is as well stated that salinity can be measured in the main floodwater source which can then act as a proxy for the salinity level of the pore water in the project area, if measurements are performed in the wet season and if the source floods the wetland at least on 20% of high tides. If the number of measurements is small, the salinity low point shall be applied. As the floodwater source proxy method for estimating salinity is allowed for usage in the project scenario, it is assumed that it is as well an appropriate method for usage in the baseline scenario.

For estimating the salinity content in PAI#1, measurements have been performed in both pore water, in the water covering the project area during high tide and at the river edge in the Bintang Bolon river adjacent to the project area. Please see section 1.13 for more information on the measurements. As all the performed measurements is above 18 ppm, the default factor can be applied.

As described in Section 4.2 *Project emissions* of this PD, the N_2O emissions in the baseline scenario are the same as the N_2O emissions in the project scenario, meaning that they cancel each other out and results in net-zero N_2O emissions in the project scenario.

Table 14: overview of the CO₂ emissions from the SOC pool ($GHG_{BSL-soil-CO_2,i,t}$), Allochthonous carbon deduction ($Deduction_{alloch}$), CH₄ emissions from the SOC pool ($GHG_{BSL-soil-CH_4,i,t}$), N₂O emissions from the SOC pool ($GHG_{BSL-soil-N_2O,i,t}$) and the overall summing of the GHG emissions in the WRC project scenario ($GHG_{BSL-TW,i,t}$) for PAI#1 in the 30 year project crediting period

Year	$GHG_{BSL-soil-CO_2,i,t}$	$Deduction_{alloch}$	$GHG_{BSL-soil-CH_4,i,t}$	$GHG_{BSL-soil-N_2O,i,t}$	$GHG_{BSL-TW,i,t}$
1	0	0	37.5	30.9	68.4

2	0	0	75.0	61.8	136.8
3	0	0	112.6	92.6	205.2
4	0	0	150.1	123.5	273.6
5	0	0	187.6	154.4	342.0
6	0	0	225.1	185.3	410.4
7	0	0	262.6	216.2	478.8
8	0	0	300.1	247.0	547.2
9	0	0	337.7	277.9	615.6
10	0	0	375.2	308.8	684.0
11	0	0	412.7	339.7	752.4
12	0	0	450.2	370.6	820.8
13	0	0	487.7	401.4	889.2
14	0	0	525.2	432.3	957.6
15	0	0	562.8	463.2	1026.0
16	0	0	600.3	494.1	1094.4
17	0	0	637.8	524.9	1162.8
18	0	0	675.3	555.8	1231.1
19	0	0	712.8	586.7	1299.5
20	0	0	750.4	617.6	1367.9
21	0	0	787.9	648.5	1436.3
22	0	0	825.4	679.3	1504.7
23	0	0	862.9	710.2	1573.1
24	0	0	900.4	741.1	1641.5
25	0	0	937.9	772.0	1709.9
26	0	0	975.5	802.9	1778.3
27	0	0	1013.0	833.7	1846.7
28	0	0	1050.5	864.6	1915.1
29	0	0	1088.0	895.5	1983.5
30	0	0	1125.5	926.4	2051.9

4.2 Project Emissions

As required in the applied methodology, the module M-ARR is used for projecting the future net GHG emissions from ARR project activities and for accounting of biomass burning. As the soil in PAI#1 qualifies as mineral (see section 1.13), the module M-TW is used for calculating net GHG emissions from the SOC pool. As it in this methodology is mandatory to include fossil fuel combustion for RWE-ARR activities, the module E-FFC is applied in the calculations as well.

If future PAIs requires the application of different modules in the calculations (for example if the soil qualifies as peat), the applicable modules and associated calculations will be added in an updated PD.

All calculations are performed in an excel file available to the auditor upon request.

Estimation of future net GHG removals from the ARR component

In the applicable module M-ARR, it is stated that future net GHG removals under the ARR project scenario are estimated as follows:

$$\Delta C_{WPS-ARR} = \sum_{t=1}^{t^*} \Delta C_{ACTUAL,t} + \Delta C_{WPS-herb}$$

Where:

$\Delta C_{WPS-ARR}$	=	Net GHG removals under the ARR project scenario up to year t^* ; t CO ₂ e
$\Delta C_{ACTUAL,t}$	=	Actual net GHG removals by sinks in year t (from AR-ACM0003); t CO ₂ e
$\Delta C_{WPS-herb}$	=	Net GHG removals under the project scenario in herbaceous vegetation up to year t^* ; t CO ₂ e
t	=	1,2,3 ... t^* time elapsed since project start; years

Estimation of actual net GHG removals by sinks ($\Delta C_{ACTUAL,t}$):

In the applicable module M-ARR, it is stated that the CDM methodology AR-ACM0003 shall be applied for estimating the net GHG removals under the ARR project scenario. In AR-ACM0003, it is stated that the actual net GHG removals by sinks ($\Delta C_{ACTUAL,t}$) shall be calculated as follows:

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

Where:

$\Delta C_{ACTUAL,t}$	=	Actual net GHG removals by sinks, in year t ; t CO ₂ e
$\Delta C_{P,t}$	=	Change in the carbon stocks in project, occurring in the selected carbon pools, in year t ; t CO 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 CDM project activity, in year t , as estimated in the tool “ <i>Estimation of non-CO₂ GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity</i> ”; t CO ₂ e

As burning of biomass is not part of any of the project activities, $GHG_{E,t}$ is set to zero.

In AR-ACM0003, it is stated that $\Delta C_{P,t}$ shall be calculated as follows:

$$\Delta C_{P,t} = \Delta C_{TREE_PROJ,t} + \Delta C_{SHRUB_PROJ,t} + \Delta C_{DW_PROJ,t} + \Delta C_{LI_PROJ,t} + \Delta SOC_{AL,t}$$

Where:

$\Delta C_{P,t}$	=	Change in the carbon stocks in project, occurring in the selected carbon pools, in year t ; t CO ₂ e
$\Delta C_{TREE_PROJ,t}$	=	Change in carbon stock in tree biomass in project in year t , as estimated in the tool “ <i>Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities</i> ”; t CO ₂ e
$\Delta C_{SHRUB_PROJ,t}$	=	Change in carbon stock in shrub biomass in project in year t , as estimated in the tool “ <i>Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities</i> ”; t CO ₂ e
$\Delta C_{DW_PROJ,t}$	=	Change in carbon stock in dead wood in project in year t , as estimated in the tool “ <i>Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities</i> ”; t CO ₂ e
$\Delta C_{LI_PROJ,t}$	=	Change in carbon stock in litter in project in year t , as estimated in the tool “ <i>Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities</i> ”; t CO ₂ e
$\Delta SOC_{AL,t}$	=	Change in carbon stock in SOC in project, in year t , in areas of land meeting the applicability conditions of the tool “ <i>Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities</i> ”, as estimated in the same tool; t CO ₂ e

Estimation of carbon stock change in tree biomass ($\Delta C_{TREE_PROJ,t}$):

According to AR-ACM0003, this parameter shall be calculated using the CDM tool AR-TOOL14 v4.2.

○ *Choice of allometric equation for AGB:*

In AR-TOOL14 v4.2, it is stated that if the chosen allometric equation for estimating AGB are to be used for ex-post carbon estimation, it shall be demonstrated that the equation is appropriate for this by applying the tool “*Demonstrating appropriateness of allometric equations for estimation of aboveground tree biomass in A/R CDM project activities*”. In this tool, it is stated that an allometric equation can be applied for ex-post carbon estimation if it is derived from the same tree species or the same group of tree species, derived from trees growing in similar edapho-climatic conditions and furthermore lives up to at least one of the following conditions:

- (a) *The equation is used in the national forest inventory, or the national GHG inventory, of the host Party;*
- (b) *The equation has been used in commercial forestry sector of the host Party for ten years or more;*
- (c) *The equation was derived from a data set of at least 30 sample trees, and the value of coefficient of determination (R^2) obtained was not less than 0.85.*

Based on the above requirements, the following allometric equation for AGB (excluding prop roots) developed by Komiyama et al (2005)²⁹ is chosen: $AGB = 0.251 * P * D^{2.46}$, where P is wood density and D is trunk diameter at 30cm above highest prop root.

In the following, the choice of allometric equation for estimating AGB is justified:

Same group of tree species: The mangrove species that has been measured for deriving the allometric equation consists of 104 individual trees, of which 46 is of the *Rhizophora* genus, which qualifies as being the same group of tree species. For the project activities, only *Rhizophora mangle* will be planted.

Trees growing in similar edapho-climatic conditions: The trees are sampled from various regions in Thailand and one region in Indonesia. The trees sampled in Thailand (87 out of 104) is sampled in the regions of Pang-nga, Trat, Satun and Ranong, and the trees sampled in Indonesia (17 out of 104) is sampled in the region Halmahera. All trees are sampled in the tropical climate zone (climate group A) as defined by Köppen-Geiger. PAI#1 is as well situated geographically within the Tropical climate zone (climate group A) as defined by Köppen-Geiger.

²⁹ Komiyama, A., Poungharn, S., Kato, S (2005) Common allometric equations for estimating the tree weight of mangroves

Derived from a data set of at least 30 sample trees: The allometric equation has been derived from the sampling of 104 trees of which 46 is of the *Rhizophora* genus.

Additional argumentation: In the article by Komiyama et al (2005), it is concluded that the developed common allometric equation is applicable for the determination of mangrove biomass in general, if the wood density of the specific species is determined and used for P. Thus, P for the specific species planted in PAI#1, only *Rhizophora* mangle, is applied. In the below section, the choice of P value is presented and justified.

○ *Selection and justification of P value (wood density):*

In a study by Paulo C. C. Virgulino-Júnior et al (2018)³⁰, the wood densities of *Rhizophora mangle* identified in 11 different studies (with study areas covering South America, Central America, North America and Africa) is summarized. In the studies, the wood density identified for *Rhizophora mangle* varies from 0.78 g/cm³ to 1.05 g/cm³. In the African studies, the density of *Rhizophora mangle* varies from 0.91 g/cm³ to 0.98 g/cm³.

According to the United States Department of Agriculture (1984), the wood density of *Rhizophora mangle* is determined to be 0.89³¹.

To be conservative, the wood density for *Rhizophora mangle* in this project is set to 0.78 g/cm³, equalling the lowest of the 12 measured densities referred above.

○ *Calculation of root-biomass:*

In the applicable tool AR-TOOL14 v4.2, it is stated that the root biomass can be determined either through a default equation provided in the tool, or by providing verifiable and transparent information justifying a different value. As the mangrove trees planted has a root-shoot ratio that differs substantially from the root-shoot ratio of a typical terrestrial tree, the default equation is determined as being inaccurate, why a different equation for accurately determining root biomass is needed.

In the study by Komiyama et al (2005) from where the allometric equation determining AGB has been selected, an allometric equation estimating the root biomass (including prop roots) is as well determined and selected for root biomass estimation in this project. The equation is as follows: $\text{Root-biomass} = 0.199 \cdot P^{0.899} \cdot D^{2.22}$, where P is wood density and D is trunk diameter at 30cm above highest prop root. For the same reasons presented above, the P value is in this project conservatively set to 0.78 g/cm³.

³⁰ Paulo C. C. Virgulino-Júnior, Danilo C. L. Gardunho, Diego N. C., Marcus E. B. Fernandes (2018): Wood density in mangrove forests on the Brazilian Amazon coast

³¹ United States Department of Agriculture (1984): Tropical Timbers of the World

○ *Estimation of projected tree density and trunk diameter:*

In the applicable tool AR-TOOL14 v4.2, it is stated that future projected stocking (number of trees per hectare) and average trunk diameter can be modelled through existing data combined with tree growth models. PAI#1 consists as presented in section 1.11 of two different strata. In this estimate, the future average trunk diameter is expected to be the same in all strata. Regarding the future stocking estimate, it is after 30 years expected to be the same because of the ecosystems reaching a natural balance.

○ *Determination of projected stocking:*

In an article by Tamoooh et al (2008)³², the tree density of natural stands of a *Rhizophora* species in Kenya is determined to be 3567 ± 398 , and in an article by Soares et al (2005), the tree density of mangrove areas in Brazil mainly consisting of *Rhizophora mangle* trees was determined to be 4100. Based on these studies, a conservative stocking estimation of 2500 trees per hectare after 30 years is selected. In the strata where approximately 10,000 propagules are planted per hectare, the mortality rate is estimated to be 40% in year 1, 20% in year 2, 20% in year 3, 20% in year 4 and 18% in year 5. In strata where 5000 trees are planted per hectare, the mortality rate is determined to be 25% in year 1, 10% in year 2, 10% in year 3, 10% in year 4 and 8% in year 5.

○ *Determination of projected average trunk diameter:*

As part of the development of this project, a Gambia field mission were conducted in 2022. During the field mission, the average DBH of *Rhizophora* trees planted in 2017 along Bintang Bolon was estimated to be 2.13 cm (5 years of age). In the study by Tamoooh et al (2008) referenced above, the average DBH of *Rhizophora* plantations 6 years of age was determined to be 2.4 ± 0.3 and the average DBH of *Rhizophora* plantations 12 years of age to be 7.9 ± 0.4 .

Based on the above numbers, a conservative average DBH of 1.5 cm is determined at a stand age of 5 years and a conservative average DBH of 4.5 cm at a stand age of 12 years.

In a study by Hutchison et al (2013)³³, global mangrove AGB estimates are modelled based on 95 studies. According to their model, the AGB of mangrove in The Gambia is placed in the mangrove zone containing 120 to 160 tonnes per hectare, but close to the mangrove zone

³² F.Tamoooh, M. Huxham, M.Karachi, M. Mencuccini, J. G. Kairo, B.Kirui (2008): Below-ground root yield and distribution in natural and replanted mangrove forests at Gazi bay, Kenya

³³ James Hutchison, Andrea Manica, Ruth Swetnam, Andrew Balmford, Mark Spalding (2013): Predicting Global Patterns in Mangrove Forest Biomass

containing 80 to 120 tonnes per hectare. To be conservative, it is estimated that the AGB to be expected after 30 years in the project area is 80 tonnes per hectare.

With a mean tree density of 2500 trees, an AGB of 80 tonnes per hectare would, if the AGB equation by Komiyama is applied, equal an average DBH of 7.9 cm.

To summarize, the expected average DBH in specific years are the following:

- 5 years after planting: 1.5 cm
- 12 years after planting: 4.5 cm
- 30 years after planting: 7.9 cm

Based on the DBH estimates above, the following polynomial equation is derived:

$DBH = -0.005x^2 + 0.4133x$, where x is age. Based on the equation, the yearly average DBH for year 1 to 30 is projected. See Figure 7 for DBH model. The DBH growth pattern over time predicted fits well with the DBH growth pattern over time estimated for 12 different common tree species by Peper et al (2001)³⁴.

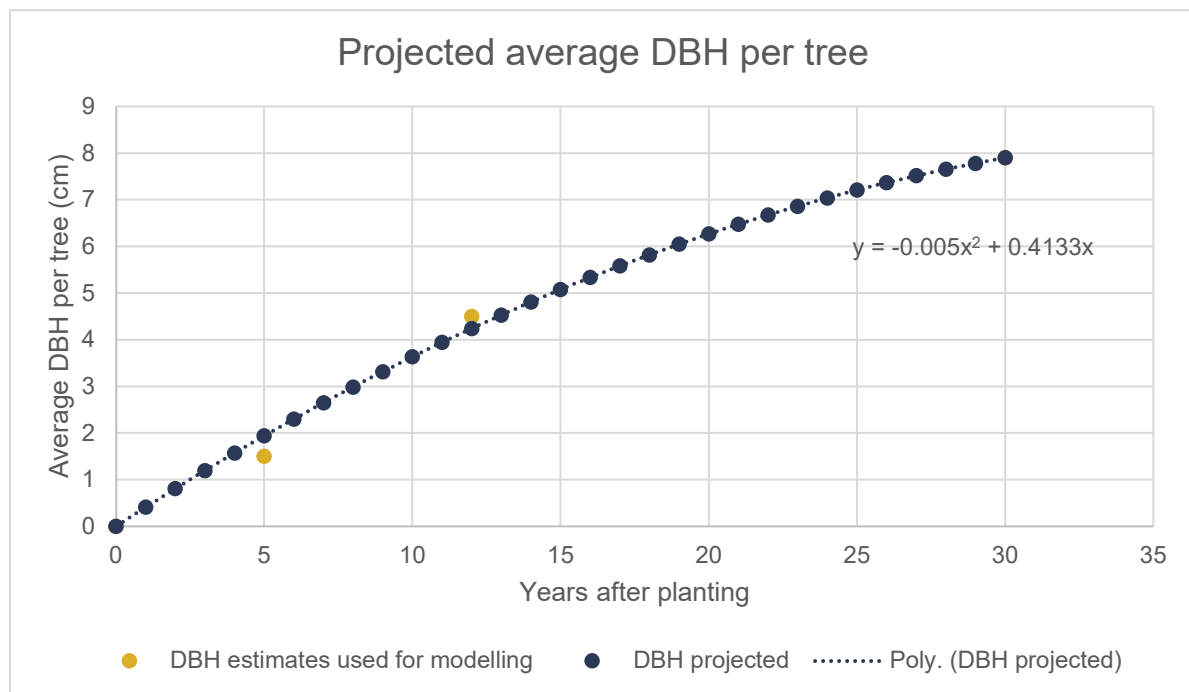


Figure 7: DBH projection

³⁴ Paula J. Peper, E. Gregory McPherson, and Sylvia M. Mori (2001) Equations for predicting Diameter, Height, Crown Width, and Leaf Area of San Joaquin Valley Street trees

Table 15: Overview of the projected DBH and stocking in PAI#1 over the 30 year project crediting period

Year	Average DBH (cm)	Stocking (trees per hectare)
0	0	10000
1	0.4	6000
2	0.8	4800
3	1.2	3840
4	1.6	3072
5	1.9	2519
6	2.3	2500
7	2.6	2500
8	3.0	2500
9	3.3	2500
10	3.6	2500
11	3.9	2500
12	4.2	2500
13	4.5	2500
14	4.8	2500
15	5.1	2500
16	5.3	2500
17	5.6	2500
18	5.8	2500
19	6.0	2500
20	6.3	2500
21	6.5	2500
22	6.7	2500
23	6.9	2500
24	7.0	2500
25	7.2	2500
26	7.4	2500

27	7.5	2500
28	7.7	2500
29	7.8	2500
30	7.9	2500

Estimation of carbon stock change in shrub biomass ($\Delta C_{SHRUB_PROJ,t}$):

The shrub biomass pool is conservatively excluded from both the baseline and the project scenario calculations.

Estimation of carbon stock change in dead wood ($\Delta C_{DW_PROJ,t}$):

According to AR-ACM0003, this parameter is to be calculated using the CDM tool AR-TOOL12. According to this tool it is, if dead wood remains in situ and is not removed from the project boundary through any type of anthropogenic activities, allowed to use a default factor for the estimation of dead wood. As no deadwood is to be removed in the project scenario, the usage of the default factor is applicable to the project and is selected.

The carbon stock in dead wood ($\Delta C_{DW,i,t}$) is through the usage of the default factor (DF_{DW}) estimated as:

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

Where:

$\Delta C_{DW,i,t}$	=	Carbon stock in dead wood in stratum i at a given point of time in year t ; t CO ₂ e
$C_{TREE,i,t}$	=	Carbon stock in trees biomass in stratum i at a point of time in year t , as calculated in the tool “ <i>Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities</i> ”; t CO ₂ e
DF_{DW}	=	Conservative default factor expressing carbon stock in dead wood as a percentage of carbon stock in tree biomass; per cent
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

In the tool, it is stated that the value of the default factor can be estimated based on the amount of yearly rainfall; In the tropical biome below an elevation of 2000 meters, the default factor is set to 1% for areas with an average annual rainfall of 1000-1600 mm, and to 2% for areas with an average annual rainfall of below 1000 mm. According to the word bank³⁵, the average rainfall in the Gambia has between 1980 and 2020 been fluctuating between 586 mm per year (1983) and 1.192 mm per year (1999). To be conservative, the chosen default factor for DF_{DW} is 1%.

Estimation of carbon stock change in litter ($\Delta C_{LI_PROJ,t}$):

The litter biomass pool is conservatively excluded from both the baseline and the project scenario calculations.

Estimation of carbon stock change in soil ($\Delta SOC_{AL,t}$):

According to the applied methodology VM0007, the SOC pool (which classifies as mineral, see section 1.13) shall be calculated using the Verra module M-TW. See section “*Estimation of future net GHG removals from the RWE component*” below for calculation descriptions. As the saplings mature, the SOC will ultimately be stratified based on crown cover in accordance with module M-TW. However, these strata cannot be forecasted.

Estimation of uncertainty for ARR project activities

In the module M-ARR, it is stated that procedures for estimating uncertainty is provided in AR-ACM0003 v2.0. In this document, it is stated that precision requirements are listed in AR-TOOL14 v4.2. In this document, it is stated that ex-ante estimation (projection) of carbon stock in tree biomass is not subjected to uncertainty control.

Long term average in case of harvesting

As the project scenario does not include harvesting, calculating the long-term average GHG-benefit is not relevant.

ARR on wetlands influenced by sea level rise

In M-ARR, it is stated that the procedures presented in module M-TW shall be followed to account for the effect of sea level rise in the project area. In module M-TW, the sea level rise procedure is

³⁵ [Gambia, The - Climatology | Climate Change Knowledge Portal \(worldbank.org\)](#)

divided into two sub-sections; *Carbon loss in biomass and soil* and *Long-term average GHG benefit in ARR-WRC project activities*.

- *Carbon loss in biomass and soil*

In module M-TW it is stated that, depending on the geomorphic setting, soil carbon stocks may be submerged and held intact or be eroded and transported beyond the project area. If biomass is submerged, it must be conservatively assumed that the carbon that it holds is immediately emitted to the atmosphere.

According to the Sea Level Projection Tool developed by Nasa and IPCC, the water level will in 2100 in Dakar, if the IPCC scenario SSP3-7.0 is assumed, have risen with 0.69 meters³⁶. In scenario SSP3-7.0, the average global temperature will have risen with 3.6 degrees in 2100³⁷. With scenario SSP3-7.0 being the second most catastrophic scenario out of the five future scenarios presented by IPCC in their Climate report AR6, assuming that the scenario represents reality in 2100 is the conservative choice.

According to several different studies, *Rhizophora* species adapt very well to significant sea level changes. In a study by Prabakaran (2020)³⁸, a mangrove community response to the 2004 Sumatra-Andaman earthquake resulting in a subsidence of 1.1 meters in the mangrove area was investigated. In the study, it was concluded that *Rhizophora* species, contrary to some of the other mangrove species, were able to adapt to the changing conditions and survive. In another study by Rollon et al (2017)³⁹, the response of planted *Rhizophora* trees to a subsidence-induced sea level rise in the Philippines caused by the 2013 Bohol earthquake which lowered the mangrove area by 0.51 meters was investigated. The study concluded that the planted *Rhizophora* trees were highly adaptable to the abrupt sea level rise, and that they responded rapidly by within three years post-quake having created new prop roots above the pre-quake height limits. In the Philippine study, the *Rhizophora* trees were pre-quake growing in areas with a water level of up to 1.1 meters at high tide. Post-quake, the water level at high tide was measured at 1.6 meters.

With the water level rise happening much more gradually and to a lesser degree in the project area than in the referenced studies above, it can be reasonably assumed that future sea level rise is not expected to have a negative impact on the mangrove trees in the project area.

³⁶ NASA: Sea Level Projection Tool. Webpage: <https://sealevel.nasa.gov/ipcc-ar6-sea-level-projection-tool>, Accessed 21st of October 2022

³⁷ IPCC (2021): Sixth Assessment Report, Chapter 4, Future Global Climate: Scenario-based Projections and Near-term information

³⁸ Prabakaran, N. (2020): Mangrove community response to subsidence inflicted sea level change in Car Nicobar Island, India

³⁹ Rollon, R. N., Villamayor, B. M. R., Oropesa, L. J. B., Samson, M. S. (2017): Prop root production response of planted *Rhizophora* to abrupt subsidence-induced sea level rise

Regarding increased erosion caused by sea level rise it can, as argued in a subsection below where $GHG_{WPS-eroded-CO2,t}$ is calculated, reasonably be assumed that the planted trees and their root system will result in a prevention of erosion that would otherwise more likely have happened without the presence of the planted trees. As a result of such, the net-effect of erosion are in the project scenario conservatively set to zero.

- Long-term average GHG benefit in ARR-WRC project activities

As the projected sea level rise is not expected to have a negative influence on carbon content within the project area, calculating the long-term average GHG benefit is not relevant and are therefore excluded.

Herbaceous vegetation

The carbon pool of herbaceous vegetation is conservatively not included in either the baseline or the project scenario.

Prescribed burning

As prescribed burning of biomass is not part of the project scenario, these calculations are excluded.

Table 16: overview of the projected change in carbon stock in tree biomass ($\Delta C_{TREE_PROJ,t}$), shrub biomass ($\Delta C_{SHRUB_PROJ,t}$), dead wood ($\Delta C_{DW_PROJ,t}$), litter ($\Delta C_{LI_PROJ,t}$) and summarized for the overall ARR project scenario ($\Delta C_{WPS-ARR}$) in PAI#1 over the 30 year project crediting period

Year	$\Delta C_{TREE_PROJ,t}$	$\Delta C_{SHRUB_PROJ,t}$	$\Delta C_{DW_PROJ,t}$	$\Delta C_{LI_PROJ,t}$	$\Delta C_{WPS-ARR}$
1	105.67	0	1.06	0	106.7
2	417.11	0	4.17	0	421.3
3	840.99	0	8.41	0	849.4
4	1286.50	0	12.87	0	1,299.4
5	1733.18	0	17.33	0	1,750.5
6	2566.53	0	25.67	0	2,592.2
7	3582.55	0	35.83	0	3,618.4
8	4761.83	0	47.62	0	4,809.5
9	6096.11	0	60.96	0	6,157.1

10	7575.61	0	75.76	0	7,651.4
11	9189.36	0	91.89	0	9,281.3
12	10,925.47.	0	109.25	0	11,034.7
13	12,771.35.	0	127.71	0	12,899.1
14	14,713.86.	0	147.14	0	14,861.00
15	16,739.51.	0	167.40	0	16,906.91
16	18,834.54.	0	188.35	0	19,022.9
17	20,985.07.	0	209.85	0	21,194.9
18	23,177.17.	0	231.77	0	23,408.9
19	25,396.98.	0	253.97	0	25,650.9
20	27,630.78.	0	276.31	0	27,907.1
21	29,865.04.	0	298.65	0	30,163.7
22	32,086.51.	0	320.87	0	32,407.4
23	34,282.26.	0	342.82	0	34,625.1
24	36,439.76.	0	364.40	0	36,804.2
25	38,546.89.	0	385.47	0	38,932.4
26	40,592.01.	0	405.92	0	40,997.9
27	42,563.98.	0	425.64	0	42,989.6
28	44,452.23.	0	444.52	0	44,896.8
29	46,246.75.	0	462.47	0	46,709.2
30	47,938.15.	0	479.38	0	48,417.5

Estimation of GHG emissions from the RWE component

As stated in the applied methodology VM0007 v1.6, the module M-TW shall be used for calculating the net-emissions from the soil pool of RWE-ARR project activities when the soils classify as mineral. In module M-TW, it is stated that the net GHG emissions from soil in the project scenario is calculated as follows:

$$GHG_{WPS-TW,i,t} = GHG_{WPS-soil-CO2,i,t} - Deduction_{alloch} + GHG_{WPS-soil-CH4,i,t} + GHG_{WPS-soil-N2O,i,t}$$

Where:

$GHG_{WPS-TW,i,t}$	=	GHG emissions from the tidal wetland SOC pool in the project scenario in stratum i in year t ; t CO ₂ e ha/yr
$GHG_{WPS-soil-CO2,i,t}$	=	CO ₂ emissions from the tidal wetland SOC pool in the project scenario in stratum i in year t ; t CO ₂ e ha/yr
$Deduction_{alloch}$	=	Deduction from CO ₂ emissions from the SOC pool to account for the percentage of the carbon stock that is derived from allochthonous soil organic carbon; t CO ₂ e ha/yr
$GHG_{WPS-soil-CH4,i,t}$	=	CH ₄ emissions from the tidal wetland SOC pool in the project scenario in stratum i in year t ; t CO ₂ e ha/yr
$GHG_{WPS-soil-N2O,i,t}$	=	N ₂ O emissions from the tidal wetland SOC pool in the project scenario in stratum i in year t ; t CO ₂ e ha/yr
i	=	1, 2, 3 ... M_{BSL} strata in the project scenario
t	=	1, 2, 3, ... t^* years elapsed since the project start date

Estimation of baseline CO₂ emissions from the SOC pool ($GHG_{WPS-soil-CO2,i,t}$):

$$GHG_{WPS-soil-CO2,i,t} = GHG_{WPS-insitu-CO2,i,t} + GHG_{WPS-eroded-CO2,i,t} + GHG_{WPS-exav-CO2,i,t}$$

Where:

$GHG_{WPS-soil-CO2,i,t}$	=	CO ₂ emissions from the tidal wetland SOC pool in the project scenario in stratum i in year t ; t CO ₂ e ha/yr
$GHG_{WPS-insitu-CO2,i,t}$	=	CO ₂ emissions from the tidal wetland SOC pool of in-situ soils in the project scenario in stratum i in year t ; t CO ₂ e ha/yr
$GHG_{WPS-eroded-CO2,i,t}$	=	CO ₂ emissions from the eroded tidal wetland SOC pool in the project scenario in stratum i in year t ; t CO ₂ e ha/yr
$GHG_{WPS-exav-CO2,i,t}$	=	CO ₂ emissions from the tidal wetland SOC pool of soil exposed to an aerobic environment through excavation in the project scenario in stratum i in year t ; t CO ₂ e ha/yr

Calculation of $GHG_{WPS-insitu-CO2,i,t}$:

In M-TW, it is stated that $GHG_{WPS-insitu-CO2,i,t}$ shall be calculated using the same procedures as set out in module BL-TW. In module BL-TW, it is stated that $GHG_{WPS-insitu-CO2,i,t}$ can be estimated using a default value of -1.46 t C/ha/yr. The default value can be applied once the crown cover

has reached at least 50%. In this project, the default value is chosen for determining $GHG_{WPS-insitu-CO2,i,t}$. It is projected that a crown cover of 50% is reached 3 years after planting.

When the default value is compared with values generated from other studies investigating the SOC accumulation in mangroves under similar conditions as the mangrove planted in the project area, the applied default value (which is derived from a study investigating carbon accumulation rates in mangrove ecosystems not limited to newly restored ones⁴⁰) can be classified as very conservative. For instance, the study by Yu et al from 2021⁴¹ where the SOC of a mudflat, a 15-year-old mangrove and a 45-year-old mangrove in China is estimated. The investigated area is, like the project area, situated in the Köppen climate sub-category Aw, with one of the dominating genres in the study area being *Rhizophora*. In the study, there is estimated a carbon content of 111.23 ± 13.62 t C/ha in the mudflat, 150.41 ± 13.09 t C/ha in the 15-year-old mangrove and 234.45 ± 16.36 in the 45-year-old mangrove. From this data, an average sequestration rate of 2.6 t C/ha/yr can be calculated between year 0 and 15, and 2.8 t C/ha/yr between year 15 and 45. Another example of a study identifying considerably higher SOC burial rates in newly restored mangrove is the one by Adame et al (2018)⁴² conducted in Indonesia, which found an accumulation rate of 2.9 t C/ha/year over the first 50 years following planting.

In the studies by Yu et al (2021) and Adame et al (2018), the soil carbon sequestration rate in a mangrove ecosystem of more than 50 years of age was investigated as well. In both studies, the SOC accumulation rate was found to decrease considerably when compared with the accumulation rate in the younger mangrove forest. A reasonable explanation of the decrease in accumulation rate can be that the mangrove ecosystems are getting closer to a carbon equilibrium. As the default value is based on a study investigating the carbon sequestration rates in all kinds of mangrove and not just newly restored ones, it is plausible that the lower default value identified can be attributed to the SOC sequestration rates being lower in older mangrove ecosystems when compared to newer ones.

To summarize, applying the default value is based on the above scientific literature and reasoning the conservative choice.

Calculation of $GHG_{WPS-eroded-CO2,i,t}$:

In M-TW, it is stated that for each stratum it must be determined whether soil erosion occurs. The planting of mangrove trees will because of the establishment of a root system and because of the trees acting as protection against waves, result in less erosion when compared to the amount

⁴⁰ Chmura, G.L., Anisfeld, S.C., Cahoon, D.R. and Lynch, J.C. 2003. Global carbon sequestration in tidal, saline wetland soils. *Global Biogeochemical Cycles* 17: 1111-1123

⁴¹ Yu, C., Guan, D., Gang, W., Lou, D., Wei, L., Zhou, Y., Feng, J. (2021): Development of ecosystem carbon stock with the progression of a natural mangrove forest in Yingluo Bay, China

⁴² Adame M.F., Zakaria R.M.m, Fry B., Chong V.C., Then Y.H.A., Brown C.J. and Lee S.Y. (2018): Loss and recovery of carbon and nitrogen after mangrove clearing. *Ocean and Coastal Management* 161: 117-126

of erosion in the baseline scenario. To be conservative, erosion is set to zero in both the project and the baseline scenario.

Calculation of $GHG_{WPS-exav-CO_2,i,t}$

In a smaller section of the project area of PAI#1 (Joreng community, polygon ID P5, P6, and P7), canals have been excavated to allow for the natural hydrology to be re-established. As part of the excavation, a smaller amount of soil has been exposed to partly aerobic conditions (see picture 1 in section 1.13).

The amount of soil dug up can be estimated through the following equation:

Total area dug up in m^3 x depth of canals dug in m x soil bulk density x SOC%

Total area dug up in m^3 and depth of canals dug has been conservatively estimated through site inspections and through inspection of detailed satellite imagery of the area post-excavation. Here, the amount of area dug up was conservatively estimated to be 5% of the total Joreng planting area. The depth of canals dug was through site inspection conservatively estimated to be 0.15 meters on average.

soil bulk density and *SOC%* has been conservatively estimated based on existing scientific literature. In the studies referenced above by Yu et al (2021) and Adame et al (2018) above, the bulk density of the topsoil layer of a mudflat was estimated to be 0.77 g/cm³ and of a clear cut mangrove to be 0.46 g/cm³. To be conservative, the bulk density is for these calculations estimated to be 0.8 g/cm³. In the same studies, the SOC% in the topsoil layer of the mudflat and the clear cut mangrove was estimated at below 2% for the mudflat and 6.3% for the clear cut mangrove. To be conservative, SOC% is in these calculations estimated to be 10%.

Based on the above conservative estimates, the amount of CO₂ emitted due to carbon exposed to aerobic conditions is 1249,38 t, equalling 1,47% of the total CO₂ sequestration expected from the project.

In the CDM tool *Tool for testing significance of GHG emissions in A/R CDM project activities V1*, it is stated that the sum of decreases in carbon pools and increases in emissions that may be neglected shall be less than 5% of the total decreases in carbon pools and increases in emissions, or less than 5% of net anthropogenic removals by sinks, whichever is lower.

As the soil excavation emissions along with the fossil fuel emissions presented later in this section of the PD are the only emissions sources considered in the assessment of *de minimis* emissions, they can as they together constitute less than 5 % of the total net-removals be classified as *de minimis* and therefore set to zero.

An excel file containing the soil excavation calculations is available to the auditor on request.

Calculation of $Deduction_{alloch}$:

In module BL-TW, it is stated that the determination of the deduction for allochthonous carbon is mandatory for the project scenario unless the project proponent can demonstrate that the allochthonous carbon would have been returned to the atmosphere in the form of carbon dioxide in the absence of the project. It is as well stated that the deduction must be calculated using the procedures set out in module BL-TW.

In module BL-TW, it is stated that peer reviewed published data may be used for estimating the percentage of allochthonous carbon in the accumulating SOC. The data must have been derived from the same or similar systems as those in the project area based on the guidelines described in the module. In the guidelines, it is stated that the published data must be from systems that are in the same or similar region as the project area, share similar geomorphic, hydrologic, and biological properties, and are under similar management regimes unless any differences should not have a substantial effect on GHG emissions.

In a study by Xiong et al (2018)⁴³, the accumulating SOC divided into allochthonous and autochthonous carbon in a mangrove area in China is investigated, by comparing the SOC content and composition of an intact mangrove area with the SOC content and composition of an adjacent mudflat.

The area investigated in the study is situated in the Köppen climate sub-category Aw, which is the same Köppen climate sub-category as the project area in this project. In the study, the SOC of areas with the same mangrove genus (*Rhizophora*) as planted in this project is amongst others being investigated. To conclude, the data from the study lives up to the requirements set out in module BL-TW, making it applicable for usage for the published value approach.

In the study, it was found that soil allochthonous carbon densities in *Rhizophora* mangrove forests (and the mangrove forests in general) were similar to or slightly higher than that in the mudflat, when calculated using the leaf litter as the proxy of mangrove C isotope composition. When calculated using the fine roots as the proxy of mangrove C isotope composition, soil allochthonous C densities in *Rhizophora* mangrove forests (and the mangrove forests in general) were similar to or slightly lower than that of the mudflat. The SOC accumulating in the *Rhizophora* mangrove (and the mangrove forests in general) is in the study therefore attributed to the autochthonous carbon.

Based on the results of the study, $Deduction_{alloch}$ is in this project set to zero.

Calculation of $GHG_{WPS-soil-CH_4,i,t}$:

⁴³ Xiong, Y., Liao, B., Wang, F. (2018): Mangrove vegetation enhances soil carbon storage primarily through in situ inputs rather than increasing allochthonous sediments

In M-TW, it is stated that $GHG_{WPS-soil-CH_4,i,t}$ shall be calculated using the same procedures as set out in module BL-TW. In module BL-TW, it is stated that if the salinity level (either salinity average or salinity low point) equals or is above 20 ppt, a default factor for $GHG_{WPS-soil-CH_4,i,t}$ can be calculated as follows:

$$GHG_{WPS-soil-CH_4,i,t} = 0.0056 \text{ t CH}_4 \text{ ha yr} \times CH_4_GWP,$$

Where CH₄-GWP is the global warming potential of CH₄ as defined by IPCC in their fifth assessment report (AR5). In this report, CH₄_GWP is defined as being 28.

In module M-TW, it is stated that salinity can be measured directly in the shallow pore water (within 30 cm from soil surface). It is as well stated that salinity can be measured in the main floodwater source which can then act as a proxy for the salinity level of the pore water in the project area, if measurements are performed in the wet season and if the source floods the wetland at least on 20% of high tides. If the number of measurements is small, the salinity low point shall be applied.

For estimating the salinity content in PAI#1, measurements have been performed in both pore water, in the water covering the project area during high tide and at the river edge in the Bintang Bolon river adjacent to the project area. Please see section 1.13 for more information on the measurements. As all the performed measurements is above 20 ppm, the default factor can be applied.

As described in Section 4.1. *Baseline emissions* of this PD, the methane emissions in the baseline scenario are the same as the methane emissions in the project scenario, meaning that they cancel each other out and results in net zero methane emissions in the project scenario.

Calculation of $GHG_{WPS-soil-N_2O,i,t}$:

In M-TW, it is stated that $GHG_{WPS-soil-N_2O,i,t}$ shall be calculated using the same procedures as set out in module BL-TW. In module BL-TW, it is stated that a default factor can be used for estimating $GHG_{WPS-soil-N_2O,i,t}$, if the project area does not receive hydrologically direct input from a point or non-point source of nitrogen. For non-seagrass wetland systems where the salinity average or salinity low point is >18 ppt, $GHG_{WPS-soil-N_2O,i,t}$ can be calculated as follows:

$$GHG_{WPS-soil-N_2O,i,t} = 0.000487 \text{ t N}_2\text{O ha yr} \times N_2O_GWP,$$

Where N₂O_GWP is the global warming potential of N₂O as defined by IPCC in their fifth assessment report (AR5). In this report, N₂O_GWP is defined as being 265.

In module M-TW, it is stated that salinity can be measured directly in the shallow pore water (within 30 cm from soil surface). It is as well stated that salinity can be measured in the main floodwater source which can then act as a proxy for the salinity level of the pore water in the project area, if measurements are performed in the wet season and if the source floods the

wetland at least on 20% of high tides. If the number of measurements is small, the salinity low point shall be applied.

For estimating the salinity content in PAI#1, measurements have been performed in both pore water, in the water covering the project area during high tide and at the river edge in the Bintang Bolon river adjacent to the project area. Please see section 1.13 for more information on the measurements. As all the performed measurements is above 18 ppm, the default factor can be applied.

As described in Section 4.2 *Project emissions* of this PD, the N₂O emissions in the baseline scenario are the same as the N₂O emissions in the project scenario, meaning that they cancel each other out and results in net-zero N₂O emissions in the project scenario.

Table 17: overview of the CO₂e emissions from the SOC pool (GHG_{WPS-soil-CO₂,I,t}), Allochthonous carbon deduction (Deduction_{alloch}), CH₄ emissions from the SOC pool (GHG_{WPS-soil-CH₄,I,t}), N₂O emissions from the SOC pool (GHG_{WPS-soil-N₂O,I,t}) and the overall summering of the GHG emissions in the WRC project scenario (GHG_{WPS-TW,I,t}) for PAI#1 in the 30 year project crediting period

Year	GHG _{WPS-soil-CO₂,I,t}	Deduction _{alloch}	GHG _{WPS-soil-CH₄,I,t}	GHG _{WPS-soil-N₂O,I,t}	GHG _{WPS-TW,I,t}
1	0.0	0	36.9	30.4	67.3
2	0.0	0	73.8	60.8	134.6
3	-1260.5	0	110.8	91.2	-1058.6
4	-2521.0	0	147.7	121.5	-2251.8
5	-3781.5	0	184.6	151.9	-3444.9
6	-5042.0	0	221.5	182.3	-4638.1
7	-6302.5	0	258.4	212.7	-5831.3
8	-7563.0	0	295.4	243.1	-7024.5
9	-8823.5	0	332.3	273.5	-8217.7
10	-10,084.0	0	369.2	303.9	-9410.9
11	-11,344.5	0	406.1	334.3	-10,604.1
12	-12,604.9	0	443.0	364.6	-11,797.3
13	-13,865.4	0	480.0	395.0	-12,990.4
14	-15,125.9	0	516.9	425.4	-14,183.6
15	-16,386.4	0	553.8	455.8	-15,376.8
16	-17,646.9	0	590.7	486.2	-16,570.0

17	-18,907.4	0	627.6	516.6	-17,763.2
18	-20167.9	0	664.6	547.0	-18,956.4
19	-21,428.4	0	701.5	577.4	-20,149.6
20	-22,688.9	0	738.4	607.7	-21,342.8
21	-23,949.4	0	775.3	638.1	-22,535.9
22	-25,209.9	0	812.2	668.5	-23,729.1
23	-26,470.4	0	849.2	698.9	-24,922.3
24	-27,730.9	0	886.1	729.3	-26,115.5
25	-28,991.4	0	923.0	759.7	-27,308.7
26	-30,251.9	0	959.9	790.1	-28,501.9
27	-31,512.4	0	996.8	820.5	-29,695.1
28	-32,772.9	0	1033.8	850.8	-30,888.3
29	-34,033.4	0	1070.7	881.2	-32,081.4
30	-35,293.8	0	1107.6	911.6	-33,274.6

Maximum Eligible Quantity of GHG Removals

As stated in the applied methodology VM0007 v1.6, the module X-STR shall be used to calculate the maximum eligible quantity of GHG emission removals from the soil carbon pool, which is limited to the difference between the remaining carbon stock in the project scenario and baseline scenario after 100 years. As there is no leakage as justified in Section 4.3, the maximum eligible quantity of GHG emissions removals is calculated using the following total stock approach formula:

$$C_{WPS-BSL,t100} = \sum_{i=0}^{M_{WPS}} (C_{WPS,i,t100} \times A_{WPS,i,t100}) - \sum_{i=0}^{M_{BSL}} (C_{BSL,i,t100} \times A_{BSL,i,t100})$$

Where:

- $C_{WPS-BSL,t100}$ = Difference between soil organic carbon stock in the project scenario and baseline scenario in stratum i at $t = 100$ (t C)
- $C_{WPS,i,t100}$ = Soil organic carbon stock in the project scenario in stratum i at $t = 100$ (t C ha⁻¹)
- $C_{BSL,i,t100}$ = Soil organic carbon stock in the baseline scenario in stratum i at $t = 100$ (t C ha⁻¹)

$A_{WPS,i,t100}$	=	Area of project stratum i at $t = 100$ (ha)
$A_{BSL,i,t100}$	=	Area of baseline stratum i at $t = 100$ (ha)
M_{WPS}	=	Total number of strata in the project scenario
M_{BSL}	=	Total number of strata in the baseline scenario
i	=	1, 2, 3, ... M stratum of the scenario
t	=	1, 2, 3, ... t^* years elapsed since the project start date

Calculation of $C_{WPS,i,t100}$

The applied methodology allows in module BL-TW and M-TW for the use of default values to account for the increase in carbon stock in the soil pool. In BL-TW, the default value carbon stock in tidal and mangrove systems is provided as $-1.46 \text{ t C ha}^{-1}\text{yr}^{-1}$. This is then multiplied by the years of at least 50% crown cover under the project scenario.

Calculation of $C_{BSL,i,t100}$

As crown cover is expected to remain at 15% or less in the baseline scenario, the soil organic carbon is expected to not increase, as it is assumed to be insignificant and accounted for as zero. In fact, they are highly likely to decrease due to ongoing oxidation of C present in the soil – however this factor has conservatively been excluded from these calculations. Therefore $C_{BSL,i,t100}$ is assigned a value of 0.

While PAI#1 has two strata, the carbon is expected to develop in the same way in both strata. As such, only one calculation is performed. The calculations for soil organic carbon stock in the project and baseline scenario at 100 years is shown in Table 18.

Table 18: Maximum eligible quantity of GHG emission from soil carbon pool after 100 years for both PAI#1 and per hectare.

	Area (ha)	$C_{BSL,i,t100}$	$C_{WPS,i,t100}$	$C_{WPS-BSL,t100}$
Per Hectare	1	0	-143.08	-143.08
Per PAI#1	235.46	0	-33,689.58	-33,689.58

The difference between the carbon stock in the project scenario and baseline scenario at $t = 100$ ($C_{WPS-BSL,t100}$) is significant if:

$$\sum_{i=0}^{M_{WPS}} (C_{WPS,i,t100} \times A_{WPS,i,t100}) \geq 1.05 \times \sum_{i=0}^{M_{BSL}} (C_{BSL,i,t100} \times A_{BSL,i,t100})$$

Seeing that the carbon stock in the project scenario is much greater than the baseline scenario of the calculated significance threshold of 0, the difference between the carbon stock in the project scenario and that of the baseline scenario is significant.

Estimation of GHG emissions from fossil fuel combustion

As stated in the applied methodology VM0007 v1.6, module E-FFC must be used for calculating the emissions from fossil fuel combustion in the project scenario. According to the conservative calculations, the emissions from fossil fuel combustion is 0.171 t CO₂e per hectare over the 30-year project period. When compared to the total expected emission removals from 1 hectare over 30 years of 355.5 t CO₂e, the fuel combustion emissions equals 0.047% of the total emission removals.

In the CDM tool *Tool for testing significance of GHG emissions in A/R CDM project activities V1*, it is stated that the sum of decreases in carbon pools and increases in emissions that may be neglected shall be less than 5% of the total decreases in carbon pools and increases in emissions, or less than 5% of net anthropogenic removals by sinks, whichever is lower.

As the fossil fuel emissions along with the soil excavation emissions are the only emissions sources considered in the assessment of *de minimis* emissions, they can as they together constitute less than 5% of the total net-removals be classified as *de minimis* and therefore set to zero.

An excel file containing fuel combustion calculations is available to the auditor upon request.

4.3 Leakage

In the applied methodology VM0007 v1.6, it is stated that module LK-ECO must be used for calculating leakage from WRC project activities, and that module LK-ASP must be used for calculating leakage from RWE-ARR project activities. As the project activities applied in PAI#1 is both WRC and RWE-ARR, both modules are applied to calculate the leakage effect.

In VM0007 v1.6, it is also stated that any GHG emission increases related to leakage prevention activities shall be accounted for. In this project however, no leakage prevention activities are performed, why there is no GHG emissions related to such to account for.

In VM0007v1.6, it is furthermore stated that where applicable, leakage due to market effects must be considered using module LK-ME, and that unsustainable fuelwood collection must be considered using module BL-DFW and LK-DFW. However, as no anthropogenic activities were present pre-project in PAI#1, such leakage analyses are not applicable to PAI#1.

Should any future added PAIs include other project activities or pre-project activities that require the inclusion of additional leakage modules, such will be included in a future updated PD.

Module LK-ECO: Estimation of emissions from ecological leakage

In the module, it is stated that the project must be designed in such a way that ecological leakage does not occur. This is secured by designing the project in a manner that ensures that the hydrological connectivity with adjacent areas does not lead to a significant increase in GHG emissions outside the project area.

In PAI#1 or any other future added instances, none of the project activities leads to any form of negative leakage outside of the project area. It is a possibility that the excavated canals in some areas of PAI#1 will result in some of the adjacent area becoming slightly wetter. However, this will not result in higher emissions outside of the project area as the following does not apply:

- **Convert non-wetlands to wetlands:** The only activities implemented that slightly changes the hydrology of adjacent areas are excavation activities in a minor part of the project area (Picture 6). The excavation work only results in better hydrological connectivity between the river body and the mudflat and is only taking place within the degraded wetland habitat. This is proved through remote sensing imagery covering all areas in which excavation work has been performed. The imagery is available to the auditor upon request.
- **Vegetated to non-vegetated:** No decrease of vegetation is occurring in the areas where excavation is performed in as no vegetation is present to begin with. This is proved through remote sensing imagery which is available to the auditor upon request.
- **Increase GHG emissions in existing wetlands:** Not only is the hydrological engineering limited in scope, but the purpose of the activity is to increase water flow and plantability of mangroves in mudflats, which will uptake carbon. Further, increased inundation will turn the area more anaerobic, which leads to less carbon oxidation.
- **Lower the water table in surrounding wetlands:** The project areas' surrounding areas all have direct connection with the ocean via Bitang Bolong. As such, it is impossible for the surrounding areas to have lowered water table.



Picture 6. Image of excavation done in Joreng to increase water flow.

Due to the above conditions, ecological leakage is in this project set to zero.

Module LK-ASP: Estimation of emissions from activity shifting for avoiding planned deforestation/forest degradation and avoiding planned wetland degradation

As no anthropogenic activities are present in PAI#1 prior to project implementation, no activity shifting leakage can arise because of the project activities. Therefore, leakage from shifting activities is in this project set to zero.

4.4 Net GHG Emission Reductions and Removals

Calculation of net GHG emission removals

As described in the applied methodology VM0007, the total net greenhouse gas emissions removals of the project are calculated as follows:

$$NER_{REDD+} = NER_{REDD} + NGR_{ARR} + NER_{WRC}$$

Where:

$$NER_{REDD+} = \text{Total net GHG emission reductions of the REDD+ project activity up to year } t^*; \text{ t CO}_2\text{e}$$

NER_{REDD}	=	Total net GHG emission reductions of the REDD project activity up to year t^* ; t CO ₂ e
NGR_{ARR}	=	Total net GHG removals of the ARR project activity up to year t^* ; t CO ₂ e
NER_{WRC}	=	Total net GHG emission removals of the WRC project activity up to year t^* ; t CO ₂ e

For each new PAI, a NER_{REDD+} value will be calculated as the PAIs are added to the grouped project.

Calculation of NER_{REDD} :

As no REDD project activities are included in PAI#1 or future instances, NER_{REDD} is set to zero.

Calculation of NGR_{ARR} :

In the applied methodology VM0007, it is stated that NGR_{ARR} is calculated as follows:

$$NGR_{ARR} = \Delta C_{WPS-ARR} - \Delta C_{BSL-ARR} - \Delta C_{LK-ARR}$$

Where:

NGR_{ARR}	=	Total net GHG removals of the ARR project activity up to year t^* ; t CO ₂ e
$\Delta C_{WPS-ARR}$	=	Net GHG removals in the ARR project scenario up to year t^* (from Module M-ARR); t CO ₂ e
$\Delta C_{BSL-ARR}$	=	Net GHG removals in the ARR baseline scenario up to year t^* (from Module BL-ARR); t CO ₂ e
ΔC_{LK-ARR}	=	Net GHG emissions due to leakage from the ARR project activity up to year t^* ; t CO ₂ e

For calculation of $\Delta C_{WPS-ARR}$, see Section 4.2 of this PD. For calculation of $\Delta C_{BSL-ARR}$, see Section 4.1 of this PD. Leakage for PAI#1 is set to zero. For estimations of leakage, see Section 4.3 of this PD.

Table 19: Overview of emission removals from the ARR component in the baseline scenario ($GHG_{BSL-ARR}$), the project scenario ($GHG_{WPS-ARR}$), leakage (GHG_{LK-ARR}) and the overall net-emissions removals (NER_{ARR}) during the 30-year project crediting period for PAI#1

Year	$\Delta C_{BSL-ARR}$	$\Delta C_{WPS-ARR}$	ΔC_{LK-ARR}	NGR_{ARR}
------	----------------------	----------------------	---------------------	-------------

1	0	106.7	0	106.7
2	0	421.3	0	421.3
3	0	849.4	0	849.4
4	0	1299.4	0	1299.4
5	0	1750.5	0	1750.5
6	0	2592.2	0	2592.2
7	0	3618.4	0	3618.4
8	0	4809.5	0	4809.5
9	0	6157.1	0	6157.1
10	0	7651.4	0	7651.4
11	0	9281.3	0	9281.3
12	0	11,034.7	0	11,034.7
13	0	12,899.1	0	12,899.1
14	0	14,861.00	0	14,861.00
15	0	16,906.91	0	16,906.91
16	0	19,022.9	0	19,022.9
17	0	21,194.9	0	21,194.9
18	0	23,408.9	0	23,408.9
19	0	25,650.9	0	25,650.9
20	0	27,907.1	0	27,907.1
21	0	30,163.7	0	30,163.7
22	0	32,407.4	0	32,407.4
23	0	34,625.1	0	34,625.1
24	0	36,804.2	0	36,804.2
25	0	38,932.4	0	38,932.4
26	0	40,997.9	0	40,997.9
27	0	42,989.6	0	42,989.6
28	0	44,896.8	0	44,896.8
29	0	46,709.2	0	46,709.2
30	0	48,417.5	0	48,417.5

Calculation of NER_{WRC} :

In the applied methodology VM0007, it is stated that NER_{WRC} is calculated as follows:

$$NER_{WRC} = GHG_{BSL-WRC} - GHG_{WPS-WRC} - GHG_{LK-WRC}$$

Where:

NER_{WRC}	=	Total net GHG emission removals in the WRC project up to year t^* ; t CO ₂ e
$GHG_{BSL-WRC}$	=	Net GHG emissions in the WRC baseline scenario up to year t^* ; t CO ₂ e
$GHG_{WPS-WRC}$	=	Net GHG emissions in the WRC project scenario up to year t^* ; t CO ₂ e
GHG_{LK-WRC}	=	Net GHG emissions due to leakage from the WRC project activity up to year t^* ; t CO ₂ e

In VM0007, it is stated that $GHG_{BSL-WRC}$ for RWE-ARR project activities is calculated as follows:

$$GHG_{BSL-WRC} = GHG_{BSL-PEAT} + GHG_{BSL-TW} + GHG_{BSL-fuel}$$

Where:

$GHG_{BSL-WRC}$	=	Net GHG emissions in the WRC baseline scenario up to year t^* ; t CO ₂ e
$GHG_{BSL-PEAT}$	=	Net GHG emissions in the WRC baseline scenario on peatland up to year t^* ; t CO ₂ e
GHG_{BSL-TW}	=	Net GHG emissions in the WRC baseline scenario on tidal wetland up to year t^* ; t CO ₂ e
$GHG_{BSL-fuel}$	=	Net CO ₂ e emissions from fossil fuel use in the baseline scenario up to year t^* (from Module BL-TW); t CO ₂ e

As no peat soils are present in PAI#1, $GHG_{BSL-PEAT}$ is set to zero. As accounted for in Section 3.3 of this PD, $GHG_{BSL-FUEL}$ is conservatively excluded from the baseline scenario calculations. For calculations of GHG_{BSL-TW} , see Section 4.1.

In VM0007, it is stated that $GHG_{WPS-WRC}$ is calculated as follows:

$$GHG_{WPS-WRC} = GHG_{WPS-PEAT} + GHG_{WPS-TW}$$

Where:

$$\begin{aligned}
 GHG_{WPS-WRC} &= \text{Net GHG emissions in the WRC project scenario up to year } t^*; \text{ t CO}_2\text{e} \\
 GHG_{WPS-PEAT} &= \text{Net GHG emissions in the WRC project scenario on peatland up to year } t^*; \text{ t CO}_2\text{e} \\
 GHG_{WPS-TW} &= \text{Net GHG emissions in the WRC project scenario on tidal wetland up to year } t^*; \text{ t CO}_2\text{e}
 \end{aligned}$$

As no peat soils are present in PAI#1, $GHG_{WPS-PEAT}$ is set to zero. For calculations of GHG_{WPS-TW} , see Section 4.2.

In VM0007, it is stated that GHG_{LK-WRC} is calculated as follows:

$$GHG_{LK-WRC} = GHG_{LK-WRC-AS,planned} + GHG_{LK-WRC-AS,unplanned} + GHG_{LK-ECO}$$

Where:

$$\begin{aligned}
 GHG_{LK-WRC} &= \text{Net GHG emissions due to leakage from the WRC project activity up to year } t^*; \text{ t CO}_2\text{e} \\
 GHG_{LK-WRC-AS,planned} &= \text{Net GHG emissions due to wetland degradation from planned deforestation displaced from the project area up to year } t^* \text{ (from Module LK-ASU); t CO}_2\text{e} \\
 GHG_{LK-WRC-AS,unplanned} &= \text{Net GHG emissions due to wetland degradation from unplanned deforestation displaced from the project area up to year } t^* \text{ (from Module LK-ASU); t CO}_2\text{e} \\
 GHG_{LK-ECO} &= \text{Net GHG emissions due to ecological leakage from the WRC project activity up to year } t^* \text{ (from Module LK-ECO); t CO}_2\text{e}
 \end{aligned}$$

Leakage for PAI#1 is set to zero. For estimations of leakage, see Section 4.3 of this PD.

Table 20: Overview of emissions from the WRC component in the baseline scenario ($GHG_{BSL-WRC}$), the project scenario ($GHG_{WPS-WRC}$), from leakage (GHG_{LK-WRC}) and from the overall net-emissions removals (NER_{WRC}) during the 30 year project crediting period for PAI#1

Year	$GHG_{BSL-WRC}$	$GHG_{WPS-WRC}$	GHG_{LK-WRC}	NER_{WRC}
1	67.3	67.3	0	0
2	134.6	134.6	0	0

3	201.9	-1058.6	0	1260.5
4	269.2	-2251.8	0	2521.0
5	336.5	-3445.0	0	3781.5
6	403.8	-4638.1	0	5042.0
7	471.2	-5831.3	0	6302.5
8	538.5	-7024.5	0	7563.0
9	605.8	-8217.7	0	8823.5
10	673.1	-9410.9	0	10,084.0
11	740.4	-10,604.1	0	11,344.5
12	807.7	-11,797.3	0	12,604.9
13	875.0	-12,990.5	0	13,865.4
14	942.3	-14,183.6	0	15,125.9
15	1009.6	-15,376.8	0	16,386.4
16	1076.9	-16,570.0	0	17,646.9
17	1144.2	-17,763.2	0	18,907.4
18	1211.5	-18,956.4	0	20,167.9
19	1278.8	-20,149.6	0	21,428.4
20	1346.1	-21,342.8	0	22,688.9
21	1413.5	-22,535.9	0	23,949.4
22	1480.8	-23,729.1	0	25,209.9
23	1548.1	-24,922.3	0	26,470.4
24	1615.4	-26,115.5	0	27,730.9
25	1682.7	-27,308.7	0	28,991.4
26	1750.0	-28,501.9	0	30,251.9
27	1817.3	-29,695.1	0	31,512.4
28	1884.6	-30,888.3	0	32,772.9
29	1951.9	-32,081.4	0	34,033.4
30	2019.2	-33,274.6	0	35,293.8

Total net-GHG emission reductions and removals for PAI#1

Table 21: Summation of the total net greenhouse gas emissions removals over the 30-year project period for PAI#1

Year	Estimated baseline emissions or removals (tCO ₂ e)	Estimated project emissions or removals (tCO ₂ e)	Estimated leakage emissions (tCO ₂ e)	Estimated net GHG emission reductions or removals (tCO ₂ e)
1	-67.3	39.4	0	106.7
2	-134.6	286.7	0	421.3
3	-201.9	1908.0	0	2109.9
4	-269.2	3551.1	0	3820.4
5	-336.5	5195.5	0	5532.0
6	-403.8	7230.3	0	7634.2
7	-471.2	9449.7	0	9920.8
8	-538.5	11,834.0	0	12,372.4
9	-605.8	14,374.8	0	14,980.5
10	-673.1	17,062.2	0	17,735.3
11	-740.4	19,885.3	0	20,625.7
12	-807.7	22,832.0	0	23,639.7
13	-875.0	25,889.5	0	26,764.5
14	-942.3	29,044.6	0	29,986.9
15	-1009.6	32,283.7	0	33,293.3
16	-1076.9	35,592.9	0	36,669.8
17	-1144.2	38,958.1	0	40,102.3
18	-1211.5	42,365.3	0	43,576.9
19	-1278.8	45,800.5	0	47,079.4
20	-1346.1	49,249.8	0	50,596.0
21	-1413.5	52,699.6	0	54,113.1
22	-1480.8	56,136.5	0	57,617.3
23	-1548.1	59,547.4	0	61,095.5
24	-1615.4	62,919.7	0	64,535.0
25	-1682.7	66,241.1	0	67,923.7

26	-1750.0	69,499.8	0	71,249.8
27	-1817.3	72,684.7	0	74,502.0
28	-1884.6	75,785.0	0	77,669.6
29	-1951.9	78,790.7	0	80,742.6
30	-2019.2	81,692.2	0	83,711.4

Total net-GHG emission reductions and removals for overall project

Table 22: Total net greenhouse gas emissions removals over the 30-year project period for the project goal of 10,000 ha using baseline and project emissions or removals.

Year	Estimated baseline emissions or removals (tCO ₂ e)	Estimated project emissions or removals (tCO ₂ e)	Estimated leakage emissions (tCO ₂ e)	Estimated net GHG emission reductions or removals (tCO ₂ e)
1	-67.3	39.4	0	106.7
2	-992.2	789.0	0	1781.2
3	-2917.5	6146.5	0	9064.0
4	-5776.1	32,668.4	0	38444.5
5	-8634.6	82,776.1	0	91410.7
6	-11,493.2	152,664.7	0	164,157.9
7	-14,351.7	228,034.3	0	242,386.0
8	-17,210.3	311,740.9	0	328,951.2
9	-20,068.8	405,862.1	0	425,931.0
10	-22,927.4	507,133.6	0	530,061.0
11	-25,785.9	615,022.5	0	640,808.5
12	-28,644.5	729,113.3	0	757,757.8
13	-31,503.0	848,938.7	0	880,441.7
14	-34,361.6	973,991.1	0	1,008,352.7
15	-37,220.1	1,103,732.5	0	1,140,952.7
16	-40,078.7	1,237,601.8	0	1,277,680.4
17	-42,937.2	1,375,021.2	0	1,417,958.4

18	-45,795.8	1,515,402.5	0	1,561,198.3
19	-48,654.3	1,658,151.5	0	1,706,805.8
20	-51,512.9	1,802,672.5	0	1,854,185.4
21	-54,371.4	1,948,372.2	0	2,002,743.7
22	-57,230.0	2,094,663.0	0	2,151,893.0
23	-60,088.5	2,240,965.9	0	2,301,054.5
24	-62,947.1	2,386,713.8	0	2,449,660.9
25	-65,805.6	2,531,353.4	0	2,597,159.0
26	-68,664.2	2,674,347.7	0	2,743,011.9
27	-71,522.7	2,815,178.2	0	2,886,700.9
28	-74,381.3	2,953,346.6	0	3,027,727.9
29	-77,239.8	3,088,376.4	0	3,165,616.2
30	-80,098.4	3,219,814.6	0	3,299,913.0

Table 23: Total net greenhouse gas emissions removals over the 30-year project period for the project goal of 10,000 ha calculated using the formula $NER_{REDD+} = NER_{REDD} + NGR_{ARR} + NER_{WRC}$. As there are no REDD activities at this time or planned for future instances, NER_{REDD} is 0.

Year	Estimated net project REDD emissions or removals (tCO ₂ e)	Estimated net project ARR emissions or removals (tCO ₂ e)	Estimated net project WRC emissions or removals (tCO ₂ e)	Estimated net GHG emission reductions or removals (tCO ₂ e)
1	0	106.7	0.0	106.7
2	0	1,781.2	0.0	1,781.2
3	0	7,803.5	1,260.5	9,064.0
4	0	19,863.5	18,581.0	38,444.5
5	0	36,772.6	54,638.2	91,410.7
6	0	55,986.4	108,171.5	164,157.9
7	0	80,681.2	161,704.8	242,386.0
8	0	113,713.0	215,238.2	328,951.2
9	0	157,159.5	268,771.5	425,931.0
10	0	207,756.2	322,304.8	530,061.0

11	0	264,970.3	375,838.2	640,808.5
12	0	328,386.3	429,371.5	757,757.8
13	0	397,536.9	482,904.8	880,441.7
14	0	471,914.6	536,438.2	1,008,352.7
15	0	550,981.2	589,971.5	1,140,952.7
16	0	634,175.6	643,504.8	1,277,680.4
17	0	720,920.3	697,038.2	1,417,958.4
18	0	810,626.8	750,571.5	1,561,198.3
19	0	902,701.0	804,104.8	1,706,805.8
20	0	996,547.3	857,638.2	1,854,185.4
21	0	1,091,572.2	911,171.5	2,002,743.7
22	0	1,187,188.1	964,704.8	2,151,893.0
23	0	1,282,816.3	1,018,238.2	2,301,054.5
24	0	1,377,889.4	1,071,771.5	2,449,660.9
25	0	1,471,854.2	1,125,304.8	2,597,159.0
26	0	1,564,173.7	1,178,838.2	2,743,011.9
27	0	1,654,329.5	1,232,371.5	2,886,700.9
28	0	1,741,823.0	1,285,904.8	3,027,727.9
29	0	1,826,178.1	1,339,438.2	3,165,616.2
30	0	1,906,941.5	1,392,971.5	3,299,913.0

Calculation of AFOLU Pooled Buffer Account Contribution

In the applied methodology VM0007, it is stated that the amount of credits set aside for the AFOLU pooled buffer account ($Buffer_{Total}$) is calculated as follows:

$$Buffer_{Total} = Buffer_{Planned} + Buffer_{Unplanned} + Buffer_{Degrad-FW/C} + Buffer_{WRC} + Buffer_{ARR}$$

Where:

$Buffer_{Total}$ = Total permanence risk buffer withholding; t CO₂e

$Buffer_{Planned}$ = Buffer withholding for avoiding planned deforestation project activities; t CO₂e

$Buffer_{Unplanned}$	=	Buffer withholding for avoiding unplanned deforestation project activities; t CO ₂ e
$Buffer_{Degrad-FW/C}$	=	Buffer withholding for avoiding degradation through extraction of fuelwood project areas; t CO ₂ e
$Buffer_{WRC}$		Buffer withholding for WRC project activities; t CO ₂ e
$Buffer_{ARR}$		Buffer withholding for ARR project activities; t CO ₂ e

Calculations of $Buffer_{ARR}$ and $Buffer_{WRC}$:

In VM0007, it is stated that $Buffer_{ARR}$ and $Buffer_{WRC}$ is calculated as follows:

$$Buffer_{ARR} = NGR_{ARR} \times Buffer\%$$

$$Buffer_{WRC} = NER_{WRC} \times Buffer\%$$

For calculations of NGR_{ARR} and NER_{WRC} , see subsection above in Section 4.4 of this PD.

As stated in VM0007, the buffer withholding percentage ($Buffer\%$) must be calculated using the *AFOLU Non-Permanence Risk Tool* (T-BAR). According to this analysis, the $buffer\%$ is estimated at 10%. The risk analysis is available to the auditor upon request.

For each new PAI, a $Buffer_{Total}$ value will be calculated as the PAIs are added to the grouped project.

Calculation of $Buffer_{Total}$ for PAI#1

As no avoiding planned deforestation, avoiding unplanned deforestation or avoiding degradation project activities has been implemented in PAI#1, $Buffer_{Unplanned}$, $Buffer_{Planned}$ and $Buffer_{Degrad-FW/C}$ are all set to zero.

Table 24: Overview of the projected buffer credits to be set aside for PAI#1 over the 30-year project crediting period

Year	$Buffer_{ARR}$	$Buffer_{WRC}$	$Buffer_{total}$
1	10.7	0.0	10.7

2	42.1	0.0	42.1
3	84.9	126.0	211.0
4	129.9	252.1	382.0
5	175.1	378.1	553.2
6	259.2	504.2	763.4
7	361.8	630.2	992.1
8	480.9	756.3	1237.2
9	615.7	882.3	1498.1
10	765.1	1008.4	1773.5
11	928.1	1134.4	2062.6
12	1103.5	1260.5	2364.0
13	1289.9	1386.5	2676.5
14	1486.1	1512.6	2998.7
15	1690.7	1638.6	3329.3
16	1902.3	1764.7	3667.0
17	2119.5	1890.7	4010.2
18	2340.9	2016.8	4357.7
19	2565.1	2142.8	4707.9
20	2790.7	2268.9	5059.6
21	3016.4	2394.9	5411.3
22	3240.7	2521.0	5761.7
23	3462.5	2647.0	6109.5
24	3680.4	2773.1	6453.5
25	3893.2	2899.1	6792.4
26	4099.8	3025.2	7125.0
27	4299.0	3151.2	7450.2
28	4489.7	3277.3	7767.0
29	4670.9	3403.3	8074.3
30	4841.8	3529.4	8371.1

Uncertainty Analysis

In the applied methodology VM0007 v1.6, it is stated that the module X-UNC must be used to produce an overall uncertainty estimate of the total net GHG emission removals. In module X-UNC, it is stated that the module is applicable for estimating uncertainty for WRC project activities, but that the CDM tool *Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities* (AR-TOOL14 v4.2) must be used for estimating the uncertainty of ARR project activities.

Estimating uncertainty from the WRC project activities through the X-UNC module

In the module, it is stated that the uncertainty of a parameter can be set to zero if the parameter is indisputably conservative, provided that the parameter is based on verifiable literature sources or expert judgement. It is furthermore stated that parameters based on default factors can be set to zero if it can be demonstrated that the default factor is as well indisputably conservative.

The parameters applicable for uncertainty estimation are according to the module for the baseline scenario $GHG_{BSL-soil-CO2,i,t}$, $Deduction_{alloc}$ (baseline scenario), $GHG_{BSL-soil-CH4,i,t}$ and $GHG_{BSL-soil-N2O,i,t}$, and for the project scenario $GHG_{WPS-soil-CO2,i,t}$, $Deduction_{alloc}$ (project scenario), $GHG_{WPS-soil-CH4,i,t}$ and $GHG_{WPS-soil-N2O,i,t}$.

Uncertainty estimation for the parameters $GHG_{BSL-soil-CO2,i,t}$ and $GHG_{WPS-soil-CO2,i,t}$

As stated in Section 4.1 and 4.2 of this PD, $GHG_{BSL-soil-CO2,i,t}$ is calculated based on the parameters of $GHG_{BSL-insitu-CO2,i,t}$, $GHG_{BSL-eroded-CO2,i,t}$ and $GHG_{BSL-excav-CO2,i,t}$, And $GHG_{WPS-soil-CO2,i,t}$ based on the parameters of $GHG_{WPS-insitu-CO2,i,t}$, $GHG_{WPS-eroded-CO2,i,t}$ and $GHG_{WPS-excav-CO2,i,t}$.

To estimate the uncertainty of $GHG_{BSL-soil-CO2,i,t}$ and $GHG_{WPS-soil-CO2,i,t}$, the uncertainty of the above listed parameters must therefore be examined.

In this PD, $GHG_{BSL-insitu-CO2,i,t}$ is estimated as zero. As the project area contains practically no vegetation, it is reasonable to assume that the input of organic material from in situ vegetation is very limited. Furthermore, it is very likely that the SOC that has built up in the soil historically from the once intact mangrove ecosystem will continue to be broken down and emitted to the atmosphere in the future. With no current carbon input from existing in situ vegetation and with a flux of CO_2 emissions to the atmosphere due to an ongoing decomposition of SOC in the soil, it is reasonable to assume that there in reality is a net-flux of CO_2 emissions from the soil to the atmosphere in the baseline scenario. Because of such, counting the $GHG_{BSL-insitu-CO2,i,t}$ parameter as zero is a conservative choice, why the uncertainty of this parameter is set to zero.

In this PD, $GHG_{WPS-insitu-CO2,i,t}$ is estimated through the application of a default value. As described and argued for based on the available scientific literature in Section 4.3 of this PD, the default value is a very conservative choice, as it is not developed based on the sequestration rate in newly restored mangrove but mangroves in general, which are generally found to have a considerably lower SOC sequestration rate. Based on the reasoning presented in the section, using the default value for determining $GHG_{WPS-soil-CO2,i,t}$ in a newly restored mangrove forest is a conservative choice, why the uncertainty of the parameter is set to zero.

In this PD, $GHG_{BSL-eroded-CO2,i,t}$ and $GHG_{WPS-eroded-CO2,i,t}$ are both set to zero. As argued for in Section 4.1 and 4.2 of this PD, such is the conservative choice as the planting of mangrove trees in the project scenario due to the establishment of a root system and because of the trees acting as protection against waves, will always result in less erosion when compared to the amount of erosion in the baseline scenario without the presence of mangrove trees. Therefore, estimating erosion in the baseline and the project scenario as zero is the conservative choice, why the uncertainty of these parameters is set to zero.

In this PD, $GHG_{BSL-excav-CO2,i,t}$ is set to zero and $GHG_{WPS-excav-CO2,i,t}$ is deemed *de minimis*. As $GHG_{BSL-excav-CO2,i,t}$ cannot be less than zero, estimating it at zero is the most conservative choice. As argued in Section 4.2, all parameters included in the estimation of $GHG_{WPS-excav-CO2,i,t}$ is determined conservatively based on inspections in the field and available scientific literature. Therefore, the estimations of these excavation parameters are the conservative choice, why their uncertainty is set to zero.

Uncertainty estimation for the parameters $GHG_{BSL-soil-CH4,i,t}$, $GHG_{WPS-soil-CH4,i,t}$, $GHG_{BSL-soil-N2O,i,t}$ and $GHG_{WPS-soil-N2O,i,t}$

As described in Section 4.1 and 4.2 of this PD, these parameters are all estimated from a default value based on the salinity content of the project area. The estimation of a default value for CH₄ and N₂O based on the salinity content is based on scientific literature linking the amount of CH₄ and N₂O emissions to the salinity content, with the CH₄ and N₂O emissions decreasing as the salinity content rises. As described in these sections and in section 1.13 of this PD, all the measured salinity contents were above 20 ppt. The measurements conducted in the actual pore water (the measurements considered to reflect the salinity content applicable most accurately for CH₄ and N₂O estimations) measured between 3,7 % and 4,7 % of salinity, which is massively above the 20 ppt that the salinity should measure at the minimum for the default factor to be applied. Furthermore, the measurements were conducted in the rainy season where salinity is generally considered as being lower when compared to the dry season.

With the CH₄ and N₂O emissions decreasing as the salinity content rises, it is appropriate to classify the estimation of the parameters $GHG_{BSL-soil-CH4,i,t}$, $GHG_{WPS-soil-CH4,i,t}$, $GHG_{BSL-soil-N2O,i,t}$ and $GHG_{WPS-soil-N2O,i,t}$ in this project as conservative, and therefore set their uncertainty to zero.

Uncertainty estimation for the parameters $Deduction_{alloc}$ (baseline scenario) and $Deduction_{alloc}$ (project scenario):

As presented in Section 4.1 and 4.2 of this PD, $Deduction_{alloc}$ is estimated at zero for both the baseline and the project scenario. As described in 4.1, estimating $Deduction_{alloc}$ to zero in the baseline scenario is the conservative choice.

As presented in Section 4.2, scientific literature, based on the investigation of a mangrove ecosystem of similar characteristics as of this project's, conclude that the increment of SOC in the mangrove when compared with the SOC of a mudflat can be attributed to the in-situ carbon input. With the SOC in-situ accumulation rate already being very conservative (see argumentation above), it is reasonable to set $Deduction_{alloc}$ in the project scenario and its uncertainty to zero.

Estimating uncertainty from the ARR project activities through the CDM tool AR-TOOL14 v4.2

In the tool, it is stated that ex-ante estimation (projection) of carbon stock in tree biomass is not subjected to uncertainty control. Therefore, uncertainty for the projection of the total net-GHG emission removals from the ARR component is set to zero.

Calculation of Verified Carbon Units

As stated in the applied methodology VM0007, the number of Verified Carbon Units (VCUs) for the monitoring period $T = t_2 - t_1$ is estimated using the following equation:

$$VCU_t = (Adjusted_{NER_{REDD+t_2}} - Adjusted_{NER_{REDD+t_1}}) - Buffer_{Total}$$

Where:

VCU_t	=	Number of Verified Carbon Units at year $t = t_2 - t_1$; VCU
$Adjusted_{NER_{REDD+t_2}}$	=	Total net GHG emission removals of the REDD+ project activity up to year t_2 and adjusted to account for uncertainty; t CO ₂ e
$Adjusted_{NER_{REDD+t_1}}$	=	Total net GHG emission removals of the REDD+ project activity up to year t_1 and adjusted to account for uncertainty; t CO ₂ e
$Buffer_{Total}$	=	Total permanence risk buffer withholding; t CO ₂ e

As stated in the module X-UNC, the allowable uncertainty is +/- 15% of NER_{REDD+} at the 95% confidence level. It is stated that if such precision level is met, then no deduction for uncertainty should be performed. As this precision level as argued above is met, no deduction for uncertainty is applied in this project.

Therefore, the value of $Adjusted_NER_{REDD+,t}$ equals the value of $NER_{REDD+,t}$ presented previously in this Section 4.4. See Table 25 below for projection of the amount of issued carbon credits from PAI#1 over the 30-year project crediting period.

Calculation of Verified Carbon Units for PAI#1

Table 25: Projected adjusted total net GHG emission removals ($Adjusted_NER_{REDD+}$), subtraction for buffer ($Buffer_{total}$) and number of verified carbon units (VCUs) in PAI#1 for the 30-year project crediting period

Year	Adjusted_ NER_{REDD+}	Buffer _{total}	VCUs
1	106.7	10.7	96.1
2	421.3	42.1	379.2
3	2109.9	211.0	1898.9
4	3820.4	382.0	3438.3
5	5532.0	553.2	4978.8
6	7634.2	763.4	6870.8
7	9920.8	992.1	8928.8
8	12,372.4	1237.2	11,135.2
9	14,980.5	1498.1	13,482.5
10	17,735.3	1773.5	15,961.8
11	20,625.7	2062.6	18,563.1
12	23,639.7	2364.0	21,275.7
13	26,764.5	2676.5	24,088.1
14	29,986.9	2998.7	26,988.2
15	33,293.3	3329.3	29,964.0
16	36,669.8	3667.0	33,002.8
17	40,102.3	4010.2	36,092.1
18	43,576.9	4357.7	39,219.2
19	47,079.4	4707.9	42,371.4
20	50,596.0	5059.6	45,536.4
21	54,113.1	5411.3	48,701.8

22	57,617.3	5761.7	51,855.5
23	61,095.5	6109.5	54,985.9
24	64,535.0	6453.5	58,081.5
25	67,923.7	6792.4	61,131.4
26	71,249.8	7125.0	64,124.8
27	74,502.0	7450.2	67,051.8
28	77,669.6	7767.0	69,902.7
29	80,742.6	8074.3	72,668.3
30	83,711.4	8371.1	75,340.2

5 MONITORING

5.1 Data and Parameters Available at Validation

As required in the applied methodology VM0007, the following data and parameters are to be available at validation:

Data / Parameter	$\Delta C_{BSL, degrad-FW/C}$
Data unit	t CO ₂ e
Description	Net greenhouse gas emissions in the baseline from degradation caused by fuelwood collection and charcoal making
Source of data	Module <i>BL-DFW</i>
Value applied	Zero
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Calculations of baseline emissions

Comments	As degradation caused by fuelwood collection and charcoal making is not part of the baseline scenario in PAI#1, this parameter is set to zero.
----------	--

Data / Parameter	$\Delta C_{BSL,planned}$
Data unit	t CO ₂ e
Description	Net greenhouse gas emissions in the baseline from planned deforestation
Source of data	Module <i>BL-PL</i>
Value applied	Zero
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Calculation of baseline emissions
Comments	As planned deforestation is not part of the baseline scenario in PAI#1, this parameter is set to zero.

Data / Parameter	$\Delta C_{BSL,unplanned}$
Data unit	t CO ₂ e
Description	Net greenhouse gas emissions in the baseline from unplanned deforestation
Source of data	Module <i>BL-UP</i>
Value applied	Zero
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Calculation of baseline emissions
Comments	As unplanned deforestation is not part of the baseline scenario in PAI#1, this parameter is set to zero.

Data / Parameter	$\Delta C_{BSL-ARR}$
Data unit	t CO ₂ e
Description	Net GHG removals in the ARR baseline scenario up to year t^*
Source of data	Module <i>BL-ARR</i>
Value applied	Zero
Justification of choice of data or description of measurement methods and procedures applied	See Section 4.1 of this PD for choice of calculation methods and justifications based on requirements set out in the applicable modules according to the applied methodology VM0007.
Purpose of Data	Calculations of baseline emissions
Comments	N/A

Data / Parameter	$GHG_{BSL-WRC}$																																								
Data unit	t CO ₂ e																																								
Description	Net GHG emissions in the WRC baseline scenario up to year t^*																																								
Source of data	Module <i>BL-TW</i>																																								
Value applied	For PAI#1: <table border="1"> <thead> <tr> <th>Year</th><th>$GHG_{BSL-WRC}$</th></tr> </thead> <tbody> <tr><td>1</td><td>67.3</td></tr> <tr><td>2</td><td>134.6</td></tr> <tr><td>3</td><td>201.9</td></tr> <tr><td>4</td><td>269.2</td></tr> <tr><td>5</td><td>336.5</td></tr> <tr><td>6</td><td>403.8</td></tr> <tr><td>7</td><td>471.2</td></tr> <tr><td>8</td><td>538.5</td></tr> <tr><td>9</td><td>605.8</td></tr> <tr><td>10</td><td>673.1</td></tr> <tr><td>11</td><td>740.4</td></tr> <tr><td>12</td><td>807.7</td></tr> <tr><td>13</td><td>875.0</td></tr> <tr><td>14</td><td>942.3</td></tr> <tr><td>15</td><td>1009.6</td></tr> <tr><td>16</td><td>1076.9</td></tr> <tr><td>17</td><td>1144.2</td></tr> <tr><td>18</td><td>1211.5</td></tr> <tr><td>19</td><td>1278.8</td></tr> </tbody> </table>	Year	$GHG_{BSL-WRC}$	1	67.3	2	134.6	3	201.9	4	269.2	5	336.5	6	403.8	7	471.2	8	538.5	9	605.8	10	673.1	11	740.4	12	807.7	13	875.0	14	942.3	15	1009.6	16	1076.9	17	1144.2	18	1211.5	19	1278.8
Year	$GHG_{BSL-WRC}$																																								
1	67.3																																								
2	134.6																																								
3	201.9																																								
4	269.2																																								
5	336.5																																								
6	403.8																																								
7	471.2																																								
8	538.5																																								
9	605.8																																								
10	673.1																																								
11	740.4																																								
12	807.7																																								
13	875.0																																								
14	942.3																																								
15	1009.6																																								
16	1076.9																																								
17	1144.2																																								
18	1211.5																																								
19	1278.8																																								

	20	1346.1	
	21	1413.5	
	22	1480.8	
	23	1548.1	
	24	1615.4	
	25	1682.7	
	26	1750.0	
	27	1817.3	
	28	1884.6	
	29	1951.9	
	30	2019.2	
Justification of choice of data or description of measurement methods and procedures applied	See Module BL-TW and Section 4.1 of this PD for details related to the calculation of the values.		
Purpose of Data	Calculation of baseline emissions		
Comments	N/A		

Data / Parameter	$E_{FC,i,t}$
Data unit	t CO ₂ e
Description	Emissions from fossil fuel combustion in stratum <i>i</i> in year <i>t</i>
Source of data	Module <i>E-FFC</i>
Value applied	Zero
Justification of choice of data or description of measurement methods and procedures applied	See Section 4.2, subsection <i>Estimation of GHG emissions from the fossil fuel combustion in the project scenario</i>
Purpose of Data	Calculation of project emissions
Comments	As the fossil fuel emissions in the project scenario are deemed <i>de minimis</i> , they are counted as zero.

5.2 Data and Parameters Monitored

As required in the applied methodology VM0007, the following data and parameters are to be monitored:

Data / Parameter	$\Delta C_{LK-AS,degrad-FW/C}$
Data unit	t CO ₂ e
Description	Net greenhouse gas emissions due to activity-shifting leakage for degradation caused by extraction of wood for fuel
Source of data	See module <i>LK-DFW</i>
Description of measurement methods and procedures to be applied	As no activity shifting leakage for degradation caused by extraction for fuel are expected in relation to PAI#1 or any future instances, no measurement methods or procedures are applied.
Frequency of monitoring/recording	As no activity shifting leakage for degradation caused by extraction for fuel are expected in relation to PAI#1 or any future instances, this parameter is not applicable and shall not be monitored.
Value applied	As no activity shifting leakage for degradation caused by extraction for fuel are expected in relation to PAI#1 or any future instances, this parameter is set to zero and shall not be monitored.
Monitoring equipment	As no activity shifting leakage for degradation caused by extraction for fuel are expected in relation to PAI#1 or any future instances, there is no monitoring equipment needed.
QA/QC procedures to be applied	As no activity shifting leakage for degradation caused by extraction for fuel are expected in relation to PAI#1 or any future instances, no QA/QC procedures shall be applied.
Purpose of data	Calculation of leakage
Calculation method	As no activity shifting leakage for degradation caused by extraction for fuel are expected in relation to PAI#1 or any future instances, no calculation is conducted.
Comments	

Data / Parameter	$\Delta C_{LK-AS,planned}$
Data unit	t CO ₂ e
Description	Net greenhouse gas emissions due to activity shifting leakage for projects preventing planned deforestation
Source of data	See module <i>LK-ASP</i>

Description of measurement methods and procedures to be applied	Preventing planned deforestation is not part of the project activities implemented in PAI#1 or any future instances, so no measurement methods and procedures is applied.
Frequency of monitoring/recording	Preventing planned deforestation is not part of the project activities implemented in PAI#1 or any future instances, so there is no monitoring/recording.
Value applied	Zero
Monitoring equipment	As preventing planned deforestation is not part of the project activities implemented in PAI#1 or any future instances, no monitoring equipment is needed.
QA/QC procedures to be applied	As preventing planned deforestation is not part of the project activities implemented in PAI#1 or any future instances, no QA/QC procedures is applied.
Purpose of data	Calculation of leakage
Calculation method	As preventing planned deforestation is not part of the project activities implemented in PAI#1 or any future instances, no calculation is conducted.
Comments	

Data / Parameter	$\Delta C_{LK-AS,unplanned}$
Data unit	t CO ₂ e
Description	Net greenhouse gas emissions due to activity shifting for projects preventing unplanned deforestation
Source of data	See module <i>LK-ASU</i>
Description of measurement methods and procedures to be applied	Preventing unplanned deforestation is not part of the project activities implemented in PAI#1, so no measurement methods and procedures are applied.
Frequency of monitoring/recording	Preventing unplanned deforestation is not part of the project activities implemented in PAI#1, so no monitoring or recording shall take place.
Value applied	Zero
Monitoring equipment	As preventing unplanned deforestation is not part of the project activities implemented in PAI#1, no monitoring equipment is needed.

QA/QC procedures to be applied	As preventing unplanned deforestation is not part of the project activities implemented in PAI#1, no QA/QC procedures are applied.
Purpose of data	<i>Calculation of leakage</i>
Calculation method	As preventing unplanned deforestation is not part of the project activities implemented in PAI#1, no calculation is conducted.
Comments	

Data / Parameter	ΔC_{LK-ME}
Data unit	t CO ₂ e
Description	Net greenhouse gas emissions due to market-effects leakage
Source of data	See module <i>LK-ME</i>
Description of measurement methods and procedures to be applied	As no markets-effects leakage are expected in PAI#1, no measurement methods and procedures are applied.
Frequency of monitoring/recording	As no markets-effects leakage are expected in PAI#1, this parameter is set to zero and shall not be monitored.
Value applied	Zero
Monitoring equipment	As no markets-effects leakage are expected in PAI#1, this parameter is set to zero and shall not be monitored and no monitoring equipment is needed.
QA/QC procedures to be applied	As no markets-effects leakage are expected in PAI#1, this parameter shall not be monitored, and so no monitoring equipment is needed.
Purpose of data	Calculation of leakage
Calculation method	As no markets-effects leakage are expected in PAI#1, no calculation is conducted.
Comments	

Data / Parameter	$DC_{WPS-ARR}$
Data unit	t CO ₂ e

Description	Net GHG emissions in the ARR project scenario up to year t^*																																																														
Source of data	See module <i>M-ARR</i>																																																														
Description of measurement methods and procedures to be applied	This parameter is as stated in the applicable module <i>M-ARR</i> to be calculated through the procedures set out in the CDM tool AR-ACM0003 and the CDM tool AR-Tool14. For a detailed description of the calculations and procedures applied, see Section 4.2 and 5.3 of this PD.																																																														
Frequency of monitoring/recording	See Section 3.3 subsection “ <i>Temporal boundaries</i> ” of this PD																																																														
Value applied	For projection: <table border="1"> <thead> <tr> <th>Year</th><th>$DC_{WPS-ARR}$</th></tr> </thead> <tbody> <tr><td>1</td><td>106.7</td></tr> <tr><td>2</td><td>421.3</td></tr> <tr><td>3</td><td>849.4</td></tr> <tr><td>4</td><td>1,299.4</td></tr> <tr><td>5</td><td>1,750.5</td></tr> <tr><td>6</td><td>2,592.2</td></tr> <tr><td>7</td><td>3,618.4</td></tr> <tr><td>8</td><td>4,809.5</td></tr> <tr><td>9</td><td>6,157.1</td></tr> <tr><td>10</td><td>7,651.4</td></tr> <tr><td>11</td><td>9,281.3</td></tr> <tr><td>12</td><td>11,034.7</td></tr> <tr><td>13</td><td>12,899.1</td></tr> <tr><td>14</td><td>14,861.00</td></tr> <tr><td>15</td><td>16,906.91</td></tr> <tr><td>16</td><td>19,022.9</td></tr> <tr><td>17</td><td>21,194.9</td></tr> <tr><td>18</td><td>23,408.9</td></tr> <tr><td>19</td><td>25,650.9</td></tr> <tr><td>20</td><td>27,907.1</td></tr> <tr><td>21</td><td>30,163.7</td></tr> <tr><td>22</td><td>32,407.4</td></tr> <tr><td>23</td><td>34,625.1</td></tr> <tr><td>24</td><td>36,804.2</td></tr> <tr><td>25</td><td>38,932.4</td></tr> <tr><td>26</td><td>40,997.9</td></tr> <tr><td>27</td><td>42,989.6</td></tr> <tr><td>28</td><td>44,896.8</td></tr> <tr><td>29</td><td>46,709.2</td></tr> <tr><td>30</td><td>48,417.5</td></tr> </tbody> </table>	Year	$DC_{WPS-ARR}$	1	106.7	2	421.3	3	849.4	4	1,299.4	5	1,750.5	6	2,592.2	7	3,618.4	8	4,809.5	9	6,157.1	10	7,651.4	11	9,281.3	12	11,034.7	13	12,899.1	14	14,861.00	15	16,906.91	16	19,022.9	17	21,194.9	18	23,408.9	19	25,650.9	20	27,907.1	21	30,163.7	22	32,407.4	23	34,625.1	24	36,804.2	25	38,932.4	26	40,997.9	27	42,989.6	28	44,896.8	29	46,709.2	30	48,417.5
Year	$DC_{WPS-ARR}$																																																														
1	106.7																																																														
2	421.3																																																														
3	849.4																																																														
4	1,299.4																																																														
5	1,750.5																																																														
6	2,592.2																																																														
7	3,618.4																																																														
8	4,809.5																																																														
9	6,157.1																																																														
10	7,651.4																																																														
11	9,281.3																																																														
12	11,034.7																																																														
13	12,899.1																																																														
14	14,861.00																																																														
15	16,906.91																																																														
16	19,022.9																																																														
17	21,194.9																																																														
18	23,408.9																																																														
19	25,650.9																																																														
20	27,907.1																																																														
21	30,163.7																																																														
22	32,407.4																																																														
23	34,625.1																																																														
24	36,804.2																																																														
25	38,932.4																																																														
26	40,997.9																																																														
27	42,989.6																																																														
28	44,896.8																																																														
29	46,709.2																																																														
30	48,417.5																																																														

	<u>For actual credit issuance:</u> to be estimated following procedures and calculations as described in Section 4.2 and 5.3 of this PD.															
Monitoring equipment	<u>For actual credit issuance</u> <i>Measurement of biomass within representative plots:</i> Measuring tape for measuring tree circumference, paint for marking measuring place on the trees, tags and nails for tagging each tree measured, long measuring tape for measuring out the plots in which the biomass is estimated, GPS for marking the geodetic coordinates of the plots. <i>If double sampling is applied:</i> potentially a drone which can map the height and crown diameter of the planted trees within the representative plots.															
QA/QC procedures to be applied	<i>“IPCC good practice guidance for land use land-use change and forestry”</i>															
Purpose of data	Calculation of project emissions															
Calculation method	In M-ARR, it is stated that $DC_{WPS-ARR}$ is calculated as follows: $\Delta C_{WPS-ARR} = \sum_{t=1}^{t^*} \Delta C_{ACTUAL,t} + \Delta C_{WPS-herb}$ Where: <table><tr><td>$\Delta C_{WPS-ARR}$</td><td>=</td><td>Net GHG removals under the ARR project scenario up to year t^*; t CO₂e</td></tr><tr><td>$\Delta C_{ACTUAL,t}$</td><td>=</td><td>Actual net GHG removals by sinks in year t (from AR-ACM0003); t CO₂e</td></tr><tr><td>$\Delta C_{WPS-herb}$</td><td>=</td><td>Net GHG removals under the project scenario in herbaceous vegetation up to year t^*; t CO₂e</td></tr><tr><td>t</td><td>=</td><td>1,2,3 ... t^* time elapsed since project start; years</td></tr></table> As $\Delta C_{WPS-herb}$ is conservatively excluded from both the baseline and the project scenario, this parameter is set to zero in the calculations. In AR-ACM0003, it is stated that $\Delta C_{ACTUAL,t}$ is calculated as follows: $\Delta C_{ACTUAL,t} = \Delta C_{P,t} - GHG_{E,t}$ Where: <table><tr><td>$\Delta C_{ACTUAL,t}$</td><td>=</td><td>Actual net GHG removals by sinks, in year t; t CO₂e</td></tr></table>	$\Delta C_{WPS-ARR}$	=	Net GHG removals under the ARR project scenario up to year t^* ; t CO ₂ e	$\Delta C_{ACTUAL,t}$	=	Actual net GHG removals by sinks in year t (from AR-ACM0003); t CO ₂ e	$\Delta C_{WPS-herb}$	=	Net GHG removals under the project scenario in herbaceous vegetation up to year t^* ; t CO ₂ e	t	=	1,2,3 ... t^* time elapsed since project start; years	$\Delta C_{ACTUAL,t}$	=	Actual net GHG removals by sinks, in year t ; t CO ₂ e
$\Delta C_{WPS-ARR}$	=	Net GHG removals under the ARR project scenario up to year t^* ; t CO ₂ e														
$\Delta C_{ACTUAL,t}$	=	Actual net GHG removals by sinks in year t (from AR-ACM0003); t CO ₂ e														
$\Delta C_{WPS-herb}$	=	Net GHG removals under the project scenario in herbaceous vegetation up to year t^* ; t CO ₂ e														
t	=	1,2,3 ... t^* time elapsed since project start; years														
$\Delta C_{ACTUAL,t}$	=	Actual net GHG removals by sinks, in year t ; t CO ₂ e														

$\Delta C_{P,t}$ = Change in the carbon stocks in project, occurring in the selected carbon pools, in year t ; t CO₂e
 $GHG_{E,t}$ = Increase in non-CO₂ GHG emissions within the project boundary as a result of the implementation of the A/R CDM project activity, in year t , as estimated in the tool *"Estimation of non-CO₂ GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity"*; t CO₂e

As no biomass burning is performed within PAI#1, $GHG_{E,t}$ is set to zero.

In AR-ACM0003, it is stated that $\Delta C_{P,t}$ is calculated as follows:

$$\Delta C_{P,t} = \Delta C_{TREE_PROJ,t} + \Delta C_{SHRUB_PROJ,t} + \Delta C_{DW_PROJ,t} + \Delta C_{LI_PROJ,t} + \Delta SOC_{AL,t}$$

Where:

$\Delta C_{P,t}$ = Change in the carbon stocks in project, occurring in the selected carbon pools, in year t ; t CO₂e
 $\Delta C_{TREE_PROJ,t}$ = Change in carbon stock in tree biomass in project in year t , as estimated in the tool *"Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"*; t CO₂e
 $\Delta C_{SHRUB_PROJ,t}$ = Change in carbon stock in shrub biomass in project in year t , as estimated in the tool *"Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"*; t CO₂e
 $\Delta C_{DW_PROJ,t}$ = Change in carbon stock in dead wood in project in year t , as estimated in the tool *"Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"*; t CO₂e
 $\Delta C_{LI_PROJ,t}$ = Change in carbon stock in litter in project in year t , as estimated in the tool *"Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"*; t CO₂e
 $\Delta SOC_{AL,t}$ = Change in carbon stock in SOC in project, in year t , in areas of land meeting the applicability conditions of the tool *"Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities"*, as estimated in the same tool; t CO₂e

As $\Delta C_{SHRUB_PROJ,t}$ and $\Delta C_{LI_PROJ,t}$ is conservatively excluded from both the baseline and the project scenario, they are both set to zero in the calculations.

$\Delta C_{DW_PROJ,t}$ is determined through a default value. See Section 4.2 of this PD for a description of the calculations and methods applied.

	As $\Delta SOC_{AL,t}$ is included in the calculations of $GHG_{WPS-WRC}$, it is in this equation set to zero. For a description of the calculations and methods applied for determining the actual value of $\Delta C_{TREE_PROJ,t}$ ex-post, see Section 4.2 and 5.3 of this PD.
Comments	For more details related to the calculations and methods applied, see Section 4.2 and 5.3 of this PD.

Data / Parameter	DC_{LK-ARR}
Data unit	t CO ₂ e
Description	Net GHG emissions due to leakage from the ARR project activity up to year t^*
Source of data	See module <i>gr</i>
Description of measurement methods and procedures to be applied	No leakage linked to the ARR project activity are expected in PAI#1, but will be monitored and measured visually by reviewing satellite or drone imagery to ensure that the land is not under agriculture or other anthropogenic usage.
Frequency of monitoring/recording	Regular imagery will be captured using a drone and satellite imagery to ensure that the leakage continues to be zero.
Value applied	Zero
Monitoring equipment	Drone and satellite imagery will be used to evaluate and monitor anthropogenic usage.
QA/QC procedures to be applied	Discussion with local communities about anthropogenic use of area will act as QA/QC.
Purpose of data	Calculation of leakage
Calculation method	As no leakage linked to the ARR project activity are expected in PAI#1, no calculation is conducted.
Comments	

Data / Parameter	$GHG_{WPS-WRC}$
Data unit	t CO ₂ e

Description	Net GHG emissions in the WRC project scenario up to year t^*																																																														
Source of data	See module M-TW																																																														
Description of measurement methods and procedures to be applied	This parameter is as stated in VM0007 to be calculated through the procedures set out in module M-TW. For a detailed description of the calculations and procedures applied, see Section 4.2 and 5.3 of this PD.																																																														
Frequency of monitoring/recording	See Section 3.3 subsection “Temporal boundaries” of this PD																																																														
Value applied	<u>For projection:</u> <table border="1"> <thead> <tr> <th>Year</th><th>GHG_{WPS-WRC}</th></tr> </thead> <tbody> <tr><td>1</td><td>67.31</td></tr> <tr><td>2</td><td>134.61</td></tr> <tr><td>3</td><td>-1058.57</td></tr> <tr><td>4</td><td>-2251.76</td></tr> <tr><td>5</td><td>-3444.95</td></tr> <tr><td>6</td><td>-4638.13</td></tr> <tr><td>7</td><td>-5831.32</td></tr> <tr><td>8</td><td>-7024.51</td></tr> <tr><td>9</td><td>-8217.70</td></tr> <tr><td>10</td><td>-9410.88</td></tr> <tr><td>11</td><td>-10,604.07</td></tr> <tr><td>12</td><td>-11,797.26</td></tr> <tr><td>13</td><td>-12,990.45</td></tr> <tr><td>14</td><td>-14,183.63</td></tr> <tr><td>15</td><td>-15,376.82</td></tr> <tr><td>16</td><td>-16,570.01</td></tr> <tr><td>17</td><td>-17,763.19</td></tr> <tr><td>18</td><td>-18,956.38</td></tr> <tr><td>19</td><td>-20,149.57</td></tr> <tr><td>20</td><td>-21,342.76</td></tr> <tr><td>21</td><td>-22,535.94</td></tr> <tr><td>22</td><td>-23,729.13</td></tr> <tr><td>23</td><td>-24,922.32</td></tr> <tr><td>24</td><td>-26,115.51</td></tr> <tr><td>25</td><td>-27,308.69</td></tr> <tr><td>26</td><td>-28,501.88</td></tr> <tr><td>27</td><td>-29,695.07</td></tr> <tr><td>28</td><td>-30,888.25</td></tr> <tr><td>29</td><td>-32,081.44</td></tr> <tr><td>30</td><td>-33,274.63</td></tr> </tbody> </table> <u>For actual credit issuance:</u> to be estimated following procedures and calculations as described in Section 4.2 and 5.3 of this PD.	Year	GHG _{WPS-WRC}	1	67.31	2	134.61	3	-1058.57	4	-2251.76	5	-3444.95	6	-4638.13	7	-5831.32	8	-7024.51	9	-8217.70	10	-9410.88	11	-10,604.07	12	-11,797.26	13	-12,990.45	14	-14,183.63	15	-15,376.82	16	-16,570.01	17	-17,763.19	18	-18,956.38	19	-20,149.57	20	-21,342.76	21	-22,535.94	22	-23,729.13	23	-24,922.32	24	-26,115.51	25	-27,308.69	26	-28,501.88	27	-29,695.07	28	-30,888.25	29	-32,081.44	30	-33,274.63
Year	GHG _{WPS-WRC}																																																														
1	67.31																																																														
2	134.61																																																														
3	-1058.57																																																														
4	-2251.76																																																														
5	-3444.95																																																														
6	-4638.13																																																														
7	-5831.32																																																														
8	-7024.51																																																														
9	-8217.70																																																														
10	-9410.88																																																														
11	-10,604.07																																																														
12	-11,797.26																																																														
13	-12,990.45																																																														
14	-14,183.63																																																														
15	-15,376.82																																																														
16	-16,570.01																																																														
17	-17,763.19																																																														
18	-18,956.38																																																														
19	-20,149.57																																																														
20	-21,342.76																																																														
21	-22,535.94																																																														
22	-23,729.13																																																														
23	-24,922.32																																																														
24	-26,115.51																																																														
25	-27,308.69																																																														
26	-28,501.88																																																														
27	-29,695.07																																																														
28	-30,888.25																																																														
29	-32,081.44																																																														
30	-33,274.63																																																														

Monitoring equipment	Salinity measurer and GPS for marking the geodetic coordinates of the spots where measurement is performed
QA/QC procedures to be applied	"IPCC good practice guidance for land use land-use change and forestry"
Purpose of data	Calculation of project emissions
Calculation method	In VM0007, it is stated that $GHG_{WPS-WRC}$ is calculated as follows: $GHG_{WPS-WRC} = GHG_{WPS-PEAT} + GHG_{WPS-TW}$ Where: $GHG_{WPS-WRC} = \text{Net GHG emissions in the WRC project scenario up to year } t^*; \text{ t CO}_2\text{e}$ $GHG_{WPS-PEAT} = \text{Net GHG emissions in the WRC project scenario on peatland up to year } t^*; \text{ t CO}_2\text{e}$ $GHG_{WPS-TW} = \text{Net GHG emissions in the WRC project scenario on tidal wetland up to year } t^*; \text{ t CO}_2\text{e}$ As no peat soils are present in PAI#1, $GHG_{WPS-PEAT}$ is set to zero. In M-TW, it is stated that $GHG_{WPS-TW,i,t}$ is calculated as follows: $GHG_{WPS-TW,i,t} = GHG_{WPS-soil-CO2,i,t} - Deduction_{alloch} + GHG_{WPS-soil-CH4,i,t} + GHG_{WPS-soil-N2O,i,t}$ Where: $GHG_{WPS-TW,i,t} = \text{GHG emissions from the tidal wetland SOC pool in the project scenario in stratum } i \text{ in year } t; \text{ t CO}_2\text{e ha/yr}$ $GHG_{WPS-soil-CO2,i,t} = \text{CO}_2 \text{ emissions from the tidal wetland SOC pool in the project scenario in stratum } i \text{ in year } t; \text{ t CO}_2\text{e ha/yr}$ $Deduction_{alloch} = \text{Deduction from CO}_2 \text{ emissions from the SOC pool to account for the percentage of the carbon stock that is derived from}$

	allochthonous soil organic carbon; t CO ₂ e ha/yr
$GHG_{WPS-soil-CH_4,i,t}$	= CH ₄ emissions from the tidal wetland SOC pool in the project scenario in stratum i in year t ; t CO ₂ e ha/yr
$GHG_{WPS-soil-N_2O,i,t}$	= N ₂ O emissions from the tidal wetland SOC pool in the project scenario in stratum i in year t ; t CO ₂ e ha/yr
i	= 1, 2, 3 ... M_{BSL} strata in the project scenario
t	= 1, 2, 3, ... t^* years elapsed since the project start date
In M-TW, it is stated that $GHG_{WPS-soil,i,t}$ is calculated as follows:	
$GHG_{WPS-soil-CO_2,i,t} = GHG_{WPS-insitu-CO_2,i,t} + GHG_{WPS-eroded-CO_2,i,t} + GHG_{WPS-exav-CO_2,i,t}$	
Where:	
$GHG_{WPS-soil-CO_2,i,t}$	= CO ₂ emissions from the tidal wetland SOC pool in the project scenario in stratum i in year t ; t CO ₂ e ha/yr
$GHG_{WPS-insitu-CO_2,i,t}$	= CO ₂ emissions from the tidal wetland SOC pool of in-situ soils in the project scenario in stratum i in year t ; t CO ₂ e ha/yr
$GHG_{WPS-eroded-CO_2,i,t}$	= CO ₂ emissions from the eroded tidal wetland SOC pool in the project scenario in stratum i in year t ; t CO ₂ e ha/yr
$GHG_{WPS-exav-CO_2,i,t}$	= CO ₂ emissions from the tidal wetland SOC pool of soil exposed to an aerobic environment through excavation in the project scenario in stratum i in year t ; t CO ₂ e ha/yr
$Deduction_{alloch}$ is set to zero. For justification, see Section 4.2 of this PD.	
$GHG_{WPS-soil-CH_4,i,t}$ is determined through the usage of a default value based on the salinity content. For description of the calculations and monitoring procedures for estimation of actual salinity	

	content and thereby CH₄ emissions in the project, see Section 4.2 and 5.3 of this PD. $GHG_{WPS-soil-N_2O,i,t}$ is determined through the usage of a default value based on the salinity content. For description of the calculations and monitoring procedures for estimation of actual salinity content and thereby N₂O emissions in the project, see Section 4.2 and 5.3 of this PD. $GHG_{WPS-insitu-CO_2,i,t}$ is determined through the usage of a default value. For justification and value applied, see Section 4.2 of this PD. $GHG_{WPS-eroded-CO_2,i,t}$ is set to zero. For justification, see Section 4.2 of this PD. $GHG_{WPS-exav-CO_2,i,t}$ is set to zero. For justification, see Section 4.2 of this PD.
Comments	For more details related to the calculations and methods applied, see Section 4.2 and 5.3 of this PD.

Data / Parameter	GHG_{LK-ECO}
Data unit	t CO ₂ e
Description	Net GHG emissions due to ecological leakage from the WRC project activity up to year <i>t</i>
Source of data	See module LK-ECO
Description of measurement methods and procedures to be applied	As no ecological leakage is expected to occur as a result of PAI#1 activities as it is avoided through project design, no measurement methods and procedures are applied.
Frequency of monitoring/recording	As no ecological leakage is expected to occur as a result of PAI#1 activities, there is no monitoring or recording.
Value applied	Zero
Monitoring equipment	As no ecological leakage is expected to occur as a result of PAI#1 activities, there is no monitoring or recording.

QA/QC procedures to be applied	As no ecological leakage is expected to occur as a result of PAI#1 activities, there is no QA/QC procedure applied.
Purpose of data	Calculation of leakage
Calculation method	As no ecological leakage is expected to occur as a result of PAI#1 activities, no calculation is conducted.
Comments	

Data / Parameter	$E_{FC,i,t}$
Data unit	t CO ₂ e
Description	Emission from fossil fuel combustion in stratum <i>i</i> in year <i>t</i>
Source of data	See module E-FFC
Description of measurement methods and procedures to be applied	As the emissions from fossil fuel combustion are deemed <i>de minimis</i> , no measurement methods and procedures are applied.
Frequency of monitoring/recording	As the emissions from fossil fuel combustion are deemed <i>de minimis</i> , this parameter is set to zero and shall not be monitored.
Value applied	Zero
Monitoring equipment	As the emissions from fossil fuel combustion are deemed <i>de minimis</i> , this parameter is set to zero and shall not be monitored.
QA/QC procedures to be applied	As the emissions from fossil fuel combustion are deemed <i>de minimis</i> , this parameter shall not be monitored, and so no monitoring equipment is needed.
Purpose of data	Calculation of project emissions
Calculation method	As the emissions from fossil fuel combustion are deemed <i>de minimis</i> , no calculation is conducted.
Comments	

Data / Parameter	$N_2O_{direct-N,i,t}$
Data unit	t CO ₂ e

Description	Direct N ₂ O emission as a result of nitrogen application on the alternative land use within the project boundary in stratum <i>i</i> in year <i>t</i>
Source of data	See module E-NA
Description of measurement methods and procedures to be applied	As nitrogen application is not part of the implemented project activities, no measurement methods and procedures are applied.
Frequency of monitoring/recording	As nitrogen application is not part of the implemented project activities, this parameter is set to zero and shall not be monitored.
Value applied	Zero
Monitoring equipment	As nitrogen application is not part of the implemented project activities, this parameter is set to zero and shall not be monitored.
QA/QC procedures to be applied	As nitrogen application is not part of the implemented project activities, this parameter shall not be monitored, and so no monitoring equipment is needed.
Purpose of data	Calculation of leakage
Calculation method	As nitrogen application is not part of the implemented project activities, no calculation is conducted.
Comments	

5.3 Monitoring Plan

Development of monitoring plan

As stated in the applied methodology VM0007 v1.6, the monitoring plan for monitoring of ARR activities must use the methods outlined in module M-ARR and must for monitoring of WRC activities on mineral soil use the methods given out in module M-TW.

Furthermore, it is stated that four specific monitoring tasks (*Monitoring of project implementation, Monitoring of actual carbon stock changes and greenhouse gas emissions, Monitoring of leakage carbon stock changes and greenhouse gas emissions and Estimation of ex post net carbon stock changes and greenhouse gas emissions*) shall be addressed in the

monitoring plan. For each of these tasks, specific points shall be addressed at minimum. In the below text, the four monitoring tasks and the points are presented and addressed.

General for all monitoring tasks

Quality control and quality assurance procedure

Ensuring accuracy or conservativeness of default values applied

As stated in the applied methodology VM0007 v1.6, the project must identify key parameters that would significantly influence accuracy of estimates. As argued throughout this PD, the parameters selected for estimation of GHG emissions removals in this PD are conservative. Potential inaccuracies related to the parameters chosen are therefore expected to always result in the GHG reduction estimations being less than in reality, ensuring that the issued credits are not overestimated.

Ensuring accurate field data collection

Collecting reliable field measurement data is an important step for ensuring sufficient quality and reliability of the ex-post GHG removals estimations. Those responsible for the measurement work will be trained by experienced teams in all aspects of the field data collection. SOPs (Standard Operating Procedures) are to be developed for each step to be taken in the field measurements, which should be adhered to at all steps. The SOPs will describe in detail all steps to be taken in the field measurement and contain provisions for documentation for verification purposes so that future field personnel can check past results and repeat the measurements in a consistent manner.

As stated in the applied methodology VM0007 v1.6, to ensure that GHG fluxes are estimated in a way that is accurate, verifiable, transparent, and consistent across measurement periods, projects must include the below points in the developed SOPs:

- Comprehensive documentation of all field measurements carried out in the project area. This document must be detailed enough to allow replication of sampling in the event of staff turnover between monitoring periods
- Training procedures for all persons involved in field measurement or data analysis. The scope and date of all training must be documented

- A protocol for assessing the accuracy of plot measurements using a check cruise and a plan for correcting the inventory if errors are discovered
- Protocols for assessing data for outliers, transcription errors, and consistency across measurement periods
- Data sheets must be safely archived for the life of the project. Data stored in electronic formats must be backed up

Procedures including all of the above are to be developed and implemented according to all requirements set out in VM0007 v1.6 and all relevant modules that it refers to, before the beginning of the first official monitoring. As for example the number of plots to be established, the delineation of strata's ex-post and the chosen method for estimation of $\Delta C_{TREE_PROJ,t}$ (*double sampling vs Direct estimation of change by re-measurement of sample plots* – see subsection *monitoring task 2* below) is dependent on the ex-post growth patterns of the trees planted, detailed SOPs cannot be developed before a clearer picture of the monitoring task has formed.

As recommended in both the applied methodology and in the tool AR-ACM0003, the relevant recommended procedures set out in the IPCC handbook “*Good Practice Guidance for Land Use, Land-Use Change and Forestry*” are to be implemented for the monitoring of ongoing actual GHG accumulation in the project area.

Procedures to internally verify field data collection

To verify that sample plots have been measured correctly, a re-measurement of some of the plots by different crew members from the original field crew could be performed at the end of the fieldwork. During this internal measurement verification process, the number of trees per plot, their DBH and the salinity content of the pore water could be remeasured and compared with the original data. The verification team will be chosen on basis of experience in forest measurement and highly attentive to details. Any errors found will be corrected and recorded, and any errors discovered will be expressed as a percentage of all plots that have been rechecked to provide an estimate of the measurement error.

Procedures to verify data entry and analysis

The data collected in the field will after collection be transferred to online spreadsheets from where it is used for estimating the GHG reduction calculations. To ensure that data is accurately entered into the spreadsheets, several measures are taken: Firstly, communication between all personnel involved in measuring and analysing data will be used to resolve any apparent anomalies before the final analysis of the monitoring data is completed. If there are any problems with the monitoring plot data that cannot be resolved, the plot will not be used in the analysis.

Secondly, the data entered is to be cross checked and qualitatively inspected to ensure that all data values fit within a realistic range.

Data archiving

All the collected data is stored on a common drive, ensuring that the data is not only available through one or few computers.

Organisation and responsibilities of the parties involved

Technical description of the monitoring task and overview of data collection procedures: The monitoring tasks are selected and defined by Ørsted and are based on the requirements set out in the applied methodology VM0007 v1.6 and the applicable modules.

The data collection procedures are made by Ørsted and is based on the requirements set out in the applied methodology VM0007 v1.6 and the applicable modules. The collection of data in the field is orchestrated by Ørsted and DPWM, who together are responsible for training the people involved in the data collection. These include Ørsted staff, DPWM staff, NGO staff and local community staff. Both Ørsted staff and DPWM staff has extensive experience with collecting data in the field. Ørsted is the responsible party regarding further processing of the collected data and for performing the remote sensing analyses.

Data to be collected: The list of data to be collected is made by Ørsted and is based on the requirements set out in the applied methodology VM0007 v1.6 and the applicable modules.

Quality control and quality assurance procedure: Ørsted is responsible for identifying the appropriate quality control and quality assurance procedures. Ørsted, DPWM and the involved NGOs are together responsible for ensuring that the appropriate procedures are implemented according to plan.

Data archiving: Data is archived by Ørsted who are also responsible of ensuring that no data is lost once it has been handed over for archiving.

Monitoring task 1: Monitoring of project implementation

Technical description of the monitoring task and overview of the data collection procedures

Geodetic coordinates of all project boundaries and strata

As stated in the applied methodology VM0007 v1.6, the geographic position of the project area boundary must be recorded for all areas of land included in the project area, including any stratification or buffer zones inside the boundary. The boundaries shall be established, recorded, and archived. The project area boundary can in this project be determined through in-field collection of GPS coordinates or in field drone mapping, potentially in combination with satellite imagery analysis.

The data collection can be performed either pre- or post- planting. If the data collection is performed pre-planting, clear marks of the area to be planted is made and thorough instructions and supervision from responsible staff is given to ensure that the communities performing the planting knows the exact area that are to be planted. If the data collection is performed post-planting, the person(s) performing the mapping is accompanied by people who knows the exact planted area (for example responsible community members and/or NGO or DPWM staff which were present at the planting event) and who can therefore guide and confirm that the mapping is performed accurately.

In PAI#1, the project boundaries are defined through the collection of GPS coordinates in the field post-planting. In PAI#1, two different strata have been established, and as required in the methodology, each stratum is encompassed by its own geographic boundary. As no buffer zones are established inside the boundary, no GPS coordinates have been collected for this. The coordinates have been collected using the GPS Garmin GPSMAP 66sr, and the project area polygons has been generated through processing of the GPS coordinates in remote sensing software. Based on the survival and growth of the plantings, PAI#1 project boundaries will be updated accordingly in the monitoring reports.

Amount of C exposed to aerobic conditions through soil excavation

A conservative estimation of the amount of SOC exposed to aerobic conditions through excavation of soil shall be performed in areas where excavation has been performed. The estimation of soil excavated is based on remote sensing analysis and/or in field inspection, and the estimation of SOC present in the soil on scientific literature and/or in field measurements of SOC content.

The remote sensing analysis can be based on satellite imagery of high resolution captured post-excavation or drone mapping performed post-excavation. Field inspection is performed post-excavation and includes the physical measuring of the depth of the excavated canals and a conservative estimation of the area that the excavated canals propagate. The direct estimation of SOC in the soil can be performed either pre- or post- excavation and consists of soil sampling of the first approximately 20cm of the soil profile, followed by a determination of its C content

through accepted scientific methods, for example through the *loss of ignition* method or through an *elemental analyser* machine⁴⁴.

In PAI#1, the conservative estimation of C exposed to aerobic conditions through soil excavation is based on remote sensing analysis, in field inspection and scientific literature. The estimation of soil excavated is based on both satellite imagery inspection and in field inspection. The satellite imagery chosen for the inspection is of the type *SkySat* from the company *PLANET LABS*. The imagery has a resolution of 0.5x0.5 meters, allowing for the visibility of the excavated canals. During the in-field inspection, the depth of the excavated canals was determined to be 10-15 cm and the cover percentage of the canals to be 2-5%. To accommodate the insecurities related to the estimations, the average depth of the canals is in this PD set to 15 cm and the cover percentage of the canals to 5%.

Identification of pre-project trees

To document that pre-project trees in the project area are not inventoried along with the trees planted in the project, that pre-project trees do not suffer mortality because of competition from trees planted in the project and that pre-project trees are neither harvested, cleared nor removed throughout the crediting period (*as required per AR-AM-tool14*), a remote sensing analysis or an in-field inspection of trees present at year 0 of the project is performed.

The mapping will have to be performed either before project initiation or during the first year following planting, where the difference between the planted trees and the pre-project trees are still indisputable. The data used for the remote sensing analysis can be either high resolution satellite imagery or drone imagery.

In PAI#1, the identification of pre-project trees is based on high resolution satellite imagery of the type *SkySat* from the company *PLANET LABS*. The imagery has a resolution of 0,5x0,5 meters and consists of 4 bands: red, green, blue and NIR. The high resolution allows for the clear visibility of pre-project trees. The satellite imagery was captured on 12th of October during the first year following planting. See Figure 8 below for an example of the SKYSAT data and the clear visibility of pre-project trees.

Once monitoring plots are established and the trees within them are to be measured, the satellite imagery captured will be used to ensure that pre-project trees are not included in the estimation of biomass growth due to project activities. The growth of the pre-project trees will however still be measured to ensure that these trees do not suffer mortality because of competition from trees planted in the project.

⁴⁴ ADAS (2019): 2018-19 Soil Policy Evidence Programme, Review of best practice for SOC monitoring

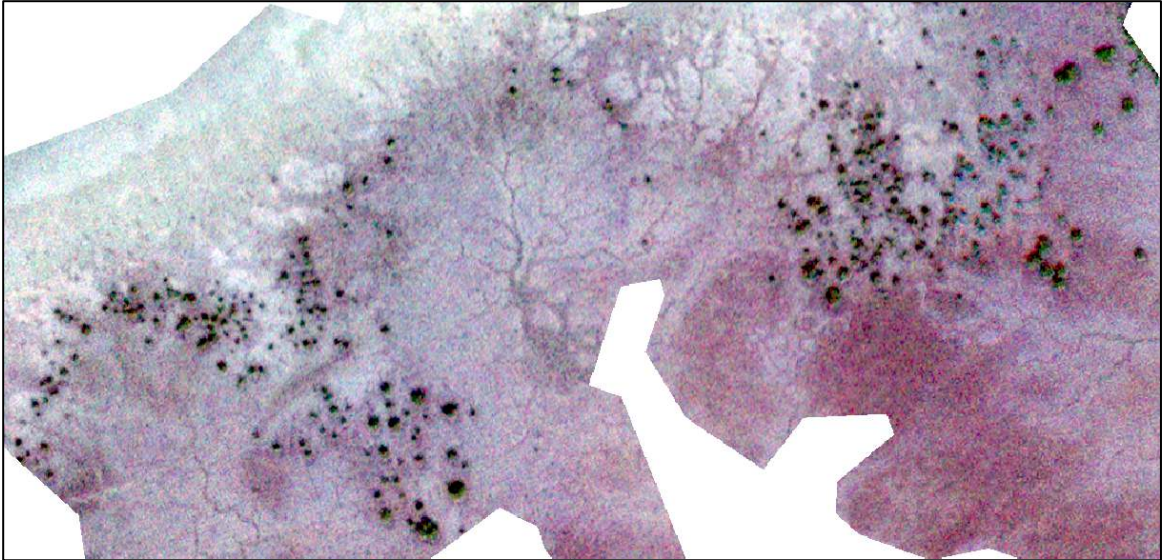


Figure 8: SKYSAT imagery of part of the P7 polygon

Salinity content

As stated in Section 4.1 and 4.2 of this PD, baseline emissions and the projection of project emissions from methane and nitrous dioxide are estimated based on the salinity content of the water within the project area in the pore water or in the tidal water above the project area and/or the salinity of the adjacent river. The salinity can either be conservatively estimated through the *salinity low point* method or more accurately through the *salinity average* method presented in module M-TW.

In PAI#1, the salinity content is conservatively estimated through the *salinity low point* method. The salinity content of both pore water, tidal water above the project area and water in the adjacent river has been measured using a salinity measurer with a sensitivity of 0,01%. As required in module M-TW, the measurements have been performed in the rainy season where the salinity content is expected to be the lowest, ensuring a conservative salinity estimation. Furthermore, for the measurements performed in the adjacent river and in the tidal water above the project area, the salinity was measured in the water closest to the surface. As saltwater due to its higher density tends to sink to the bottom of the water column, the salinity content of the surface water will generally be lower than the average salinity of the water column, further ensuring indisputable conservative estimations.

Data to be collected

- Geodetic coordinates of all project boundaries and strata
- Amount of soil exposed to aerobic conditions through soil excavation
- Identification of pre-project trees

- Salinity content

Monitoring task 2: Monitoring of actual carbon stock changes and greenhouse gas emissions

Technical description of the monitoring task and overview of the data collection procedures

ARR

As stated in the applied methodology VM0007, the monitoring plan must use the methods given in module M-ARR for monitoring of carbon stock changes for ARR project activities. Further, it is required that all relevant parameters from the modules are to be included in the monitoring plan. In module M-ARR, it is stated that GHG emissions and removals in the biomass carbon pools shall be monitored through the procedures provided in AR-ACM0003.

In module M-ARR, it is stated that the parameters of $\Delta C_{ACTUAL,t}$, $C_{TREE_PROJ,t}$, $C_{SHRUB_PROJ,t}$ and $C_{WPS-herb,i,t}$ shall be available at validation and shall be continuously monitored.

As estimations of $C_{SHRUB_PROJ,t}$ and $C_{WPS-herb,i,t}$ is conservatively excluded from this project, they are as well excluded from the monitoring plan and therefore set to zero.

$\Delta C_{ACTUAL,t}$ is as described in Section 4.2 of this PD calculated by adding together the values of $\Delta C_{TREE_PROJ,t}$ and $\Delta C_{DW_PROJ,t}$. As $\Delta C_{DW_PROJ,t}$ is estimated through a standard value, it is not to be monitored. The parameters of $\Delta C_{TREE_PROJ,t}$ and $C_{TREE_PROJ,t}$ are to be estimated through the following methods:

Direct estimation of change by re-measurement of sample plots

As stated in the tool AR-ACM0003, $\Delta C_{TREE_PROJ,t}$ shall be calculated as stated in the tool AR-TOOL14 v4.2. According to this tool, the parameter can be calculated ex-post in different ways. As there is expected to be a significant correlation between the plot biomass values on the measuring occasions (typically when there has been no harvest or disturbance on a stratum and therefore no significant spatial re-distribution of biomass has occurred in the stratum after the first estimation), the method of *Direct estimation of change by re-measurement of sample plots* is applicable and chosen for this project. The method is applied as required in the tool. Overall, the method requires the establishment on permanent sampling plots in which the diameter of the trees is measured and then through an allometric equation converted into a biomass estimate. For each monitoring, the same plots are measured and the difference in biomass between the measurements calculated.

Sampling design

As stated in AR-TOOL14 v4.2, the sampling design can consist of either *stratified random sampling* or *double sampling*. In *stratified random sampling*, the sampling plots are established and measured. In *double sampling*, a secondary variable is measured in all the sample plots in a stratum and tree biomass is measured in a sub-set of the same sample plots.

As the mangrove ecosystem of the Gambia has been observed in some areas to be difficult to enter, measuring biomass directly in all plots through DBH measurements can prove to be challenging. Should such be the case and/or should a secondary variable prove to show a strong linear relationship between the plot biomass values and the plot values of the secondary variable, the method of *double sampling* could be applied. In several scientific studies, a strong linear relationship has for example been found between mangrove biomass, mangrove tree height and mangrove canopy diameter⁴⁵.

Strata boundaries

As of this PD, the project area is divided into two strata: One with hydrological engineering and one without. To evaluate whether this division of strata accurately reflects the actual biomass growth, remote sensing analysis from either satellites or drones and in-field inspections are performed. Should this initial division of strata prove to accurately reflect the actual biomass growth, they will be kept for the ex-post biomass monitoring. However, should the analysis reveal that biomass within the project area can be more accurately estimated through different strata boundaries, such will be established for ex-post monitoring.

Estimation of continued presence of pre-project trees

In the representative plots established for biomass estimation, the presence of pre-project trees at project start is inspected through the mapping of the pre-project trees performed at project implementation (see monitoring task 1). Through either remote sensing analysis or in-field inspection, the continued presence of the pre-project trees within the plots are investigated. Furthermore, identification of pre-project trees within the plots ensures that they can be excluded from the DBH measurements and tree count of the plots, and thereby excluded from the net GHG removals estimations.

WRC

⁴⁵ Navarro, A. et al (2020): The application of Unmanned Aerial Vehicles (UAVs) to estimate above-ground biomass of mangrove ecosystems

As stated in the applied methodology VM0007, the monitoring plan must use the methods given in module M-TW for monitoring GHG emissions from tidal wetlands for WRC project activities.

Estimation of tree crown cover for appliance of the $GHG_{WPS-insitu-CO2,i,t}$ default value

In module M-TW, it is stated that $GHG_{WPS-insitu-CO2,i,t}$ shall be calculated using the same procedures as set out in module BL-TW. In this module, it is stated that the default factor of -1.46 t C ha/yr can be applied if the crown cover is at least 50%. Is the crown cover between 15% and 50%, linear interpolation can be applied. Therefore, the crown cover percentage must be monitored until it has reached at least 50%. The monitoring of crown cover will be performed through remote sensing analysis, and the default factor counted into the GHG calculations corresponding to the crown cover.

Alternative methods for the estimation of SOC accumulation in the project area

As the default value for $GHG_{WPS-insitu-CO2,i,t}$ currently selected (as argued in Section 4.2 in this PD) is very conservative, it is a possibility that SOC accumulation in the future of this project will be estimated using one of the other available methods as presented in the applicable module M-TW. If an alternative SOC estimation method is selected, the execution of the method will fulfil all requirements as set out in the module.

Estimation of salinity content for continuous estimation of methane and nitrous dioxide emissions

The ongoing estimation of salinity content will follow the same procedures as set out in monitoring task 1 above to continuously estimate methane and nitrous dioxide emissions from the project area. The measurements performed will either apply to the *salinity low point* method or the *salinity average* method as required in module M-TW.

Data to be collected

- DBH and number of planted trees in representative plots within each stratum
- Updated strata boundaries
- Presence and DBH of pre-project trees
- Crown cover percentage
- Salinity content
- *(Potentially): Secondary variable showing strong linear relationship with biomass*

- (Potentially): Data related to an alternative estimation of SOC accumulation

Monitoring task 3: Monitoring of leakage carbon stock changes and greenhouse gas emissions

No leakage is taking place in this project (see Section 4.3 of this PD); however, monitoring will occur to ensure that no leakage (LK ARR) occurs.

Lack of anthropogenic use

In PAI#1, there are no anthropogenic use. This is verified by using SkySat imagery from the company PLANET LABS and drone imagery. By acquiring and reviewing remote sensing data, anthropogenic use such as agriculture can be easily identified. Additionally, discussions with communities will confirm absence of anthropogenic use.

Data to be collected

- Presence/Absence of anthropogenic use such as agriculture in project area

Monitoring task 4: Estimation of ex post net carbon stock changes and greenhouse gas emissions

For each monitoring period, the ex post net carbon stock changes and greenhouse gas emissions are to be estimated based on the collected data as presented above and the calculation methods presented in Section 4.4 (and the sections referred to herein) of this PD. All calculations shall be in compliance with the applied methodology VM0007 v1.6 as well as all applicable modules and tools that the methodology refers to.

Continued appliance with the applicability conditions for WRC project activities

As required in the applied methodology VM0007 v1.6, continued compliance of the WRC project activities with the applicability conditions of this methodology must be ensured by monitoring that:

- The water table is not lowered except where the project converts open water to tidal wetlands, or improves the hydrological connection to impounded waters
- The burning of organic soil as a project activity does not occur
- Peatland fires within the project area do not occur in the project scenario. If they do occur as non-catastrophic events, they are accounted for by cancelling the Fire Reduction Premium for the entire project or the individual project activity instance.

- Nitrogen fertilizers are not used within the project area in the project scenario

As the above points are neither currently taking place in the project area nor will in the future take place in the project area, their monitoring is not relevant. However, as it is a requirement of the applied methodology, the continued appliance with the above applicability conditions is to be confirmed during each monitoring period.

Monitoring

As stated in the applied methodology VM0007 v1.6, the ex-post monitoring must have two key aspects:

Task 1: Monitoring according to monitoring plan

Task 2: Revising the baseline for future project crediting periods

Task 1: Monitoring according to monitoring plan:

Monitoring of key variables

ARR: As stated in the applied methodology VM0007v1.6, changes in biomass carbon stocks in the project area must be measured before each verification as part of the monitoring. Methods must be consistent with the methodology given in Module M-ARR and any technical guidance specified in the monitoring plan designed for this project.

WRC: As stated in the applied methodology VM0007 v1.6, information required to periodically reassess the project baseline must include changes in the drainage layout and climate variables, as specified in Module BL-TW and, where relevant, any technical guidance specified in the monitoring plan.

As stated in the applied methodology VM0007 v1.6, carbon stocks in most cases will not have to be monitored during the baseline period, except in the following cases:

- Where there is an increased accuracy and precision of the ex-ante carbon stock estimates, which are also used for ex-post calculations. Verifiable evidence must be provided to VCS verifiers that the accuracy and precision of the carbon stock estimates have improved, compared to previous estimates. Any change in carbon stock densities will be subject to validation.
- Where emissions reductions/removals are claimed for avoiding forest degradation caused by extraction of wood for fuel or charcoal or carbon sequestration in forest

land that would have been deforested in the baseline case. In such cases, the methods described in Module M-REDD.

As required in the applied methodology VM0007 v1.6, Carbon stocks are to be reassessed at every baseline revision.

As further required in the applied methodology VM0007 v1.6, the calculations of actual carbon stock changes and greenhouse gas emissions are to be reported using transparent procedures. Methods are to be consistent with the methodology given in Module M-TW and any technical guidance specified in the monitoring plan.

Task 2: Revising the baseline for future project crediting periods:

As required in the applied methodology VM0007 v1.6, baselines are to be revised over time because agents, drivers and underlying causes of deforestation as well as drainage layouts and climate variables change dynamically. The methodological procedure used to update the baseline are to be the same as used in the first estimation.

APPENDIX

N/A