



Verified Carbon Standard

REFORESTATION AND RESTORATION OF DEGRADED MANGROVE LANDS, SUSTAINABLE LIVELIHOODS AND COMMUNITY DEVELOPMENT IN MYANMAR



WORLDVIEW
INTERNATIONAL FOUNDATION

Document Prepared by Worldview International Foundation

Project Title	Reforestation and Restoration of degraded mangrove lands, sustainable livelihood and community development in Myanmar
Version	6.0
Report ID	WIF-MR-0822-01
Date of Issue	11-10-2023
Project ID	1764
Monitoring Period	15-June-2021 – 14-June-2022
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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

The project's goal is to restore and protect 2,065.87 ha of degraded mangrove forests located in the northern part of the Ayeyarwady Division of Myanmar. The areas of mangrove forests that were restored are in the village tracts of Magyi, Thabawkan, and Thaegone. The project started on 15th May 2015 and have completed the implementation of mangrove restoration by planting mangrove seedlings in 2019. This 5th monitoring report covers the monitoring activities from the period of 15th June 2021 through 14th June 2022. During this time, the project continued and built upon activities conducted during the first four monitoring periods and introduced new activities as appropriate. As an example, community activities included ongoing support of community-based businesses such as the ice plant development.

The purpose of this project is to establish and maintain a sustainably managed mangrove ecosystem that can help trap carbon, lower the risk of natural disasters, and offer local residents with long-term employment opportunities. To reach this purpose, the project includes strengthening the ability to supply mangrove ecosystem services which can mitigate and adapt the climate change, as well as supporting the economic development while additionally affecting local individuals. In the absence of the project, mangroves in the project area will be disappeared due to various anthropogenic activities. This would result in the release of both above and belowground carbon deposits into the atmosphere. The species identified for this reforestation project are *Rhizophora mucronata*, *Rhizophora apiculata*, *Bruguiera gymnorhiza*, *Bruguiera cylindrica*, *Bruguiera sexangula* and *Ceriops tagal*. This combination of mangrove restoration and coastal green belt protection will improve the biodiversity and serve as means of reducing the risk of natural disasters such as waves or tsunamis. In order to create a viable alternative to forest degradation in Myanmar, the project proponent seeks to use the carbon credits generated by the Verified Carbon Standard (VCS) through the Afforestation, Reforestation, and Revegetation (ARR) project category in providing a sustainable revenue stream for project area protection, local community, and infrastructure development.

The project has sequestered 60,225 tCO₂e over a period of 1 year. In addition to the carbon sequestration the project will also launch:

- Poverty alleviation with new livelihoods and wealth creation in rural areas
- Community empowerment through active participation in the planning and development of the project
- Improvement of basic infrastructure for rural communities

1.2 Sectoral Scope and Project Type

This project is an Agriculture, Forestry and Other Land Use (AFOLU) project under the Afforestation, Reforestation and Revegetation (ARR) project category.

Project is NOT a grouped project.

As per the section 3.2.8 of VCS Standard (Version 4.3), all ARR projects that occur on wetlands shall adhere to both the respective project category requirements and the WRC (Wetlands Restoration and Conservation) requirements unless the expected emissions from the Soil Organic Carbon (SOC) pool or change in the SOC pool in the project scenario is deemed below *de minimis* or can be conservatively excluded as set out in the VCS Program document *VCS Methodology Requirements*, in which case the project shall not be subject to the WRC requirements.

For this project soil organic carbon is an important part of the total amount of the carbon sequestered, hence the project will comply with both ARR requirements and WRC requirements. Upon the requirements, the periodic reassessment of the baseline, at least not more than 10 years, will be undertaken to capture changes in the drivers and/or behavior of agents that cause the change in land use, hydrology, sediment supply and/or land or water management practices and changes in carbon stocks. At the time of baseline assessment, the latest approved version methodology will be adhered and the project description will be updated by following both ARR and WRC requirements.

In addition, the section A1.13 of Appendix 1 of VCS Standard (Version 4.3) also mentions that mangrove is one of the common wetland types. Therefore, according to the VCS Standard (Version 4.3) and relevant methodologies, the project is also eligible for the WRC category.

1. The project is a mangrove restoration project and will reduce GHG emissions, hence falls both ARR and WRC categories.
2. The baseline scenario is bare lands, degraded and severely degraded mangrove lands or coastal tidal wetlands.
3. The project reduces carbon emission by restoring mangroves or coastal tidal wetlands.
4. The calculation of GHG emissions were done based on approved methodologies.
5. Project activities neither lower nor raise the water table, and remain the tidal range by maintaining the mangrove ecosystems.
6. No modification of hydrology is required, and the original mangroves and its tributaries will remain natural, and no significant increase can occur in the GHG emissions outside the project area. Mangrove restoration is carried out on the degraded coastal wetlands, and
7. No burning of organic soil is applied in the project activities.

1.3 Project Proponent

Organisation name	Worldview International Foundation (WIF)
Contact person	Dr. Arne Fjortoft

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1.4 Other Entities Involved in the Project

Organisation name	Pathein University
Role in the Project	Land right holder and research partner
Contact person	Dr. U Htay Aung
Title	Research Manager
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Organisation name	Thabawkan Village Tract Mangrove Conservation Committee
Role in the Project	Land right holders and labour force
Contact person	U Chit San
Title	Village tract leader
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Organisation name	Thaegone Village Tract Mangrove Conservation Committee
Role in the Project	Land right holders and labour force
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Title	Village tract leader

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Organisation name	Forest Department
Role in the Project	Land right recommendation and consultation for forest services
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Organisation name	Ayeyarwady Regional Government
Role in the Project	Landowner and local authority
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Organisation name	Forest Research Institute
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Organisation name	University of Forestry and Environmental Science
Role in the Project	Research Partner
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1.5 Project Start Date

Project start date is 15th May 2015.

The start date of the project activity is 15th May 2015, when the land preparation started.

1.6 Project Crediting Period

The duration of the project is 20 years and 00 months, beginning on 15th June 2015 and ending on 14th June 2035 with renewable condition.

Start date of the crediting period is 15th June 2015, when the planting started.

1.7 Project Location

The project is implemented in three village tracts namely, Magyi, Thabawkan and Thaegone in ShweThaung Yan Township. This is in the Northern part of Ayeyarwady Division of Myanmar. There were no changes in project location and project boundaries during this monitoring period.



Figure 1: Location of the project (Source: <https://wif.maps.arcgis.com/>)

The details of each parcel of land are enclosed in the supporting documentation where the location of the planting sites in each village including detailed information for each planting plot is shown on Google Earth image (kml file).

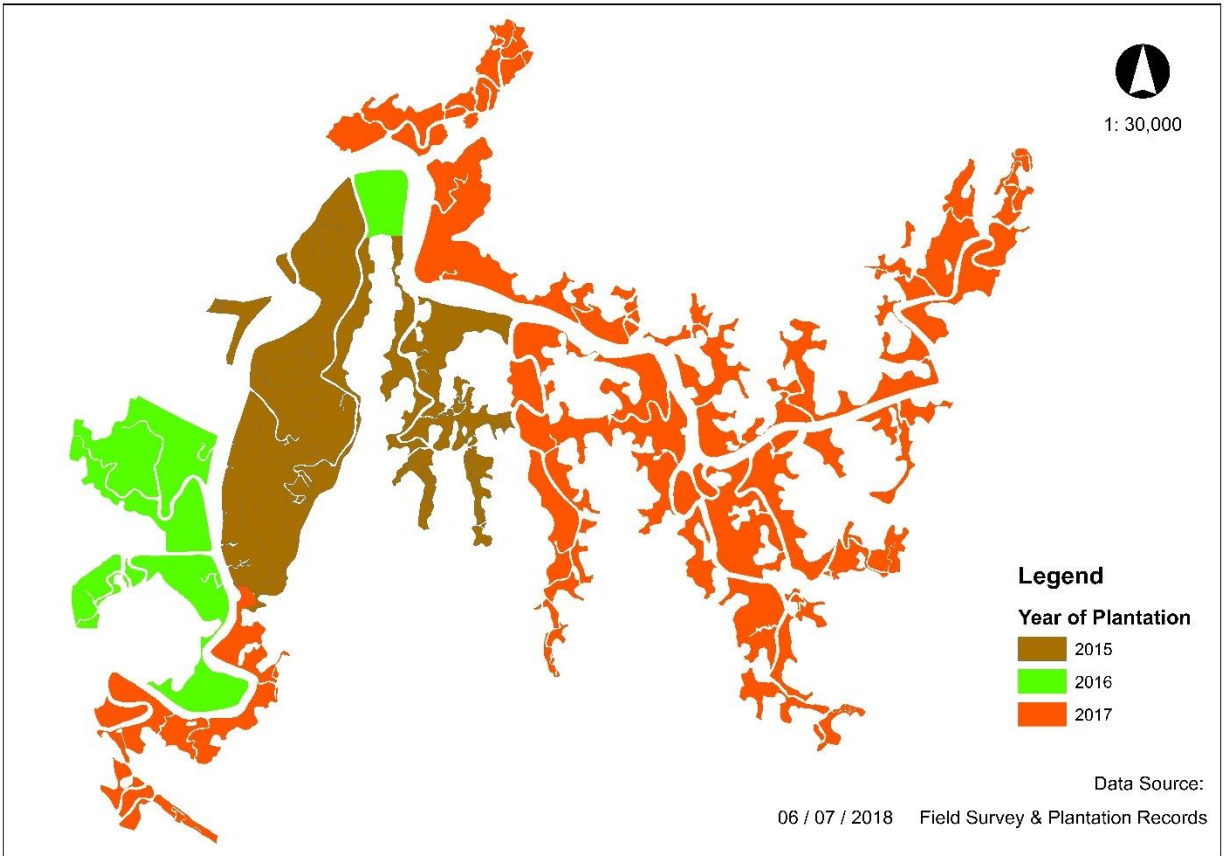


Figure 2: Project Location indicating in Magyi area including 2015, 2016 and 2017 planting/restoration strata

Thaegone and Thabawkan 2018 Planting Area

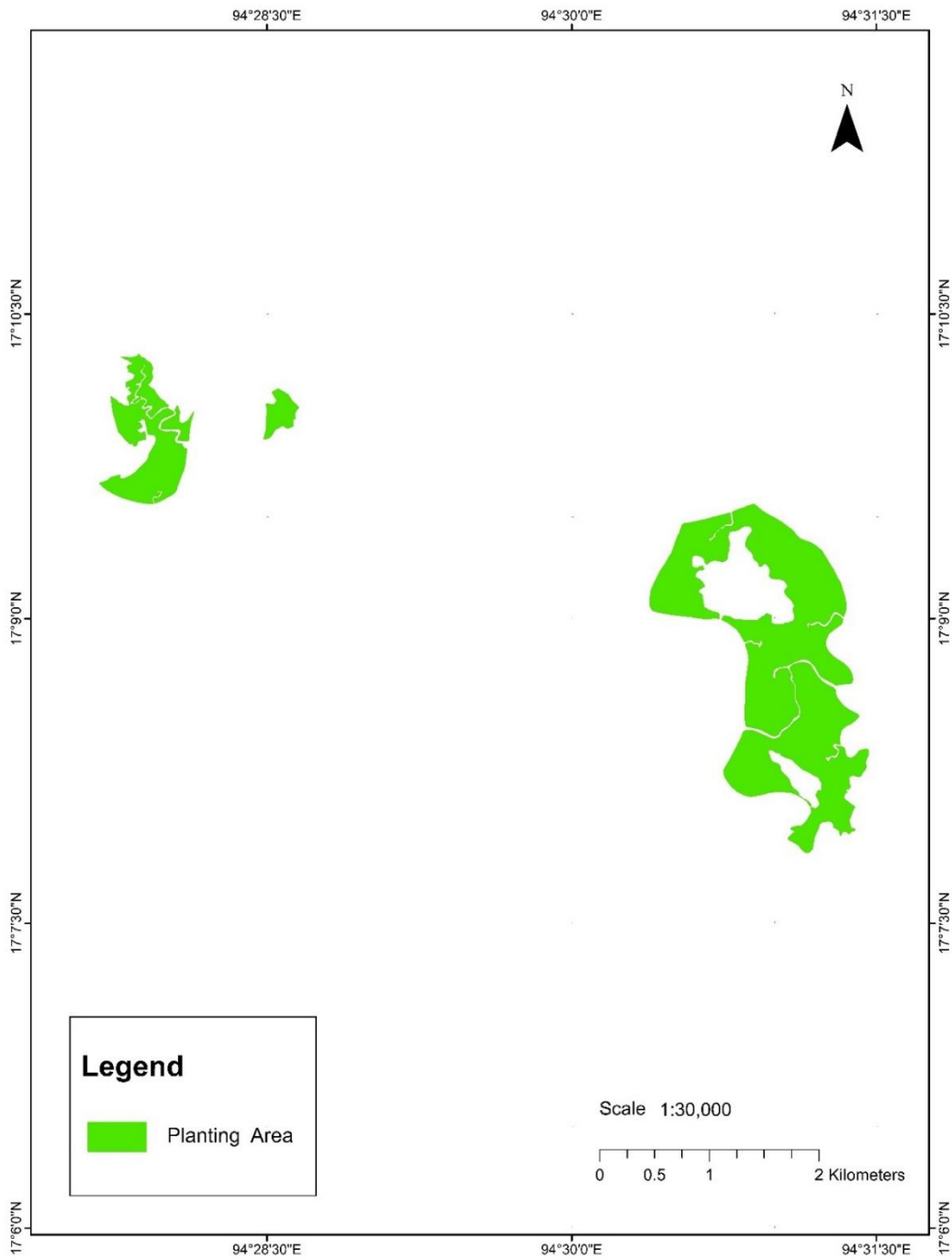


Figure 3: Project Location indicating Thaegone and Thabawkan areas including 2018 planting strata

Thaegone and Thabawkan 2019 Planting Area

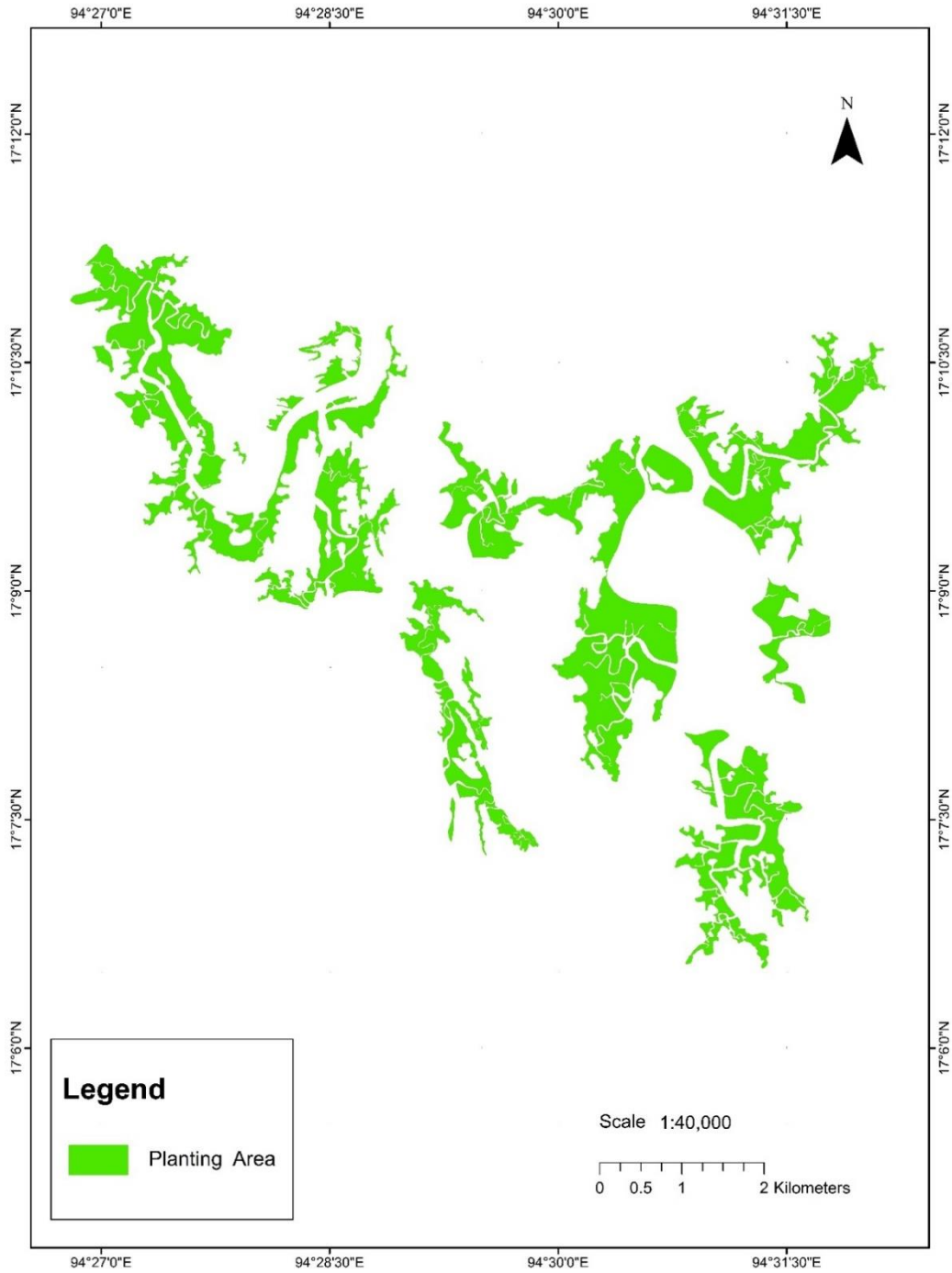


Figure 4: Project Location indicating Thaegone and Thabawkan areas including 2019 planting strata

1.8 Title and Reference of Methodology

A/R Large-scale Methodology: Afforestation and reforestation of degraded mangrove habitats (AR AM0014) Version 03.0 and under Sectoral scope(s): 14 of the Clean Development Mechanism

The methodology also refers to the latest approved versions of the following tools:

- (i) “Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities” (Version 01);
- (ii) “Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities” (Version 04.2);
- (iii) “Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities” (Version 03.1);
- (iv) “Estimation of non-CO₂ GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity” (Version 04.0.0);
- (v) “Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity” (Version 02.0).
- (vi) “Guideline for objective demonstration and assessment of barriers” (Version 01 EB-50)

1.9 Participation under other GHG Programs

Include the following information, as applicable:

- Emission Trading Programs and Other Binding Limits: NONE
- Other Forms of Environmental Credit: The project has not sought or received another form of GHG-related environmental credit, including renewable energy certificates, during this monitoring period.
- Participation under Other GHG Programs: The project is not registered under any other GHG program.

1.10 Other Forms of Credit

Emission Trading Programmes and Other Binding Limits: The project is not included in any other emission trading programme.

Other Forms of Environmental Credit: The project has not sought or not received any other form of GHG-related environmental credits during this monitoring period.

1.11 Sustainable Development Contributions

The project delivers on 9 of the 17 Sustainable Development Goals. The program delivers superior impact in the following 9 core SDGs:

1. SDG 3 – Good health and well-being,
2. SDG 4 – Quality education,
3. SDG 5 - Gender equality,
4. SDG 7 – Affordable and clean energy,
5. SDG 8 – Decent work and economic growth,
6. SDG 9 – Industry, innovation and infrastructure,
7. SDG 13 - Climate action,
8. SDG 14 – Life below water,
9. SDG 15 - Life on Land.

Table 1 gives a detailed explanation of how project activities result in the SD contributions referring to the SDG indicators list¹.

Table 1: Sustainable Development Contributions

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
1)	3.8	3.8.2 Proportion of people have an access to COVID 19 protective equipment	Implemented activities to increase	The project has provided COVID 19 personal protective equipment (PPE) to 1413 people in Thabawkan village. The provided PPE kits are infra-thermometer, face masks, hand spray bottles, hand gel bottles, PPE suits, and spray machines.	The project has supported 1413 people with quality and essential COVID 19 preventive medicines and equipment among the most disadvantaged population. 100 % of coverage this population.
2)	4.a	4.a.1 Proportion of schools with access to educational facilities	Implemented activities to increase	The project supported school desks and chairs, multimedia equipment, school items (books, raincoats, solar lamps, umbrella) and school renovation (school cement flooring) to 5 schools.	Increased the access to education facilities and infrastructure to 5 school villages in the project boundary 30 % of all school in project targeted villages are covered.

¹ <https://www.fao.org/forestry/12674-0353fe60e1dd4ede696dce7fca06e5c5c.pdf>

3)	4.b.	4.b.1 Volume of official development assistance flows for scholarships by sector and type of study	Implemented activities to increase	In this monitoring period, students could not continue schools due to the shutdown of schools affected from political situations.	Total 15 students high, middle and primary levels were awarded scholarships.
4)	4.4	4.4.1 Proportion of youth and adults with information and communications technology (ICT) skills, by type of skill	Implemented activities to increase	Fuel efficient stove making training, computer training program, shell craft training, seaweed training and mobile video production training were given to 145 local people.	<p>The project aims to increase the number of local people who have relevant skills, including technical, and vocational skills for employment and entrepreneurship. Until this monitoring period, 145 local people received fuel efficient stove making training, computer training program, shell craft training, seaweed training and mobile video production trainings.</p> <p>(5% of the total population is covered in 15 targeted villages)</p>
5)	5.5	5.5.2 Proportion of women in managerial positions	Implemented activities to increase	Proportion of women participated in leading roles in Village Development Committee.	40% and above of those percentages of the women are targeted to ensure women participation in village development committee.
6)	7.1	7.1.1 Proportion of population with access to electricity	Implemented activities to increase	Proportion of household received electricity supply in 3 villages.	40% and above of those percentages of household are targeted to access electricity in 3 villages.
7)	7.1	7.1.2 Proportion of population with primary reliance on clean fuels and technology	Implemented activities to increase	243 cooking stoves are distributed to villagers to save fuelwood consumption, and monsoon tree plantation intended to promote community energy forest.	<p>In total 243 stoves were distributed to 937 populations of 4 targeted villages.</p> <p>(22% of the total population is covered in 4 targeted villages.)</p>

8)	8.3	8.3.1 Proportion of informal employment in non-agricultural employment by sex	Implemented activities to increase	Revolving funds are implemented, and cash for work activities such as constructing and repairing the village infrastructure, provision of capital in cash to their livelihood sector.	Nearly 828 villagers received income from seasonal livelihood activities and cash for work activities. (39% of the total population is covered in 12 targeted villages.)
9)	9.1	9.1.1 Proportion of the rural population who live within 2 km of an all-season road	Implemented activities to increase	Infrastructure to increase the daily transport, reduce salt intrusion and promote the access to drinking water storage.	4 Box culverts construction which are 22ft, 24ft, 26ft and 18ft length, dike renovation and rainwater harvesting pond renovation.
10)	13.0	Tonnes of greenhouse gas emissions avoided or removed	Implemented activities to increase	By conserving 2065.87 ha of the mangrove forest, the project has prevented the release of 60,225 tonnes of carbon into the atmosphere during the monitoring period.	The project prevented the emission of 244,520 tonnes of carbon into the atmosphere from 2015 to 2022.
11)	13.1	13.1.1 Number of countries with national and local disaster risk reduction strategies	Implemented activities to increase	Myanmar is one of the countries which aims to reduce disaster risks ² . Mangrove restoration is aligned with the national management of coastal forest and trees to reduce natural disasters.	2065.87 ha of mangrove forests in Shwe Thaug Yan Township are restored and replanted by WIF.
12)	13.1	13.1.2 Number of deaths, missing persons and persons affected by disaster per 100,000 people	Implemented activities to decrease	Mangrove restoration will reduce the numbers of local people which can be affected from future coastal storms.	2065.87 ha of mangrove forests in Shwe Thaug Yan Township are restored and replanted by WIF.

² <https://sustainabledevelopment.un.org/content/documents/11803Official-List-of-Proposed-SDG-Indicators.pdf>

13)	14.5	14.5.1 Coverage of protected areas in relation to marine areas	Implemented activities to increase	The project areas are protected from cutting trees down with the cooperation of local villages, Forest Department and Patheingyi University. But villagers are allowed to do catching crabs or other benthic species such as clams, and oysters for their food.	2065.87 ha of mangrove forests in Shwe Thung Yan Township are restored and replanted by WIF.
14)	15.2	15.2.1 Towards sustainable forest management	Implemented activities to increase	WIF worked together with Forest Department, Patheingyi University and local communities to prevent the degradation and increase the carbon sequestration of the mangrove forest.	2065.87 ha of mangrove forests in Shwe Thung Yan Township are restored and replanted by WIF.
15)	15.b	15.b.1 Official development assistance on the project	Implemented activities to increase	As of the fourth monitoring period, the project has sequestered 60,152 tCO ₂ e over a period of 1 year. The VCS program gave the carbon credits opportunity to successfully restore and protect the forest.	In the previous four years, the project received the carbon credits with VCS program and subsequent finance to continually protect the forest and provide benefits to the local communities.

Mangrove restoration can be identified as a multi-faceted strategy for sustainable development. This has been classified by WIF under 3 criteria namely Environmental, Social and Economic criteria.

Environmental criteria:

Mangrove forests are part of the coastal ecosystem that typically includes mud flats, seagrass meadows, tidal marshes, salt barrens and even coastal upland forests and freshwater wetlands (i.e., peatlands), freshwater streams and rivers.

Establishing mangrove forests on degraded, and underutilised lands sequester significant amount of GHGs compared to the baseline. The project was implemented by WIF in cooperation with the government and universities that are committed to environmental sustainability and social responsibility.

Under the project, sediments, heavy metals, and other pollutants are trapped within the dense roots network. This retains sediments flowing from upstream and prevents contamination of downstream waterways and protects other marine ecosystems like coral reefs and seagrass beds below. The soil organic contents and mineral contents are improved due to proper land management. The restoration support fisheries and contribute to biodiversity by serving as nursery grounds for numerous coastal and marine species. This protects coastal towns from extreme weather like hurricanes, stabilize coasts, and prevent or stop soil erosion. Protecting endangered flora and fauna is another environmental benefit of the project. Recent mangrove plantations have brought back elephants and other wildlife that were previously not visible.

It is a wonderful sight to see the wildlife returning to the mangrove lands ensuring that their habitats have been reinstalled due to the project activities. Baya weavers, Warblers, and Sunbirds, are inhabiting and relying on mangrove plants for food and nesting. Apart from the birds, a variety of brackish fish such as the Blue-spotted mud hoppers have shown an abundant growth since the implementation of the project activities.



Figure 5: Wildlife at the project sites

Social criteria:

Low-income households in the area will benefit from the project because they will have more possibilities to enhance their income and thus be less likely to engage in unsustainable behaviors that would increase CO₂ emissions, damage the ecosystem, and further deplete mangrove populations.

The project created direct employment at agreed wages for the local communities involved in the project and provides all the necessary training as well. The project promoted a working family model where both men and women actively participate in the project.

Improvements to the infrastructure in the area were done to provide economic accessibility of the project area and also facilitate farmers' access and strengthen the competitiveness of the farmers when it comes to taking their food crops to the market.

Throughout the project implementation, village communities have shown a keen interest in the employment opportunities delivered through the project. All training program implemented during the monitoring period (15/6/2021 to 14/6/2022) are refresher shell craft training with 19 participants including all females (25/10/2021 to 28/10/2021), seaweed training with 15 participants including all females (4/10/2021 to 9/10/2021), stove making training with 17 participants including 12 males and 5 females (15/6/2021 to 16/6/2021), basic computer training with 40 participants including 12 males and 28 females (9/2/2022 to 25/3/2022), basic English speaking training with 30 participants including 6 males and 24 females (28/3/2022 to 15/5/2022), and elephant awareness training of trainers (ToT) with 24 participants including 23 males and 1 female (23/5/2022 to 24/5/2022), a total of 145 trainees including 66 males and 76 females representing with the gender participation of 47 % male and 53 % female. Photos can be referred to **Appendix 1**.

Furthermore, the project has aided the village communities by building dykes to prevent 160 acres of paddy fields and 17 wells from salt water intrusion. The 26 ft length box culvert, 24 ft concrete tube and 18 ft concrete tube were also built in Thabawkan village to support better drainage system. In addition, providing basic computer training programmes for students, computer accessories to schools (20 sets of school desks in Poe Laung village, 40 sets of desks and chairs in Ohn Chaung village, and water tank at schools in Poe Laung and Thae Kone villages), distributing solar lamps, rain coats, bags and books to students, and constructing rainwater harvesting ponds to provide safe drinking water during the dry season were implemented. These developments to their villages have uplifted the spirits among the village communities resulting in more engagement in the project over time. More Photos can be referred to **Appendix 1**.



Figure 6: Construction of dyke at Ohn Chaung village (left) and overhead water tank at schools (right)

Economic Criteria:

The labour requirement for the project was fulfilled through local employment. Therefore, the major portion of the budget on labour was retained within the region and the local community. The project paid its workers above normal wages with additional support in solving problems such as supporting construction of community dike, pond renovation to secure fresh water supplies in the dry season, repairing broken floors and roofs of school buildings, distributing solar lamps to families with school children, distribution of school bags and raincoats etc. in addition to creating new livelihoods.

In 2021, with the support of WIF, an ice plant was completely installed in Magyi community. The land was contributed by the village. The goal was inspired by an urgent request from fishermen who have long struggled to obtain ice to secure their catch, as 40 percent of it spoils on the way to market due to a lack of ice. Many households rely heavily on fishing for subsistence and income generation. The project has a significant social and economic impact on the local harvesting of seafood and food security. The Magyi community was willing to establish an ice plant for the creation of livelihoods opportunities of the local people and sustainable income generation. More Photos can be referred to **Appendix 1**.



Figure 7: Meeting with local authorities to implement the ice plant

2 SAFEGUARDS

2.1 No Net Harm

With the intervention of project activities, the involvement of local stakeholders in the project has been increasingly improved as the local field offices are accommodated, the field staff are assigned and stay regularly communicated with local communities and relevant stakeholders for day-to-day project activities. In the meantime, the awareness of mangroves and environmental conservation is raised to local stakeholders about the role and importance of mangrove ecosystems. Therefore, the degraded mangroves have been well restored to the healthy mangrove ecosystems. With the job opportunities and incomes from generating carbon revenues, the grassroot families are improved their health, education and economic status. In addition, gender equity and poverty reduction of the grassroots are prioritized with the livelihood improvement project activities.

In summary, as the project design is aimed to restore mangrove ecosystems that are coupled with the livelihood development of local communities, accordingly there are no negative impacts to local

stakeholders due to the implementation of the project activities, rather positive impacts are significantly delivered.

Stakeholder consultation has been a priority of the project from day one, believing that a participatory approach is the only way to success. The project is not only about mangrove trees, but also focused on the people.

The situation of the people in the project areas is critical. Their living standard of the majority is below the poverty line. The aim is to increase family income, and this was done in close consultation with the people in the areas. According to the socio-economic survey conducted by WIF and University of Patheingyi, there are 827 households in Shwe Thaung Yan city (Magyi Township) and the total population is approximately 3,000. There were 1,034 households and the population in Thaegone is around 4,550. Thabawkan has 633 houses, and the population is 3,283. These communities have been depending on mangroves for their food production and fuel-wood consumption. Therefore, during the stakeholder meetings, it was discussed and agreed to introduce alternative livelihoods and solutions for their fuel requirements.

Eight main stakeholder meetings were held to discuss the positive and negative impacts including challenges of the activities implementation such as seaweed farming. The objectives of the project planned activities and the benefits of carbon credits were presented at these meetings. The importance of protecting the mangroves and their role in carbon sequestration was also explained. Local communities reported a resurgence of fishery resources as well as increased storm protection. They further identified the importance and need for growing mangroves, but they lack the capacity to do so. Moreover, young people in the areas have been engaged in mobile video production trainings which majorly aim to use their mobile phones to document events and activities in their communities, allowing their video recordings to help local development. Additionally, the training's outcomes will support their professional lives.

There is no displacement of charcoal production and grazing occurring due to the project activity. Therefore, surrounding communities and the Forest Department officers have no objection in this project. In fact, they have positive attitudes towards the ARR VCS project activity due to following reasons:

(1) Income increase

This project was designed especially targeting the local community. The objective of the project proponent, WIF, being an INGO, is sustainable development and natural resource management of the project area. Therefore, the project has embraced any persons who would like to work based on this model. Low-income families in the area will get more opportunities to increase their income, which will be a support for their livelihoods.

(2) New employment opportunities

Skilled and unskilled labour is needed for this project. The project creates direct employment opportunities, through the maintenance and monitoring of the mangroves in the project/villages area. Previously, many of youth in these villages had gone to neighbouring districts for income generating employment. As a result, in many cases, only the children and older generation remained on their land. Reportedly, due to this reason, many youths stopped going to school at a young age. This situation has

good potential to change due to newly created employment provided by the project. Youth would have the opportunity to both work and study and reach their personal goals.

The project promotes a working family model where both men and women are actively participating in the project. There are also sufficient opportunities where women can work in the project.

(3) Knowledge on silvicultural techniques

As identified in the barrier analysis, planting mangroves requires proper silvicultural knowledge if the plants are to succeed in the long run. WIF and its staff have very good experience and knowledge of mangroves and this is being transferred to the local communities.

(4) Infrastructure development & Lifestyle changes

During the current monitoring period, WIF has been in close communication with the village communities following the COVID-19 regulations, to offer the best possible outcomes. WIF established a dedicated team in the field to carry out the project activities and to serve the village communities. Unemployment has sharply increased in the project areas due to the COVID-19 pandemic. The community partners are therefore thankful for job opportunities to be offering well-paying jobs. WIF has, since September 2021, supported the most marginalised in the community with food and other basic supply during the crisis, as well as providing valuable equipment to the local hospitals. In addition to that, WIF has provided Personal Protective Equipment (PPE) such as Surgical Masks, Hand sanitizers, Surgical Gowns, Gloves, Infra-Thermometers, N95 Masks, PPE suits, Bacterial Filtration efficiency caps and Sprayer equipment to Township Covid-19 Control and Emergency Response Committee in Shwe Thaug Yan township, Ayeyarwady Region in support of Myanmar's response to the COVID-19 global pandemic.



Figure 8: Distribution of COVID 19 protection kits and medical equipment

The livelihood/sustainable development activities in partnership with communities became partly affected, but most of the activities progressed as planned. Meetings held with the village communities mainly discussed the needs of the villagers and the deliverance of them. Some of them are, to improve

education and knowledge of the village students by providing computers, accessories such as tables and chairs, and other school supplies, awareness programmes on mangrove restoration, production and distribution of fuel-efficient stoves combined with energy forest, rainwater harvesting project for rural communities, a seaweed production project that will provide good livelihood opportunities for the local communities to get an extra income and learn a trade. In addition, they can benefit technical knowledge and nutrition from this project.

2.2 Local Stakeholder Consultation

In communicating with the person from Forest Department letter communication is used. A requested letter is sent for the date and time appointment for the meeting. For the communication with the village tract committees, WIF field offices use mobile communication. The minutes of stakeholder consultation and meetings are recorded. If the minutes are in Myanmar language, they are translated into English for the verification process of VCS. Meeting minutes are saved at the WIF cloud service or at the respective persons. Any suggestions or requests during the meeting are followed up by the livelihood team with mobile communication. WIF office is open at Magyi office and local stakeholders can send complaint letters regarding with the project activities to the WIF offices in the village tract. Complaints are resolved after receiving them. In addition, all stakeholders are aware of the process of VCS Program validation and verification and the validation or verification's site visit.

Risks, costs and benefits of the project are analysed and explained in Section 2.1 and 2.3. They are also presented to the community at each annual review meeting. In Myanmar, the labor law is issued and it includes the wages, allowances, public holidays and leave etc. During the current monitoring, any changes to the labor law and workers' rights were not made in Myanmar. WIF follows the regulations of labor laws and provide benefits to its staff.

As the livelihood field officer is majorly responsible for introducing the WIF livelihood projects and activities, the officer communicates with the local stakeholders and reporting the feedback of the local people who attended the meeting. The meeting minutes are usually archived at the WIF cloud service. Among regular stakeholder meetings, the following key meetings were held during 2021/2022:

Date/ Participants	Points discussed	Location
21.05.2021 WIF - Livelihood Team - Officer - Assistant Thabawkan Village Community - Leaders - 15 members	<ul style="list-style-type: none"> - Introducing WIF mangrove conservation projects in the village and the rest of the country and rural development projects. - Introducing the formation of livelihood projects; selecting project villages, forming village development committees, selecting beneficiaries, project identification, implementation, monitoring and evaluation. - The villager pointed out to resolve issues related to aquaculture and the officer explained to help implement aquaculture farms suitable for the area. - Officer gave examples of ice plant construction and cash for activities in other villages such as Magyi and Ohn Chaung. 	U Chit San, village leader house, Thabawkan village

Date/ Participants	Points discussed	Location
	Plans to provide fuel efficient stove training, and distributing them to the needy households. <ul style="list-style-type: none"> - Questions how can WIF support the village's livestock and agricultural farms. How to prepare a proposal to fix the village infrastructure. 	
23.6.2021 WIF – Livelihood Team <ul style="list-style-type: none"> - Officer - Assistant Shwe Thaug Yan <ul style="list-style-type: none"> - 5 members 	<ul style="list-style-type: none"> - Discussed about the seaweed cultivation problems and challenges - The farmers discussed that although the seaweed plants grow well, the nets exploded and the fish destroy the seaweed, need to give space in the frame for seaweed reproduction and money to invest - Another farmer discussed the barnacles attach to the seaweed frame and they can damage the net, fish destroy seaweed plants from damaged net - WIF Livelihood team suggested to put the seaweed in a good frame and Revolving Fund loan can be supported for investment in the seaweed frames etc 	Shwe Thaug Yan, Livelihood office
18.09.2021 WIF – Livelihood Team <ul style="list-style-type: none"> - Officer - Civil Engineer - Assistant Shwe Nadi Ward -1, Shwe Thaug Yan Community <ul style="list-style-type: none"> - 7 members 	<ul style="list-style-type: none"> - WIF plans to reduce the cost of drinking water and water supply in Shwe Nadi 1. - The village leader offered to donate land for building the wells and water reservoirs. - Plans for the construction and beneficiary numbers 	U Kyaw Min Naing home, Shwe Nadi 1, Shwe Thaug Yan
10.8.2021 WIF – Livelihood Team <ul style="list-style-type: none"> - Officer - Admin and finance - Assistant Ohn Chaung village <ul style="list-style-type: none"> - 4 members 	<ul style="list-style-type: none"> - To establish the revolving fund in the village - Processes of revolving fund 	Ohn Chaung Church Hall
12.10.2021 WIF – Livelihood Team <ul style="list-style-type: none"> - Officer - Assistant Shwe Thaug Yan Ward 2 <ul style="list-style-type: none"> - 8 members 	<ul style="list-style-type: none"> - Discussed that WIF and Patheingyi University will be doing crab farms experiments and to distribute the technology to the local people when successful During the meeting, crab farming market conditions in Shwe Thaug Yan area was discussed.	Shwe Thaug Yan Ward 2, Daw Thin Thin Khaing Home
8.11.2021 WIF – Livelihood Team <ul style="list-style-type: none"> - Senior livelihood officer - Officer - Assistant Wethe village <ul style="list-style-type: none"> - 35 members 	<ul style="list-style-type: none"> - Introducing the formation of village development committee and livelihood programs of WIF - The importance of PRA workshop to identify village's true needs - Future PRA workshops in other villages 	Wethe village

Date/ Participants	Points discussed	Location
4.2.2022 WIF – Livelihood Team - Officer - Assistant Wethe village - 10 members	- The village leader discussed the difficulty of electricity and the least development of the village impacted by the lack of electricity - The livelihood officer discussed to provide the detail information of the electricity supply and WIF can provide the non-capital funding. - The village wants to more power poles than the amounts of poles provided by the Department of Electricity between the house of village leader and the end of the village. - The estimated cost and the draft map is discussed	Wethe village, U Hae Sel Home
15.2.2022 WIF – Livelihood Team - Officer - Assistant Thabawkan village - 7 members	- The village will participate in Monsoon Tree plantation and to plant 5100 Manganshar seedlings along the road next to school and on the way to the cemetery - For the natural fertilizer making, to buy cow dung from the village committee - After planting, the plants will be maintained by the village development committee and the village	Thabawkan village, U Chit San House

2.3 AFOLU-Specific Safeguards

Since 2015, and continually thereafter, the project has conducted a series of stakeholder consultations at different levels – national, regional and village. The project has distributed information on the ecosystem restoration concession idea, planned activities, predicted project impacts, management plans, and project boundary establishing processes through this process, and has incorporated stakeholder feedback into agreed-upon plans and legal approval.

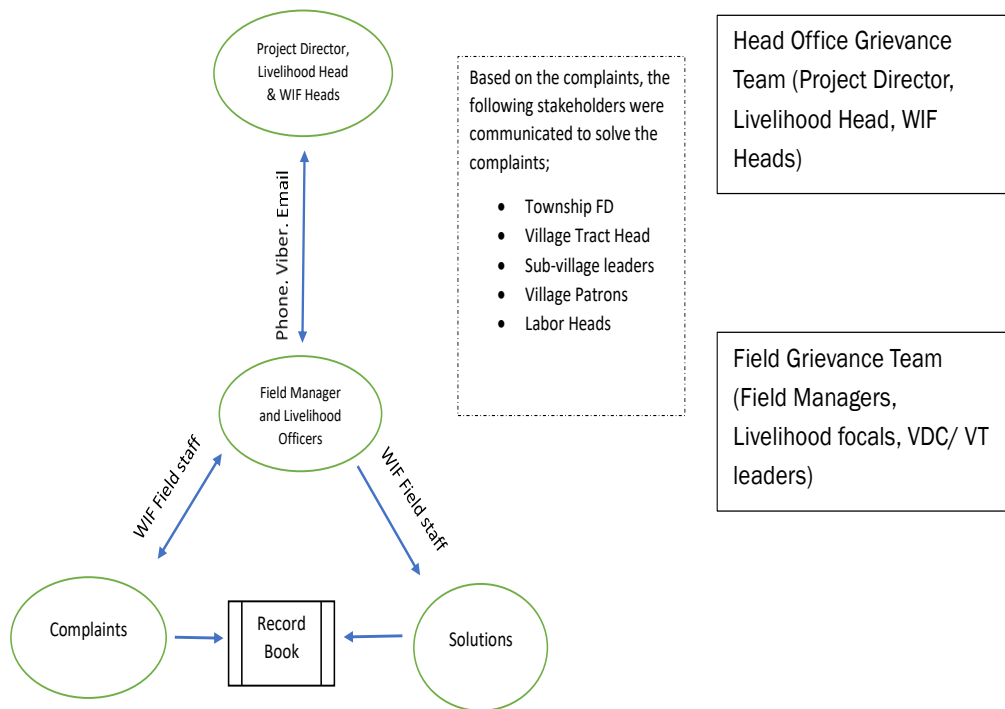
During the monitoring period, events with stakeholders were held ranging from workshops, discussion forums, training, and formal planning sessions. Efforts have been taken during all community discussions to ensure that adequate, understandable, honest, and accurate information, including information on costs, risks, and benefits, is supplied as a foundation for any decisions.

Processes to ensure ongoing communication and consultation with local stakeholders, including a grievance redress procedure to resolve any conflicts that may arise between the project proponent and local stakeholders are the following:

- Complaints/ suggestions that are able to be handled at the local office are discussed with the local team led by Mr. Win Maung. For higher decision making, the Rector of Patheingyi University and Dr. Arne of WIF are involved. For Thabawkan and Thae-gone, the chief of village tract committees is also responsible for recording the complaints, suggestions regarding the project and reporting to Mr. Win Maung and Dr Arne from WIF. Telephone numbers of Prof. Htay Aung and Mr. Win Maung have been given to the local communities to be contacted.
- Any comments, complaints, grievances in relation to the project are as a first stage reported by phone or in writing to the WIF office in Magyi

Contact person by email: htayaungpathein@gmail.com
 Contact person by phone: Prof. Htay Aung
 Office phone: +95-9970530946

- In the case of grievances reported by phone, a grievance note is filled out including the name, contact details of the claimant, date of complaint and the detailed description of the complaint/ grievance, as well as any comments or suggestions of how to address the complaint. For any grievances submitted by email, the above details are recorded.
- WIF responds in writing to any claimant within 15 days and takes immediate action to address those grievances in consultation with the claimant if any resource restriction has been caused by the project. Claims, responses, and actions taken to address grievances are filed and included in project monitoring.
- If the claimant is not satisfied with the response by the local office, the grievance may be submitted to Worldview International country office in Yangon.



Flow chart of an existing grievance mechanism (Note: VDC is village development committee and VT is village tract)

WIF Country Office: #70, Yaw Min Gyi Street, Dagon Township, Yangon

Activities implemented to mitigate risks local stakeholders due to project implementation are the following:

- Risks to local stakeholders due to project implementation and how the project will mitigate such risks. Mangroves were not planted in any areas that had other land-uses. These lands were degraded mangroves and were not using for any other purpose. There is no risk to local stakeholders due to the project implementation. In addition, the project activities are focused on gender equity and poverty reduction. Wages are made equally between male and female, and the grassroot supports are prioritized. As the project design is aimed to restore mangrove ecosystems that are coupled with the livelihood development of local communities, no gender discrimination or sexual harassment is formed.
- Risks to local stakeholder resources due to project implementation and how the project will mitigate such risks, including the plans to ensure the project will not impact local stakeholder's property rights without the free, prior and informed consent.

When the project was implemented, WIF applied for the VCS registration with the consent of local communities and the government. Stakeholder meetings were conducted with multiple stakeholders and minutes were presented during validation. The project generates VCUs and the communities are aware of this. In addition, during the development of all written agreements (i.e., MoUs) each village is given time to discuss internally, raise questions, seek clarification and make the final agreement. Therefore, the project will not impact local stakeholder's property rights without the free, prior and informed consent.

The primary project activity in the current project is mangrove restoration, species used for planting, the mangrove species restored in the project are neither invasive species nor non-native species. WIF carried out the vegetation surveys and assessment in the project areas, and the species used in the project are true mangroves and native species to the Ayeyarwady Region. The severely degraded and degraded mangroves have been restored to healthy mangrove ecosystems that provides the ecosystem goods and services to local communities such as nursery grounds for fish and marine resources, medicinal foods and supply, storm protection function, and climate regulation. In respect of such project interventions, there has been no negative impacts to local stakeholder resources observed due to the implementation of the project activities that have resulted in both positive social and environmental benefits until this project monitoring periods.

During the current monitoring period, no complaints from communities are reported to the field office and Head office (Yangon).

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

The project activity started in May 2015 and planting started in June 2015. As of July 2021, a total of 2065.87 hectares have been planted. The project's activities continue to successfully conserve a vast ecosystem of mangrove forest which would have otherwise been degraded. All project activities are implemented within the context of the national forest policy, forest resource management and the VCS

standard by monitoring the project boundary, planted plots, tree growth and community development. In 2021, the Pathein University also conducted research on the soil carbon accumulation of the forest to assess the restoration impacts on the soil carbon sequestration. A summary of project activities and their achievements during the monitoring period is provided below. No unexpected negative impacts on biodiversity or community occurred as a result of the project's activities during this monitoring period.

1. Avoided degradation and deforestation

The project continues to avoid the deforestation, and degradation of the forest. In the 4th monitoring period, there was an encroachment by the Hotel. However, in this monitoring period, no encroachment was occurred.

2. Soil carbon sequestration assessment

According to the research done by Pathein University in 2021, the soil carbon sequestration of the forest becomes increased compared to the condition of the forest before the project activity. The research paper is provided as a supporting document.



Figure 9: Soil carbon sequestration research by Pathein University

3. Protection and monitoring

Protection activities seek to prevent illegal exploitation of the project area, including illegal logging, encroachment, and forest clearance with fire. This is achieved through a combination of activities, all of which were conducted during the current monitoring period and the previous monitoring activities, including:

- Mobilization of trained forest rangers and patrol teams targeted on main access points
- Replacing the damaged or lost number tags of the trees in permanent sample plots with new ones so that trees can be easily identified for the patrolling teams
- Measuring the growth of the trees in permanent sample plots



Figure 10: Replacing new number tags of the trees in permanent sample plots



Figure 11: Measuring growth of the trees (height and DBH) in permanent sample plots

4. Community and livelihood development

Community livelihood development is a core priority of the project. The goal is to bring substantial benefits to the project-zone communities through sustainable economic development and land use, through support for activities identified during the participatory planning process. A range of activities were supported during the current monitoring time and a selection of these are summarized below.

- Provision of educational facilities to schools and students
- Local economic development (e.g., ice plant installation)
- Development of village infrastructure such as construction of box culverts and dykes
- Seasonal job opportunities such as mangrove seeds collection
- Vocational training such as seaweed culture, mobile video production, and computer trainings
- Reducing fuel consumption with fuel efficient stoves and creating community energy forest by planting

Moreover, both the monitoring report and the Non-Permanence Risk Assessment Report have also been prepared, assuring congruence among the different documents. The Non-Permanence Risk Report (Version 2.0) that was prepared in November 2017 was revised based on the activities during the 5th monitoring period and has been used as the base report to monitor the parameters related to non-permanence risk.

The leakage for the project has been proven to be assumed zero as per the tool “Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity” (Version 02).

3.2 Deviations

3.2.1 Methodology Deviations

No methodology deviations, were made during this monitoring period.

3.2.2 Project Description Deviations

In efforts to adopt the most current standards, this project is verified for this monitoring period under the most current version of both VCS Standard v4.3 and VCS Monitoring report template v4.1.

No new project description deviations were introduced during this monitoring period. However, During the 4th monitoring period, an illegal encroachment of 5.19 ha for a hotel construction from the project area was identified. WIF has taken necessary legal measures to prevent any further encroachments by this construction process. Letter issued by the Ayeyarwady Regional Forest Department to take necessary actions on the company owners and a letter issued by the District Administrative Committee with the company agreeing to the terms of the Reginal Government are provided as evidence.

Since the final area have not increased beyond the intended planting area mentioned in the VCS PD, and the encroached area is removed from the project area, this has not impacted the applicability of the methodology, additionality or the appropriateness of the baseline scenario since the lands have met the applicability criteria. In addition, the staff have over 30 years of experience, and with consultation with field management, it was ensured that silviculture operations were not impacted. As per the methodology, the baseline emissions have been calculated to be zero. Since the baseline emissions are zero, this change in planting area does not change the baseline emissions. However, the ex-post GHG reductions will change but not beyond the ex-ante estimations. This change does not impact the additionality.

3.3 Grouped Projects

This is not a grouped project.

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

Data / Parameter	$\Delta C_{BSL,t}$
Data unit	t CO ₂ -e
Description	Baseline net GHG removals by sinks in year t
Source of data	N/A
Value applied	0
Justification of choice of data or description of measurement methods and procedures applied	<p>Applying the conditions of the applied methodology AR-AM0014, carbon stock in trees in the baseline is accounted as zero since the following three conditions were met;</p> <p>(a) The pre-project trees are neither harvested, nor cleared, nor removed throughout the crediting period of the project activity;</p> <p>(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;</p> <p>(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</p>
Purpose of Data	Calculation of baseline emissions
Comments	N/A

Data / Parameter	CF_{TREE}
Data unit	t C (t d.m.) ⁻¹
Description	Carbon fraction of tree biomass
Source of data	Default value of AR CDM tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" Version 04.2
Value applied	0.47
Justification of choice of data or description of measurement methods and procedures applied	Default value of AR-TOOL14 is used unless transparent and verifiable information can be provided to justify a different value
Purpose of Data	Calculation of project emissions
Comments	N/A

Data / Parameter	$f_j(X_{1,l}, X_{2,l}, X_{3,l}, \dots)$
Data unit	t d.m.
Description	Total biomass of the tree returned by the allometric equation for species j relating the measurements of tree l to the total biomass of the tree
Source of data	For ex-post: Ya Min Thant et al. (2012) Above ground - $W_{\text{Top}} = 0.22 \rho (DBH^2H)^{0.82}$ Below ground - $W_{\text{Root}} = 1.69 \rho (DBH^2H)^{0.40}$
Value applied	Above ground - $W_{\text{Top}} = 0.22 \rho (DBH^2H)^{0.82}$ Below ground - $W_{\text{Root}} = 1.69 \rho (DBH^2H)^{0.40}$ Where: DBH = Diameter at breast height; cm H = Height (m) ρ = Wood density (kg/m ³)
Justification of choice of data or description of measurement methods and procedures applied	Equation used in ex-post estimation. Justification included in Section 4.2 Project Emissions
Purpose of Data	Calculation of project emissions
Comments	N/A

Data / Parameter	dSOC _t
Data unit	t C ha ⁻¹ yr ⁻¹
Description	The rate of change in SOC stocks within the project boundary, in year t
Source of data	Estimated (Research done by the University of Pathein)
Value applied	7.32
Justification of choice of data or description of measurement methods and procedures applied	University of Pathein carried out an in-depth soil analysis. The average carbon stock stored was estimated as 732.26 tC/ha for a mean soil depth of around 1 meter. Applying a conservative estimate of 100 years accumulation, this would result in 7.32 tC/ha/year for soil depth around 1 m.
Purpose of Data	Calculation of project emissions
Comments	N/A

4.2 Data and Parameters Monitored

Data / Parameter	A_i																				
Data unit	ha																				
Description	Area of tree biomass stratum i																				
Source of data	GPS and GIS																				
Description of measurement methods and procedures to be applied	<p>Areas in project area will be tracked in the field using the GPS.</p> <p>Each plot which will be subject to planting is tracked - a standard procedure of the baseline and monitoring inventory</p>																				
Frequency of monitoring/recording	Before the start of the project (planting) and adjusted thereafter every two years since the year of the initial verification																				
Value monitored	<table border="1"> <thead> <tr> <th>Strata</th> <th>Area (ha)</th> </tr> </thead> <tbody> <tr> <td>A₁ (2015 planting)</td> <td>93.92</td> </tr> <tr> <td>A₂ (2016 planting)</td> <td>71.63</td> </tr> <tr> <td>A₃ (2017 planting)</td> <td>249.53</td> </tr> <tr> <td>A₄ (2018 planting)</td> <td>297.88</td> </tr> <tr> <td>A₅ (2019 planting)</td> <td>1108.24</td> </tr> <tr> <td>A₇ (2015 restoring)</td> <td>107.97</td> </tr> <tr> <td>A₈ (2016 restoring)</td> <td>22.28</td> </tr> <tr> <td>A₉ (2017 restoring)</td> <td>114.42</td> </tr> <tr> <td>Total</td> <td>2065.87</td> </tr> </tbody> </table>	Strata	Area (ha)	A ₁ (2015 planting)	93.92	A ₂ (2016 planting)	71.63	A ₃ (2017 planting)	249.53	A ₄ (2018 planting)	297.88	A ₅ (2019 planting)	1108.24	A ₇ (2015 restoring)	107.97	A ₈ (2016 restoring)	22.28	A ₉ (2017 restoring)	114.42	Total	2065.87
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A ₉ (2017 restoring)	114.42																				
Total	2065.87																				
Monitoring equipment	GPS (Garmin), GPS Smartphones, ArcGIS or QGIS software																				
QA/QC procedures to be applied	Field-team members are fully aware of all procedures and the importance of collecting data as accurately as possible; all field team members are trained in GPS/GIS application																				
Purpose of the data	Calculation of project emissions																				
Calculation method	Using the GPS to measure the boundary of planting of each year																				
Comments	N/A																				

Data / Parameter	n_i
Data unit	Dimensionless
Description	Number of sample plots in stratum i
Source of data	Calculated
Description of measurement methods	Based on the CDM tool, the total number of sample plots were 54. Each plot is 10 m x 10 m giving a value of 0.01 ha (100 m ²). GPS coordinates of each plot is marked and kept for future monitoring. For the 2018

and procedures to be applied	planting 3 extra plots were added and for the 2019 planting 1 extra plot was added, raising the number of sample plots from 17 to 18 for 2019.																				
Frequency of monitoring/recording	n_i is calculated for each monitoring event, at least every five years																				
Value monitored	2015 planting – 8 plots, 2016 planting – 7 plots, 2017 planting – 8 plots, 2018 planting – 13 plots, 2019 – 18 plots <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="background-color: #d3d3d3;">Stratum</th> <th style="background-color: #d3d3d3;">No of sample plots</th> </tr> </thead> <tbody> <tr> <td>n_1 (2015 planting)</td> <td>4</td> </tr> <tr> <td>n_2 (2016 planting)</td> <td>4</td> </tr> <tr> <td>n_3 (2017 planting)</td> <td>6</td> </tr> <tr> <td>n_4 (2018 planting)</td> <td>13</td> </tr> <tr> <td>n_5 (2019 planting)</td> <td>18</td> </tr> <tr> <td>n_7 (2015 restoring)</td> <td>4</td> </tr> <tr> <td>n_8 (2016 restoring)</td> <td>3</td> </tr> <tr> <td>n_9 (2017 restoring)</td> <td>2</td> </tr> <tr> <td>Total</td> <td>54</td> </tr> </tbody> </table>	Stratum	No of sample plots	n_1 (2015 planting)	4	n_2 (2016 planting)	4	n_3 (2017 planting)	6	n_4 (2018 planting)	13	n_5 (2019 planting)	18	n_7 (2015 restoring)	4	n_8 (2016 restoring)	3	n_9 (2017 restoring)	2	Total	54
Stratum	No of sample plots																				
n_1 (2015 planting)	4																				
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n_5 (2019 planting)	18																				
n_7 (2015 restoring)	4																				
n_8 (2016 restoring)	3																				
n_9 (2017 restoring)	2																				
Total	54																				
Monitoring equipment	GPS is used to locate the sample plots																				
QA/QC procedures to be applied	Corners of the plot are marked with 4 wooden poles and GPS coordinates are recorded. A solid concrete pole is fixed at the centre of each plot to ensure plot is identifiable in the future. GPS point of the centre is also recorded. <div style="text-align: center; margin-top: 20px;"> </div>																				
Purpose of the data	Calculation of project emissions																				
Calculation method	The calculation method is described in the tool “Calculation of the number of sample plots for measurements within A/R CDM project activities” (version 02.1.0)																				
Comments	N/A																				
Data / Parameter	w_i																				
Data unit	<i>Dimensionless</i>																				
Description	Relative weight of the area of stratum i , the area of the stratum i divided by the project area.																				

Source of data	Calculated																
Description of measurement methods and procedures to be applied	N/A																
Frequency of monitoring/recording	Calculated for each monitoring event, at least every five years																
Value monitored	<table border="1"> <tr> <td>w₁ (2015 planting)</td> <td>0.23</td> </tr> <tr> <td>w₂ (2016 planting)</td> <td>0.17</td> </tr> <tr> <td>w₃ (2017 planting)</td> <td>0.60</td> </tr> <tr> <td>w₄ (2018 planting)</td> <td>1.00</td> </tr> <tr> <td>w₅ (2019 planting)</td> <td>1.00</td> </tr> <tr> <td>w₇ (2015 restoring)</td> <td>0.44</td> </tr> <tr> <td>w₈ (2016 restoring)</td> <td>0.09</td> </tr> <tr> <td>w₉ (2017 restoring)</td> <td>0.47</td> </tr> </table>	w ₁ (2015 planting)	0.23	w ₂ (2016 planting)	0.17	w ₃ (2017 planting)	0.60	w ₄ (2018 planting)	1.00	w ₅ (2019 planting)	1.00	w ₇ (2015 restoring)	0.44	w ₈ (2016 restoring)	0.09	w ₉ (2017 restoring)	0.47
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Monitoring equipment	N/A																
QA/QC procedures to be applied	N/A																
Purpose of the data	Calculation of project emissions																
Calculation method	Area of the stratum i divided by the project area																
Comments	N/A																

Data / Parameter	$A_{PLOT,i}$
Data unit	ha
Description	Size of sample plot in stratum i
Source of data	Field measurement, GPS and GIS
Description of measurement methods and procedures to be applied	<p>Areas in the project area are tracked in the field using the GPS. Each planting area is tracked as a standard procedure of the baseline and monitoring inventory.</p> <p>Each plot represents a 0.01 ha of area covering the trees within the plot. 10 m x 10 m plots are laid using random sampling in the project area after calculating the number of sample plots needed for each stratum</p>
Frequency of monitoring/recording	Annually
Value monitored	0.01 ha
Monitoring equipment	Measuring tape, GPS

QA/QC procedures to be applied	Field teams are trained in all inventory procedures including layout of plots. Field-team members are fully aware of all procedures and the importance of collecting data as accurately as possible.
Purpose of the data	Calculation of project emissions
Calculation method	The GPS coordinates of the plots are collected and recorded at the establishment of these plots. Annually the growth measurements needed to be recorded hence the staff visit the plots using the pre-recorded coordinates and then check the plot area using a tape.
Comments	N/A

Data / Parameter	DBH
Data unit	cm
Description	Diameter at breast height of tree
Source of data	Field measurement
Description of measurement methods and procedures to be applied	<p>Diameter at Breast Height (DBH) is measured at 1.3 m along the stem using a DBH tape</p> <p>For plants below 1.3 m practically it is difficult to measure diameter using the diameter-tape. Therefore, a calliper was used to measure the basal diameter (D_{10}). As mentioned in the document "Field Guidance on growth measurements of mangroves" the Diameter of <i>Rhizophora</i> spp. was done taking the measurement at the 1st prop root is visible. Page 71 of the PD states that "For the initial verification, until the trees reach a height beyond 1.3 m, D_{30} or the basal diameter is measured and recorded."</p>
Frequency of monitoring/recording	Annually measured and recorded
Value monitored	<p>Mean diameter for trees planted in 2015 – 2.71 cm</p> <p>Mean diameter for trees planted in 2016 – 2.84 cm</p> <p>Mean diameter for trees planted in 2017 – 2.57 cm</p> <p>Mean diameter for trees planted in 2018 – 2.89 cm</p> <p>Mean diameter for trees planted in 2019 – 1.66 cm</p>
Monitoring equipment	Diameter Tape/ Calliper
QA/QC procedures to be applied	Field teams are trained in all inventory procedures including correct measurement. Field-team members are fully aware of all procedures and the importance of collecting data as accurately as possible. Two people take measurements each time. One person measures and reads it loudly to the person who records. He then confirms the value by reading it loud to the measurer. This way recording errors are minimised.

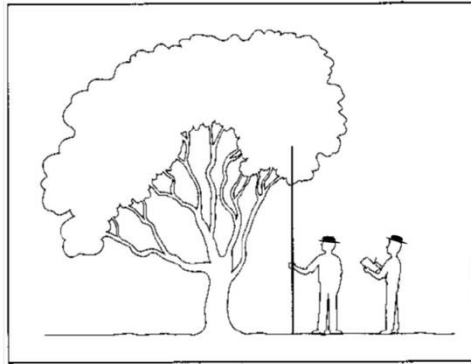
	<p>A pole with a mark at 1.3 m length is used to determine the 1.3 m from the bottom. This way if anyone takes the measurement, DBH is measured at 1.3m from the ground.</p> <p>For plants below 1.3 m practically it is difficult to measure diameter using the diameter-tape. Therefore, a calliper was used to measure the basal diameter (D_{10}). As mentioned in the document “Field Guidance on growth measurements of mangroves” the Diameter of <i>Rhizophora</i> spp. was done taking the measurement at the 1st prop root is visible.</p> <p>Project Director selected 100% of the data sheets and cross-checked with actual field measurements before sending the data to the Managing Director. This helped minimise the errors during data measurement and entering.</p>
Purpose of the data	Calculation of project emissions
Calculation method	N/A
Comments	For the initial verification, until the trees reach a height beyond 1.3 m, D_{30} or the basal diameter (D_{10}) is measured and recorded.

Data / Parameter	H
Data unit	m
Description	Tree height
Source of data	Field measurement
Description of measurement methods and procedures to be applied	First the trunk is determined by selecting the start of the second strongest/thickest branch from top. In case there are two equally thick branches the second one is determined as the start of the trunk. The height of the tree is then measured using a PVC or bamboo pole.
Frequency of monitoring/recording	Annually measured and recorded
Value monitored	Mean height for trees planted in 2015 – 173.59 cm Mean height for trees planted in 2016 – 121.50 cm Mean height for trees planted in 2017 – 119.82 cm Mean height for trees planted in 2018 – 118.28 cm Mean height for trees planted in 2019 – 81.24 cm
Monitoring equipment	Measuring tape, PVC or bamboo pole
QA/QC procedures to be applied	Field teams are trained in all inventory procedures including correct measurement. Field-team members are fully aware of all procedures and the importance of collecting data as accurately as possible. Two people take measurements each time. One person measures and reads it loudly

to the person who records. He then confirms the value by reading it loud to the measurer. This way recording errors are minimised. To measure the height of each mangrove tree:

- Stand the height pole up directly below the highest point of the tree as shown in the figure.
- Measure the height of the tree to the nearest 10cm, based on the known length of the pole.
- Record the result.

Note: As this can be very difficult and if the tree canopy is higher than 10m, the use of a clinometer is recommended in such situations.



Once the trees each are than 2-meter height, the pole is divided into 1-meter intervals and marked each point in red masking tape.

Then using yellow colour tape each 0.5 m is marked. Once the pole is kept near the tree, the top of trunk is determined, and measurement is taken. Once the pole is on the ground, a measuring tape is used to calculate the exact tree height.

The Project Director selected 100% of the data sheets and cross-checked with actual field measurements before sending the data to the Managing Director. This helped minimise the errors during measurement and entering of data.

Purpose of the data	Calculation of project emissions
Calculation method	Direct measurement
Comments	

Data / Parameter	T
Data unit	Year

Description	Time period elapsed between two successive estimations of carbon stock in a carbon pool
Source of data	N/A
Description of measurement methods and procedures to be applied	N/A
Frequency of monitoring/recording	N/A
Value monitored	N/A
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of the data	Calculation of project emissions
Calculation method	If the two successive estimations of carbon stock in a carbon pool are carried out at different points of time in year t_2 and t_1 , (e.g. in the month of June in year t_1 and in the month of February in year t_2), then a fractional value will be assigned to T
Comments	

Measuring equipment	Model	Purpose	Calibration method
GPS	Garmin Oregon 650	To collect coordinates of sample plots and mark the project boundaries	The GPS is calibrated at the factory. No calibration needed. The Garmin manual is attached for reference.
Diameter tape	No special model	To measure diameter	No calibration needed
Caliper	Several calipers are used. No special mode	To measure diameter	No calibration needed
Bamboo stick	No special model	To measure height	No calibration needed
PVC pole	No special model	To measure height	No calibration needed.
Measuring tape	No special model	To measure height	No calibration needed

4.3 Monitoring Plan

1. The methods used for generating/measuring, recording, storing, aggregating, collating and reporting the data on monitored parameters.

Monitoring was organised according to Section 06 of AR-AM0014 and as mentioned in the VCS PD version 3.0³. All the data that are mentioned in this section were be collected and archived electronically and kept for 2 years after the end of last crediting period.

- Project Boundary

Keeping records of the project boundary is one of the most important activities during monitoring. The geographic coordinates of the project boundary and all stratifications within the project have been established and were recorded. Field surveys using GPS, satellite images and land use maps were used in this activity. WIF has a GIS Expert who has been coordinating this section. There were two staff members who worked with him in recording proper boundaries.

- Existing plants

Existing plants are not accounted for the carbon stocks but will be left to grow and are monitored throughout the crediting period of the project activity. During the baseline studies, the area has been visited by the survey team. Existing plants are recorded. Therefore, there are records of existing plants in each sample plot. These plants will not be removed and will be monitored throughout the project period.

- Supervision of project activities

The Project Director has full responsibilities for all activities and has trained all staff members regarding mangrove forest management, mangrove nursery techniques, natural resource management and community forestry activities. Technical Assistants and Field Assistant shall supervise all field operations.

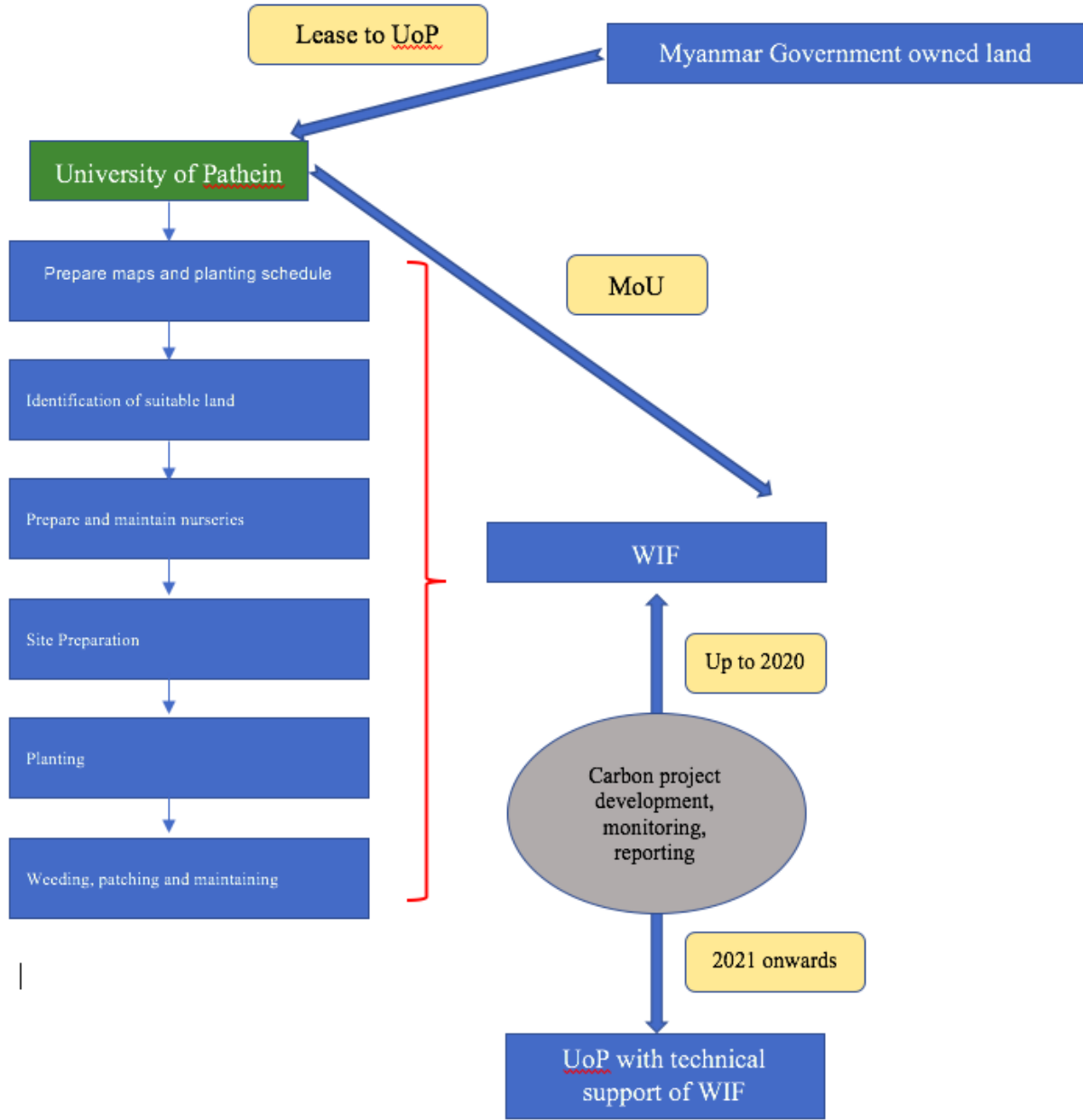
2. The organizational structure, responsibilities and competencies of the personnel that carried out the monitoring activities.

- Organisational Structure

The following describes the organisational management structure for the project. Planting and management of Magyi land is different to the structure of Thabawkan and Thaegone hence two have been presented.

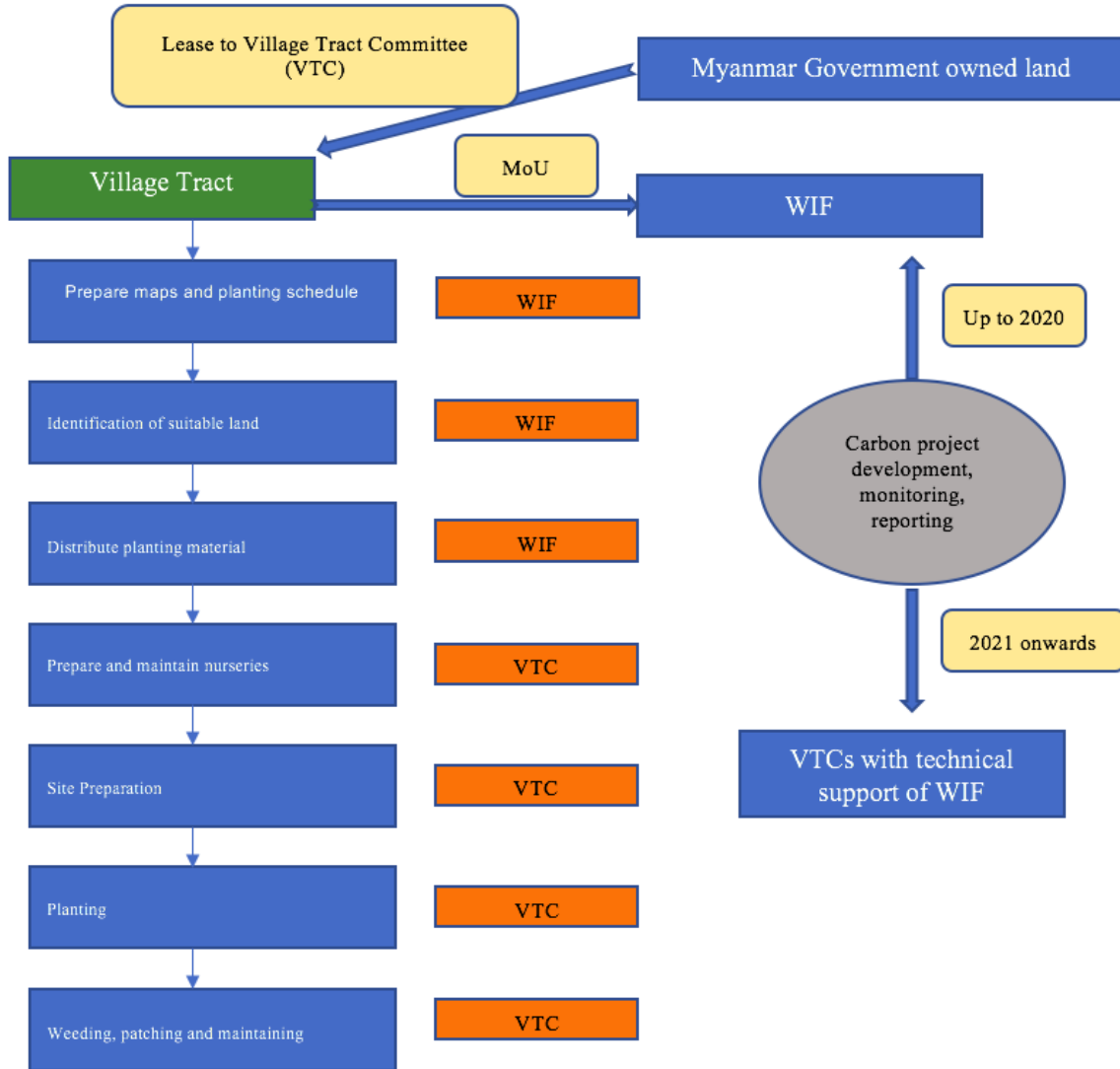
Magyi – Myanmar Government has leased the land to University of Patheingyi (UoP) and UoP has an MoU with WIF. WIF is conducting the activities mentioned in the following graph.

³ https://cdm.unfccc.int/Panels/ar/038/meeting/ARWG38_Annex_04_AR-AM0014_ver03.0.pdf



Thabawkan and Thaegone – Myanmar Government has leased the land to two Village Tract Committees (VTC) of 2 villages. These two VTCs have MoUs with WIF. WIF and VTCs are conducting the activities mentioned in the following graph.

The overall management of the carbon component is done by WIF including setting up the sample plots and taking annual recordings up to 2020. After 2020, the management of carbon project has undertaken by 2 VTCs under the supervision and technical support of WIF. This is to make sure the project will reach a self-reliance status in the future.



The following figure presents the overall organisational structure of the project.

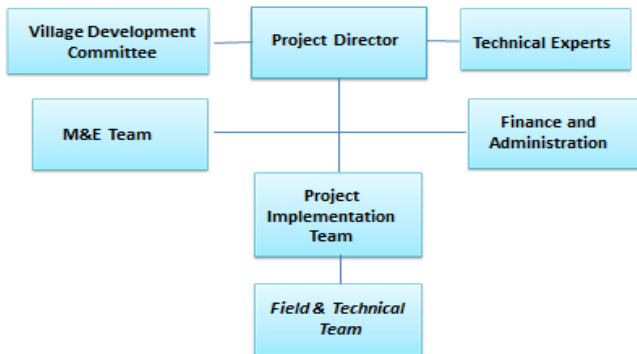


Figure 12: Overall Organisational Structure of Project

The project proponent is responsible for implementation of this ARR project activity together with the local communities. WIF has more than 130 professional staff at the Administrative Unit, Field Units and in Patheingyi University Park with backgrounds on forestry, marine science, economic and social Science, remote sensing & GIS. The project employs workers for the reforestation and restoration activities.

The following professionals constitute the administrative team of WIF:

No	Name	Position title	Professional experience
1	Dr. Arne Fjortoft	Secretary General	Specialty in development communication, public education, sustainable development project implementation and climate change/environmental conservation
2.	Dr. (Ms.) Sandii Lwin	Chairman	Founder and Managing Director of Myanmar Health and Development Consortium, A public health and development specialist with over twenty years of experience and has worked in more than 30 countries across 6 regions, working at the organizations such as World Bank, UNDP, International Monetary Fund, and National Network of Asian and Pacific Women
3.	U Bo Ni	Managing Director	Former Director of Watershed Management Division of Forest Department. Over 30 years of experience in forestry
4.	Win Maung	Project Director	Former Director Forestry Department. 30 year working experience in mangrove conservation as government official; researcher and Project Manager of NGO/UN-LIFT projects
5.	Dr. Htay Aung	Science advisor and field controller in charge of liaison with Patheingyi University and local communities	Over 20 years of experience in marine science research in the project area
6.	Dr. Dhanya M. Nambiar	Carbon consultant	20 years of consulting experience in environment & sustainability. Worked on 100+ projects in the area of climate change mitigation and adaptation
7.	Htun Thiri Naing	VCS and carbon measurement technical coordinator	Research experience on marine benthos in the Dutch Wadden Sea, greenhouse gases flux measurement on the tidal mudflats, river basin management, blue carbon and nature-based solutions and wastewater engineering in the Netherlands, Sweden and Switzerland. 2-year experience in developing VCS projects with WIF
8.	Aung Aung Myint	GIS Expert	Over 25 years of experience in forestry and mangrove restoration with experience in GIS and mapping

9.	Dr. Ranil Senanayake	Senior Science Director WIF	Founder of Analog Forestry and Chairman Raniforest Rescue International
10.	Dr. Aung Myat San	International Project Coordinator	19 years of experience in Forestry Department of Myanmar, particularly planning, implementing, monitoring and evaluation of the mangrove restoration and rehabilitation projects, as well as developing plans for National Forest Inventory
11.	Win Sandar Htay	Finance controller	Lawyer and accountant in charge of administration and financial management, public relation, database, procurement and sub-contracts
12.	Naw Grace Boni	Head of Livelihood	4-year experience as a Program Policy Officer at United Nation-World Food Program, 8-year experience in different humanitarian assistance, relief and recovery organizations in Myanmar, A proven excellent capacity in social mobilization, working with partner communities and humanitarian work, Ability to manage to achieve sustainable goals with the support of her professional background and her supportive talented team
13.	Tun Tun Aung	Communication specialist in charge of social mobilisation	Former commercial content manager at the MyanmarTimes particularly in creating contents related to the Myanmar Times brand in English and Myanmar such as video scripts, advertorials, translation, articles, etc), Former content lead at Wall Street English Myanmar, generated the innovative company's social media channels and website, Former News Editor at Internal Journal, majorly wrote news, communicated with people from various sector and as a moderator in panel discussion and speaker in events
14.	Ye Linn Kyaw	Field Manager	Served as a technical assistant with over 3-year experience of mangrove plantation and community development activities at WIF

3. The implementation of sampling approaches, including target precision levels, sample sizes, sample site locations, stratification, frequency of measurement and QA/QC procedures.

The project implementation is based on the local presence of WIF staff in project area. The main role of the field manager and officers are to manage the reforestation/restoration activity in close cooperation with WIF science and technical programme coordinators. Following are some of their responsibilities:

- Randomly select and verify GPS locations of at least 10% of the plots planted during a particular planting season.
- Conduct comparisons between the trees actually planted and the trees recorded in the management plan
- Assess the survival rate of the mangrove seedlings and prepare reports with the findings.
- Area verification. Project parcels are verified using GPS in the field as well as through drone images and Google Earth imagery analysis.
- Identification and monitoring of strata. Baseline stratification was done based on the land use type. Most of the planting sites are severely degraded mangrove areas. Ex-ante stratification is done based on the year of replanting and year of restoration. Even though plot types are similar in the same land use type, there is variation in soil composition, water salinity and water availability.

Certain manmade activities such as replanting and protection also have influence on growth and survival. Therefore, a stratification implemented today may not be realistic in the future once the local community starts managing these lands. Hence the final factors considered for the stratification will be the differences in the estimated carbon sinks for each mangrove species as the project evolves. Due to this reason, strata will be monitored periodically. If a change in number and area of the project strata occurs, the sampling framework will be adjusted accordingly. There were no differences observed in strata. Strata were determined per the year of planting and this continues for this monitoring period as well.

Sampling Design

This ARR VCS project is designed as to the planting and restoration occurred during 2015-2019. Therefore, the database will be updated periodically capturing the following:

- Unpredicted disturbance occurring during the crediting period
- Unpredicted disturbances occurring during the crediting period (changes in hydrology, sedimentation, disease, and/or human factors), affecting differently different parts of an originally homogeneous stratum or stand
- Mangrove forest establishment (planting, re-replanting) may be implemented at different intensities, dates and spatial locations than mentioned in the PD;

There were no disturbances observed. However, the changes in mangrove forest establishment than mentioned in the PD and has been recorded as a permanent change. These changes are mentioned in Section 3.2.2 as Project Description Deviations.

- Sampling plan and stratification: As mentioned above, the ex-ante stratification of the project was done by year of planting. Such stratification was selected to increase the measuring precision without increasing unnecessary costs.

For ex-post stratification the strata are as follows:

Strata 1: 2015 planting – applicable for this monitoring period 2021-2022

Strata 2: 2016 planting – applicable for this monitoring period 2021-2022

Strata 3: 2017 planting – applicable for this monitoring period 2021-2022
 Strata 4: 2018 planting – applicable for this monitoring period 2021-2022
 Strata 5: 2019 planting – applicable for this monitoring period 2021-2022
 Strata 7: 2015 restoration - applicable for this monitoring period 2021-2022
 Strata 8: 2016 restoration - applicable for this monitoring period 2021-2022
 Strata 9: 2017 restoration - applicable for this monitoring period 2021-2022

The project has adopted to the following sampling framework.

- Sampling sizes

The number of samples and sample size was determined using “Calculation of the number of sample plots for measurements within A/R CDM project activities (Version 02.1.0)”.

Initial estimate of number of plots is done with targeted precision level for biomass estimation within each stratum at +/- 10% of the mean at a 90% confidence level. The number of required plots (n) was calculated using the following equation:

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

Where;

- n Number of sample plots required for estimation of biomass stocks within the project boundary; dimensionless
- N Total number of possible sample plots within the project boundary (i.e., the sampling space or population); dimensionless
- t_{VAL} Two-sided Student’s t-value, at infinite degrees of freedom with 90% confidence level; dimensionless
- w_i Relative weight of the area of stratum i (i.e., the area of stratum i divided by project area); dimensionless
- s_i Estimated standard deviation of biomass stock in stratum i; t d.m. (or t d.m. ha⁻¹)
- E Acceptable margin of error in estimation of biomass stock within the project boundary; t d.m. (or t d.m. ha⁻¹), i.e., in the units used for s_i
- i 1,2,3,..... Biomass stock estimation strata within the project boundary

The number of plots allocated to each stratum was calculated as follows:

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

Where;

- n_i Number of sample plots allocated to stratum i; dimensionless

- n Number of sample plots required for estimation of biomass stocks within the project boundary; dimensionless
- w_i Relative weight of the area of stratum i (i.e. the area of stratum i divided by project area); dimensionless
- s_i Estimated standard deviation of biomass stock in stratum i ; t d.m. (or t d.m. ha⁻¹)
- i 1,2,3,..... Biomass stock estimation strata within the project boundary

- Types of plots

In order to monitor the project through time, permanent-sampling plots were established and maintained.

- Number of Plots

The number of samples and sample size was determined using “Calculation of the number of sample plots for measurements within A/R CDM project activities (Version 02.1.0)” as explained above. 23 sample plots are needed for the planting done in 2015, 2016 and 2017. For 2015, planting 8 sample plots were set up while for 2016, planting 7 plots were set up. Another 8 plots were set up for the trees planted in 2017. 13 plots were set up for the trees planted in 2018 and 18 for 2019 planting.

- Location of sample plots

In order to avoid bias with regard to plot locations, permanent sample plots were located systematically with a random start. The geographical position (GPS coordinate), location, stratum and sub-stratum series number of each plot were recorded and archived. It is to be ensured that the sampling plots are distributed randomly.

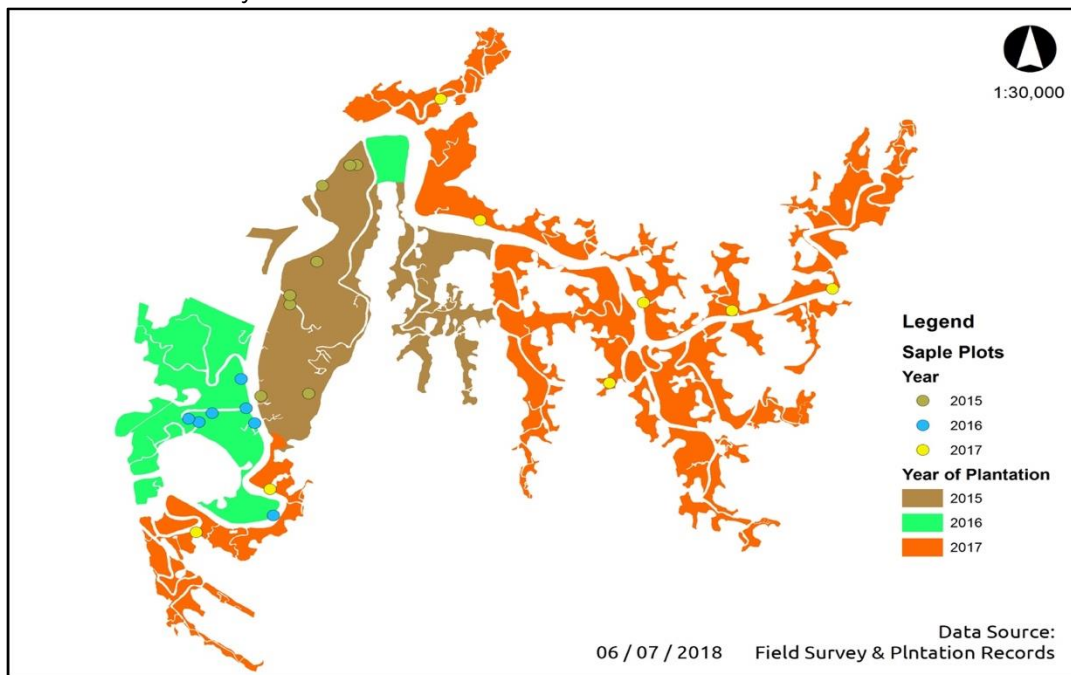


Figure 13: Location of sample plots for each planting stratum planted in 2015, 2016, 2017

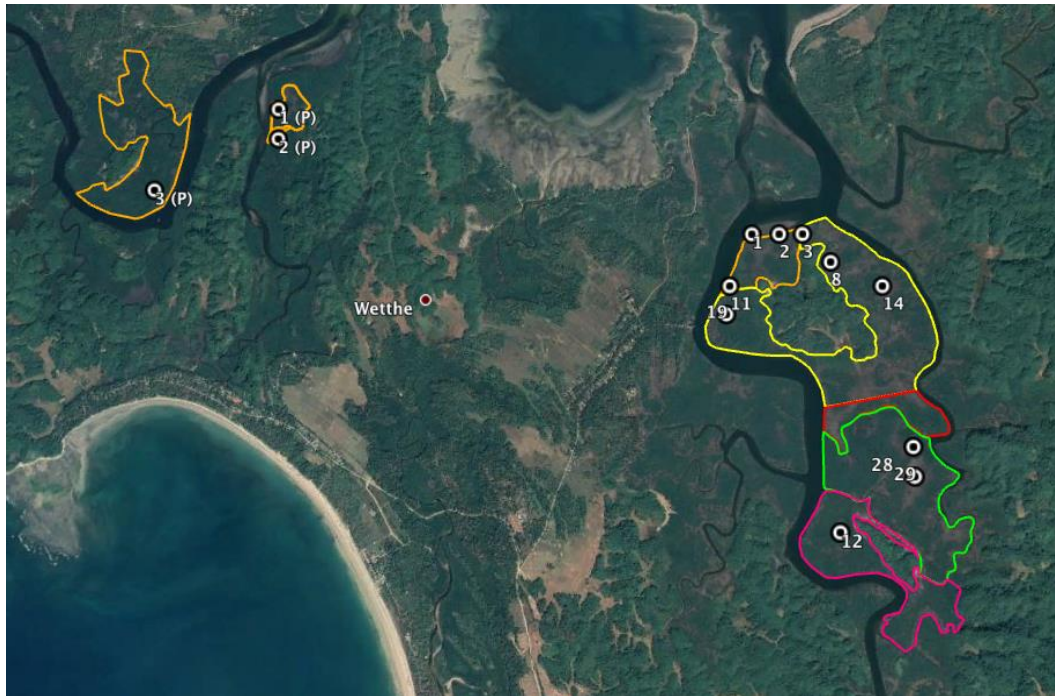


Figure 14: Location of sample plots for each planting stratum planted in 2018

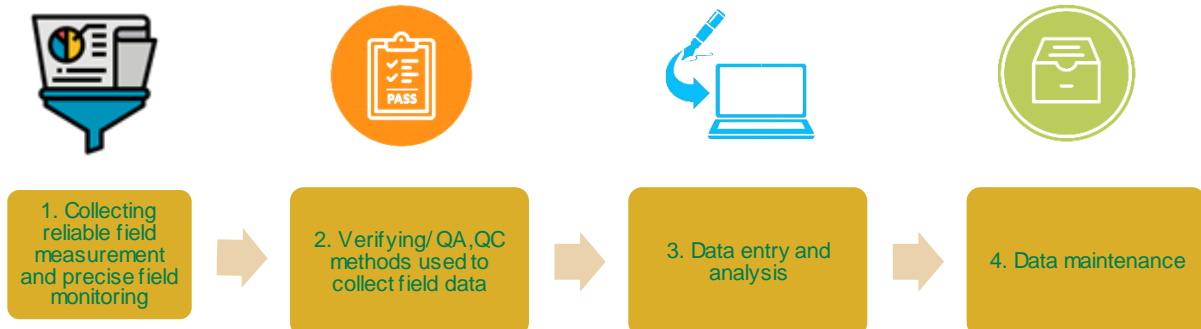


Figure 15: Location of sample plots for each planting stratum planted in 2019

- Monitoring frequency**
 Plantation established from 2015 to 2019 are applicable for this monitoring period. Permanent plots were monitored annually to assess actual above and below ground biomass accumulation.
- Measuring and estimating carbon stock changes over time**
 Carbon stock changes in above- and below-ground biomass on each plot were estimated using the diameter as a parameter. Soil organic carbon was also calculated.
- Stratification and sample size**
 Sample plots of 0.01 ha (100m²) with 10 m x 10m were established systematically with a random start for each stratum based on the year of planting.
- Monitoring GHG emissions by sources as the results of the ARR VCS project activity**
 GHG emissions from the project are monitored annually.

QA/QC procedures

The QC and QA procedures under the project aim at implementing standard and methodical procedures for monitoring and collection of precise field measurements. Quality control (QC) and quality assurance (QA) procedures that are applied to monitor actual GHG removals by sinks include



(1) Collecting reliable field measurements and precise field monitoring

A team consisting of members representing the entire project area was formed. This team involved in field monitoring were trained in data collection and analysis. Each team member has been assigned in duties related to monitoring actual GHG removal. Data collection was conducted by a well-trained team. Those responsible for the measurement work were trained in all aspects of the field data collection and data analyses. The project uses the IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry (2003) as the main reference document for all monitoring activities.

In order to ensure the collection and maintenance of reliable field data:

- a) Field-team members were made fully aware of all procedures and the importance of collecting data as accurately as possible;
- b) Field teams established sample plots in the field and measured all pertinent components;
- c) The document has listed all names of the field team and the project manager certifies that the team is trained;
- d) New staff were adequately trained.

(2) Verifying the methods used to collect field data

The data collected by the team were verified by taking random checks from stands, including their re-measurement by a senior member of the monitoring team. In case of errors, they are corrected and recorded for each stratum.

(3) Verifying data entry and analysis techniques

Reliable carbon estimates require proper entry of data into the emission reduction calculation spreadsheets. Possible errors in this process were minimised by cross checking these entries. In order to ensure more precise output, internal tests were incorporated into the spreadsheets to ensure that the data are realistic. Calculations were based on the methodologies for A/R CDM project activities. After the calculation is done, it is reported in the monitoring report.

Quantifying data is an important procedure and were done accordingly.

(4) Data maintenance and archiving

Because of the relatively long-term nature of these project activities, data archiving (maintenance and storage) is an important component of the work. Data archiving takes several forms and copies (electronic and paper) of all field data, calculations, and models; estimates of the changes in carbon stocks and corresponding calculations and models used; any GIS products; and copies of the measuring and monitoring reports are stored in WIF's Yangon office. These monitored data will be achieved for 2 years following the end of the crediting period as well (Note that this project has a renewable crediting period).

4. The procedures used for handling any internal auditing performed and any non-conformities identified.

Internal auditing and non-conformities are addressed through the formats that incorporate multiple quality assurance and quality control (QA/QC) measures. All data collected, recorded, stored and reported are subject to review and approval by team leaders and/or project managers with reference to data covering each level of data management. In order to ensure the security and traceability of data entry

and QA/QC procedures, all users are allocated unique user IDs and passwords in order to access the database, and in turn their access and roles can be restricted as appropriate.

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

Under the applicability conditions of the applied methodology AR-AM0014 “Afforestation and reforestation of degraded mangrove habitats” (Version 03.0), it is expected that the baseline carbon stocks in litter and soil organic carbon pools will not show a permanent net increase. The baseline net GHG removals by sinks should be calculated using Equation 1 of the methodology:

$$\Delta C_{(BSL,t)} = \Delta C_{(TREE_BSL,t)} + \Delta C_{(SHRUB_BSL,t)} + \Delta C_{(DW_BSL,t)} \dots\dots\dots \text{Equation (1)}$$

Where,

$\Delta C_{(BSL,t)}$ = Baseline net GHG removals by sink in year t; t CO₂e

$\Delta C_{(TREE_BSL,t)}$ = Change in carbon stock in baseline tree biomass within the project boundary in year t, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"; t CO₂e

$\Delta C_{(SHRUB_BSL,t)}$ = Change in carbon stock in baseline shrub biomass within the project boundary in year t, as estimated in the "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"; t CO₂e

$\Delta C_{(DW_BSL,t)}$ = Change in carbon stock in baseline dead wood biomass within the project boundary in year t, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"; t CO₂e

However, Section 5 of the methodological tool AR-Tool 14 (Version 04.2) explains 3 conditions under which carbon stock and change in carbon stock may be estimated as zero. According to the tool the carbon stock in trees in the baseline can be accounted as zero if all of the following conditions are 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.

LandSat images and Worldview 2 images from the year 2013 were used to conduct a satellite image analysis. Field verification was also conducted to identify the baseline land use types of the area. According to the analysis the following categories were identified.

- a. Severely degraded mangrove areas
- b. Degraded mangrove areas
- c. Bare lands
- d. Shallow water areas where planting is possible
- e. Abandoned shrimp pond areas

For the trees planted in 2015, 2016 and 2017, severely degraded mangrove areas, bare lands and shallow water areas were replanted with a density of 5,000 plants per hectare. Degraded mangrove areas were restored using approximately 3,000 plants per hectare since there are mangrove plants that fall below the forest threshold but still remain as plants. For trees planted in 2018, a density of 4,000 trees were applied based on the land condition and trees planted in 2019 a density of 2,040 trees per hectare was applied. There is no timber harvesting in this project and there will be monitoring to protect the existing and newly planted plants. Furthermore, these existing mangrove plants are not removed or allowed to suffer mortality. The condition of these lands will be improved with the restoration program. These existing plants are not accounted for the carbon stocks but will be left to grow and are monitored throughout the crediting period of the project activity.

Hence, all applicability conditions (a), (b) and (c) are met.

Paragraph 12 of the same tool states that the changes in carbon stocks in trees and shrubs in the baseline may be accounted as zero for those lands that have met above (a), (b) and (c) conditions.

Hence the Baseline net GHG removals by sinks are conservatively accounted as zero throughout the project period.

5.2 Project Emissions

The ex-post actual net GHG removals by sinks over the period of 2015-2019 were estimated using the equation 2 described in section 5.5 of the methodology AR-AM0014 A/R Methodology: Afforestation and reforestation of degraded mangrove habitats Version 03.0:

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

Where,

$$\Delta C_{ACTUAL,t} = \text{Actual net GHG removals by sinks, in year } t; t \text{ CO}_2\text{e}$$

$$\Delta C_{P,t} = \text{Change in the carbon stocks in project, occurring in the selected carbon pools, in year } t; t \text{ CO}_2\text{e}$$

$GHG_{E,t}$ = 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 on non-CO₂ GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity"; t CO₂e

Summary of Actual Net GHG Removals by sinks in all planting/restoration strata within the project boundary for the current monitoring period⁴

Period	Change in the carbon stocks in project, occurring in the selected carbon pools (t CO ₂ e)	Increase in non-CO ₂ GHG emissions within the project boundary (t CO ₂ e)	Actual net GHG removals by sinks (t CO ₂ e)
15.06.2021-31.12.2021	33,000.19	0.00	33,000.19
01.01.2022-14.06.2022	27,225.15	0.00	27,225.15
Total ER for the monitoring period of 15.06.2021 – 14.06.2022 (Considering balance VCU at 25% discount due to uncertainty)			60,225.34

Change in the carbon stocks in project, occurring in the selected carbon pools in year t were calculated using equation 3 described in section 5.5 of the methodology AR-AM0014 A/R Methodology: Afforestation and reforestation of degraded mangrove habitats Version 03.0:

$$\Delta C_{P,t} = \Delta C_{TREE_PROJ,t} + \Delta C_{SHRUB_PROJ,t} + \Delta C_{DW_PROJ,t} + \Delta SOC_{PROJ,t} \quad \text{Equation (3)}$$

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

$\Delta SOC_{PROJ,t}$ = Change in carbon stock of the soil organic carbon (SOC) pool within the project boundary, in year t

⁴ "Uncertainty Calc and Final VCUs" Tab of "5th_2022_VCUs_Consolidated Calcs Data_24%Buffer_20231010.xlsx"

Change in the carbon stocks in project, occurring in the selected carbon pools of planting/restoration strata 2015, 2016 and 2017 (i₁, i₂, i₃, i₇, i₈, and i₉)⁵

Period	Change in carbon stock in tree biomass in project in year t (t CO ₂ -e)	Change in carbon stock in shrub biomass in project in year t (t CO ₂ -e)	Change in carbon stock in dead wood in project in year t (t CO ₂ -e)	Change in carbon stock in the soil organic carbon (SOC) pool within the project boundary, in year t (t CO ₂ -e)	Change in the carbon stocks in project, occurring in the selected carbon pools, in year t (t CO ₂ -e)
15.06.2021-14.06.2022	3061.69	0.00	0.00	17,707.69	20,769.38
Total ER for the monitoring period of 15.06.2021 – 14.06.2022					20,769.38

Change in the carbon stocks in project, occurring in the selected carbon pools of planting/restoration strata 2018 (i₄)⁶

Period	Change in carbon stock in tree biomass in project in year t (t CO ₂ -e)	Change in carbon stock in shrub biomass in project in year t (t CO ₂ -e)	Change in carbon stock in dead wood in project in year t (t CO ₂ -e)	Change in carbon stock in the soil organic carbon (SOC) pool within the project boundary, in year t (t CO ₂ -e)	Change in the carbon stocks in project, occurring in the selected carbon pools, in year t (t CO ₂ -e)
15.06.2021-14.06.2022	1,971.25	0.00	0.00	7,995.10	9,966.35
Total ER for the monitoring period of 15.06.2021 – 14.06.2022					9,966.35

⁵ "Change in Carbon stk" tab in 5th_2022-Vcus_2015-17 plantations-20231010.xlsx

⁶ "Change in Carbon stk" tab in 5th_2022-Vcus_2018 plantations-20231010.xlsx

Change in the carbon stocks in project, occurring in the selected carbon pools of planting/restoration strata 2019 (i₅)⁷

Period	Change in carbon stock in tree biomass in project in year t (t CO ₂ -e)	Change in carbon stock in shrub biomass in project in year t (t CO ₂ -e)	Change in carbon stock in dead wood in project in year t (t CO ₂ -e)	Change in carbon stock in the soil organic carbon (SOC) pool within the project boundary, in year t (t CO ₂ -e)	Change in the carbon stocks in project, occurring in the selected carbon pools, in year t (t CO ₂ -e)
15.06.2021-14.06.2022	1,336.91	0.00	0.00	29,745.16	31,082.07
Total ER for the monitoring period of 15.06.2021 – 14.06.2022					31,082.07

Summary of change in the carbon stocks in project, occurring in the selected carbon pools of planting/restoration of all strata within project boundary

Year of Planting/Restoration Stratum	Change in Carbon Stock (t CO ₂ e)	Total (t CO ₂ e)
2015-2017	20,769.38	61,817.80
2018	9,966.35	
2019	31,082.07	

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

The change in carbon stocks in the tree biomass was estimated using the methodological tool AR-TOOL-14 Version 04.2 [“Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities”]. Based on the tool the stock difference method was applied and the ex-ante tree biomass was estimated using the method of “Estimation by modelling of tree growth and stand development”, presented in section 8 of the tool. For the estimation of the changes in carbon stocks in tree biomass ex-post, field measurements in permanent sample plot at two points of time were taken, and the calculations were done following the “difference of two independent stock estimations” method, available in section 6 of the tool. Under this method, method b, “Direct estimation of change by re-measurement of sample plots” was used. Actual field measurements were used in combination with tree growth models to estimate the growth of trees and the development of the tree stand over time.

⁷ “Change in Carbon stk” tab in 5th_2022_VCU_s_2019 plantations-20231010.xlsx

Mean carbon stock in trees within the tree biomass per hectare was estimated using equation 12, 13 and 14 stated in AR-Tool14 Version 04.2 [“Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities”]:

$$C_{TREE} = \frac{44}{12} \times CF_{TREE} \times B_{TREE} \quad \text{Equation (12)}$$

$$B_{TREE} = A \times b_{TREE} \quad \text{Equation (13)}$$

$$b_{TREE} = \sum_{i=1}^M w_i \times b_{TREE,i} \quad \text{Equation (14)}$$

Where,

C_{TREE}	=	Carbon stock in tree in the tree biomass estimation strata; t CO ₂ e
CF_{TREE}	=	Carbon fraction of tree biomass; t C (t d.m.) ⁻¹ A default value of 0.47 is used unless transparent and verifiable information can be provided to justify a different value
B_{TREE}	=	Tree biomass in the tree biomass estimation strata; t d.m.
A	=	Sum of areas of the tree biomass estimation strata; ha
b_{TREE}	=	Mean tree biomass per hectare in the tree biomass estimation strata; t d.m. ha ⁻¹
w_i	=	Ratio of the area of stratum i to the sum of areas of tree biomass estimation strata (i.e. $w_i = A_i/A$); dimensionless
$b_{TREE,i}$	=	Mean tree biomass per hectare in stratum i ; t d.m. ha ⁻¹

Carbon stock in trees in the tree biomass estimation of planting/restoration strata 2015, 2016 and 2017 (i_1 , i_2 , and i_3)⁸

Period	Mean tree biomass per hectare within the biomass estimation strata (bTREE) (t d.m. ha-1)	Sum of areas of the biomass estimation strata (A) (ha)	Tree biomass in the tree biomass estimation strata (BTREE) (t.d.m)	Carbon fraction of tree biomass (CFREE) (t C (t.d.m.)-1)	Carbon stock in trees in the tree biomass estimation strata (CTREE) (t CO2e)
15.06.2021-14.06.2022	3.06	415.08	1270.14	0.47	2,188.87

⁸ “ABG & BGB refores” tab in 5th_2022_VCUs_2015-17 plantations-20231010.xlsx

Carbon stock in trees in the tree biomass estimation of planting/restoration strata 2015, 2016 and 2017 (i₇, i₈, and i₉)⁹

Period	Mean tree biomass per hectare within the biomass estimation strata (bTREE) (t d.m. ha-1)	Sum of areas of the biomass estimation strata (A) (ha)	Tree biomass in the tree biomass estimation strata (BTREE) (t.d.m)	Carbon fraction of tree biomass (CFTREE) (t C (t.d.m.)-1)	Carbon stock in trees in the tree biomass estimation strata (CTREE) (t CO ₂ e)
15.06.2021-14.06.2022	2.07	244.67	506.47	0.47	872.82

Carbon stock in trees in the tree biomass estimation of planting/restoration strata 2018 (i₄)¹⁰

Period	Mean tree biomass per hectare within the biomass estimation strata (bTREE) (t d.m. ha-1)	Sum of areas of the biomass estimation strata (A) (ha)	Tree biomass in the tree biomass estimation strata (BTREE) (t.d.m)	Carbon fraction of tree biomass (CFTREE) (t C (t.d.m.)-1)	Carbon stock in trees in the tree biomass estimation strata (CTREE) (t CO ₂ e)
15.06.2021-14.06.2022	3.84	297.88	1,143.86	0.47	1,971.25

Carbon stock in trees in the tree biomass estimation of planting/restoration strata 2019 (i₅)¹¹

Period	Mean tree biomass per hectare within the biomass estimation strata (bTREE) (t d.m. ha-1)	Sum of areas of the biomass estimation strata (A) (ha)	Tree biomass in the tree biomass estimation strata (BTREE) (t.d.m)	Carbon fraction of tree biomass (CFTREE) (t C (t.d.m.)-1)	Carbon stock in trees in the tree biomass estimation strata (CTREE) (t CO ₂ e)
15.06.2021-14.06.2022	0.70	1108.24	775.77	0.47	1,336.91

⁹ "ABG & BGB restoration" tab in 5th_2022_VCUs_2015-17 plantations-20231010.xlsx

¹⁰ "ABG & BGB refores" tab in 5th_2022_VCUs_2018 plantations-20231010.xlsx

¹¹ "ABG & BGB refores" tab in 5th_2022_VCUs_2019 plantations-20231010.xlsx

Summary of carbon stock in trees in the tree biomass estimation of all planting/restoration strata in 2015-17, 2018 and 2019¹²

Year of Planting/Restoration Stratum	Change in Carbon Stock (t CO ₂ e)	Total (t CO ₂ e)
2015-2017	3,061.69	6,369.85
2018	1,971.25	
2019	1,336.91	

Estimating mean tree biomass per hectare in each stratum ($b_{TREE,I}$)

According to Tool 14, V.4.2 the tool “Demonstrating appropriateness of allometric equations for estimation of aboveground tree biomass in A/R CDM project activities (Version 01.0.0)” was applied. The tool states “For ex ante estimation of aboveground tree biomass in project scenario any allometric equation can be used.”

A thorough literature review was conducted to identify most suitable allometric equation for ex-ante estimations since there are no equations developed in the project area. It was mentioned in the VCS PD (Version 3.0) that for ex-post estimation allometric equations will be developed using the continued research data and research personal and using the permanent sample plots that have been set ups.

However, it was found that there were not enough data yet to develop its own allometric equation. A detailed assessment by Ya Min Thant, Mamoru Kanzaki, Seiichi Ohta from Kyoto University and Maung Maung Than (DFID program, British Council) have developed five common allometric equations for stem, branch, leaf, above ground and below ground for six mangrove species based on specific gravity of stem.

Their study was published in the journal TROPICS published by Japan Society of Tropical Ecology (Link: https://www.jstage.jst.go.jp/article/tropics/21/1/21_1/article/-char/en). Title of the paper is “Carbon sequestration by mangrove plantations and a natural regeneration stand in the Ayeyarwady Delta, Myanmar”.

The equations to estimate above ground and below ground biomass seem to be most plausible equations. Results on this equation and results from field measurements gave similar results thus proving that this equation is the most plausible for ex-post estimations.

Total aboveground and belowground biomass was estimated using –

Above ground - $W_{Top} = 0.22 \rho (DBH^2H)^{0.82}$

¹² “VCUs for 2022” Tab of 5th_2022_Vcus_Consolidated Calc Data_24%Buffer_20231010.xlsx

Below ground - $W_{\text{Root}} = 1.69 \rho (DBH^2H)^{0.40}$

Where:

DBH = Diameter at Breast Height; cm

H = Height (m)

ρ = Wood density (kg/m³)

Wood density of mangrove species

Species	Density (g/cm ³)
<i>Bruguiera cylindrica</i>	0.763
<i>Bruguiera gymnorrhiza</i>	0.73
<i>Ceriops tagal</i>	0.884
<i>Rhizophora apiculata</i>	0.855
<i>Rhizophora mucronata</i>	0.792
<i>Bruguiera sexangula</i>	0.763
Average	0.7978

The applied wood density values of each species shown in above table were taken from page (66) of the published combined report: [Preparation of Baseline Data Mangrove Ecosystem Management in Bintan Island] of ITTO project RED-PD 064/11 Rev.2 (F) ¹³.

The above assessment was conducted in Ayeyarwady Delta. The VCS project is also implemented in the Ayeyarwady Delta. Assessment by Ya Min Thant et al. was conducted for 6-7-year-old mangroves hence the equation is well fitted for the estimation between 1-7-year-old mangroves. The mangroves in the project were planted in 2015 hence the equation is well suited within the time period.

Ya Min Thant studied the following species: *Avicenia marina* (Am), *Avicenia officinalis* (Ao) and *Sonneratia apetala* (Sa) and a naturally regenerated stand under regeneration improving felling operation (NR: consists of *Ceriops decandra*, *Bruguiera sexangula*, and *Aegicerus corniculatum*) protected for seven years since 2000. The total carbon stock in biomass was 73 tC ha⁻¹ in NR, 43 tC ha⁻¹ in Sa, 21 tC ha⁻¹ in Am and 18 tC ha⁻¹ in Ao for 6-year-old plantations.

Using the same equation, the VCS project gives a 2.6 tC ha⁻¹ for a 3-year-old stand. Hence WIF has taken a very conservative approach and the most suitable and available equation for the project ex-post estimations. Therefore, using the equation provided by Ya Min Thant et al. provides conservative ex-post estimates for the group of mangrove species used in this VCS project. And Myanmar being a Least Developed Country (LDC), WIF have used the best available allometric equation to conservatively calculate ex-post reductions.

¹³ Combined report on “Preparation of Baseline Data Mangrove Ecosystem Management in Bintan Island” made by CV. IDEAS under ITTO project RED-PD 064/11 Rev.2 (F) “Promoting Local Community Initiative on the Rehabilitation of Mangrove Ecosystem with Demonstration Activities in Bintan Island to Reduce further Deforestation and Forest Degradation” (https://www.itto.int/files/itto_project_db_input/2985/Technical/Baseline%20Data%20of%20Mangrove%20Ecosystem-%20Combined%20report.pdf?v=1392885114)

Estimation of mean tree biomass in all planting/restoration strata 2015, 2016, 2017, 2018, and 2019^{14 15 16}

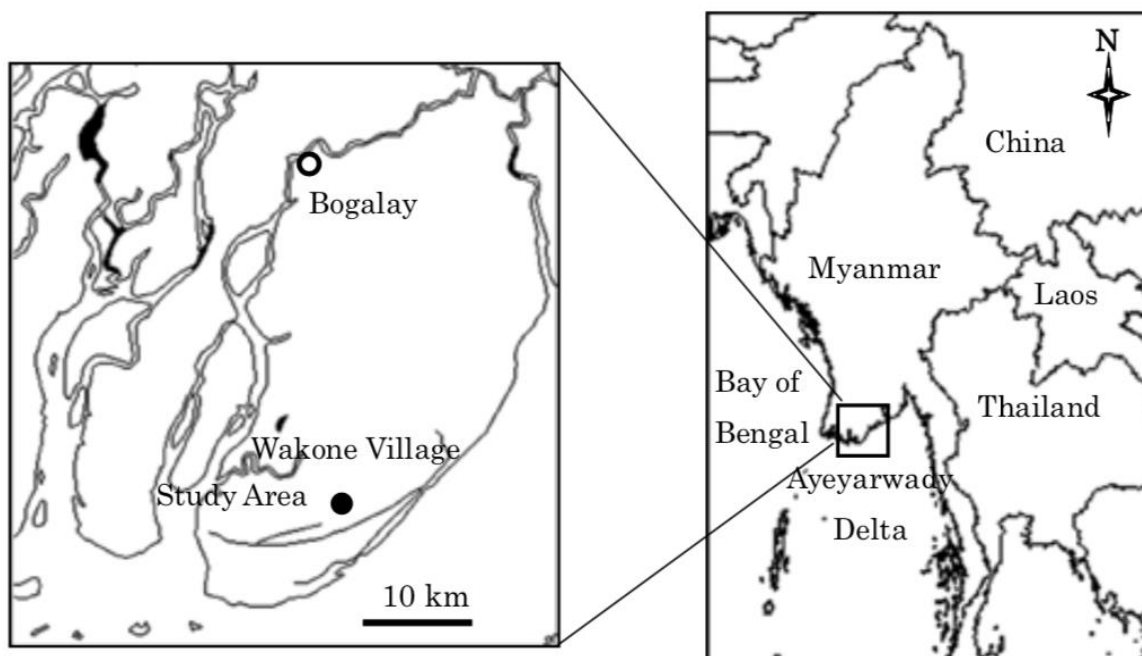
Yearly Stratum	Period	DBH	Height	Above ground weight (kg)	Below ground weight (kg)	Total Biomass per tree	Number of trees per ha	Total Biomass (t/ha)	Mean tree biomass per hectare in stratum i ($b_{TREE,i}$)	Ratio of the area of stratum i to the sum of areas of tree biomass estimation strata (w_i)	Mean tree biomass per hectare in the tree biomass estimation strata (b_{TREE})
		cm	m	Wtop	Wroot	kg/tree	n	t/ha	t d.m. ha-1	dimensionless	t d.m. ha-1
2015 (i1)	2021-22	2.71	1.74	1.42	3.75	5.17	4,310	22.28	4.61	0.23	1.06
2016 (i2)	2021-22	2.84	1.22	1.15	3.37	4.52	4,444	20.09	2.82	0.17	0.48
2017 (i3)	2021-22	2.57	1.20	0.96	3.09	4.05	3,361	13.61	2.54	0.60	1.52
2015 (i7)	2021-22	2.71	1.74	1.42	3.75	5.17	2,585	13.36	2.76	0.44	1.21
2016 (i8)	2021-22	2.84	1.22	1.15	3.37	4.52	2,667	12.05	1.69	0.09	0.15
2017 (i9)	2021-22	2.57	1.20	0.96	3.09	4.05	2,016	8.16	1.52	0.47	0.71
2018 (i4)	2021-22	2.89	1.18	1.15	3.38	4.53	3,752	17.00	3.84	1.00	3.84
2019 (i5)	2021-22	1.66	0.81	0.34	1.86	2.20	1,514	3.33	0.70	1.00	0.70

¹⁴ "I1, I2, I3, I7 restore, I8 restore, I9 restore" tab in 5th_2022_VCUs_2015-17 plantations-20231010.xlsx

¹⁵ "I4" tab in 5th-2022_VCUs_2018 plantation-20231010.xlsx

¹⁶ "I5" tab in 5th_2022_VCUs_2019 plantation-20231010.xlsx

The following map shows the study area of Ya Min Thant et al and the VCS project area both located in the Ayeyarwady Delta area.



The DBH and Height values of monitoring data were obtained from the permanent sample plots as the following table.

Plot No.	Year 3		Year 4		Year 5		Year 6		Year 7	
	DBH (cm)	Height (cm)	DBH (cm)	Height (cm)	DBH (cm)	Height (cm)	DBH (cm)	Height (cm)	DBH (cm)	Height (cm)
Restoration and Planting Strata in 2015										
2015 Plot 4									2.56	231.92
2015 Plot 5									2.57	209.20
2015 Plot 11									1.94	170.12
2015 Plot 33									4.26	108.67
2015 Plot 45									2.59	199.87
2015 Plot 53									3.31	142.75
2015 Plot 90									3.07	115.70
2015 Plot 99									1.43	210.50

Plot No.	Year 3		Year 4		Year 5		Year 6		Year 7	
	DBH (cm)	Height (cm)	DBH (cm)	Height (cm)	DBH (cm)	Height (cm)	DBH (cm)	Height (cm)	DBH (cm)	Height (cm)
Average									2.71	173.59
Restoration and Planting Strata in 2016										
2016 Plot 21							2.77	110.21		
2016 Plot 25							2.78	188.44		
2016 Plot 32							2.49	68.83		
2016 Plot 34							3.48	92.91		
2016 Plot 43							2.58	114.94		
2016 Plot 48							3.19	124.68		
2016 Plot 73							2.59	150.52		
Average							2.84	121.50		
Restoration and Planting Strata in 2017										
2017 Plot 6					2.19	119.87				
2017 Plot 19					2.51	116.05				
2017 Plot 26					2.39	111.38				
2017 Plot 62					3.24	123.75				
2017 Plot 68					2.32	86.58				
2017 Plot 77					2.35	110.26				
2017 Plot 100					2.77	154.05				
2017 Plot 106					2.81	136.60				
Average					2.57	119.82				
Restoration and Planting Strata in 2018										
2018 Plot 1			3.30	187.86						

Plot No.	Year 3		Year 4		Year 5		Year 6		Year 7	
	DBH (cm)	Height (cm)	DBH (cm)	Height (cm)	DBH (cm)	Height (cm)	DBH (cm)	Height (cm)	DBH (cm)	Height (cm)
2018 Plot 2			3.11	205.21						
2018 Plot 3			2.57	109.21						
2018 Plot 5			2.65	122.19						
2018 Plot 11			3.21	82.79						
2018 Plot 12			4.21	92.52						
2018 Plot 14			2.56	161.95						
2018 Plot 19			3.03	98.45						
2018 Plot 28			2.39	111.10						
2018 Plot 29			3.10	79.78						
2018 1 (P)			2.17	64.78						
2018 2 (P)			2.67	105.55						
2018 3 (P)			2.59	116.32						
Average			2.89	118.28						
Restoration and Planting Strata in 2019										
2019 Plot 1	1.38	74.75								
2019 Plot 3	1.46	81.86								
2019 Plot 4	1.24	77.17								
2019 Plot 5	1.61	78.31								
2019 Plot 7	1.26	76.69								
2019 Plot 16	1.15	61.68								
2019 Plot 17	1.37	66.22								
2019 Plot 23	1.53	75.92								

Plot No.	Year 3		Year 4		Year 5		Year 6		Year 7	
	DBH (cm)	Height (cm)	DBH (cm)	Height (cm)	DBH (cm)	Height (cm)	DBH (cm)	Height (cm)	DBH (cm)	Height (cm)
2019 Plot 29	1.77	99.65								
2019 Plot 32	1.33	80.67								
2019 Plot 37	1.34	86.22								
2019 Plot 38	1.59	84.71								
2019 Plot 40	2.67	120.94								
2019 Plot 42	2.30	84.04								
2019 Plot 43	1.98	84.64								
2019 Plot 46	1.56	57.32								
2019 Plot 48	2.58	85.89								
2019 Plot 49	1.71	85.60								
Average	1.66	81.24								

The equations were applied for each year and then the tool AR-Tool 14 (Version 04.2) was used to develop the calculations in Microsoft Excel sheets. Default carbon fraction: 0.47 as per A/R methodological tool.

Out of the strata, only 6 Strata i_1, i_2, i_3 were areas reforesting from 2015 to 2017 and i_7, i_8, i_9 are areas that were restored using mangrove plants. The state i_4 was planted in 2018 and i_5 was planted in 2019. Calculations for i_4 and i_5 were done separately since they are newly planted areas.

Strata	Year of planting	Area planted (ha)
i_1	2015	93.92
i_2	2016	71.63
i_3	2017	249.53
i_4	2018	297.88
i_5	2019	1,108.24
Total area (ha)		1,821.20

Strata	Year of planting	Area restored (ha)
i ₇	2015	107.97
i ₈	2016	22.28
i ₉	2017	114.42
Total area (ha)		244.67

Thus, using the above information and equations, the above-ground and the below-ground biomass were calculated to be as indicated in the table below.

	2015-2017 Planting tCO ₂ e	2018 Planting tCO ₂ e	2019 Planting tCO ₂ e
Above-ground and Below-ground Biomass	3,061.69	1,971.25	1,336.91

Survival Rate

Based on the survival rate counts in the 54 sample plots covering all planted areas in 2015-2019, an average 92 % survival rate has been acquired and applied in which 2015-17 areas represent 97 %, 2018 areas represent 97 % and 2019 areas represent 82 %.

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

As no shrubs are planted as part of this project this carbon stock will be accounted as zero for the ex-ante and ex-post estimations.

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

Deadwood is expected to remain in the project area and will not be removed. Therefore, carbon stock in this pool is assumed not to increase under a conservative approach.

Calculation of uncertainty

This was done following the guidance of Appendix 2 of the A/R Methodological Tool “Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities”. The values are presented in the table below:¹⁷

¹⁷ “Uncertainty Calc and Final VCU” Tab of 5th_2022_VCUs_Consolidated Calc Data_24%Buffer_20231010.xlsx

Stratum	Mean t d.m. ha ⁻¹	s _i t d.m. ha ⁻¹	n _i	Standard error of mean (SEM)	SEM expanded at 90% confidence level	Uncertainty
2015 planted	19.92	4.58	8	1.62	3.07	15.41
2016 planted	17.80	3.35	7	1.27	2.46	13.81
2017 planted	16.25	3.12	8	1.10	2.09	12.87
2018 planted	17.94	4.66	13	1.29	2.30	12.83
2019 planted	4.53	1.48	18	0.35	0.61	13.36
Total			54	Average		13.66

Stratum	Change in Carbon Stock	Total	Balance VCUs (at 25% discount due to uncertainty)
2015-2017 planted	3,061.69	6,369.85	4,777.39
2018 planted	1,971.25		
2019 planted	1,336.91		

Estimation of changes in carbon stocks in Soil Organic Carbon: $\Delta SOC_{PROJ,t}$

As explained in the VCS PD (version 3.0) the changes in carbon stocks in the SOC pool were calculated as indicate in the equation 4 of the Methodology AR-AM0014 (03.0):

$$\Delta SOC_{PROJ,t} = \frac{44}{12} \times \sum_{t=1}^t A_{PLANT,t} \times dSOC_t \times 1 \text{ year} \quad \text{Equation (4)}$$

Where,

$\Delta SOC_{PROJ,t}$ = Change in carbon stock of the soil organic carbon (SOC) pool within the project boundary, in year t;

$A_{PLANT,t}$ = Area planted in year t; ha

$dSOC_t$ = The rate of change in SOC stocks within the project boundary, in year t; t C ha⁻¹ yr⁻¹
The following default value is used, unless transparent and verifiable information can be provided to justify a different value:

1. $dSOC_t = 0.5 \text{ t C ha}^{-1} \text{ yr}^{-1}$ for $t = t_{PLANT}$ to $t = t_{PLANT} + 20$ years, where t_{PLANT} is the year in which planting takes place;
2. $dSOC_t = 0 \text{ t C ha}^{-1} \text{ yr}^{-1}$ for $t > t_{PLANT} + 20$ years

The IPCC published in its “2013 Supplement to the 2006 IPCC Guideline for National Greenhouse Gas Inventories: Wetlands”, a default value of 1.62 tC/ha/year for mangrove ecosystems with a range of 0.10-10.2 tC/ha/year. Regarding the default accumulation timeframe of this value, the same guidelines state

on page 4.27 “Craft et al (2003) found that (a) soil carbon accumulation, developed almost instantaneously with the establishment of vegetation along a chronosequence 1- to 28-year old constructed marshes and (b) a similar soil carbon accumulation rate over 10 years in a natural and created marsh (Craft et al., 2002) and over 20 years in a created mangrove (Osland et al., 2012)”.

This IPCC value is mainly based on the study conducted by Breithaupt et al. (2012) which estimated a geometric mean global organic carbon burial rate of 163 (+39.2; -32) g OC m⁻² yr⁻¹ resulting 1.63 tC/ha/year. This comparative study included 19 studies from Brazil, Columbia, Malaysia, Indonesia, China, Japan, Vietnam, Thailand, Mexico and the United States.

For the proposed VCS ARR project in Myanmar, the University of Patheingyi carried out an in-depth soil analysis. The samples collected were analysed at the Universities’ Research Centre of the University of Yangon. According to this analysis, average carbon stock stored was estimated as 732.26 tC/ha for a mean soil depth of around 1 meter.

Applying a conservative estimate of 100 years accumulation, this would result in 7.32 tC/ha/year for soil depth around 1 m. The *dSoC_t* value of 7.32 tC/ha/year has already been fixed since the initial verification. Hence, for this monitoring period, conservatively, the same SoC parameter 7.32 tC/ha/year determined at validation throughout the project crediting period remains fixed.

Change in SOC stock occurring in the selected carbon pools of planting/restoration strata 2015, 2016 and 2017 (*i₁*, *i₂*, *i₃*, *i₇*, *i₈*, and *i₉*)¹⁸

Period	The rate of change in SOC stocks within the project boundary, in year <i>t</i> ; tC/ha ¹ /yr ¹ (<i>d SOC_t</i>)	Area planted in year <i>t</i> ; ha (<i>A_{PLANT, t}</i>)	Change in SOC stock within the project boundary, in year <i>t</i> ; tCO ₂ e ($\Delta SOC_{Proj,t}$)
15.06.2021-14.06.2022	7.32	659.75	17,707.69

Change in SOC stock occurring in the selected carbon pools of planting/restoration strata 2018 (*i₄*)¹⁹

Period	The rate of change in SOC stocks within the project boundary, in year <i>t</i> ; tC/ha ¹ /yr ¹	Area planted in year <i>t</i> ; ha	Change in SOC stock within the project boundary, in year <i>t</i> ; tCO ₂ e
15.06.2021-14.06.2022	7.32	297.88	7,995.10

¹⁸ “SOC” Tab in 5th_2022_VCU_s_2015-17 plantations-20231010.xlsx

¹⁹ “SOC” Tab in 5th_2022_VCU_s_2018 plantation-20231010.xlsx

Change in SOC stock occurring in the selected carbon pools of planting/restoration strata 2019 (i₅)²⁰

Period	The rate of change in SOC stocks within the project boundary, in year t; tC/ha ¹ /yr ¹	Area planted in year t; ha	Change in SOC stock within the project boundary, in year t; tCO ₂ e
15.06.2021-14.06.2022	7.32	1,108.24	29,745.16

Summary of change in SOC stock occurring in all planting/restoration strata 2015, 2016, 2017, 2018 and 2019

Carbon Pool	2015-2017 Planting tCO ₂ e	2018 Planting tCO ₂ e	2019 Planting tCO ₂ e	Total tCO ₂ e
SOC	17,707.69	7,995.10	29,745.16	55,447.95

5.3 Leakage

According to the methodology AR-AM0014 (Version 03.0), the leakage emission has to be assessed with the tool “Estimation of the increase in GHG emissions attributable to the displacement of pre-project agricultural activities in A/R CDM project activity” (Version 02). This tool evaluates the displacement of crop cultivation and grazing activities. Section 6 of this tool indicates that leakage emissions can be considered insignificant if they meet the following requirements:

1. Leakage emission attributable to the displacement of agricultural activities due to implementation of an A/R CDM project activity is estimated as the decrease in carbon stocks in the affected carbon pools of the land receiving the displaced activity.
2. Leakage emission attributable to the displacement of grazing activities under the following conditions is considered insignificant and hence accounted as zero:
 - (a) Animals are displaced to existing grazing land and the total number of animals in the receiving grazing land (displaced and existing) does not exceed the carrying capacity of the grazing land;
 - (b) Animals are displaced to existing non-grazing grassland and the total number of animals displaced does not exceed the carrying capacity of the receiving grassland;
 - (c) Animals are displaced to cropland that has been abandoned within the last five years;
 - (d) Animals are displaced to forested lands, and no clearance of trees, or decrease in crown cover of trees and shrubs, occurs due to the displaced animals;
 - (e) Animals are displaced to zero-grazing system.

Most of the project areas are emerged salty mudflats, on bare lands or with a few mangrove plants. Grazing is not a common practice in the area. The protection from any future illegal grazing on mangrove

²⁰ “SOC” Tab in 5th_2022_VCU_s_2019 plantation-20231010.xlsx

sites is part of the project activities. Therefore, leakage in the whole project area can be assumed as zero for the duration of the project.

Prior to the project, some of the local communities have been involved in charcoal production. With the lands being degraded and abandoned, these charcoal producers had to abandon the charcoal production.

One might argue that with the mangrove reforestation program, these charcoal producers may start the charcoal production again thus lead to deforestation. To prevent those in the community living nearby mangrove forest depending on cutting mangrove to make charcoal and get income for their livelihood, Worldview International Foundation (WIF) employ them, paying daily wages of Kyats 8000/-, in planting mangrove in the belief that their participation in planting process would create a feeling of ownership and that they would not readily cut mangrove as they had done so before.

In addition, WIF, in consultation with them, look for an alternative income generation project that might interest them to take care of their livelihood. These people have been made aware that in order to receive an income via carbon credits they need to protect these mangroves. They have also agreed on the alternative livelihood opportunities proposed by WIF for them. This way WIF ensures that the mangrove trees planted by the project will not be cut for the charcoal production. This is in line with Section 3.6.2 of the AFOLU Requirements (version 3.6).

Regular patrolling in the project area is done and any illegal cutting is to be reported to the project office and strict measures are taken for offenders with the support of the forest department officials.

5.4 Net GHG Emission Reductions and Removals

The ex-ante net anthropogenic GHG emission reductions and removals are calculated using equation 6 of the methodology AR-AM0014:

$$\Delta C_{ARR-CDM,t} = \Delta C_{ACTUAL,t} - \Delta C_{BSL,t} - LK_t \quad \text{Equation (6)}$$

Where,

$\Delta C_{ARR-CDM,t}$ = Net anthropogenic GHG removals by sinks, in year t; t CO₂e

$\Delta C_{ACTUAL,t}$ = Actual net GHG removals by sinks, in year t; t CO₂e

$\Delta C_{BSL,t}$ = Baseline net GHG removals by sink in year t; t CO₂e

LK_t = GHG emissions due to leakage, in year t; t CO₂e

The AFOLU Non-Permanence Risk Tool, V4.0 was used to calculate the non-permanence risk for the project. The total internal risk that accounts for project management, financial viability, opportunity cost and project longevity was assessed as 19. Similarly, the total external risk that accounts for land tenure

and resource access, community engagement, political risk was assessed as 1. Then, the total natural risk that accounts for fire, pest and disease outbreaks, extreme weather, geological risk and other natural risk such as Tsunami was assessed as 3.5. In summary, the overall risk rating for all three risk categories was assessed as 24%

In order to demonstrate the in-depth assessment of risk rating and scores counted and ensure the buffer pool to be allocated, the “Non-Permanence Risk Report” for the project has been produced as a separate document with the AFOLU Non-Permanence Risk Tool, V4.0 excel sheet used for the calculation. Accordingly, 14,454 tCO₂e buffer credits are needed to be deposited into the AFOLU pooled buffer account. After reducing, the balance credits are 45,771 tCO₂e.

Year	Baseline emissions or removals (tCO ₂ e)	Project emissions or removals (tCO ₂ e)	Leakage emissions (tCO ₂ e)	Net GHG emission reductions or removals (tCO ₂ e)	Buffer pool allocation	VCUs eligible for issuance
15-06-2021 – 31-12-2021	0.00	33,000.19	0.00	33,000.19	7,920.05	25,080.14
01-01-2022 – 14-06-2022	0.00	27,225.15	0.00	27,225.15	6,534.04	20,691.11
Total	0.00	60,225.34	0.00	60,225.34	14,454.09	45,771.25

(Notes: Balance VCUs at 25% discount due to uncertainty)²¹

²¹ “Uncertainty Calc and Final VCUs” Tab in 5th_2022-VCUs Consolidated Calcs Data-24%Buffer_20231010.xlsx

6 APPENDIX:

6.1 Appendix 1: Section 1.11-Social Criteria



Figure 1: Shell craft Training Programme



Figure 2: Seaweed Training Programme: demonstrating how to prepare the ropes (left) and tying the seaweed plants with ropes for cultivation (right)



Figure 3: Energy Efficient Cookstove Training and distributing to targeted households



Figure 4: Mobile Video Production Training



Figure 5: Distribution of school accessories to schools and the scholarship holders



Figure 6: Construction of box culverts



Figure 7: Construction of the ice plant (left) and Production of ice blocks (right)

6.2 Appendix 2: Summary of mean height and DBH of plants in permanent sample plots

2015 Planting

	Avg DBH (cm)	Avg Height (cm)	No. of Plants
Plot 4	2.56	231.92	48
Plot 5	2.57	209.20	41
Plot 11	1.94	170.12	49
Plot 33	4.26	108.67	48
Plot 45	2.59	199.87	39
Plot 53	3.31	142.75	55
Plot 90	3.07	115.70	23
Plot 99	1.43	210.50	38
Average	2.71	173.59	

2016 Planting

	Avg DBH (cm)	Avg Height (cm)	No. of Plants
Plot 1			
Plot 21	2.77	110.21	58
Plot 25	2.78	188.44	54
Plot 32	2.49	68.83	106
Plot 34	3.48	92.91	120
Plot 43	2.58	114.94	49

Plot 48	3.19	124.68	81
Plot 73	2.59	150.52	66
Average	2.84	121.50	

2017 Planting

	Avg DBH (cm)	Avg Height (cm)	No. of Plants
Plot 6	2.19	119.87	39
Plot 19	2.51	116.05	41
Plot 26	2.39	111.38	29
Plot 62	3.24	123.75	40
Plot 68	2.32	86.58	43
Plot 77	2.35	110.26	19
Plot 100	2.77	154.05	39
Plot 106	2.81	136.60	15
Average	2.57	119.82	

2018 Planting

	Avg DBH (cm)	Avg Height (cm)	No. of Plants
Plot 1	3.30	187.86	69
Plot 2	3.11	205.21	68
Plot 3	2.57	109.21	43
Plot 5	2.65	122.19	74
Plot 11	3.21	82.79	84
Plot 12	4.21	92.52	85
Plot 14	2.56	161.95	94
Plot 19	3.03	98.45	74
Plot 28	2.39	111.10	91
Plot 29	3.10	79.78	86
1 (P)	2.17	64.78	92
2 (P)	2.67	105.55	92
3 (P)	2.59	116.32	19
Average	2.89	118.28	

2019 Planting

	Avg DBH (cm)	Avg Height (cm)	No. of Plants
Plot 1	1.38	74.75	16
Plot 3	1.46	81.86	14
Plot 4	1.24	77.17	12
Plot 5	1.61	78.31	16
Plot 7	1.26	76.69	13
Plot 16	1.15	61.68	19
Plot 17	1.37	66.22	18
Plot 23	1.53	75.92	13
Plot 29	1.77	99.65	23
Plot 32	1.33	80.67	9
Plot 37	1.34	86.22	9
Plot 38	1.59	84.71	17
Plot 40	2.67	120.94	16
Plot 42	2.30	84.04	23
Plot 43	1.98	84.64	14
Plot 46	1.56	57.32	22
Plot 48	2.58	85.89	18
Plot 49	1.71	85.60	15
Average	1.66	81.24	