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

Document Prepared By Worldview International Foundation

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1 PROJECT DETAILS

1.1 Summary Description of the Project

The proposed project falls under the ARR (Afforestation, reforestation and Revegetation) category of the Verified Carbon Standard (VCS). The project will be implemented on 2146.48 ha of degraded lands of the Northern part of Ayeyarwady Division of Myanmar. The lands that will be restored under the project belong to Magyi, Thabawkan and Thaegone village tracts and this restoration will create a healthy mangrove ecosystem.

The objective of the project is to establish and maintain a sustainably managed mangrove ecosystem for carbon sequestration, natural disaster risk reduction, poverty reduction with sustainable livelihoods in the coastal communities. A vital component of the project is the conservation of bio-diversity and establishment of the first mangrove gene bank in Myanmar.

The project will also contribute to food security by reducing danger of erosion and salt intrusion in low lying agricultural land due to rising sea level. Restoration of mangrove forests will in addition substantially increase sea food resources to reverse the trend of crisis for small scale fishermen in the area.

Improving the ability to provide a variety of ecosystem services, climate change mitigation, economic consideration and active local community participation are main components of the project. Without the project, carbon stocks in the project area will continue to decrease due to various anthropogenic activities. During 2015-2020 of mangrove restoration, the project will restore approximately 2146.48 ha of degraded lands by planting 9,116,390 new mangrove plants. The species identified for this reforestation project are *Rhizophora mucronata, Rhizophora apiculata, Bruguiera gymnorrhiza, Bruguiera cylindrica, Bruguiera sexangula and Ceriops tagal*. This combination of mangrove restoration and coastal green belt protection will improve the biodiversity and also be a natural disaster risk reduction asset from natural disasters such as sea waves or tsunami, will also play a role as a carbon sink and also promote sustainable rural development in the area.

The concept of the project based on 3 years of research in cooperation with Pathein University and Myeik University to secure sustainability with maximum multi-purpose benefits in creating resilient communities for adaptation and mitigation to climate change.

The project will sequestrate an estimated 3.68 million tCO_2e over a period of 20 years.

The project will provide over and above the carbon sequestration:

- Poverty alleviation with new livelihoods and wealth creation in rural areas,
- Communities empowerment through active participation in all stages of the project, and
- Improvement of basic infrastructure for rural communities.

Project's contribution towards sustainable development

Environmental criteria:

Mangrove forests are coastal plant communities that are part of a larger 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 (Lewis, 2001)

Establishing mangrove forests on degraded, underutilized lands will sequestrate significant amount of GHGs compared to baseline. Project is implemented by Worldview International Foundation in cooperation with Pathein University who are committed to environmental sustainability and social responsibility and are confident that the extraordinary costs involved in pioneering this project will eventually be covered by the supplementary cash flow from sale of VCUs.

Under the project, soil conditions are checked, nutrition is retained on the land and therefore water quality will be increased compared with the baseline scenario. The soil organic contents and mineral contents will be improved due to proper land management. Vegetation cover is expected to improve soil conditions. Mangrove restoration will further increase fish resources with up to 50%, protecting lives and properties from extreme weather, provide cooling effect from mangrove trees and provide other vital ecosystem services and establishment of the first mangrove gene bank with 64 species to be followed with long-term research. Protecting endangered flora and fauna with emphasis on sea grass meadows/ coral reefs/ blue carbon and protection of endangered dugongs and elephants, including other species as per are other environmental benefits of the project.

Social criteria:

The project involves low income families in the area who will get more opportunities to increase their income and thus be less prone to pursue unsustainable practices that might increase CO_2 emissions, harm the environment and further reduce the mangroves.

The project creates direct employment at agreed wages of the local communities involved in the project and the project promoter is committed to provide all the training necessary. The project proponent (PP) will promote a working family model where both men and women can actively participate in the project. Emphasis to be made on women projects, as well as expansion of scholarships for university studies to girls from poor families.

Improvements to the infrastructure in the area are being carried out by the PP to provide economic accessibility of the project area but also to facilitate farmers' access and strengthen the competitiveness of the farmers when it comes to taking their food crops to the market.

Economic criteria:

Labour requirement for the project will be fulfilled with local employment. Therefore the major portion of the budget on labour will be retained within the country and the local community. The project pays its workers above normal wages with additional support in solving problems such as supporting construction of community flood walls, securing 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 create new livelihoods. 30% of the total project budget is for public education, social mobilisation, livelihood creation, micro loans, cottage industries, aquaculture, scholarships, distribution of solar lamps, and subsidy for fuel saving stoves, women projects and scholarships.

More permanent job opportunities are in progress: a demonstration unit on oyster culture was established in 2016, colouring textiles with natural mangrove colours was established with 12 women participants in

2016, nypa sap production initiated in 2015, virgin coconut oil production, sea weed production and mini hydroponic projects to start in 2017. This will be followed up with new projects after consultation with community leaders and local entrepreneurs.

The project has from the start been supporting schools in the area with educational assistance, and in particular on mangrove restoration, as well as establishing school nurseries, art competitions etc. This has to a great extent made the community to understand the value of mangrove restoration.

1.2 Sectoral Scope and Project Type

Sectoral Scope 14: Agriculture, Forestry, Land use.
Afforestation, Reforestation and Revegetation (ARR)
Project is NOT a grouped project.

As per the section 3.1.11 of VCS AFOLU Requirements (Version 3.6), all ARR projects shall comply also WRC requirements (Wetlands Restoration and Conservation) when soil organic carbon pool in the project scenario is not deemed below *de minimis.* For this project soil organic carbon is an important part of the total amount of the carbon sequestrated, hence the project will comply both ARR requirements and WRC requirements. However the project do not consider any GHG emissions reductions and therefore does not fall under the description of WRC project in the section 4.2.19 of the AFOLU Requirements (Version 3.6)

1.3 Project Proponent

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1.4 Other Entities Involved in the Project

Organization 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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Organization name	Thabawkan Village Tract Mangrove Conservation Committee
Role in the project	Land right holders and labour force
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Organization name	Thaegone Village Tract Mangrove Conservation Committee
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Organization name	Prime Carbon Co Ltd
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Organization name	Forest Department
Role in the project	Land right recommendation and consultation for forest services
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Organization name	Myanmar University of Forestry
Role in the project	Research partner
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Organization name	Forest Research Institute
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Organization name	Ayeyarwady Regional Government
Role in the project	Land owner and local authority
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1.5 Project Start Date

Project start date is 15th May 2015.
The start data of the project activity is 15th May 2015, which is the date of the land preparation occurred. Proof for the project start date will be provided during validation.

1.6 Project Crediting Period

20 years and 00 months, Renewable
Start date of the crediting period is the start date of planting, which is 15th June 2015
15th June 2015 to 14th June 2035

1.7 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	
Large project	X

Year	Estimated GHG emission reductions or removals (tCO_2e)
2015	7,521
2016.	13,982
2017	35,161
2018	51,315
2019	63,447
2020	96,668
2021	118,828
2022	172,444
2023	215,732
2024	250,148
2025	290,429
2026	310,907
2027	329,081
2028	337,240
2029	342,849
2030	306,848
2031	227,274
2032	199,766
2033	156,895
2034	153,591
Total estimated ERs	3,680,125
Total number of crediting years	20
Average annual ERs	184,006

1.8 Description of the Project Activity

The reforestation and restoration of mangroves is undertaken by WIF incorporation with several organizations. University of Pathein has been given the lands in Magyi village tract for the reforestation and restoration. Thaegone Village Tract Mangrove Conservation Committee and Thabawkan Village Tract Mangrove Conservation Committee have been given the lands for the project in Thaegone and Thabawkan areas respectively. Therefore the project proponent will work with these 3 for the reforestation and restoration.

A total of 2146.48 ha of degraded land will be reforested and restored under this project. The following table presents the area to be planted:

Table 1: Area to be planted for the project activity

Year of planting	Magyi (ha)	Thabawkan (ha)	Thaegone (ha)	Total area (ha)	Total number of plants (@ 5000 tree per ha)
2015	200			200	1,000,000
2016	160			160	800,000
2017	118.24	200	100	118.24	2,091,200
2018		350	100		2,250,000
2019		150	50		1,000,000
2020		126.91	52.66		897,850
Total area (ha)	**478.24**	**826.91**	**302.66**	**1607.81**	**8,039,050**

In addition an area of 538.67 ha will be restored and regenerated using 1,077,340 plants. The total number of plants that will be planted is 9,116,390.

Table 2: Area to be restored

Year of planting	Magyi (ha)	Thabawkan (ha)	Thaegone (ha)	Total area (ha)	Total number of plants (@2000 trees per ha)
2015	80			80	160,000
2016	80			80	160,000
2017	80	60.96	218.91	359.87	719,740
2018	18.8			18.8	37,600
2019	-	-	-	-	-
2020	-	-	-	-	-
Total area (ha)	**258.8**	**60.96**	**218.91**	**538.67**	**1,077,340**

Table 3: Planting schedules for proposed ARR VCS project activity are presented below.

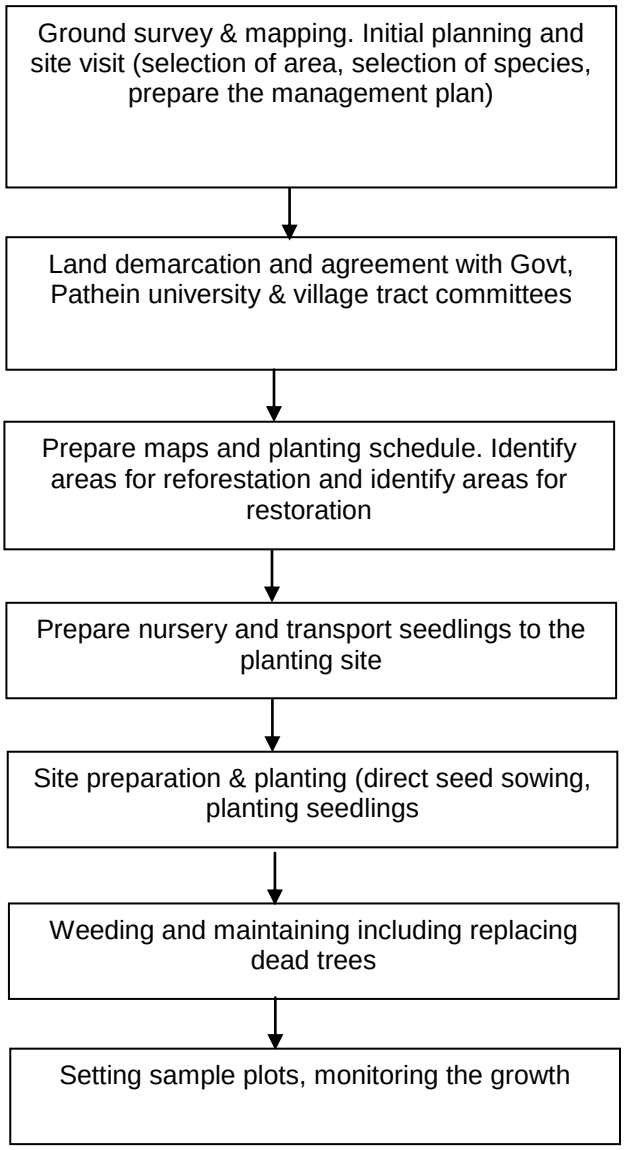
No	Activity	Year 2014											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Discussions with Govt, Pathein university												
2	Prepare maps and planting schedule												
3	Identify areas for reforestation and identify areas for restoration												
4	Preparation of the												

	nurseries/ Exploring options to buy propogules												
5	Maintain the plants in the nursery												

No	Activity	Year 2015, 2016, 2017, 2018, 2019											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Maintain the plants in the nursery												
2	Site preparation												
3	Planting (direct seed sowing, planting seedlings												
4	1st weeding operation												
5	Patching												
6	2nd weeding operation												
7	Identify lands for following year												
8	Contact the relevant village tract												

No	Activity	Year 2020											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Maintain the plants in the nursery												
2	Site preparation												
3	Planting (direct seed sowing, planting seedlings												
4	1st weeding operation												
5	Patching												
6	2nd weeding operation												

Activities involved in the reforestation and restoration component is presented in the following steps:



Ground survey and mapping

A thorough ground survey followed up with a mapping process was done for the project. This survey was led by Mr. Win Maung, project director with the assistance of University of Pathein.

Forest Inventory and social survey

An inventory was done to identify the existing species and for the identification of endangered species. The social survey was done in all three village tracts (Magyi, Thabawkan and Thaegone).

Species used for planting

The species identified for this reforestation project are *Rhizophora mucronata, Rhizophora apiculata, Bruguiera gymnorrhiza, Bruguiera cylindrica, Bruguiera sexangula and Ceriops tagal*. Key factors that were considered in selecting the species are already common species found in the area (not been a new

species to the area), not being an invasive species and the availability of planting material. The following provides a description of each species (All species are under the 'least concern' category of IUCN Red List)

Scientific Name	Local Name	Economic use	Habitat & Ecology
Rhizophora mucronata Lam.	Byu chi dauk ama	Used for fuel wood and commercially exploited for charcoal. Also used as a construction wood	Found in the intermediate to upstream estuarine zone in the lower to mid-intertidal region, and more to the seaward side. Tolerates a maximum salinity of 40 ppt and a salinity of optimal growth of 8-33 ppt. This is a hardy species that is easily propagated and is fast-growing. It can grow up to 35 m, and can grow to 6 m high within seven years on plantations.
Rhizophora apiculata Blume	Byu chi dauk apho	Used as a fuel wood species and used for charcoal production	Found in the intermediate estuarine zone in the mid-intertidal region. Tolerates a maximum salinity of 65 ppt and a salinity of optimal growth of 8-15 ppt. It is a hardy species, and fast-growing. This species can grow to 30 m.
Bruguiera gymnorhiza (L.) Lam.	Byu oak saung	Commonly sold as timber and fuel wood	Found in downstream to intermediate estuarine zones in the mid to high intertidal region. It is shade tolerant with a maximum pore water salinity of 50 ppt and a salinity of optimal growth of 8-34ppt. It is a small to large buttressed tree that can grow to 25 m but more commonly is found up to 10 m.
Bruguiera cylindrica (L.) Blume	Nan byu	This species is harvested for medicinal purpose, fuel wood and construction	Found in downstream and intermediate estuarine zones in the mid-intertidal region. It is shade tolerant.
Bruguiera sexangula (Lour.) Poir.	Byu kyet tet or Byu shwe war	Juice from the fruits is used to treat sore eyes, shingles and burns. The timber is used as poles as well as for firewood and charcoal.	Found in intermediate to upstream estuarine zones in middle intertidal regions. It is restricted to larger riverine estuaries and tidal swamps, and prefers a maximum porewater salinity of 33 ppt. This is a slow-growing species that can grow to 30 m
Ceriops tagal (Perr) CB.Rob.	Madama myaw	Bark is harvested for tannins for dyes, and it is harvested for construction materials and fuel wood.	Found from downstream to intermediate estuarine zones in the mid to high intertidal regions. It is shade intolerant with a maximum porewater salinity of 45 ppt and a salinity of optimal growth of 0-15 ppt. This species is slow-growing but is a hardy species and is very prolific

(Source: IUCN Red List)

Rhizophora mucronata

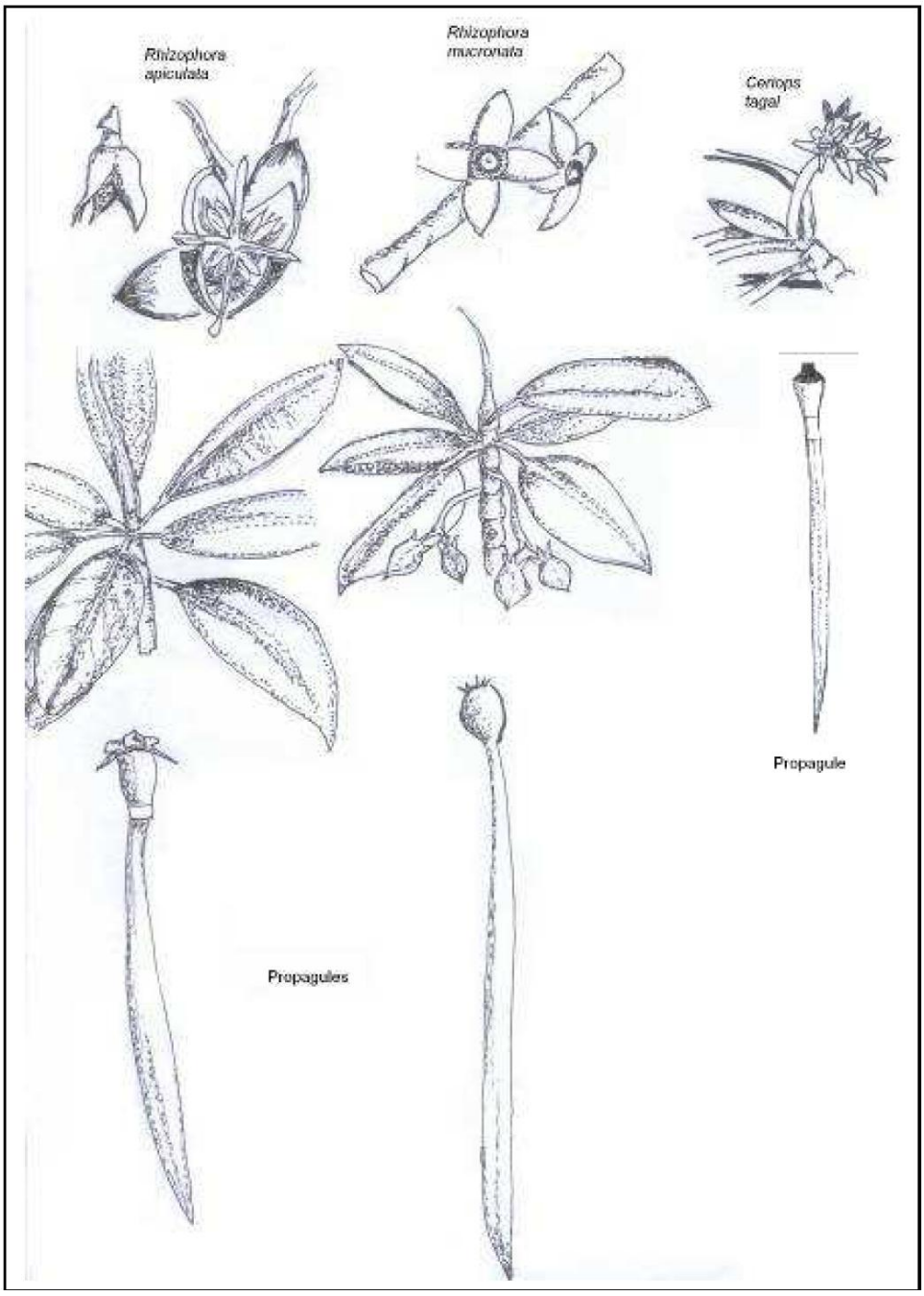
Link

Link

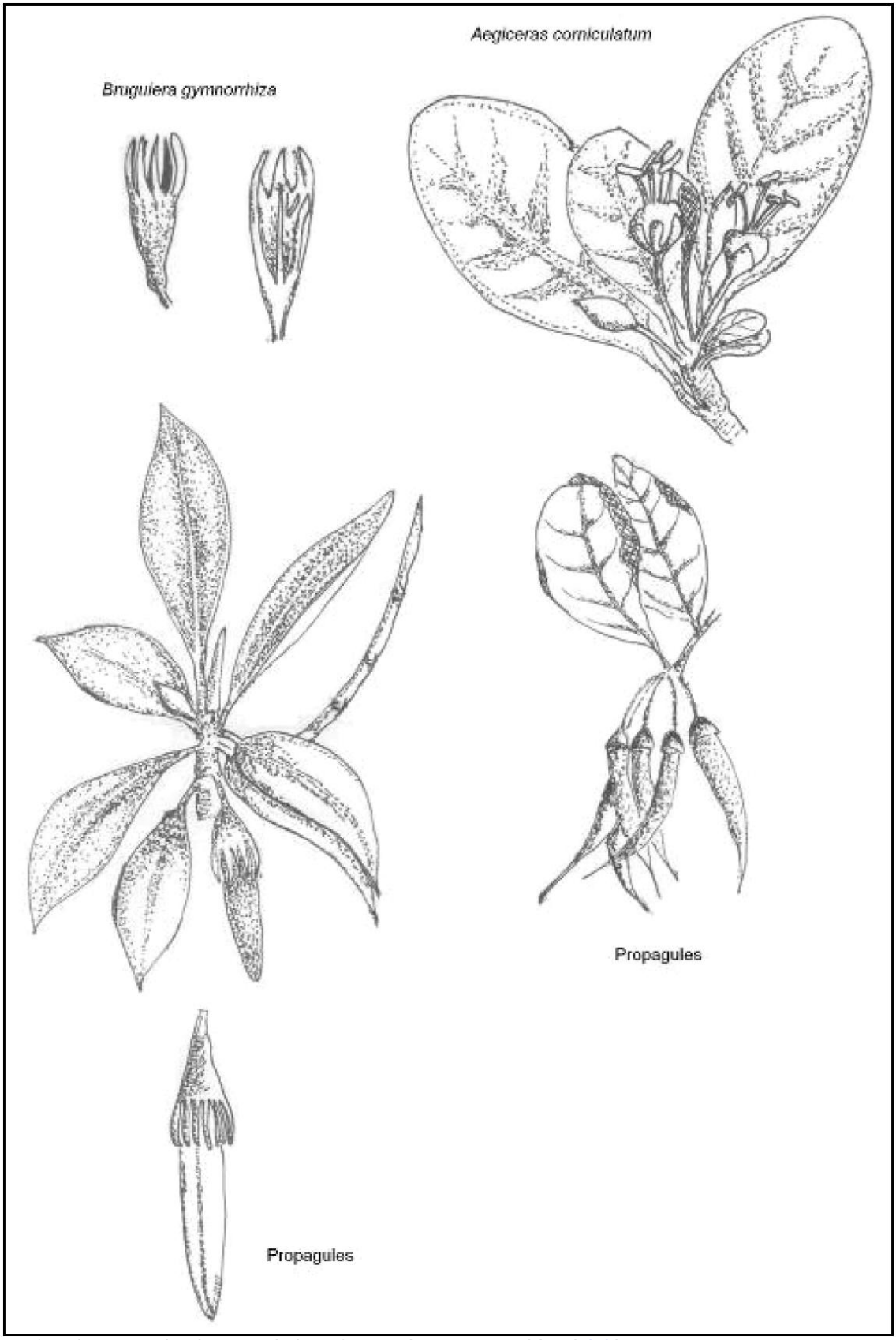
Rhizophora apiculata

Link

Link



Leaf and propagule characteristics of *Rhizophora apiculata, R. mucronata* and *Ceriops tagal* (Link)



Leaf and propagule characteristics of *Bruguiera gymnorrhiza* (Link)

Bruguiera cylindrica

Link

Link

Bruguiera sexangula

Link

Link

Ceriops tagal

Link

Link

Establishment of nursery

(a) Nursery management

Mangrove nurseries are established at least one year ahead the planting because of shortage of mangrove seeds and fruiting time. Mangrove species can be establish by direct seed sowing method but at least 50% of target plants must be established in the nursery one year ahead. Nursery system is pound nursery system and water flow is control by sluice gate.

(b) Construction of Nursery - Criteria of setting a Nursery site are as follows

- Boats should be able to enter every low tide and high tide
- Ground level should be low ground or medium ground
- It should be easy to monitor

  At least 300ft x 150ft is needed for 300,000 seedlings. An area of 1 meter depth will be dug and an embankment will be made. The depth of the pound is around 1 meter and even during a low tide day in the dry season water should be able to flow into the nursery area. Sluice gate is the best to control the tide inundation. Natural mangrove soil is the best to put in plastic bags. Mangrove seeds are collected during February to May and are grown in these plastic bags. This project has assigned 4 permanent staff members to manage the nursery operation and is supervised by a supervisor.
- For direct seed sowing, 60ft x 20ft of seed storage building is constructed and has the capacity to store about 300,000 seedlings.

Due to lack of supply of seeds within the project area, the seeds are bought from the Gwa Township in Rakhine, which is the former Mangrove Rehabilitation and community development project area.

Figure 1: Nursery consisting of planting materials for the project

Storage of Mangrove seeds (propagule)

Most of the mangrove species seeds are viviparous and get matured during the dry season (February to April). Almost all propagules already produce new shoots on the mother tree. Direct seed sowing is not possible during the hot weather due to exposing to direct sun light. Therefore seeds should be stored under the shade during February to May. Watering should be done once in every 3 days and change the position once in 2 weeks. Approximately 50 seeds should be bundled by a rope and kept in the horizontal position.


Figure 2: Bundling propagules

Planting spacing and density

Plant spacing in reforested areas is 1 meter by 2 meter which allows to plant 5000 plants per hectare. At the end of 10th year the density is expected to be approximately 3000 plants per hectare. The planting density in areas that will be restored is around 2000 new plants per hectare.

Land preparation and planting

Areas which are severely degraded will be reforested while areas with a few mangrove plants will be restored. Areas to be reforested need to be cleaned from wastes, sea-grass or any other debris.

The project has two engine powered fiber boats that are used to transport the staff to the project area. PP has hired 1 wooden boat and a fiber boat for the transportation of seedlings. Seedlings are carried out to the planting site from the nursery. The seedlings are placed in plastic baskets are loaded on to the boat. Each basket carries 50 seedlings and one boat can transport 30 baskets.

Both direct seed sowing and planting seedlings is applied for this project activity.

(a) Direct seed sowing

The monsoon enters the coastal area during the last week of May. Direct seed sowing operation will began on the starting date of high tide days in the last week of May. This timing allows the propagules not been exposed to direct sun burn.

(b) Planting seedlings

Planting seedlings will be done in July when there is sufficient rain. One group of laborers will dig suitable size of holes ahead. Another group of laborers will take out the plastic bag from the seedlings and plant in the hole. The field staff is given proper training on planting and there are supervisors to supervise their activities.

Plantation maintenance and Replanting

1. Weeding

   The climbers that need to be removed are species such as *Finlaysonia maritima, Derris trifoliate, Acanthus ilicifolius, Dalbergia spinosa.* The initial weeding should be done in June followed up with a second weeding operation in November. Weeding is done manually.

2. Patching

   About 10% of the planted seedlings need to be replanted because of crab attacks and damages of seedling during the loading and unloading operation. Patching operation will be carried out in August by potted seedlings.

3. Protection
   (A) Natural Disasters
   There are no natural disaster impacts that are foreseen within the project area unless cyclones that may occur once in a while (Cyclone Marlar caused damage in this area in 2006). Coastal mangrove areas are not susceptible to insect attacks and/or diseases.
   (B) The project team has organized Village Mangrove Environment Conservation Committees (VMECC) in Thaegone and Thabawkan village tracts who are responsible and committed to project these mangroves and report to the team in case of such activities.

Figure 3: Providing instructions and guidance in planting mangroves

Figure 4: Transporting seedlings and planting of mangroves in the project area

The proposed project activities are based on four major components:

Component A: Capacity building and awareness program (Implementing period 2015 – 2020)

a. Training programme for local community on Community Based Natural Resource Management (CBNRM) system – 3 programmes for 3 village tracts to be conducted
b. Improving the capacity of project staff and government partners on Project Cycle Management (PCM) - 3 workshops for 3 village tracts to be conducted
c. Implementing local community training on Disaster Risks Reduction (DRR) programme for climate change mitigation – either 3 individual training workshops for 3 village tracts or coupled with training on CBNRM.
d. Extending awareness programs among local communities on biodiversity and mangrove ecosystems – this awareness program will be coupled with training on CBNRM
e. Conducting Public Educational Programme, Stakeholder Forum and media shows on mangrove conservation
f. Coordinating implementation of livelihoods/ sustainable community projects while special giving special focus on women

Information, education and communication materials (IEC) will be given to all stakeholders of the project. These materials will include T-shirts, maps, booklets, videos, posters, wall papers and power point presentation explaining coastal ecosystem management and mangrove protection. The project will also organize awareness raising and people participation on conservation of mangrove ecosystems as well as empowering the community to manage forest projects. Social media, radio and TV programs are to follow.

Component B: Mangrove restoration & coastal landscape protection

a. Conducting public consultation on Resource Mapping and Land Identification
b. Conducting Field Identification and Resource Mapping the Pathein University Park and community area boundaries.
c. Forming Village Development Committees on mangrove conservation and community projects to be conducted by local communities.
d. Policy guidelines and technical guidelines for mangrove conservation to be integrated
e. Regular drone monitoring to observe field activities, growth of plants and provide security.
f. Cooperating with Forest Department, local authorities and communities.
g. Set up permanent sample plots for the carbon monitoring

Figure 5: Planting of mangroves in the project area

Component C: Community development

a. Baseline survey of local community on their livelihood systems based on Sustainable Development Goals (SDGs)
b. Formulating potential Energy, Fishery and Agriculture practices for local community

c. Funding Micro-credit systems to improve local sustainable development
d. Developing Income Generation Activities (IGA) to secure local livelihood improvements

Component D: Project management, monitoring and evaluation

a. Day-to-day project management
b. Project operation supports for the field team with project planning
c. Producing Project Management Manual and technical guidelines
d. Conduct regular project Monitoring & Evaluation (M&E) programs based on the management plan
e. Provide yearly/monthly budgets, accounts and progress reports.
f. Carbon monitoring according to standard operating procedures on the permanent sample plots
g. Regularly monitoring growth of trees

Regarding component B Mangrove restoration & coastal green-belt protection, representing the 'carbon relevant' component of this holistic project approach, the standardized WIF approach includes the following steps:

1. Conducting socio-economic surveys with regular monitoring in the proposed area.
   WIF has collected baseline data from the communities in project areas by using questionnaire survey sheets. Survey questionnaires will include numbers of people in households; occupation, living condition, education level, income, fuel-wood consumption and commercial fish harvesting from streams, rivers and sea. Survey questionnaires will be combined statistically to monitor the current situation on livelihood standard of the community and natural resources condition.
2. Recording Mangrove ecosystems in the proposed areas, including mangrove forest species, edible plants, medicinal plants, birds, mammals, fish species
   Mangrove forest and its ecosystem are very important for the communities. The project will continue research to explore identification of important food species and introduction of salt resistant food crops, housing materials, livelihood creation, honey collection and marketing of foods and medicines. As part of livelihoods creation, the project will also continue its initial project for production of nypa mangrove palm sap as natural sweetener with conservation of nypa mangrove palms, as well as establishing an ice manufacturing plant to assist fishermen in preserving catches for better market prices, sea weed production, oyster culture and other aqua culture projects, virgin coconut oil production to better utilise coconut resources in the area, as well as expanding the first production centre of coloured textiles with natural mangrove colours. Production of bee honey from 4 of the mangrove species will provide livelihood for women bee honey production co-operatives. Other new livelihood ideas will come from regular interventions with local entrepreneurs and CBOs.
   These initiatives, in addition to community forest concept will create ownership and empower the communities to improve the future for all in a sustainable process with regular income from VCS based carbon trading to be managed by a development committee of elected community representatives.

3. Establishing a special unit in cooperation with Pathein University for following up the marine sanctuary in protection of sea grass, coral reefs, dugongs, sea turtles and other endangered species. To be coordinated with Regional Government, Ministry of Fisheries, Fishing community and the navy as the law enforcement entity. The first task in protecting/conserving the sea grass meadows is to stop any form for sea pollution at a time when the beaches is about to be fully developed with hotels and tourist activities. Protective rules to be legislated by the relevant authorities and demarcation of the areas to be completed before end of June 2017. WIF and Pathein University will undertake regular surveillance, observation and research on the marine environment to monitor and take timely action when needed. Without immediate action, it is a danger that the valuable sea grass meadows will be spoilt by uncontrolled activities, as have happened in other areas without proper environmental protection. Land erosion, dumping of plastic and other damaging materials as well as raw sewage from hotels will have a devastating effect on the vulnerable sea grass areas close to the hotel development projects.
4. Regularly monitoring activities and all conservation needs in the marine sanctuary by using boats, drones, satellite observation as well as regular scientific monitoring and research by Pathein University's Marine Science Department.
5. Introducing small scale renewable energy projects like mini windmills, kite energy units, bio gas and other renewable energy sources in addition to already established community energy forest projects.
6. Distributing solar lamps to all families with school going children to improve their learning capacity.
7. Formulating Small and Medium Enterprises (SME) through community energy forest (CF) establishment. The first *Glirisidia* test plantation was initiated in 2016.

   It is important for local people for long-term natural resources management to maintain mangrove forest for sustainability in combination with livelihoods programs based on available natural resources.
8. Skills training for local people to implement livelihood program and sharing of information is ongoing thereby promoting micro-economic zones in each village
9. Defining borders of proposed conservation of sea grass meadows (Research by Pathein University, Flora and Fauna International and Australia University in progress).

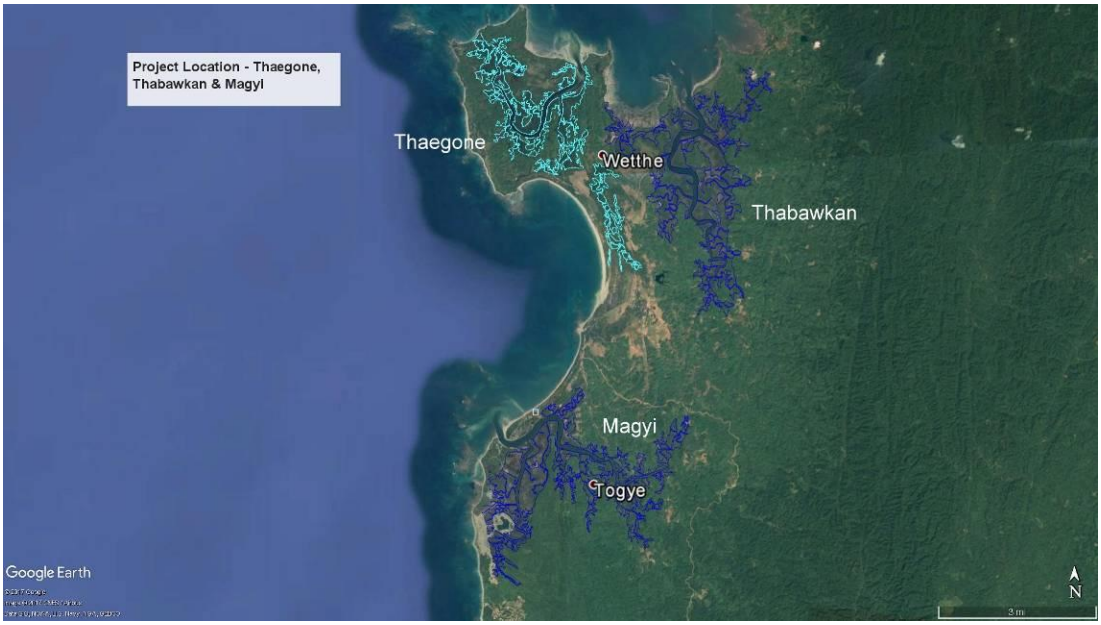
The project is not located within a jurisdiction covered by a jurisdictional REDD+ program.

1.9 Project Location

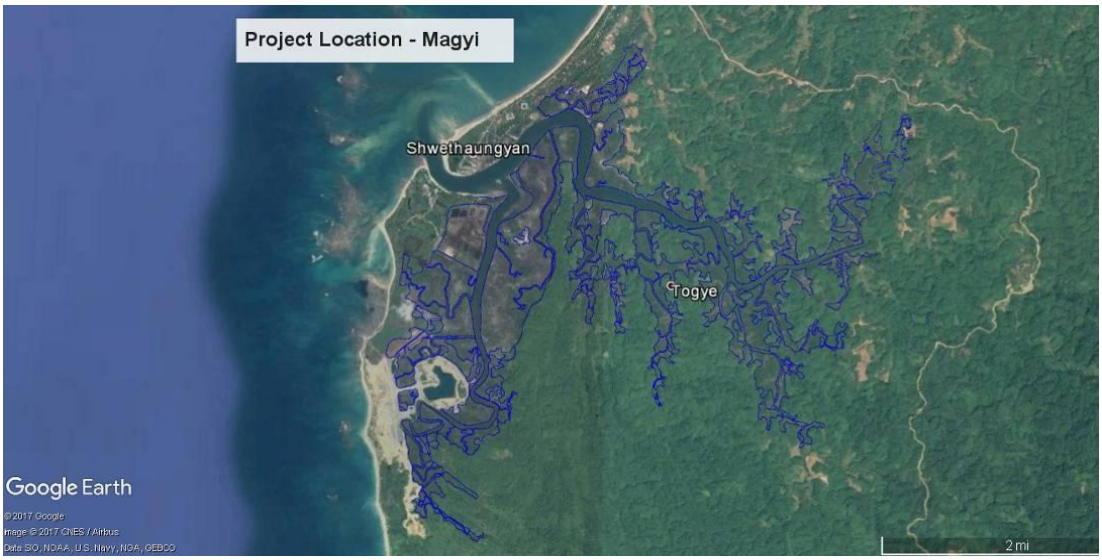
The project is implemented in three village tracts namely Magyi, Thabawkan and Thaegone in ShweThaung Yan Township. This is located in the Northern part of Ayeyarwady Division of Myanmar.

Map 1: Location of the project (Source: http://www.nationsonline.org/maps/myanmar_map.jpg)

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) or shape file (This document will be provided during validation)



Map 2: Project Location indicating Thaegone, Thabawkan and Magyi



Map 3: Project Location of Magyi

Map 4: Project Location indicating Thaegone and Thabawkan

1.10 Conditions Prior to Project Initiation

The vegetation on the project area is documented to be degraded and/or severely degraded mangroves that are below the threshold of the FAO forest definition. This has been identified during the baseline assessment and certified by the Regional Ministry of Natural Resources and Environmental Conservation. These lands have been subjected to continuous deforestation since the 1980s. According to National Biodiversity Strategy and Action Plan (2011), mangroves in Ayeyawaddy delta in 1924 was 253,018 hectares but as of 2001, it only remained 111,939 hectares. Over 1 million ha of mangrove forests in the country have been lost since 1980 (FAO and Myanmar Forest Department). According to the latest NASA (2014) report only 16% of mangrove forests are left in the Ayeyarwaddy Region by 2013. The study documents that the total mangrove extent in Ayeyarwaddy had been reduced from 81,800 hectares in the year 2000 to 46,200 hectares by 2013 losing over 36,500 hectares in just 13 years. This catastrophic development is also happening in neighboring Rakhine region which has lost 26,400 hectares of mangroves between 2000 and 2013.

These losses seen since 2000 were largely due to agricultural expansion, charcoal production with large scale deforestation (Giri et al. 2008 in NASA report, 2014). There was some evidence of mangrove clearing for aquaculture, but this was minor compared to the other two causes of disturbance. Myanmar has acknowledged the potential benefit of coastal mangroves, and has previously enacted legislation and set up mangrove plantations to attempt regrowth efforts.

Sit Bo (1992) reported a rapid deforestation rate of 7,775 ha per year in the Ayeyarwaddy delta (between 1984 – 1991) which was 3 times faster than any other forest lost in Myanmar. This study Ya Min Thant et al. 2012 mention that the main reason for this deforestation was due to production of charcoal for local consumption and supply for Yangon city. Other threats include increased population, conversion to paddy fields, fish and shrimp ponds and salt production areas. The practice of paddy cultivation in this area is of a shifting cultivation due to salt and acid sulphate intrusion. This intrusion results in lands unsuitable for paddy and the farmers have to move to a new area (Ya Min Thant et al. 2012).

Projections of the extent by 2030 by NASA indicate only 13,000 hectares of mangroves will be left in Ayeyarwaddy while 68,000 hectares will be left in Rakhine. The huge area of loss projected in the future for Myanmar's mangroves indicates an urgent need to address current methods of natural resource management and enforcement. Without a change in current practices and laws, mangroves are projected to be largely non-existent in the future, where large segments of Myanmar's population will be vulnerable to natural disasters and negative impacts on the local economy, side-effects of a major loss in mangroves. With projections indicating mangrove health and extent only to get worse, local community's economy will only suffer further as the abundance of local aquatic species decreases, environmental quality degrades, and as the risk of storm damage increases without the protective coastal barrier provided by mangroves.

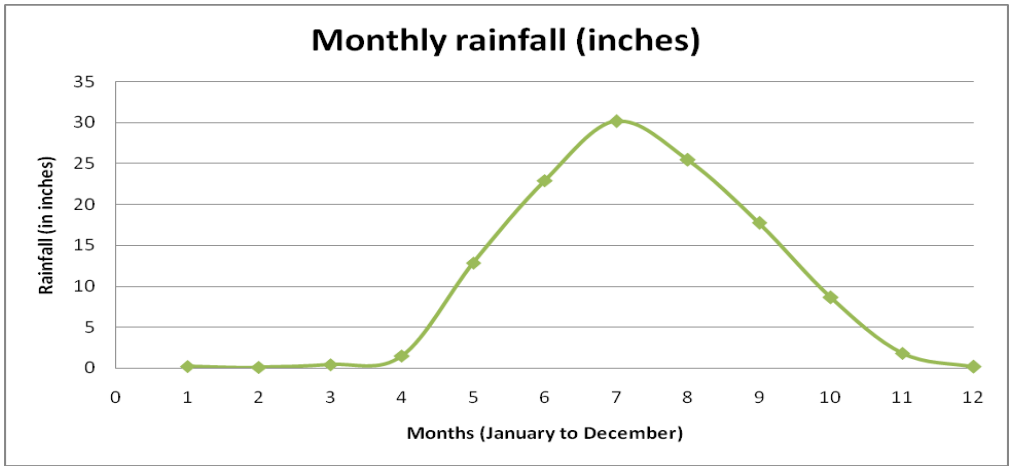
Figure 6: Conditions of the mangroves prior to the project initiation

The following is description about the climate, hydrology, topography, relevant historic conditions, soils, vegetation and ecosystems.

1. Climate

a. Precipitation

Most of the rain falls during the monsoons between mid-May and mid-November. It is cool and dry from mid-October to mid-February when temperatures begin to rise with pre-monsoon squalls in April and early May. Data from 2007-2016 indicate an annual rainfall of 3000 mm (122 inches) for the past 10 years. Results also indicate that the area has got approximately 130 days with rain per year.



Source: Department of Meteorology and Hydrology, Myanmar

Table 4: Monthly rainfall in Pathein area for the period of 2007-2016

Month	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches
January	0.0	1.1	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.2
February	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
March	0.0	0.0	0.0	0.0	3.4	0.2	0.0	0.0	0.7	0.4
April	0.0	5.4	3.1	0.0	4.3	0.0	0.0	0.0	2.2	0.0
May	17.0	31.2	9.6	8.9	7.8	4.0	14.3	3.4	15.7	16.6
June	18.2	23.0	23.4	14.4	20.7	31.6	15.8	20.6	31.0	30.7
July	37.2	27.3	39.2	15.1	28.7	32.3	34.2	27.7	34.3	26.1
August	24.0	15.2	22.3	19.7	19.2	43.8	20.1	32.3	18.7	39.1
September	21.0	11.2	25.1	19.8	20.3	16.4	15.6	25.5	9.7	12.9
October	10.9	4.6	13.2	11.3	4.2	5.6	7.7	6.7	8.8	13.3
November	3.5	2.4	3.9	0.2	0.0	0.0	0.4	5.6	0.0	2.5
December	0.0	0.0	0.0	0.5	1.3	0.0	0.0	0.0	0.0	0.0
Total	131.7	122.3	139.9	89.8	111.0	133.8	108.1	121.8	121.1	141.7

Source: Department of Meteorology and Hydrology, Myanmar

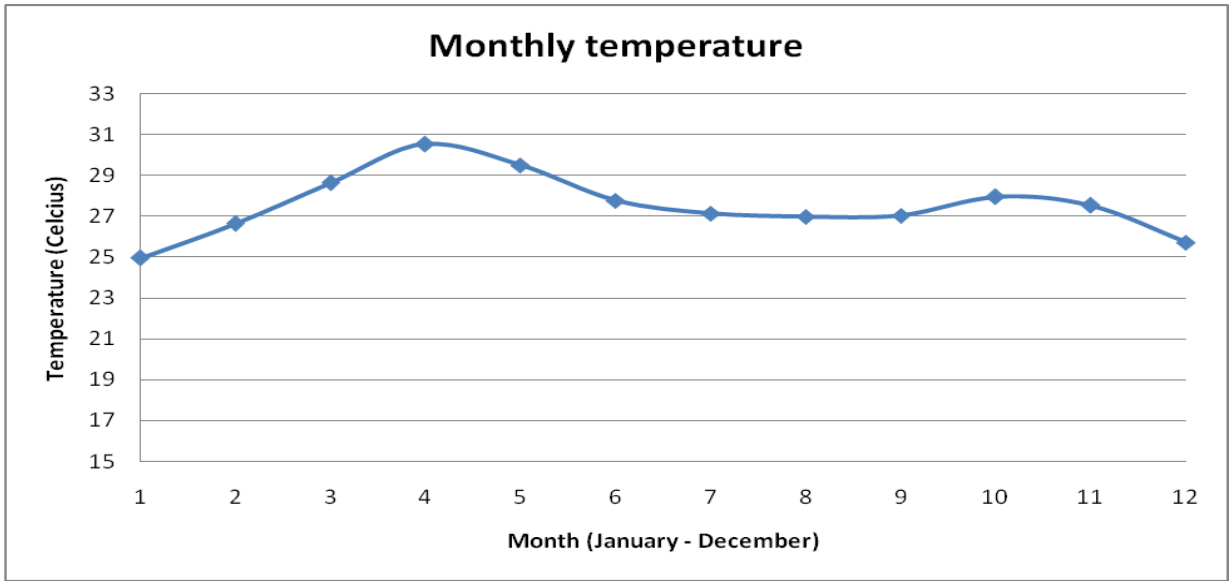
Table 5: Number of days with rain in the Pathein Area (2007-2016)

Month	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
January	0	1	0	0	2	-	0	0	0	1
February	0	1	0	0	-	-	0	0	0	0
March	0	0	0	0	2	1	0	0	1	1
April	0	6	5	0	4	-	0	0	2	0
May	17	20	8	10	19	8	13	10	12	13
June	26	17	22	20	25	26	22	22	28	23
July	24	27	28	21	28	29	29	27	28	22
August	24	22	24	23	28	26	22	22	28	23
September	21	19	24	22	22	24	20	26	21	25
October	13	10	19	20	11	10	11	20	14	20
November	8	2	3	1	-	-	1	6	0	4
December	0	0	0	1	3	-	-	0	0	0
Total	133	125	133	118	144	124	118	133	134	132

Source: Department of Meteorology and Hydrology, Myanmar

b. Temperature

Temperatures between years 2007-2016 is presented in following Table. The hottest year recorded was 2010 and the temperature recorded was 28.2 ^{0}C.



Source: Department of Meteorology and Hydrology, Myanmar

Table 6: Temperature of the area from 2007 - 2016

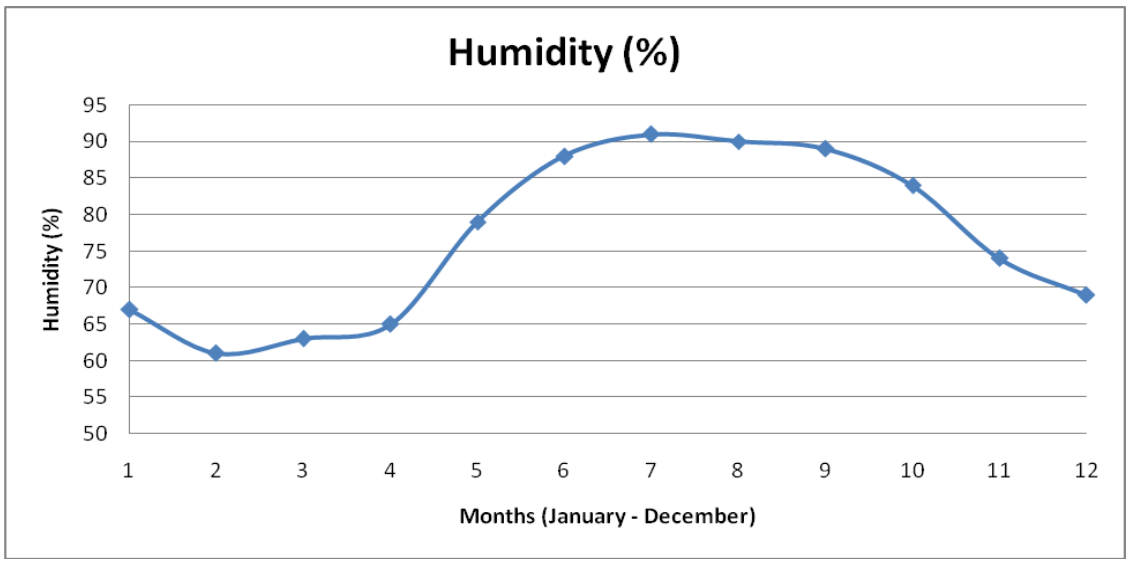
Month	2007		2008		2009		2010		2011	
	Max	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**
January	33.3	17.2	34.4	18.3	32.8	17.8	33.9	20.0	30.2	17.7
February	35.0	19.4	33.9	18.9	35.0	19.4	34.4	19.4	33.3	18.9
March	36.7	21.1	35.0	21.7	36.1	22.8	34.4	22.2	33.0	21.4
April	37.8	24.4	36.1	24.4	35.6	25.0	37.8	22.2	35.2	24.1
May	32.2	25.6	31.1	24.4	33.9	25.0	36.4	25.6	32.6	25.0
June	32.8	25.6	31.1	24.4	31.1	24.4	32.4	25.7	31.3	24.9
July	30.0	24.4	30.0	24.4	30.0	24.4	31.9	25.3	30.3	24.4
August	30.6	24.4	30.0	24.4	31.1	25.0	31.6	24.7	30.5	24.6
September	31.1	24.4	31.1	24.4	30.6	24.4	32.1	24.7	30.0	24.4
October	33.3	24.4	32.8	24.4	32.2	24.4	32.0	24.7	32.8	24.5
November	33.9	22.8	32.8	22.2	33.9	22.8	32.9	22.6	32.9	21.6
December	33.3	18.9	32.2	18.3	32.2	18.9	30.9	19.7	30.8	19.9
Mean	**33.3**	**22.7**	**32.5**	**22.5**	**32.9**	**22.9**	**33.4**	**23.1**	**31.9**	**22.6**

Month	2012		2013		2014		2015		2016	
	Max	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**
January	31.6	17.8	30.0	17.2	31.5	18.2	32.3	16.4	31.7	17.0
February	34.5	19.5	33.9	19.4	33.4	19.3	34.4	16.4	35.0	19.6
March	35.9	21.7	35.6	21.1	36.4	21.6	36.8	19.3	37.0	22.9
April	36.9	24.6	36.7	24.4	37.5	25.0	38.0	21.8	38.5	24.8
May	35.4	26.0	33.3	24.4	35.6	25.5	34.8	22.4	35.7	25.1
June	30.8	24.3	30.6	22.8	31.7	25.3	30.9	20.7	30.6	24.1
July	29.9	23.8	31.1	22.2	30.9	24.0	30.8	20.4	31.0	23.7
August	29.1	23.9	30.6	21.1	30.3	23.6	30.6	20.0	30.5	22.9
September	30.8	24.0	30.6	19.4	30.7	22.6	32.2	20.1	31.1	22.0
October	32.9	24.4	32.8	22.2	33.5	22.1	33.1	19.1	32.0	21.2
November	32.6	23.8	33.3	21.1	33.6	20.9	35.0	19.4	33.2	19.3
December	31.6	19.2	33.3	19.4	33.6	17.8	33.0	20.2	33.2	18.0
Mean	**32.7**	**22.8**	**32.7**	**21.2**	**33.2**	**22.2**	**33.5**	**19.7**	**33.3**	**21.7**

Source: Department of Meteorology and Hydrology, Myanmar

c. Humidity

Recorded average humidity in this area is about 77%. Highest humidity can be observed during July-August while lowest is recorded during February-March.



Source: timeanddate.com

2. Hydrology

The project area is classified as a wetland. The tide inundation has been estimated to be 1.5 – 2.33 meters per year. Fresh water coverage time is about 3-7 days 2-3 times during the monsoon period.

3. Soil

Soil texture in the project area can be classified as muddy-clay. The pH varies between 5.7 to 6.5. Sedimentation rate in the area has been calculated to be 0.01 – 0.02 meters per year.

Following table presents key environmental parameters assessed by the University of Pathein.

Table 7: Key environmental parameters in the project area

No.	Environmental Parameter Assessment	
	Impacts	**Level**
1	Sea level raising	No
2	Side sub dance	No
3	Precipitation	100 in - 150 in / year
4	Tide inundation	1.5 -2.33 meter/ year
5	Current speed	2.4 - 4.8 kilo / year
6	Soil texture	mud-clay
7	Soil salinity changes	25‰ - 35‰
8	Sea water salinity changes	20‰ - 32‰
9	Sea water salinity > 18 ‰	more than 18‰ per year
10	Soil *p*H changes	5.7 -6.5
11	Sedimentation rate in mangrove	0.01 - 0.02 meter / year
12	Red clay interfere	No

13	No_3 -N in soil	0.7 - 1.4 ppm
14	No_3 -N in sea water	0.5 - 0.9 ppm
15	Top thin aerobic layer changes	0.05 - 0.08 meter / year
16	Turbidity	2 - 3 meter in monsoon period
17	Transparency	4 - 5 meter in post monsoon
18	Fresh water coverage time	3 - 7 days / 2 - 3 time in monsoon period

(Source: Marine Science Department, University of Pathein)

4. Ecosystem

The vegetation type in this area is mangrove forests comprised of different mangrove species that has been subjected to heavy destruction due to charcoal production, agricultural practices, aquaculture, shrimp and fish ponds. This affected the characteristics of secondary habitats that have been cleared of the mangrove forests. Most of these lands are bare lands or degraded mangrove lands. Names of floral species found in the area are presented in the Baseline Study. The source of the ecosystem information was the baseline study conducted by a team from Forest Research Institute and the University of Pathein. The Regional Ministry of Natural Resources and Environmental Conservation have issued a letter stating the lands belonging to the project activity are severely degraded.

An important discovery during the assessment was the species *Bruguiera hainesii*. This is one of the two Critically Endangered mangrove species listed in the IUCN Red List of Threatened Species which has a very limited patchy distribution. Only recorded to be in Singapore, Malaysia, and Papua New Guinea the plants found within the project area will be given special care and protection in order to conserve this very important mangrove species.

Figure 7: *Bruguiera hainesii* found within the project area

During the assessment it was found that Magyi area has had four dominant mangroves species namely;

1) Bruguiera gymnorrhiza

2) Ceriops targal

3) Rhizophora apiculata
4) Ceriops decandra

Following species used to be associated mangrove species in the area:
1) Nypa fruticans
2) Xylocarpus granatum
3) Rhizophora mucronata
4) Bruguiera cylindrica
5) Lumnitzera littorea
6) Phoenix paludosa

During the assessment it was found that Thabawkan and Thaegone areas have had the following mangroves species as dominant in the area;
1) Bruguiera cylindrica
2) Lumnitzera racemosa
3) Rhizophora apiculata
4) *Ceriops tagal*
5) *Bruguiera gymnorrhiza*

The following species are also grown as associated mangrove species.
1) Nypa fruticans
2) Xylocarpus granatum
3) Rhizophora mucronata
4) Bruguiera cylindrical
5) Lumnitzera littorea
6) *Phoenix paludosa*

Figure 8: Baseline study conducted by WIF, University of Pathein and Forestry University students

1.11 Compliance with Laws, Statutes and Other Regulatory Frameworks

The project is in compliance with all laws and regulations of the country. Constitution of the Republic of the Union of Myanmar (2008) mentioned that "The Union shall protect and conserve natural environment" (in Article 45) and "Every citizen has the duty to assist the Union is carrying out the following matters; (a) preserving and safeguarding of cultural heritage; (b) Environmental conservation; (c) Striving for development of human resources; (d) protection and preservation of public property."(Article 390)

Myanmar is a Party to the following main Multilateral Environmental Agreements;

- Convention on Biological Diversity (CBD) and its Cartagena and Nagoya Protocols.
- United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol
- Vienna Convention on the Protection of the Ozone Layer,
- Montreal Protocol on Substance that Deplete the ozone Layer and its London, Copenhagen, Montreal and Behring Amendments;
- Convention on International Trade in Endangered Species of Wild Fauna and Flora, Washington, D.C, 1973 and their convention as amended in Bonn, 1979 (CITES)
- United Nations Convention to Combat Desertification (UNCCD);
- Stockholm Convention Persistent Organic Pollutants (POPs)
- Basel Convention on the control of Trans boundary Movements of Hazardous Wastes and their Disposal

Myanmar also submitted its new Climate Action Plan to the UN Framework Convention on Climate Change (UNFCCC) on September 2015. (Intended Nationally Determined Contribution-INDC)
The detailed Myanmar Laws and regulations to support the project activities are as follows:

- Forest Law (1992)[1]
- Protection Of Wildlife And Conservation Of Natural Areas Law (1994)[2]
- Myanmar Agenda 21 (1997)[3]
- Forestry Master Plan (2001-2030)[4]
- Environmental Conservation law (2012)[5]

The following policies were also assessed to confirm the project's compliance with laws and regulations of the country.

- National Land Use Policy (2006)[6]
- National Biodiversity Strategy and Action Plan 2015-2020 (2015)[7]
- National Adaptation Programme of Action to Climate Change (2012)[8]
- Myanmar Action Plan on Disaster Reduction 2012[9]
- National Sustainable Development Strategy (2009)[10]
- National Environmental Policy (1994)[11]
- Forest Policy (1995)[12]

[1] http://www.fao.org/faolex/results/details/en/c/LEX-FAOC003290/
[2] http://www.fao.org/faolex/results/details/en/c/LEX-FAOC139132/
[3] http://www.un.org/esa/agenda21/natlinfo/countr/myanmar/natur.htm
[4] http://www.fao.org/forestry/14871-095a15477c1192458cbb5d861551416d6.pdf
[5] http://www.fao.org/faolex/results/details/en/c/LEX-FAOC139025/
[6] http://www.fao.org/faolex/results/details/en/c/LEX-FAOC152783/
[7] http://www.fao.org/faolex/results/details/en/c/LEX-FAOC161482/
[8] http://www.fao.org/faolex/results/details/en/c/LEX-FAOC152937/
[9] http://www.fao.org/faolex/results/details/en/c/LEX-FAOC142708/
[10] http://www.fao.org/faolex/results/details/en/c/LEX-FAOC152933/
[11] http://www.forestlegality.org/risk-tool/country/myanmar

1.12 Ownership and Other Programs

1.12.1 Project Ownership

The lands under the project area are owned by the Regional Ministry of Natural Resources and Environmental Conservation. They have leased the lands in Magyi to Pathein University for a period of 30 years which can be renewed for a further period of 90 years. Similarly, lands in Thabawkan have been leased to the Village Tract Mangrove Conservation Committee and lands in Thaekone have been leased to the Village Tract Mangrove Conservation Committee. In each situation the periods is 30 years with the option of extending further 90 years and are in accordance with the Community based rights of the Forestry Law.

The project proponent, WIF is approved by Myanmar Ministry of Home Affairs as an international NGO.
It has a long term MOU for partnership with Myanmar Ministry of Natural Resources/Forest Department and Environmental Conservation, as well as Pathein University and village tract committees of Thabawkan and Thaekone to develop this ARR VCS project on these degraded lands.

1.12.2 Emissions Trading Programs and Other Binding Limits

The project is not included in any other emission trading program.

1.12.3 Other Forms of Environmental Credit

The project has not sought or not received any other form of GHG-related environmental credits.

1.12.4 Participation under Other GHG Programs

The project has not been registered nor seeking registration under any other GHG program.

1.12.5 Projects Rejected by Other GHG Programs

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

1.13 Additional Information Relevant to the Project

Eligibility Criteria

The project is not a grouped project

Leakage Management

Burning of any biomass within the project area is not a common practice under the pre-project scenario. Therefore under the project there will be no displacement of burning to any other

[12] http://www.burmalibrary.org/docs20/1995-Forest_Policy+1996-Forest_Policy_Statement-en-tu.pdf

location outside the boundary. There are no cows or any grazing that will be displaced outside the boundary.

Cutting of mangroves for charcoal production has been a practice under the pre-project scenario. Villagers who were involved in charcoal production are employed in the project thus they have agreed to stop the charcoal production (which will be monitored). The project has established mangrove protection and monitoring committees with the intention of monitoring any illegal activities within the project. These committees are responsible for routine check up for such deforestation and will report them as explained in the monitoring plan.

During the interview with former charcoal burners, they mentioned that they stopped charcoal production not only because lack of trees but also it only resulted in very low income. 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 5000/-, 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.The project has established mangrove protection and monitoring committees with the intention of monitoring any illegal activities within the project. These committees are responsible for routine check up for such deforestation and will report them as explained in the monitoring plan. In addition WIF have 4 forest guards and 2 project staff responsible for patrolling the project area. WIF, in consultation with the local people are developing alternative income generation activities that might interest them to take care of their livelihood.
The use of charcoal has been reduced due to increased use of gas among the upper and middle class, increasingly changing to use gas which is regarded as a better and cleaner way to cook food. There is no available statistics but energy consumption is not static and shifting over to gas.
Leakage management section has mentioned about recruiting former charcoal burners into the project thus in line with the Section 3.6 of AFOLU requirements, v 3.6 " Leakage mitigation activities may be supplemented by providing economic opportunities for local communities that encourage forest or wetland protection, such as employment as protected-area guards…."

There is no market leakage because the project does not reduce production of any commodity that causes a change in the supply and market demand. There is no activity shift leakage either since these charcoal burners have not moved their activity outside the project boundary. They have stopped their practice and joined the project as staff. There is no ecological leakage in the project since none of the project activity causes changes in GHG emissions or fluxes of GHG emissions from ecosystems that are hydrologically connected to the project area (As per section 4.6 of AFOLU requirements, v 3.6)

Commercially Sensitive Information

There is no commercially sensitive information.

Sustainable Development

A detailed description about the project's contribution towards sustainable development is presented in section 1.1 hence not repeated.

Further Information

All information are provided in each section with supporting evidence.

2 APPLICATION OF METHODOLOGY

2.1 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-CO_2 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)

2.2 Applicability of Methodology

The selected methodology AR-AM0014 Version 03.0 is applicable since the project meets the following conditions:

Condition 1: The land subject to the project activity is degraded mangrove habitat
Applicability:
According to the 2003 IPCC GPG LULUCF guidance wetland category includes land that is covered or saturated by water for all or part of the year and that does not fall into the forest land, cropland, grassland or settlements categories. The lands belonging to the project that will be planted or restored with mangroves are all inundated during high tide and are all influenced by ambient salinity; therefore all areas fall under the wetland category.

The lands belonging to the project have been subjected to deforestation in more than 20 years. Due to the degraded conditions the existing mangroves have been deteriorating that these are not in a condition to meet the forest definition. This has been certified by the Regional Ministry of Natural Resources and Environmental Conservation.

Condition 2: More than 90 per cent of the project area is planted with mangrove species. If more than 10 per cent of the project area is planted with non-mangrove species then the project activity does not lead

to alteration of hydrology of the project area and hydrology of connected up-gradient and down-gradient wetland area;

Applicability:
All the lands will be planted different species of mangroves. There will be no non-mangrove species used for the project. The species that will be used are; *Rhizophra mucronata, Rhizophora apiculata, Bruguiera gymnorrhiza, Bruguiera cylindrica, Bruguiera sexangula and Ceriops tagal*.

Condition 3: Soil disturbance attributable to the A/R clean development mechanism (CDM) project activity does not cover more than 10 per cent of area.
Applicability:
There will not be any harmful site preparation techniques such as chemical or aerial site preparation in this reforestation project activity. The planting is done manually and will consist in preparing a small hole for the roots of the seedling, respecting the complete structure of the soil. Hence applicability condition 3 has been met.

Condition 4: A project activity applying this methodology shall also comply with the applicability conditions

Applicability conditions of the tool: "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities" (Version 01)
a) Forestation of the land[13] within the proposed project boundary performed with or without being registered as the ARR CDM project activity shall not lead to violation of any applicable law even if the law is not enforced.
Justification - This project is in compliance with applicable laws and regulations requirements as outlined in section 1.11 hence has met with this applicability condition.

b) This tool is not applicable to small - scale afforestation and reforestation project activities.
Justification - "Small-scale afforestation and reforestation project activities under the CDM" are those that are expected to result in net anthropogenic greenhouse gas removals by sinks of less than 16 kilotonnes of CO_2 per year and are developed or implemented by low-income communities and individuals as determined by the host Party (9/CMP.3).

This grouped project will generate more than 16 kilotonnes of CO_2 per year, so it is not a small scale afforestation and reforestation project. Hence the project has met with this applicability condition.

Applicability conditions of the tool: "Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity" (Version 04.0)

a) The tool is applicable to all occurrence of fire within the project boundary.
b) Non-CO_2 GHG emissions resulting from any occurrence of fire within the project boundary shall be accounted for each incidence of fire which affects an area greater than the minimum threshold area reported by the host Party for the purpose of defining forest, provided that the accumulated area affected by such fires in a given year is ≥5% of the project area.

[13] In the context of this tool, forestation is used for the identification of possible land use scenarios that go beyond afforestation and reforestation as defined in the Marrakech Accords and includes the any establishment of forest through natural or artificial means.

Justification – Lands belonging to the project are covered with water and are subjected to low tide and high tide. These lands are degraded and below the forest definition. Burning is not practiced because of the wet condition and being not needed of such practice. Any debris during the site visits is left onsite since it will also provide nutrition to the new plants. Fire is also not a practice in these areas due to tidal conditions. Therefore this tool does not apply.

Applicability conditions of the tool: "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities" (Version 03.1)

This tool has no internal applicability conditions.

Applicability conditions of the tool: "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" (Version 04.2)

This tool has no internal applicability conditions.

Applicability conditions of the tool: "Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity" (Version 02.0)
a) This tool is not applicable if the displacement of agricultural activities is expected to cause, directly or indirectly, any drainage of wetlands or peat lands.
The lands belonging to the project are degraded lands which under the help of the project will be replanted and restored. The village tract committees and the University of Pathein agreed with the project objectives and activities by signing a legally binding MoU with the Project Proponent and are interested in the benefits derived from the combination of both activities. The project will not apply any activity that implies any drainage of wetlands or peat lands directly or indirectly.

Applicability conditions of the tool: "Calculation of the number of sample plots for measurements within A/R CDM project activities" (Version 2.1.0)

This tool has no internal applicability conditions

Applicability conditions of the tool: "Guideline for objective demonstration and assessment of barriers" (Version 01 EB-50)

This tool has no internal applicability conditions

Demonstrating Land Eligibility as per AFOLU Requirements Version 3.6

AFOLU Requirements Version 3.6 states that a project shall use an internationally accepted definition of forest, such as those based on UNFCCC host-country thresholds or FAO definitions. PP used the FAO definition which was also used by the Regional Ministry of Agriculture, Livestock, Natural Resources and Environment when assessing the lands belonging to the project area. According to the FAO definition – Forest is a land with tree crown cover of more than 10 percent and area of more than 0.5 hectares (ha). The trees should be able to reach a minimum height of 5 meters (m) at maturity *in situ*.

After the University of Pathein and two village tracts (Thaegone and Thabawkan) applied for land from the Government, the Ministry had to assess the land condition before giving the land. Based on their assessment the Ministry issued letters dated 17 May 2017 confirming that the lands belong to the project are below the Myanmar forest definition and are severely degraded.

Mangroves in Ayeyawaddy delta including the project site were exploited and subjected to continuous deforestation since the 1980s. According to the Regional Ministry of Natural Resources and Environmental Conservation these lands are unfertile or severely degraded lands on which neither mangroves will grow unless restored. Therefore it cannot be concluded that these lands will regain their original state if untouched. These lands have been degraded to the state that no natural regeneration is likely to occur. The Regional Ministry of Natural Resources and Environmental Conservation have issued a letter stating the lands belonging to the project activity are severely degraded. This complies with stage one of the tool and thus it have been further proven that the lands are not under any management to reverse the degradation. As a result of being underutilized there is no possibility of being temporarily unstocked as a result of any human intervention.

In addition to the Government issued certification letter, PP used LandSat images of 2013 to assess the landuse condition at the start date. Since clear images of 2014 were not available, PP had to use maps of 2013.

Since this project is a VCS project, the applicable condition was based on the AFOLU Requirements: Version 3.6. Section 3.1.6 of the document states “Activities that convert native ecosystems to generate GHG credits are not eligible under the VCS Program. Evidence shall be provided in the project description that any ARR, ALM, WRC or ACoGS project areas were not cleared of native ecosystems to create GHG credits (e.g., evidence indicating that clearing occurred due to natural disasters such as hurricanes or floods). Such proof is not required where such clearing or conversion took place at least 10 years prior to the proposed project start date.” Therefore the period of assessment was limited to 10 years prior to project start date as per VCS rules and regulations.

In addition to the letter provided by the Ministry confirming the no-forest criteria, PP used satellite images to further to prove no forest criteria. LandSat images of 2003 were used to assess the landuse condition 10 years prior the start date. Since clear images of 2004 were not available, PP had to use maps of 2003. These maps also proved that there were no forests before 10 years the project started and the land were degraded.

Interviews with local communities also evident that these areas were subjected to deforestation more than 10 years before the project start date. Reasons include charcoal production.

Section 3.1.7 of the document further state - Activities that drain native ecosystems or degrade hydrological functions to generate GHG credits are not eligible under the VCS Program. The natural hydrological functions (eg: tidal change in the area) are not altered. In fact the mangroves grow on a well balanced ecosystem with the tidal change therefore no such activities that drain the native ecosystem will be done. Hence the project is eligible under VCS program in terms of the Section 3.1.7.

2.3 Project Boundary

The boundary of the project was identified through a study done by the University of Pathein together with the Regional Ministry of Natural Resources and Environmental Conservation. The team have used maps and field visits to identify and demarcate the degraded mangrove areas against the non-mangrove areas. The project boundaries are recorded using a GPS and maps.

According to the AR Large-scale methodology (AR-AM0014) Afforestation and reforestation of degraded mangrove habitats Version 03.0 the project proponent has selected the following emission sources to be included and excluded from the project activity.

As mentioned before, there will not be any kind of site preparation during this project, not even fertilization or burning of pre-existing vegetation, therefore, the project does not lead to GHG emissions by sources. In the applied methodology the only source of project emission is biomass burning but as is shown in the following table and abovementioned this is not a source of emission in this project case.

Gases considered from emissions by sources other than resulting from changes in stocks in carbon pools

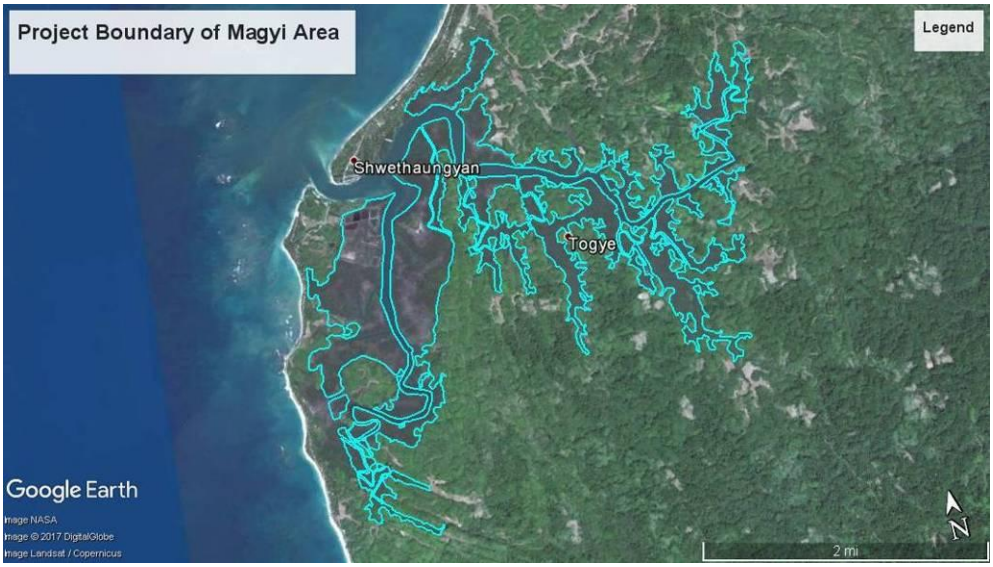
Source		Gas	Included?	Justification/Explanation
Baseline	Burning of woody biomass	CO_2	No	Burning of woody biomass within the project boundary was not a common practice
		CH_4	No	Burning of woody biomass within the project boundary was not a common practice
		N_2O	No	Burning of woody biomass within the project boundary was not a common practice
Project	Burning of woody biomass	CO_2	No	Burning of woody biomass is not done during site preparation or any other activity during the project
		CH_4	No	Burning of woody biomass is not done during site preparation or any other activity during the project
		N_2O	No	Burning of woody biomass is not done during site preparation or any other activity during the project

Baseline and project GHG removals by sinks

Carbon pool		Whether selected	Justification/Explanation
Baseline	Above-ground biomass	Yes	Major carbon pool subject to the project activity
	Below-ground biomass	Yes	Carbon stock in this pool is expected to increase due to the implementation of the ARR VCS project activity
	Litter	No	Litter biomass is subjected to high turnover and displacement due to tidal currents. It is a conservative choice to exclude the pool from accounting because the project activity will not decrease the rate of accumulation of the litter
	Deadwood	No	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
	Soil organic carbon	Yes	Even stock changes in SOC in the baseline are not expected, this carbon pool has been considered because project activity is expected to lead to an

Carbon pool		Whether selected	Justification/Explanation
			increase of SOC stock changes.
Project	Above-ground biomass	Yes	Major carbon pool subject to the project activity
	Below-ground biomass	Yes	Carbon stock in this pool is expected to increase due to the implementation of the ARR VCS project activity
	Litter	No	Litter biomass is subjected to high turnover and displacement due to tidal currents. It is a conservative choice to exclude the pool from accounting because the project activity will not decrease the rate of accumulation of the litter
	Deadwood	No	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
	Soil organic carbon	Yes	The methodology provides a conservative default approach to account for the increase in carbon stock in the soil organic carbon pool.

The following 3 maps present the project boundary of the project.



2.4 Baseline Scenario

Latest version of "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities" version 01 was used to identify the baseline scenario and demonstrate additionality in the project. Steps followed are presented in following paragraphs.

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

- The starting date of the project is 15th May 2015; therefore it was after 31 December 1999.

- Prior finalizing the project activities, WIF explored the potential of receiving carbon credits for the project in order to implement it. PP also had discussions with investors, in which there is sufficient evidence to demonstrate that the incentive from the planned use of 'carbon credits' was seriously considered in the decision to proceed with the project. Continuing and real actions were taken to secure carbon project status for the project in parallel with its implementation. The evidence to support this is the contracts between the financiers and the consultants to elaborate the project description documents.

Important events in project development

Date	Key event related to VCS	Key event related to project implementation
April 21st 2014	Board of WIF decided to explore carbon funding in order to continue the initial project idea and develop a long-term sustainable model	
December 22nd 2014	Air Mandalay agreed to invest in the project pending VCS registration	
January 15th 2015	Letten Foundation inform WIF that they will not continue funding after June 2015.	
January 15th 2015	Starboard Co Ltd willing to fund the project provided carbon credits are generated.	
January - February 2015	Bio8 willing to fund the project as a carbon financing project	
March 2015		Socioeconomic Survey Report on Shwethaungyan sub-Township
April 2015		Forest Inventory and Survey Report on Shwethaungyan/ Magyi area
April 2015		Conducting soil carbon analysis to calculate the soil organic carbon content.
May 15th 2015		With the commitments from carbon financiers assured, WIF begin the project with an internal loan to be settled after agreements signed with funders. Land clearing started
June 15th 2015		Planting of mangroves started
July 7th 2015	Rector of Pathein University gives consent to sell the carbon credits.	
August 24th 2015		Contacting Thaegone Village tract for establishing Environment and Mangrove Conservation Committee
September 15th 2015	Bio8 sign contract with WIF for carbon financing based on the initial mutual agreement in January 2015	
December 21st 2015	Board decided to include degraded lands	

	from Thaegone and Thabawkan into the project and instructed the team to explore suitable land	
May 2016		Forest Inventory and Survey Report on Thaegone and Thabotkan area.
July 8th 2016		Contacting Thabawkan Village tract for establishing Environment and Mangrove Conservation Committee
August 3rd 2016	Contacting the Validator	
December 2016		Socio economic Survey - Thaegone
January 2017	Pre-validation visit by the validator	
February 2017		Socio economic Survey - Thabawkan
June 2017	Listing the VCS PD under VCS Pipeline	
August 2017	Validation visit by the validator	

STEP 1: Identification of alternative land use scenarios to the proposed A/R CDM project activity

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

The following alternative land use scenarios have been identified as the plausible land use scenarios for the proposed ARR VCS project;

1. Continuation of the pre-project land use which is the degraded and abandoned lands

2. Mangrove reforestation & restoration of the land within the project boundary performed without being registered as a VCS ARR project

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

Following laws and regulations were checked for any statement prohibiting alternative 1 and 2.

- Forest Law (1992)
- Protection Of Wildlife And Conservation Of Natural Areas Law (1994)
- Myanmar Agenda 21 (1997)
- Forestry Master Plan (2001-2030)
- Environmental Conservation law (2012)

The following policies were also assessed to confirm that alternative 1 and 2 are consistent with applicable policies.

- National Land Use Policy (2006)
- National Biodiversity Strategy and Action Plan 2015-2020 (2015)
- National Adaptation Programme of Action to Climate Change (2012)
- Myanmar Action Plan on Disaster Reduction 2012
- National Sustainable Development Strategy (2009)
- National Environmental Policy (1994)
- Forest Policy (1995)

It was found that both alternatives were in compliance with the legal and regulatory requirements.

Outcome of Sub-step 1b: The following are the plausible alternative land uses to the VCS ARR project activity which are in compliance with all applicable legal and regulatory requirements of Myanmar.
Alternative 1: Continuation of the pre-project land use which is the degraded and abandoned lands

Alternative 2: Mangrove reforestation & restoration of the land within the project boundary performed without being registered as a VCS ARR project

STEP 2. Barrier analysis
Sub-step 2a. Identification of barriers that would prevent the implementation of at least one alternative land use scenarios

This project has taken a pioneering step in reforesting and restoring degraded mangrove areas which could be replicated across the world where almost everywhere mangroves face the threat of degradation and deforestation. The Board of WIF decided to go ahead with the project implementation based on an innovative and socially just model which not only encourages sustainable development but also contribute immensely towards research on these vital ecosystems. The Board has accepted the extraordinary costs trusting in successful registration as a VCS ARR project. The project activity faces following barriers that prevent the implementation of the activities. 'Continuation of the abandoned and degraded land use with no project activity' does not face any of the following barriers.

The barriers included are:

- Investment barriers, other than insufficient financial returns
- Technological barriers;

Investment barriers, other than insufficient financial returns
The objective of the project is to establish and maintain a sustainably managed mangrove ecosystem for carbon sequestration, natural disaster risk reduction, poverty reduction with sustainable livelihoods in the coastal communities. However no direct income is expected from the mangrove forests and the wood is not harvested. Therefore no timber production is planned and the benefits are of indirect or long-term nature. There is neither credit nor credit funding for this type of non-profitable activities. This reforestation and restoration is only possible because of the VCS benefits that project provides.

Worldview International Foundation is an international non-government organization (non-profit) and other partners involved are the University of Pathein and local communities from three village tracts. WIF was established in 1979 and have been involved in projects in various issues: communication, health, agriculture and food security, environment, education, democracy and human rights. Worldview has worked in close cooperation with UN Agencies and other international and national partners.

Their mission is

a. Environmental and Biodiversity protection by teaching and training at grass root level
b. Provision of sustainable alternate income for the poor and
c. Working closely with the Governments and universities to develop policies and research initiatives for sustainable development

WIF has demonstrated capacity in environmental conservation, awareness and in mobilizing local communities. The University has also the capacity to involve in mangrove reforestation but lack the necessary funding for this kind of projects since Pathein University is a government university and not a investor. Local communities also lack the financial strength to initiate this project due to their poor living standards. Even though WIF and its partners lack the financial strength to implement this project, Bio8

confirmed their funding in early 2015 hence WIF decided to start planting even before the contract was signed. WIF granting an internal loan only for the initial planting was later settled once the agreement was signed in September 2015.
Analysing past or ongoing restoration activities, similar mangrove reforestation projects have only been implemented with grants or other non-commercial finance terms (Government funds). Myanmar Government (Forest Department) has reforested mangroves mainly in Bogalay, Laputta and Pyarpon townships. Between the period of 2008-2016 an area of 1,943 ha have been planted in Bogalay (242 ha/year) while an area of 1,781 ha have been planted in Laputta (222 ha/year). An area of 951 ha have been planted in Pyarpon between the period 2009-2016 (136 ha/year). The local NGO, Mangrove Service Network (MSN) has established around 575 ha of mangroves over the period of 2013-2017 with the funding from POSCO DAEWOO in Rakhine State (115 ha planting per year). Another local NGO, Forest Resource Environment Development and Conservation Association (FREDA) has planted 2,940 ha of mangroves in Pyarpon Township (Ayeyarwaddy Region) over a period of 20 years (147 ha planting per year) funded by different agencies. In the past the planting of mangroves have been less than 150 ha per year by any NGO due to different constraints.

The WIF Board only approved the project since it was assured by the carbon investors about potential financial support through carbon revenue. Unless carbon financing is available, this kind of a project is not sustainable in the long run. This is further sustained by the fact that Co-Operative Bank Ltd of Myanmar rejected another loan application by PP for the continuation of the project. Reasons include the risk of the nature of the project and not availability of any assets for the particular project.

As explained above, mangrove restoration has been done only by the Myanmar Government (Forest Department) and a few NGOs with grants but the management of plantings may fail due to financing and capacity deficits. According to Government statistics more than 100,000 ha have been cultivated by the Government but NASA studies identified only 46,200 ha of mangroves were left in 2013. It is therefore evident that these cultivation efforts have not been successful in increasing the mangrove forest cover in the area. The majority of attempts simply involved planting but there have been practical difficulties in maintaining in the long run and protect the mangroves from external threats due to lack of effective management practices.
Therefore alternative 2: Mangrove reforestation & restoration of the land within the project boundary performed without being registered as a VCS ARR project faces investment barriers. Alternative 1: Continuation of the pre-project land use which is the degraded and abandoned lands does not face this barrier since no investment is needed for alternative 1.

Technological barriers
Nature of the organizations involved are explained in the above section. None of these organizations or parties have prior experience in similar VCS projects in any other locations. Alternative 2: Mangrove reforestation & restoration of the land within the project boundary performed without being registered as a VCS ARR project requires 9.1 million plants to reforest and restore 2146.48 hectares of land. It has been evident that this amount of seeds is not available in the area. Therefore the seeds are bought from the Gwa Township in Rakhine, which is the former Mangrove Rehabilitation and community development project area. The best transportation method for seeds is by boat which takes 7-8 hours per trip which involves higher costs than time consuming Therefore alternative 1 is lacking the necessary planting materials for the project implementation.

Most of the previously implemented projects have failed in part due to a lack of technological assistance. The proposed project will only be possible due to a combination of factors, including infrastructure,

logistics, awareness expertise, experience in working with the local communities, and the knowhow of WIF and the University supported by VCS credits. Although the local communities are interested in planting mangroves, there is a lack of sufficient access to technical and organizational support without carbon credits. With the increasing population and demand for more economic welfare local communities are compelled to earn money to survive. The proposed project is a first attempt in the region to include the communities in mangrove replanting and restoration while enhancing their livelihoods. So far almost all previous mangrove projects have had little stake in its activities apart from wage income. Therefore at the beginning, the absorptive capacity of local communities to conduct this activity has been identified as a barrier in the region. The working model that WIF is proposing this the project comprises of 4 main components (as described under Section 1.8) that addresses socio-economic and environmental aspects in a holistic way.

There are no organizations that have the strength and capacity to involve a group of villagers for such planting activity. The proposed project has created village committees in two village tracts for this project and also micro-credits systems and income generation activities but need the support from VCS credits to implement these activities. Since this will be the first project for WIF related to mangrove restoration via carbon financing, an extra cost will arise for the project implementation.

Therefore alternative 2 faces with technological barriers while alternative 1 does not need such technology hence do not face any barriers.

The table below displays the barrier analysis matrix which identifies alternatives and barriers. A more complete discussion of the barriers follows

Alternative land use scenarios	Investment	Technological
Continuation of the pre-project land use which is the degraded and abandoned lands		
Mangrove reforestation & restoration of the land within the project boundary performed without being registered as a VCS ARR project	X	X

Outcome of Sub-step 2b: The land use types that are not prevented by any barriers are as follows.
Alternative 1: Continuation of the pre-project land use which is the degraded and abandoned lands

Sub-step 2c. Determination of baseline scenario The following decision tree was applied to the outcome of sub-step 2b.

Is forestation without being registered as an A/R CDM project activity included in the list of land use scenarios that are not prevented by any barrier?
→ If yes, then:
Does the list contain only one land use scenario?
→ *If yes, then the proposed A/R CDM project activity is not additional.*
→ If no, then continue with Step 3: Investment analysis.
→ If no, then:
Does the list contain only one land use scenario?

→ If yes, then the remaining land use is the baseline scenario. Continue with Step 4: Common practice test

→ If no, then through qualitative analysis, assess the removals by sinks for each scenario and select one of the following options:

Option 1: Baseline scenario is the land use scenario that allows for the highest baseline GHG removals by sinks. Continue with Step 4: Common practice test, .

Option 2: Continue with Step 3: Investment analysis.

Since Mangrove reforestation & restoration of the land within the project boundary performed without being registered as a VCS ARR project and the list of sub-step 2b contain only one land use scenario, the remaining land use is the baseline scenario. Therefore the baseline scenario is: Continuation of the pre-project land use which is the degraded and abandoned lands. The Decision Tree allows continuing with Step 4: Common practice analysis.

STEP 4: Common practice analysis

The geographical region considered for the following comparison of the proposed ARR VCS project and other project activities was Myanmar. There are presently no registered ARR VCS or any other forest carbon project (AR CDM etc) in Myanmar. Mangroves are not established as a commercial plantation or as any industry in the country and also have to overcome many issues that hinder the development of the forestry sector.

Out of the forest areas only 4% comprise of mangrove forests in Myanmar. Although the mangroves in Myanmar including those in Ayarwaddy area and Rakhine State are destroying at an alarming rate, no systematic planting or restoration efforts are underway that will ensure creation of mangrove forests.

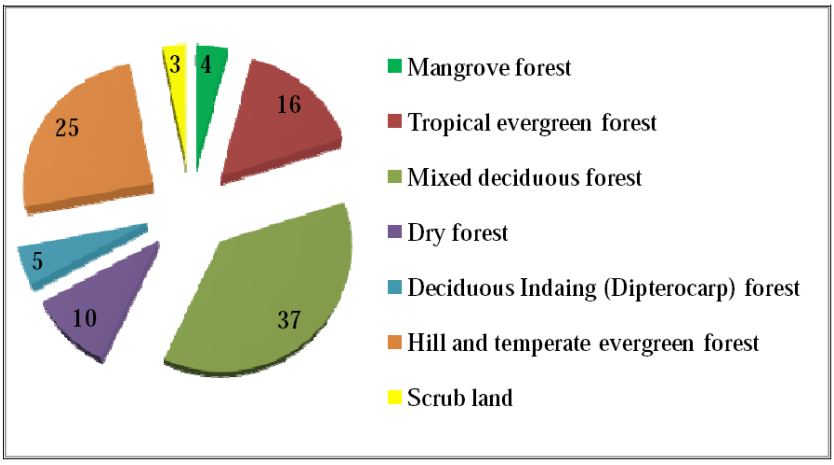


Figure 8: Forest Area by forest types of Myanmar (% of total forest area)
(Source: Remote Sensing and GIS Section, Planning and Statistic Division, FD 2011)

The Government of Myanmar also have identified the importance of mangrove forests but it's effort to reforest have faced number of constraints including financial support and maintaining the established plantations. Even though the National Sustainable Development Strategy for Myanmar (2009) has identified rehabilitating degraded mangrove forests in Ayeyarwady Delta, Rakhine State and Tanintharyi Division as a key objective, it does not specify an ambitious plan with clear goals and targets.

Analysing past or ongoing restoration activities, most efforts by the Government (Forest Department) are concentrated in Bogalay, Laputta and Pyarpon townships. Between the period of 2008-2016 an area of 1,943 ha have been planted in Bogalay (242 ha/year) while an area of 1,781 ha have been planted in Laputta (222 ha/year). An area of 951 ha have been planted in Pyarpon between the period 2009-2016 (136 ha/year). However the percentage of survival is not documented and the destruction due to natural and anthropogenic activities is not followed up.

The local NGO, Mangrove Service Network (MSN) has established around 575 ha of mangroves over the period of 2013-2017 with the funding from POSCO DAEWOO in Rakhine State (115 ha planting per year). Another local NGO, Forest Resource Environment Development and Conservation Association (FREDA) has planted 2,940 ha of mangroves in Pyarpon Township (Ayeyarwaddy Region) over a period of 20 years (147 ha planting per year) funded by different agencies. In the past the planting of mangroves have been less than 150 ha per year by any NGO due to different constraints.

Table 8: Area of planting by FREDA during 1999 - 2018

no	Duration	Area (ha)	Funded by
1	1999 - 2018	2550	ACTMANG
2	2011 - 2016	300	EED
3	2008 - 2016	30	Lion Club
4	2011	24	MERN
5	2008	20	DKH
6	2010	16	Postal

The following graph presents the destruction of mangroves from 1924-2001.

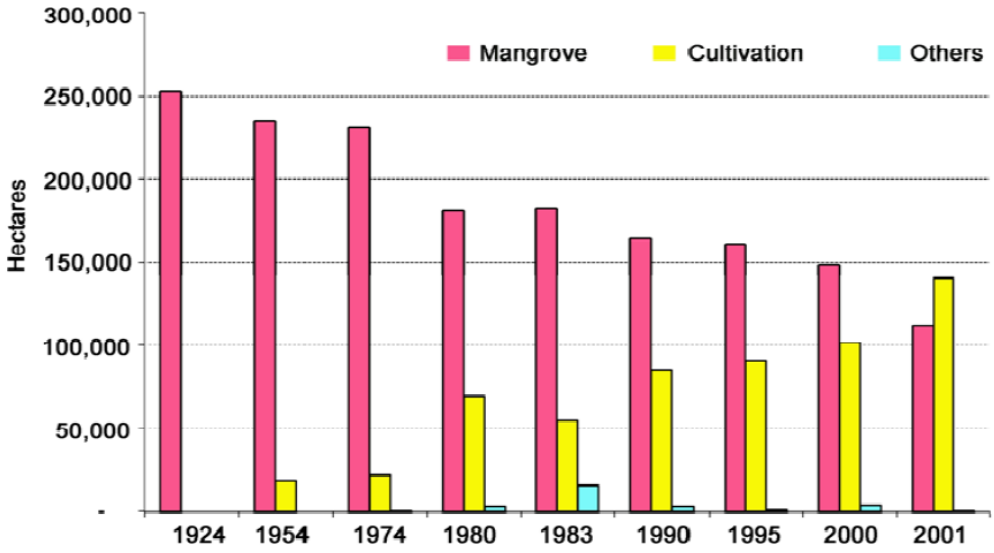


Figure 9: Mangrove deforestation and cultivation in Ayarwaddy delta)
(Source: National Biodiversity Strategy and Action Plan, 2011)

Although the above action plan state that more than 100,000 ha has been cultivated by the Government, NASA studies identified only 46,200 ha of mangroves were left in 2013. It is therefore evident that these cultivation efforts have not been successful in increasing the mangrove forest cover in the area. The

majority of attempts simply involved planting but there have been practical difficulties in maintaining in the long run and protect the mangroves from external threats due to lack of effective management practices. Typically, attempts at mangrove restoration fail for several reasons:

- Land tenure and ownership issues make it difficult to restore mangroves back where they belong.
- Lack of understanding of the ecological requirements of mangroves, and the ecological and water processes that promote their establishment and early growth
- Lack of financial incentives to maintain them and protect from external threats in the long-run coupled with lack of support from local communities
- Unable to effectively address the drivers of deforestation and mangrove degradation

By analyzing the situation of forestation activities in Myanmar, it is clear that the proposed ARR VCS project is not similar to other mangrove planting activities in the country. This project has unique characteristics and also faces barriers mentioned in the Barrier Analysis. Due to the conditions in the area in terms of degraded land condition, lack of local experience in mangrove reforestation activities, particularly in forms which are economically, socially and politically sustainable, the project proponent committed itself to this investment trusting in a supplementary cash flow from VCS registration. This has proven even more vital than originally believed as the lack of experience in mangrove reforestation investments has proven to have repercussions also in the financial sector as it does not give any financial return as a commercially valuable species yet is vital for a healthy coastal ecosystem.

Traditional plantation models based on concessions which involve transfer of ownership have proven socially, politically and environmentally unsustainable. Therefore the project proponent has realized that a sustainable model that minimizes the political risk of the investment needs a strong element of corporate social responsibility and has to respect traditional rights of land ownership. This has caused the project proponent to design and implement activities in social and legal terms resulting in extraordinary costs of this pioneer project.

When analyzing the history of mangrove restoration in the project area, there have been neither such activities implemented either by the Government nor any other NGO. Although the area has an important biodiversity value the outside threats to the mangroves and its nearby sea-grass areas have been increasing. The following two images compare the same land area in year 2010 and 2015. It clearly shows how the lands are being used for development activities thus creating a threat to the coastal ecosystem.

Figure 10: Maps of 2010 and 2015 comparing the land-use change

In most of other reforestation projects where incase the funding is ended, the project will end or halt due to lack of funding to continue. Since the proposed project will be developed as a ARR VCS project, the sale of credits will ensure long-term funding is flowing in the project in order to motivate all parties to continue the project. This is another distinctive feature of the proposed project compared to other reforestation projects in the country.

PP has used the "Guideline for objective demonstration and assessment of barriers, version 01 EB-50 to demonstrate barriers. One notable point is that Myanmar being a least developed country (LDC) has constraints in obtaining data hence the guideline states it is sufficient to transparently describe each barrier.

In summary, current and expected planting and/or restoration efforts in the absence of this project are not significant. As outlined above in the barrier analysis, one of the most important barriers is the knowledge and capacity to successfully establish and maintain site-adapted plantations as well as engage communities in sustainable mangrove restoration which will sustain and will grow into mature mangrove forests.

Outcome: The proposed project activity is not the baseline scenario and, hence, it is additional.

2.5 Additionality

Demonstration and assessment of additionality has been done in section 2.4. using the "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities" version 01, as it is required in the selected methodology.

2.6 Methodology Deviations

There are no methodology deviations.

3 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

3.1 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:

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

Where

$\Delta C_{BSL,t}$	=	Baseline net GHG removals by sinks in year *t*; t CO_2-e
$\Delta C_{TREE\_BSL,t}$	=	Change in carbon stock in baseline tree biomass within the project boundary in year *t*, as estimated in the tool “Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities”; t CO_2-e
$\Delta C_{SHRUB\_BSL,t}$	=	Change in carbon stock in baseline shrub biomass within the project boundary, in year *t*, as estimated in the tool “Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities”; t CO_2-e
$\Delta C_{DW\_BSL,t}$	=	Change in carbon stock in baseline dead wood biomass within the project boundary, in year *t*, as estimated in the tool “Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities” ; t CO_2-e

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 landuse 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

Severely degraded mangrove areas, bare lands, abandoned shrimp pond areas and shallow water areas will be replanted with a density of 5000 plants per hectare. Degraded mangrove areas will be restored using approximately 2000 plants per hectare since there are mangrove plants which fall below the forest threshold but still remain as plants. 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.

Figure 11: Landuse map of Magyi area

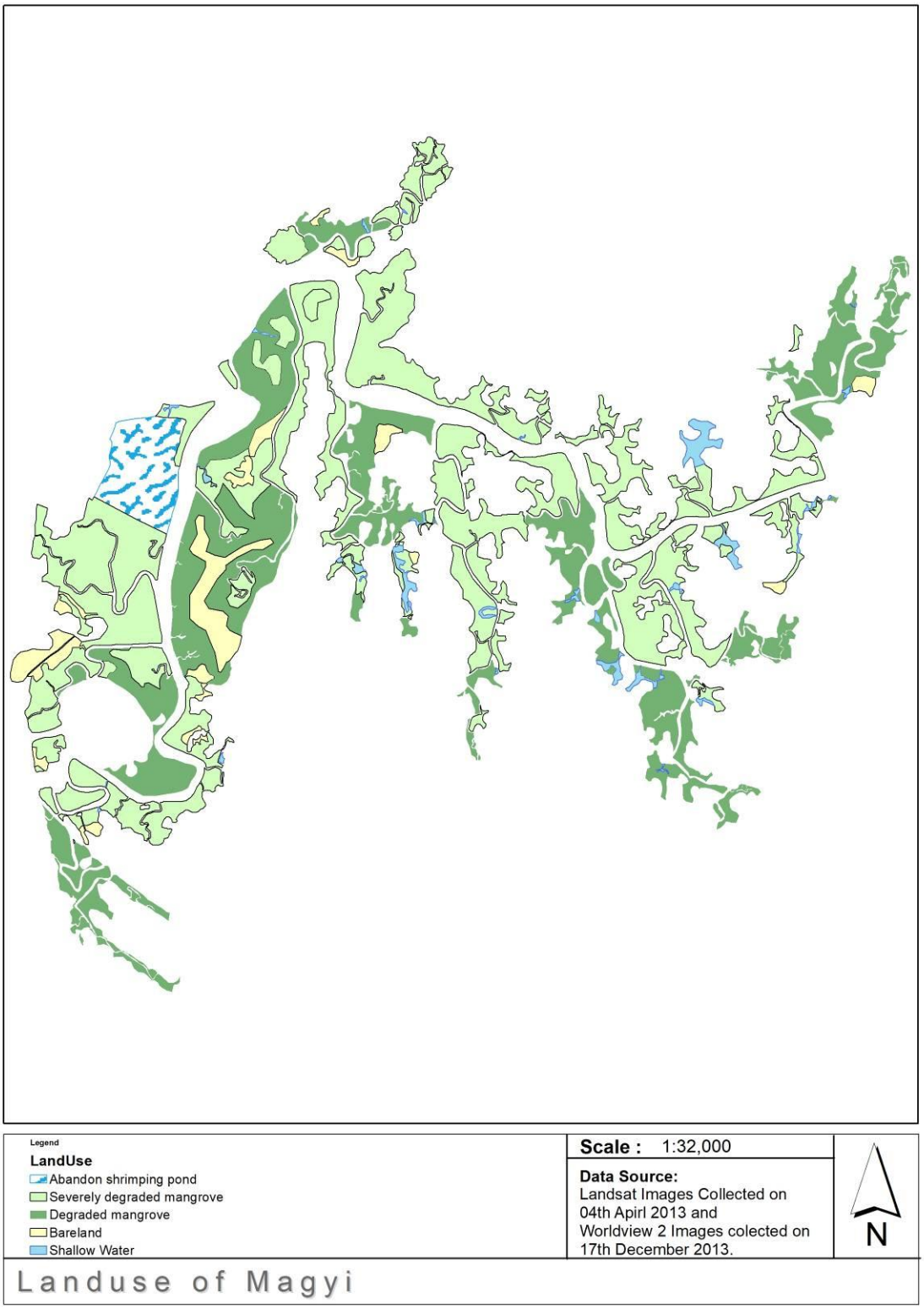


Figure 12: Landuse map of Thabawkan area

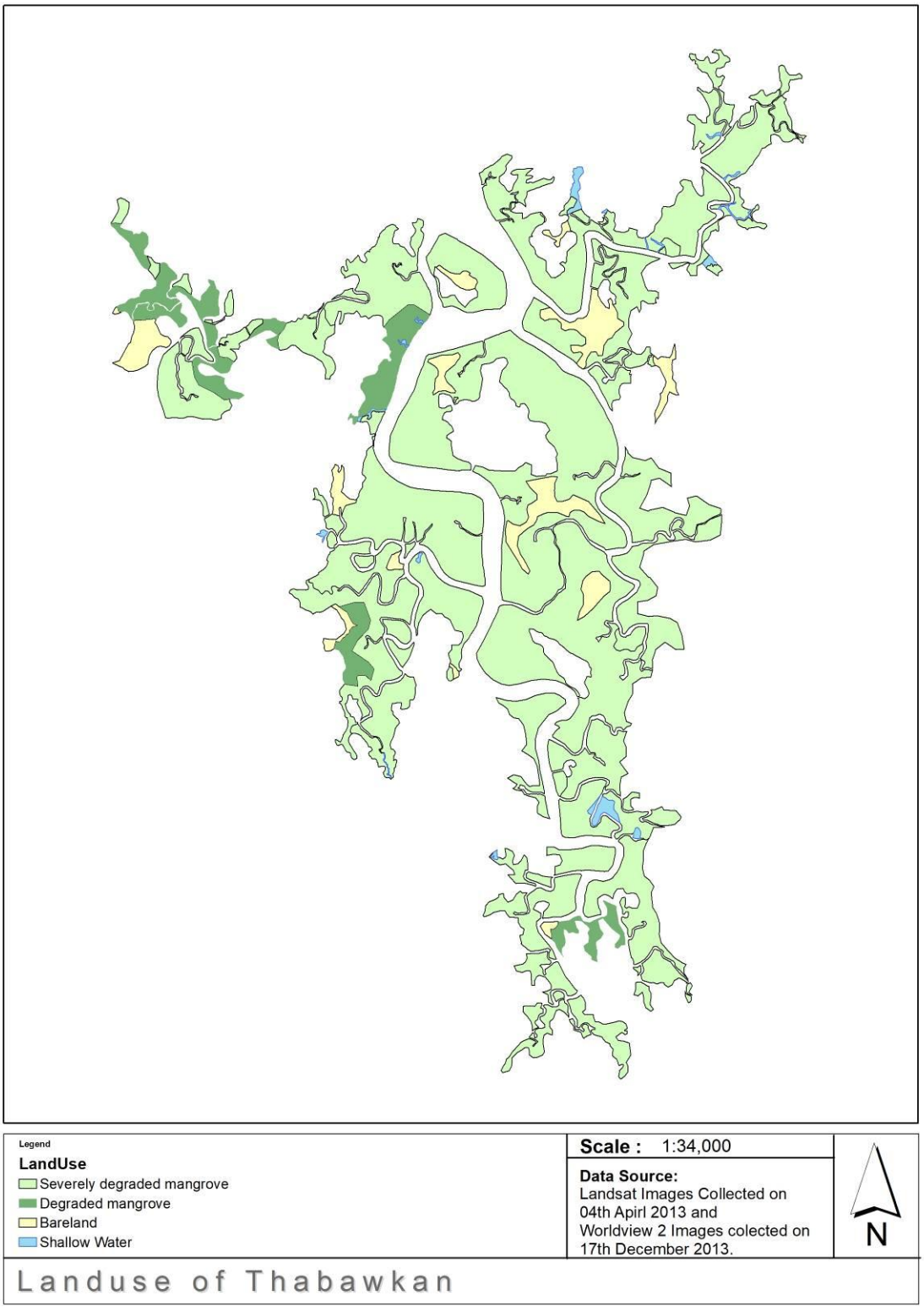
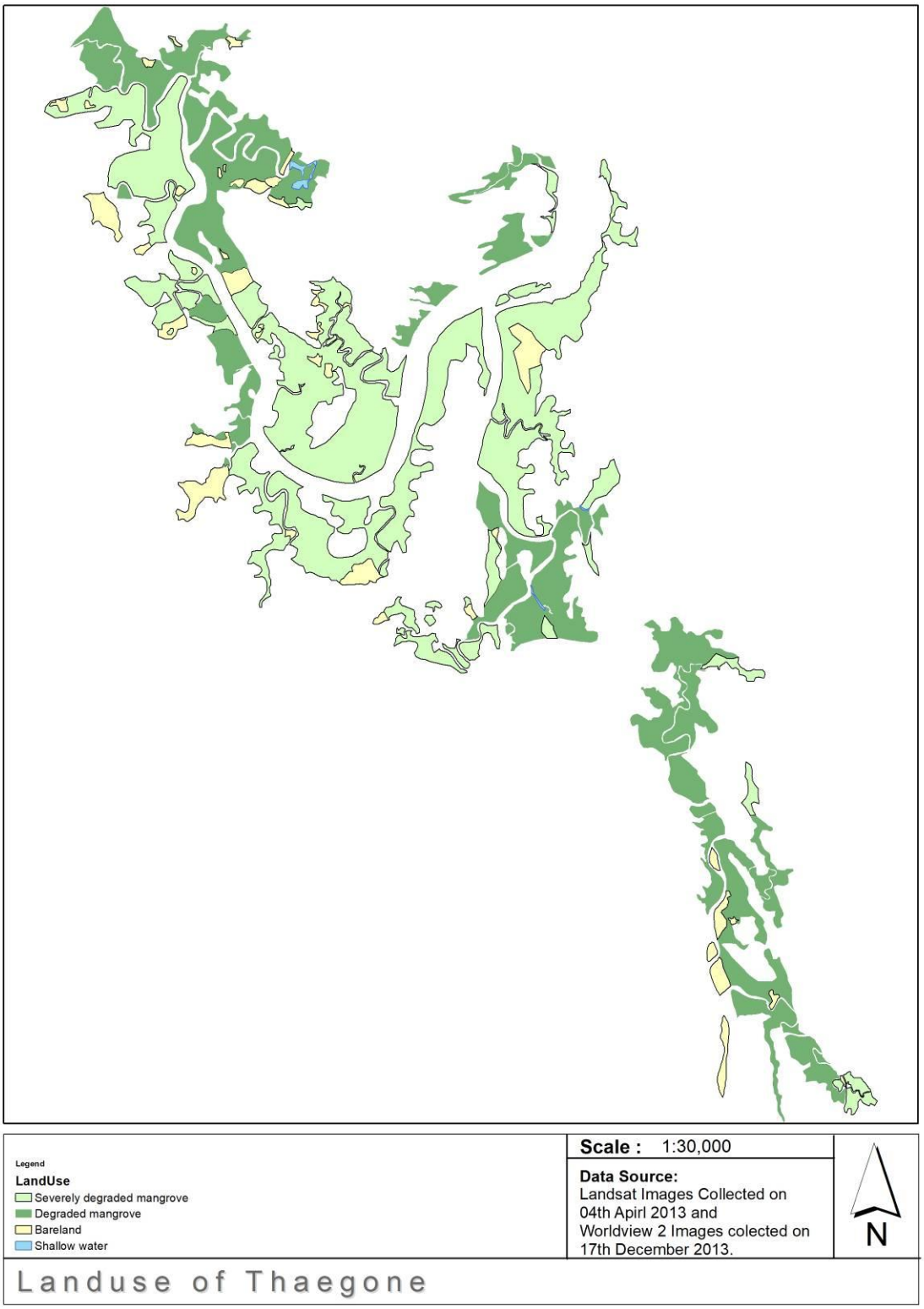


Figure 13: Landuse map of Thaegone area



3.2 Project Emissions

The ex-ante actual net GHG removals by sinks 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:

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

Where:

$\Delta C_{ACTUAL,t}$	=	Actual net GHG removals by sinks, in year *t*; t CO_2-e
$\Delta C_{P,t}$	=	Change in the carbon stocks in project, occurring in the selected carbon pools, in year *t*; t CO_2-e
$GHG_{E,t}$	=	Increase in non-CO_2 GHG emissions within the project boundary as a result of the implementation of the A/R CDM project activity, in year *t*, as estimated in the tool "Estimation of non-CO_2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity"; t CO_2-e

Change in the carbon stocks in project, occurring in the selected carbon pools in year *t* were calculated as follows:

$$\Delta C_{P,t} = \Delta C_{TREE\_PROJ,t} + \Delta C_{SHRUB\_PROJ,t} + \Delta C_{DW\_PROJ,t} + \Delta SOC_{PROJ,t}$$

Where:

$\Delta C_{P,t}$	=	Change in the carbon stocks in project, occurring in the selected carbon pools, in year *t*; t CO_2-e
$\Delta C_{TREE\_PROJ,t}$	=	Change in carbon stock in tree biomass in project in year *t*; t CO_2-e
$\Delta C_{SHRUB\_PROJ,t}$	=	Change in carbon stock in shrub biomass in project in year *t*; t CO_2-e
$\Delta C_{DW\_PROJ,t}$	=	Change in carbon stock in dead wood in project in year *t*; t CO_2-e
$\Delta SOC_{PROJ,t}$	=	Change in carbon stock in the soil organic carbon (SOC) pool within the project boundary, in year *t*; t CO_2-e

Estimation of the changes in carbon stocks in tree biomass: $\Delta C_{TREE\_PROJ,t}$

The change in carbon stock in tree biomass in this project within the project boundary was estimated using the A/R methodological tool "estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" (Version 04.2). 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

will be realized, and the calculations will be done following the "difference of two independent stock estimations" method, available in section 6 of the tool.

Under the "Estimation by modelling of tree growth and stand development" method, existing data (diameter etc) were used in combination with tree growth models to predict the growth of trees and the development of the tree stand over time.

According to the methodology, ex-ante estimation of carbon stock in tree biomass is not subjected to uncertainty control, although the project participants should use the best available data and models that apply to the project site and the tree species.

Mean carbon stock in trees within the tree biomass per hectare was estimated as follows:

$$C_{TREE} = \frac{44}{12} \times CF_{TREE} \times B_{TREE}$$

$$B_{TREE} = A \times b_{TREE}$$

$$b_{TREE} = \sum_{i=1}^{M} w_i \times b_{TREE,i}$$

Where:

C_{TREE} = Carbon stock in trees in the tree biomass estimation strata; tCO_2e

CF_{TREE} = Carbon fraction of tree biomass; t C (t d.m.)$^{-1}$ A default value of 0.47 was used as per the methodology

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 (wi = A_i/A); dimensionless

$b_{TREE,i}$ = Mean tree biomass per hectare in stratum *i;* t d.m. ha^{-1}

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 allomatric equation for ex-ante estimations since there are no equations developed in the project area. For ex-post estimation allomatric equations will be developed using the continued research data and research personal and using the permanent sample plots that have been set ups.

A research done by Sukardjo & Yamada (1992) on mangroves species in Indonesia seems to be most plausible equation. Results on this equation and results from field measurements gave similar results thus proving that this equation is the most plausible for ex-ante estimations.

Total aboveground and belowground biomass was estimated using –

$\log_{10}$ (total biomass) = -0.9036 + 2.9499 $\log_{10}$ DBH (Sukardjo & Yamada, 1992)

Where;
Total biomass (kg) – Biomass of both above-ground and below-ground
DBH (cm) - Diameter at breast height
The DBH values were obtained from the Mangrove Service Network (MSN). For ex-ante estimation of growth, the following values were used:

Year (t)	Diameter (cm)
1	0.5
2	0.8
3	1.5
4	3.2
5	4.4
6	6.4
7	7.5
8	9.0
9	10.4
10	11.5
11	12.5
12	13.5
13	14.5
14	14.9
15	15.0
16	15.3
17	15.4
18	15.7
19	15.8
20	16.0

The equation was applied for each year and then the tool AR-Tool 14 (Version 04.2) was used to develop the calculations in Microsoft Excel sheets. The assumed ex-ante planting density is 5,000 plants ha^{-1} which is reduced to 3000 after 10 years due to natural mortality. Default carbon fraction: 0.47 as per A/R methodological tool.

10 strata were identified. Strata i_1, i_2, i_3,…..i_6 are areas reforesting from 2015 to 2020 and i_7,i_8, i_9, i_{10} are areas that will be restored using mangrove plants.

Strata	Year of planting	Magyi (ha)	Thabawkan (ha)	Thaegone (ha)	Total area (ha)
i_1	2015	200			200
i_2	2016	160			160
i_3	2017	118.24	200	100	418.24
i_4	2018		350	100	450
i_5	2019		150	50	200
i_6	2020		126.91	52.66	179.57
	Total area (ha)	**478.24**	**826.91**	**302.66**	**1607.81**

Strata	Year of planting	Magyi (ha)	Thabawkan (ha)	Thaegone (ha)	Total area (ha)
i_7	2015	80			80
i_8	2016	80			80
i_9	2017	80	60.96	218.91	359.87
i_{10}	2018	18.8			18.8
	Total area (ha)	**258.8**	**60.96**	**218.91**	**538.67**

Ratio of the area of stratum i to the sum of areas of biomass estimation strata

w_1	0.09	w_6	0.08
w_2	0.07	w_7	0.04
w_3	0.19	w_8	0.04
w_4	0.21	w_9	0.17
w_5	0.09	w_{10}	0.01

Table 9: Carbon stock in trees in the tree biomass estimation of reforestation strata $i_1 – i_6$

		Mean tree biomass per hectare within the biomass estimation strata (b_{TREE})	Sum of areas of the biomass estimation strata (A)	Tree biomass in the tree biomass estimation strata (B_{TREE})	Carbon fraction of tree biomass (CF_{TREE})	Carbon stock in trees in the tree biomass estimation strata (C_{TREE})
Year	t	t d.m. ha-1	ha	t d.m.	t C (t d.m.)-1	t CO_2e
2015	1	0.01	200	1.51	0.47	2.59
2016	2	0.03	360	10.30	0.47	17.75
2017	3	0.20	778.24	152.58	0.47	262.95
2018	4	1.71	1228.24	2100.05	0.47	3619.09

2019	5	4.04	1428.24	5773.60	0.47	9949.84
2020	6	13.18	1607.81	21190.11	0.47	36517.63
2021	7	20.75	1607.81	33364.10	0.47	57497.46
2022	8	38.66	1607.81	62162.13	0.47	107126.08
2023	9	54.30	1607.81	87303.31	0.47	150452.71
2024	10	65.62	1607.81	105496.89	0.47	181806.31
2025	11	79.89	1607.81	128454.92	0.47	221370.64
2026	12	87.49	1607.81	140674.71	0.47	242429.41
2027	13	93.86	1607.81	150904.50	0.47	260058.75
2028	14	95.74	1607.81	153933.02	0.47	265277.91
2029	15	97.95	1607.81	157492.31	0.47	271411.74
2030	16	87.41	1607.81	140532.60	0.47	242184.51
2031	17	60.20	1607.81	96786.50	0.47	166795.40
2032	18	49.32	1607.81	79293.67	0.47	136649.42
2033	19	34.77	1607.81	55901.12	0.47	96336.26
2034	20	32.67	1607.81	52533.42	0.47	90532.59

Table: 10: Carbon stock in trees in the tree biomass estimation of restoration strata i_7 – i_{10}

		Mean tree biomass per hectare within the biomass estimation strata (b_{TREE})	Sum of areas of the biomass estimation strata (*A*)	Tree biomass in the tree biomass estimation strata (B_{TREE})	Carbon fraction of tree biomass (CF_{TREE})	Carbon stock in trees in the tree biomass estimation strata (C_{TREE})
Year	t	t d.m. ha-1	ha	t d.m.	t C (t d.m.)-1	t CO_2e
2015	1	0.00	80	0.21	0.47	0.37
2016	2	0.01	160	1.37	0.47	2.35
2017	3	0.05	519.87	25.72	0.47	44.32
2018	4	0.27	538.67	147.95	0.47	254.96
2019	5	0.74	538.67	398.62	0.47	686.95
2020	6	2.71	538.67	1461.61	0.47	2518.84
2021	7	3.98	538.67	2146.30	0.47	3698.80
2022	8	8.28	538.67	4460.13	0.47	7686.29
2023	9	8.24	538.67	4437.84	0.47	7647.88
2024	10	11.54	538.67	6214.52	0.47	10709.68
2025	11	12.31	538.67	6630.26	0.47	11426.15
2026	12	11.68	538.67	6293.42	0.47	10845.67
2027	13	12.27	538.67	6609.43	0.47	11390.25
2028	14	15.44	538.67	8315.50	0.47	14330.37
2029	15	14.87	538.67	8010.62	0.47	13804.97

2030	16	7.57	538.67	4080.16	0.47	7031.48
2031	17	3.07	538.67	1652.13	0.47	2847.16
2032	18	5.91	538.67	3182.60	0.47	5484.67
2033	19	3.15	538.67	1698.23	0.47	2926.61
2034	20	5.85	538.67	3148.74	0.47	5426.32

Estimation of the changes in carbon stocks 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 the changes in carbon stocks 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.

Estimation of the changes in carbon stocks in soil organic carbon (SOC): $\Delta SOC_{PROJ,t}$

Changes in carbon stocks in the SOC pool is calculated as indicate in the Methodology AR-AM0014 (03.0):

$$\Delta SOC_{PROJ,t} = \frac{44}{12} \times \sum_{t=1}^{t} A_{PLANT,t} \times dSOC_t \times 1\ year$$

Where

$\Delta SOC_{PROJ,t}$ = Change in SOC stock within the project boundary, in year *t*; t CO_2-e

$A_{PLANT,t}$ = 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 of is used, unless transparent and verifiable information can be provided to justify a different value:

(i) $dSOC_t$ = 0.50 t C ha^{-1} yr^{-1} for $t = t_{PLANT}$ to $t = t_{PLANT}$ + 20 years, where t_{PLANT} is the year in which planting takes place;

(ii) $dSOC_t$ = 0 t C ha^{-1} yr^{-1} for $t > t_{PLANT}$ +20.

The IPCC published in its '2013 Supplement to the 2006 IPCC Guidelines 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 chrono-sequence of 1- to 28-yr 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 in 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 Pathein 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.

Table 11: Change in SOC stock within project boundary, in year t

		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**
Year	**t**	$dSOC_t$	$A_{PLANT,t}$	$\Delta SOC_{PROJ,t}$
2015	1	7.32	280	7518
2016	2	7.32	520	13962
2017	3	7.32	1298.11	34854
2018	4	7.32	1766.91	47441
2019	5	7.32	1966.91	52810
2020	6	7.32	2146.48	57632
2021	7	7.32	2146.48	57632
2022	8	7.32	2146.48	57632
2023	9	7.32	2146.48	57632
2024	10	7.32	2146.48	57632
2025	11	7.32	2146.48	57632
2026	12	7.32	2146.48	57632
2027	13	7.32	2146.48	57632
2028	14	7.32	2146.48	57632
2029	15	7.32	2146.48	57632
2030	16	7.32	2146.48	57632
2031	17	7.32	2146.48	57632
2032	18	7.32	2146.48	57632
2033	19	7.32	2146.48	57632
2034	20	7.32	2146.48	57632

3.3 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 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 either 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 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 start 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 5000/-, 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 PP for them. This way PP ensures that the mangrove trees planted by the project will not be cut for the charcoal production. This is in line with the 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 will be taken strict measures for offenders with the support of the forest department officials.

3.4 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:

$$\Delta C_{AR-CDM,t} = \Delta C_{ACTUAL,t} - \Delta C_{BSL,t} - LK_t$$

Where:

$\Delta C_{AR-CDM,t}$	=	Net anthropogenic GHG removals by sinks, in year *t*; t CO_2-e
$\Delta C_{ACTUAL,t}$	=	Actual net GHG removals by sinks, in year *t*; t CO_2-e
$\Delta C_{BSL,t}$	=	Baseline net GHG removals by sinks, in year *t*; t CO_2-e
LK_t	=	GHG emissions due to leakage, in year *t*; t CO_2-e

Table 12: Change in the carbon stocks in project, occurring in the selected carbon pools: $\Delta C_{P,t}$

		Change in carbon stock in tree biomass in project in year t	Change in carbon stock in shrub biomass in project in year t	Change in carbon stock in the soil organic carbon (SOC) pool within the project boundary, in year t	Change in carbon stock in dead wood in project in year t	Change in the carbon stocks in project, occurring in the selected carbon pools, in year t
Year	t	t CO2-e	t CO2-e	t CO2-e	t CO2-e	t CO2-e
2015	1	3	0	7518	0	7521
2016	2	20	0	13962	0	13982
2017	3	307	0	34854	0	35161
2018	4	3874	0	47441	0	51315
2019	5	10637	0	52810	0	63447
2020	6	39036	0	57632	0	96668
2021	7	61196	0	57632	0	118828
2022	8	114812	0	57632	0	172444
2023	9	158101	0	57632	0	215732
2024	10	192516	0	57632	0	250148
2025	11	232797	0	57632	0	290429
2026	12	253275	0	57632	0	310907
2027	13	271449	0	57632	0	329081
2028	14	279608	0	57632	0	337240
2029	15	285217	0	57632	0	342849
2030	16	249216	0	57632	0	306848
2031	17	169643	0	57632	0	227274

2032	18	142134	0	57632	0	199766
2033	19	99263	0	57632	0	156895
2034	20	95959	0	57632	0	153591

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
2015	0	7521	0	7521
2016	0	13982	0	13982
2017	0	35161	0	35161
2018	0	51315	0	51315
2019	0	63447	0	63447
2020	0	96668	0	96668
2021	0	118828	0	118828
2022	0	172444	0	172444
2023	0	215732	0	215732
2024	0	250148	0	250148
2025	0	290429	0	290429
2026	0	310907	0	310907
2027	0	329081	0	329081
2028	0	337240	0	337240
2029	0	342849	0	342849
2030	0	306848	0	306848
2031	0	227274	0	227274
2032	0	199766	0	199766
2033	0	156895	0	156895
2034	0	153591	0	153591
Total	0	3,680,125	0	3,680,125

According to the methodology, ex-ante estimation of carbon stock in tree biomass is not subjected to uncertainty control, however PP has used the best available data and models that apply to the project site and the tree species.

4 MONITORING

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	Value based on section 5 of AR-TOOL14 as described in section 3.1. of this document

measurement methods and procedures applied	
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	$f_j(x_{1,l},x_{2,l},x_{3,l},...)$
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-ante: Sukardjo & Yamada (1992) For ex-post: more project and species specific equations will be used
Value applied	$\log_{10}$ (total biomass) = -0.9036 + 2.9499 $\log_{10}$ DBH Where: DBH = Diameter at breast height; cm
Justification of choice of data or description of measurement methods and procedures applied	Equation used in ex-ante estimation
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	Areas in project area will be tracked in the field using the GPS. Each plot which will be subject to planting is tracked - a standard procedure of the baseline and monitoring inventory
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 applied	Presented in Section 1.8
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 data	Calculation of project emissions
Calculation method	Using the GPS 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 and procedures to be applied	*N/A*
Frequency of monitoring/recording	n_i is calculated for each monitoring event, at least every five years
Value applied	
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of 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	Dimensionless
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 applied	For the first monitoring the following sample plot numbers are calculated for each stratum:

w_1	0.09	w_6	0.08
w_2	0.07	w_7	0.04
w_3	0.19	w_8	0.04
w_4	0.21	w_9	0.17
w_5	0.09	w_{10}	0.01

	w_1, w_2….w_{10} – values for 10 strata
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of 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	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. 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
Frequency of monitoring/recording	Annually
Value applied	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 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 breast height of tree
Source of data	Field measurement
Description of measurement methods and procedures to be applied	Diameter at breast height (DBH) is measured at 1.3 m along the stem using a DBH tape
Frequency of monitoring/recording	Annually measured and recorded
Value applied	N/A
Monitoring equipment	Diameter Tape
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 minimized. 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, GBH is measured at 1.3m from the ground.
Purpose of 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 is measured and recorded.

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 applied	N/A
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A

Purpose of 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	

4.3 Monitoring Plan

Monitoring will be organized according to Section 06 of AR-AM0014. All the data that are mentioned in this section will 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 will be recorded. Field surveys using GPS, satellite images and land use maps have been used in this activity. This activity will be done throughout the project period to ensure there are no errors in the definition of the project boundary. The project participant has a GIS expert who will be coordinating this section. There will be two staff members working with him in recording proper boundaries.

Existing plants 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. 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 Manager has full responsibilities for all activities. There are 14 project staff members in the Magyi area as follow:

(1) Field Office Manager 1
(2) Technical Assistants 3
(3) Field Assistants 10

Project Manager 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. Similar structure is practiced in other areas (Thaegone and Thabawkan)

The Project Proponent will be responsible for implementation of this ARR project activity together with the local communities. PP has more than 130 professional staff at the Administrative Unit, Field Units and in Pathein University Park with backgrounds on forestry, marine science, economic and social Science, Remote sensing & GIS. The project will also employ over 300 workers for the reforestation and restoration activities.

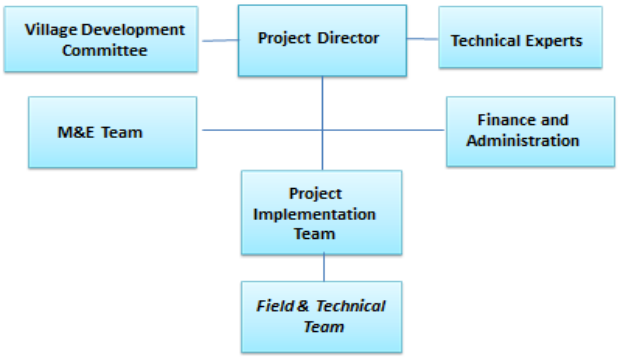
The following professionals constitute the administrative team of WIF:

- Dr. Arne Fjortoft, Secretary General WIF (Speciality in development communication, public education, sustainable development project implementation and climate change/environmental conservation).

- Aye Lwin, Chairman (Administrative experience from government, diplomacy, business and NGO sector, former Director General of ASEAN).
- 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.
- Maung Maung Pyone. Assistant manager. 25 years experience in forestry and mangrove restoration with speciality in mapping, GPS locations and social mobilization.
- Dr. Htay Aung, science advisor and field controller in charge of liaison with Pathein University and local communities. Over 20 years experience in marine science research in the project area.
- Dr. Ranil Senanayake, Senior Science Director WIF, Founder of Analog Forestry and Chairman Raniforest Rescue International.
- Suraj Anuradha Vanniarachchy, Senior Scientific Carbon Associate from Prime Carbon. Overall coordinator for the VCS project development with experience in carbon project development in the Asian region.
- Joacim Kontny, Biogeochemist from Norwegian University of Life Sciences
- Win Sandar Htay, Lawyer and accountant in charge of administration and financial management, public relation, database, procurement and sub-contracts.
- NawHtoo Say WahKhaing, communication specialist in charge of social mobilisation.
- Myint Sein, Field Manager, served as Field administrator with over 20 year experience of mangrove conservation and community development activities at Forest Department.

The following figure presents the overall organizational structure of the project -

Figure: Overall Organizational Structure of Project



The project implementation is based on the local presence of WIF staff in project area. The main role of the field officers is to manage the reforestation/restoration activity in close cooperation with WIF technical program 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 will be 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 landuse 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 landuse type, there is variation in soil composition, water salinity and water availability. Certain manmade activities such as replanting, 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.

This proposed ARR VCS project is designed as to the planting and restoration will happen from 2015-2020. 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;

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 ante* stratification the strata are as follows:
Strata 1: 2015 planting
Strata 2: 2016 planting
Strata 3: 2017 planting
Strata 4: 2018 planting
Strata 5: 2019 planting
Strata 6: 2020 planting
Strata 7: 2015 restoration
Strata 8: 2016 restoration
Strata 9: 2017 restoration
Strata 10: 2018 restoration

The project will adopt the following sampling framework.

- Sampling framework

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

si 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 si

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;

ni 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

si 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

Sampling plot area: 10 m x 10 m plots of 0.01 ha ($100m^2$) will be laid out.

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 will be applied to monitor actual GHG removals by sinks include (1) Collecting reliable field measurements and Precise field monitoring (2) Verifying methods used to collect field data

using independent expert opinion; (3) Verifying data entry and analysis techniques using independent expert opinion ; and (4) Data maintenance and archiving.

(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 will be carefully trained in data collection and analysis. Each team member has been assigned in duties related to monitoring actual GHG removal. Data collection will be conducted by a well trained team. Those responsible for the measurement work are trained in all aspects of the field data collection and data analyses. It is good practice to develop Standard Operating Procedures (SOPs) for each step of the field measurements, which will be adhered to at all times. 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. These SOPs describe in detail all steps that should be taken in the field measurements and contain provisions for documentation for verification purposes so that future field personnel can check past results and repeat the measurements in a consistent fashion.

In order to ensure the collection and maintenance of reliable field data:
a) Field-team members will be made fully aware of all procedures and the importance of collecting data as accurately as possible;
b) Field teams will establish test plots if needed in the field and measure all pertinent components using the SOPs to estimate measurement errors;
c) The document will list all names of the field team and the project manager will certify that the team is trained;
d) New staff will be adequately trained.

(2) Verifying the methods used to collect field data

The data collected by the team will be 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 will require proper entry of data into the data analysis spreadsheets. Possible errors in this process will be minimized by cross checking these entries. In order to ensure more precise output, internal tests will be incorporated into the spreadsheets to ensure that the data are realistic. Communication between all personnel involved in measuring and analyzing data will be used to resolve any apparent anomalies before the final analysis of the monitoring data is completed. If there are any problems with the monitoring plot data that cannot be resolved, the plot will not be used in the analysis. Quantifying data is an important procedure and will be done accordingly.

(4) Data maintenance and achieving

Because of the relatively long-term nature of these project activities, data archiving (maintenance and storage) will be an important component of the work. Data archiving will take several forms and copies (electronic and paper) of all field data, data analyses, 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 will be stored in a dedicated and safe place, preferably offsite. 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).

Sampling Design

- **Type of plots**

In order to monitor the project through time, permanent-sampling plots will be established and maintained. These will be managed in an identical way to the rest of the project, and will permit the most cost and labor effective form of forest monitoring.

- **Number of Plots**

Number of plots will be calculated using accepted formulae.

- **Location of sampling plots**

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

- **Monitoring frequency**

Plantation establishment will be conducted from 2015 to 2020. Permanent plots will be 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 are estimated using the diameter as a parameter.

- **Stratification and sample size**

Sample plots of 0.01 ha ($100m^2$) with 10 m x 10m will be established systematically with a random start for each strata based on the year of planting. Stratification for *ex ante* estimation of the actual net GHG removals by sinks was done according to the year of planting. Stratification for sampling will be the same as above. These plots will be monitored and the information will be collected and recorded.

- **Measuring and estimating carbon stock changes over time**

Carbon stock changes over time will be measured according to the procedures above.

- **Monitoring GHG emissions by sources as the results of the ARR VCS project activity**

GHG emissions from the project will be monitored annually.

5 SAFEGUARDS

5.1 No Net Harm

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 firstly about people.

The situation for the people in the project areas is critical. Their living standard for the majority is below poverty line. The aim is to increase family income with 100% during the next 5 years. This will be done in close consultation with the people in the areas. According to the socio-economic survey conducted by WIF and University of Pathein, there are 827 households in Shwe thaun gyan city (Magyi Township) and the total population is approximately 3000. There were 1034 households and the population in Thaegone is around 4550. Thabawkan had 633 houses and the population was 3283. 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 need.

Three main stakeholder meetings were held to discuss positive and negative impacts of the proposed project. Two meetings were held in each village tract and other with the Forest Department officers. The objectives of the project, planned activities and the benefits of carbon credits were presented in these meetings. The importance of protecting the mangroves and their role in carbon sequestration was explained in different ways. Local communities admitted that they have experienced decreasing fishery resources and more damage from cyclones since there are no mangroves left. They further identified the need of growing mangroves but they lack the capacity to do so. Forest Department officers mentioned the decrease of mangroves has resulted in decrease in wild animals that used to be there and also has an impact on food security, protection against natural disasters (tsunami, cyclones etc). According to the forest officers they did not foresee any negative impacts but suggested WIF to provide good training to workers who are involved in the project. Moreover, schools have been engaged in art competitions and creation of nurseries. These paintings were used as a media of communication in promoting the importance of mangroves.

Figure 14: Meetings during the stakeholder consultation

Figure 15: Children drawing and presenting their paintings during the art competitions

There is no displacement 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) Increase their income

This project is designed specially targeting the local community. The objective of the Project Proponent being an INGO is sustainable development and natural resource management of the project area. Therefore the project has embraced any villager who would like to work on the basis of this model. Low income families in the area will get more opportunities to increase their income. This will be a support for their livelihood.

(2) New employment opportunities

Skilled and unskilled labour will be needed for this project. The project creates direct employment opportunities in the establishment, maintenance and monitoring the mangroves in the project/villages area. Previously many of youth in these villages have 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 many youth 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 to reach their potential.

The project will promote a working family model where both men and women can actively participate in the project. There are sufficient opportunities where women can work in the project.

(3) Knowledge on silvicultural techniques

As identified in the barrier analysis planting mangroves needs proper silvicultural knowledge if the plants are to succeed in the long run. The project has experienced a survival rate of over 80% for the established plants. The project proponent and its staff have very good experience and knowledge of mangroves and will transfer it to the local communities.

(4) Infrastructure development & Change in lifestyle

WIF mobilized support based on the university's own priorities, with assistance to improve the university's library, support to upgrade its IT section, as well as scholarships to students to complete research on mangrove restoration, involving 42 students producing equal numbers of research papers. WIF also

provided an International lecturer and trainer for 3 years. The university recommended one of their most knowledgeable and experiences professors with Ph.D. in marine science, as liaison officer to the project. Regular meetings were held at the university as well as at in the field. This has lead to rewarding benefits for all stakeholders.

The same participatory approach was introduced with the communities around the first project site, as well as in the two new areas, with a number of meetings and consultations. Requests for help to repair schools buildings and establish flood control in a village affected by yearly flood, have been positively followed up. Public education on mangrove restoration and sustainable development has been implemented in all affected villages. The next phase is to develop livelihoods and promote sustainable development in all villages involved in project activities. Handicapped children have been provided medical support of obtaining artificial legs. Training of women entrepreneurs, establishment of oyster farm, initiative to start nypa sap production, virgin coconut oil and other products based on coal raw materials are underway. Regular meetings are held with village officials and the people in order to mobilise maximum participation. The final aim is to make everyone active partners and to demonstrate that the communities are better off with living trees in the area, than short sighted destruction of the living environment. VCS will in this extent be a major contribution to long time benefits for the participating communities.

5.2 Environmental Impact

The proposed ARR VCS project is expecting to obtain CCB certification in future, if possible during the next VCS verification. Therefore the environmental impacts have been given a special attention.

Environmental impact assessment (EIA) or Initial environmental examination (IEE)
Under the laws and regulations of Myanmar this kind of community based mangrove restoration projects does not need any IEE or EIA. There are no significant negative impacts envisaged by the project. In fact the following positive impacts have been identified:

Increased forest cover
Mangroves only consist of 4% of all forests in the country and the existing mangroves are being destroyed. By planting 9.11 million mangroves, the project will restore 2146.48 ha of degraded mangrove ecosystem. The project will increase the forest cover with multiple species thus creating a natural habitat for a variety of fauna and flora species.

Increased biodiversity
The study conducted by University of Pathein indicates a low biodiversity of flora and fauna due to degraded condition. It is important to restore most of the initial biodiversity. A mangrove in good condition not only regenerates degraded lands but also generates income. Beside direct ecological benefits for the protection from erosion and seawater intrusion, mangrove is therefore a huge potential economic source of income, combining productive fishing, ecotourism and carbon credit.

Invasive plant species occur in some mangrove degraded areas, but they will not be able to compete again after mangrove is rehabilitated, their impact on mangrove health and biodiversity is therefore negligible.

Improvement of soil conditions
Due to accumulation and compaction of produced organic matter, in the mid-long term, mangroves contribute to the restoration of soil conditions. Mangrove roots also contribute to decreased water erosion potential and promote soil sedimentation in the intertidal areas.

Climate change mitigation and adaptation
While sequestrating large amounts of carbon thus supporting climate change mitigation, the proposed project also helps adaptation. The improved conditions of the coastal ecosystem will directly support climate change adaptation.

5.3 Local Stakeholder Consultation

As mentioned in the previous sections WIF has emphasises stakeholder consultation from day one of the project, believing that a participatory approach is the only way to success therefore 23 stakeholder consultation meetings were held in three village tracts. Meeting with Forest Department officers was also held. These were organized with the following 3 main objectives:

- Explain about the project to the local communities
- Discussion on formation of Environment and Mangrove Conservation Committees (EMCC) is each village tract and how to obtain the lands for the project from the Government
- Follow-up meetings on the formation of EMCCs.

In addition art competitions were also organized in a way of disseminating the information of mangrove conservation.

A summary of the most relevant meeting dates; location and objectives are presented below.

Table 13: Information about meetings held during stakeholder consultation

Date	Location	Meeting topic	Participants	Village Tract
9-Oct-15	Shwethaungyan township	Environmental Awareness Ceremony for School Children and Mangrove Art painting Competition for School Children	WIF, Mangrove Service Network(MSN), School children, School staff, parents of the children	
15-Jan-16	Thaegone	• Discussed the reasons for mangrove destruction • Discussed the negative impacts of deforestation and impacts of reforestation • Discussed the project including carbon credit options • All of the participants agreed to organize Environment and Mangrove Conservation	WIF, local community	Thaegone

		Committee –EMCC. • The above committee would lead to submit Government of Ayeyarwady Region for land right and land use. • WIF agreed to help the committee for submitting.		
7-Feb-16	Wet The	• Discussed about present status of mangrove lands, threats from natural disasters because mangroves no longer exist and reasons for deforestation. • Also discussed potential future threats to natural resources in the area and importance of the project • All of the participants agreed to organize Environment and Mangrove Conservation Committee –EMCC. • The above committee would lead to submit Government of Ayeyarwady Region for land right and land use. • WIF agreed to help the committee for submitting.	WIF, local community	Thaegone
1-Jul-16	Thaekyin	• Discussed about present status of mangrove lands, threats from natural disasters because mangroves no longer exist and reasons for deforestation. • Lack of capacity to reforest these lands by local people is a major problem therefore they need help. • All of the participants agreed to organize Environment and Mangrove Conservation Committee –EMCC. • The above committee would lead to submit Government of Ayeyarwady Region for land right and land use. • WIF agreed to help the committee for submitting.	WIF, local community	Thaegone
5-Jul-16	Thaegone	Follow up of the request for lands from the Government. WIF provided maps, documents and knowledge needed	WIF, local community	Thaegone
20-Jul-16	Wet The	Follow up of the request for lands from the Government. WIF provided maps, documents and knowledge needed	WIF, local community	Thaegone
15-Aug-16	Wet The	• Discussed about present status of mangrove lands, threats from natural disasters because mangroves no longer exist and reasons for deforestation. • Lack of capacity to reforest these lands by local people is a major problem therefore they need help. • All of the participants agreed to organize Environment and Mangrove Conservation Committee –EMCC. • The above committee would lead to submit Government of Ayeyarwady Region for land right and land use.	WIF, local community	Thaegone

		• WIF agreed to help the committee for submitting.		
1-Sep-16	Thaekyin	Follow up of the request for lands from the Government. WIF provided maps, documents and knowledge needed	WIF, local community	Thaegone
8-Jul-16	Thabokkan	• WIF explained about the project concept and carbon credits. • Also discussed the status of mangrove lands and reasons for deforestation and the importance of reforestation. • Negative impacts of being degraded was also highlighted by the local community. • No negative impacts of the project were identified. • All of the participants agreed to organize Environment and Mangrove Conservation Committee –EMCC. • The above committee would lead to submit Government of Ayeyarwady Region for land right and land use. • WIF agreed to help the committee for submitting.	WIF, local community	Thabawkan
11-Sep-16	kyunchaung Village	• Discussed about present status of mangrove lands, threats from natural disasters because mangroves no longer exist and reasons for deforestation. • Lack of capacity to reforest these lands by local people is a major problem therefore they need help. • All of the participants agreed to organize Environment and Mangrove Conservation Committee –EMCC. • The above committee would lead to submit Government of Ayeyarwady Region for land right and land use. • WIF agreed to help the committee for submitting.	WIF, local community	Thabawkan
21-Sep-16	Jinchaung	• All of the participants agreed to organize Environment and Mangrove Conservation Committee –EMCC. • The above committee would lead to submit Government of Ayeyarwady Region for land right and land use. • WIF agreed to help the committee for submitting.	WIF, local community	Thabawkan
16-Feb-17	Thabokkan	• All of the participants agreed to organize Environment and Mangrove Conservation Committee –EMCC. • The above committee would lead to submit Government of Ayeyarwady Region for land right and land use.	WIF, local community	Thabawkan

		• WIF agreed to help the committee for submitting.		

5.4 Public Comments

Comments about eligibility (Answers by PP are in blue colour)

There is not support for the no forest criteria at the start date. They cited a study carried out by FAO before the project start date, but it is not clear how this study prove the no forest criteria in the project area. They include all the area as eligible, and it is not clear if they extract the water bodies (see Page 42, Fig. 10) and other lands (as villages, etc.) from the eligible area.
FAO has not done any study as mentioned in the comments. PP has only used the FAO forest definition of the minimum height of 5m since the Regional Ministry of Agriculture, Livestock, Natural Resources and Environment used that criterion when assessing the lands belonging to the project area. The Ministry issued letters dated 17 May 2017 confirming that the lands belong to the project are below the Myanmar forest definition. After the University of Pathein and two village tracts (Thaegone and Thabawkan) applied for land from the Government, the Ministry had to assess the land condition before giving the land. Based on their assessment these lands do not have any forests and are severely degraded.
In addition to the letter provided by the Ministry confirming the no-forest criteria, PP used satellite images to further to prove no forest criteria. LandSat images of 2003 were used to assess the landuse condition 10 years prior the start date and LandSat images of 2013 were used to assess the landuse condition at the start date. Since clear images of 2004 or 2014 were not available, PP had to use maps of 2003 and 2013 respectively.

About whether we extracted the water bodies and other lands (as villages, etc.) from the eligible area :
We have removed major rivers and water bodies. There is the tidal difference in these areas. Satellite images are being taken usually in the morning when there is probably the high tide. Therefore areas are inundated with water and may appear as water bodies. However when the tide is low these areas are exposed and mangroves can will be planted in those areas. We have not included any village tracts or settlement areas within the project boundary.
To delineate the project boundary, we have prepared a KML file showing the clear cut boundary demarcation of each parcel of land included in the project. These parcels are then uniquely numbered and the details regarding the latitude longitude, area, land class etc. are extracted in the excel format. These excel sheet and the KML files are available for verification
The Watershed Management & Mangrove Conservation Division of the Forest Department has issued a letter stating that the lands belonging to the project area have been subjected to deforestation for over 10 years. Discussions with the local people have found that these mangroves have been cleared for over 20-30 years and that these mangroves have been severely degraded. When the stems are being cleared for charcoal production and other uses, these mangroves are no longer able to produce propogules. Their capacity to natural regenerate stops. This has been the situation in these lands which has also been certified by the Forest Department.

The separation between reforested and restored areas is not necessary if all area is classified as no forest.
Pag. 20. About conditions before project initiation: There is not support for the demonstration of no forest condition according to FAO criteria for 2015 and ten years before.
A satellite image interpretation was done using maps of 2003 and 2013. Also kindly refer the answer above

Pag. 33. There is not an analysis of define the project boundaries (degraded vs. no mangroves). According to the PO all the areas are no forest.

There is an analysis of the land areas. The maps have different land use categories which explain the land use types.

Comments about mortality rates

There is not scientific support for the mortality rates they used. According to Bayraktarov et al. (2016), the average survival rate in restoration projects in mangroves is 51%, and in the best case, developed countries could achieve 56,3%. Nevertheless, in this PD is mentioned a survival rate for the area of 80% (Pag. 78) and there is not documented support for this number. Likewise, there is not support for the distribution of mortality rates over the years. For this PD they assume mortality is zero for the first three years and only 5% for the year 4. Despite the range of survival rates for the first plantation years is wide (Primavera and Esteban, 2008), some studies such us Toledo (2001) reported survival of 77% until 1,5 years and 74% after year two.

Study team led by Mr. Win Maung (project manager) and his staff (graduates from the University of Forestry, Myanmar) have established 100 sample plots (10m x 10m) for each planting year (2015, 2016, 2017). These plots are monitored and measurements are taken to calculate the survival rate. As at present they have achieved a survival rate of more than 80%. The data is available for verification.

Another study on survival rates of *Avicennia officinalis, Avicennia marina, Bruguiera sexangula, Heritierafomes, Rhizophora apiculata and Sonneratia apetala*in the Ayeyarwady Delta in Myanmar was conducted by Yokohama National University and Action for Mangrove Reforestation (ACTMANG) - Link

Avicennia marina - survival rate was 81% after four years and three months for trees in high ground and 54% after five years and 3 months for trees in low ground.

Avicennia officinalis – survival rate was 91% after 3 years and 2 months for trees in high ground and 78% after five years and 3 months for trees in low ground.

Heritiera fomes - survival rate was 69% after 2 years and 4 months for trees in high ground and 67% after 2 years and 4 months for trees in low ground.

Rhizophora apiculata - survival rate was 88% after 3 years and 9 months for trees in low ground

Sonneratia apetala - survival rate was 74% after 5 years and 3 months for trees in low ground

South Pole refer to a report by Bayrakatrov et al. (2016) that the survival rate in restoration projects in mangroves is 51%, with the best case 56,3%. No geographical area is mentioned. If results from Myanmar had been included, the average survival rate would have been higher. It is a fact that local conditions and knowledge/methods are essential. We can therefore only refer to achievements in Myanmar, even if there are other areas with higher documented results than mentioned above.

Coastal Livelihood and Environmental Assets Rehabilitation in Rakhine (CLEARR) funded and monitored by UN LIFT has documented over 83% survival rate. Mangrove Service Network (MSN) project in KyaukPhyu Township, Rakhine State has documented over 74% (Certified document provided). Moreover, the survival rate of Forest Department in Ramree township (YannBywe), Rakhine State is over 85%. The survival rate of Forest Department in PyarPon Township, Ayeyarwady Region is 90.53%. (Certified letter provided).

It does not serve any constructive purpose to ignore information from the relevant country. We have only mentioned an estimated survival rate for ex-ante estimations based on results from the project and from other projects in Myanmar. Actual survival rates of the plants are monitored through permanent sample plots and shall be used for ex-post estimations.

Why for the case of restoration areas (Plantation density: 2000 trees) do they assume mortality zero?
We have made the same assumption of 80% survival rate and made the changes. Actual ex-post calculations will be done based on survival rates from the permanent sample plots.
Also refer the answer above

Comments about estimation of carbon stock in above ground biomass

It is not consistent with the document about the project scale, size, and type of project. We think the estimations are overestimated, but in the hypothetic case those estimations are correct, the project must be classified as large scale. Additionally, throughout the document, there are inconsistencies with the classification of the type of project (in some cases they mention there is a grouped project, e.g. page 32, and in other sections they say it is not a grouped project).
The project is not a grouped project. Corrections have been done and consistency is maintained throughout the document.

Pag 49. They use the allometric equation for biomass estimation proposed by Sukardjo and Yamada (1992). We think this equation cannot be used because its diametric range is 3,9 cm to 7,80 cm (see article). In this sense, according to the Table showed in page. 49, the equation only is applicable for years 5-7.
We did research with local trees in the area, and found out the equation from Komiyama was highly underestimating the stock at our site (Refer report by Joacim Kontny titled Measurements of biomass in Thor Heyerdahl Climate Park (THCP)). Comparing with different equations, we found this to be the most fitting for our results. As this is ex-ante estimation, no credits will be given. WIF together with Pathein University and AFOLU project development specialists will develop site-specific equations to calculate the ex-post estimations.
In case this equation is accepted for *ex-ante* estimations, it cannot be used for *ex-post* estimation due to the following reasons:
According to Tool 14, V.4.2 it is necessary to apply the Tool "*Demonstrating appropriateness of allometric equations for estimation of aboveground tree biomass in A/R CDM project activities*", which requires the accomplishment of the following conditions:
(a) The equation is used in the national forest inventory, or the national GHG inventory, of the host Party; (b) The equation has been used in commercial forestry sector of the host Party for 10 years or more; (c) The equation was derived from a data set of at least 30 sample trees, and the value of coefficient of determination (R2) was not less than 0.85.
In this sense, the equation is not applicable for *ex-post* estimations due to it was built with 10 data.
Indeed. Page 65 of the VCS PD states the following:
For ex-ante: Sukardjo & Yamada (1992)
For ex-post: more project and species specific equations will be used
Therefore for ex-post estimations, site specific equations will be developed and used for the calculations.

Pag. 49. What is the precedence of Table with Diameter per year? Was there enough data to adjust the curve? Was there a monitoring for plots for different ages? Additionally, considering the plantation density is like a natural mangrove, is difficult to achieve the same diameter per tree as in a plantation scenario, especially, because there are not management practices.
The table with diameter was obtained from the Mangrove Service Network (MSN). This is based on their research on mangrove growth. However this is only estimated figures used for ex-ante calculations. No

credits are expected to trade using this diameter values. For ex-post calculations PP will monitor and record diameter of all species in the permanent sample plots that have been set up for the VCS project.

Pag. 50. The Equation used for the estimation of mean change in the biomass per hectare in trees is only applicable for *ex-post* estimation. This equation requires plot remeasures. For this *ex-ante* estimations, Equation 13 must be used. Furthermore, for the estimation presented in the PD, there was a mistake in the use of the Equation used because they did not include the number of plots in the estimations.
Thanks for the comment. Corrections are done in all relevant places

Pag. 59-60. Tables 19 and 20 show the change in C stock in reforestation and restoration strata. Final values are in tCO2e/ha/year. We did the exercise to convert those values to tC /ha/year and the biomass with the aim to compare the results with values reported in the scientific literature. From Table 19, the average of tC /ha/year is 28,05. This value is higher than the average value reported by Alongi (2014), 11,1 t C /ha/year, and the range found in Thailand Mangroves 9,35 -12,9 t/C/ha (Komiyama 2014). This big difference could be a consequence of the diameter range used (Table in page 49) and due to the biomass estimation outside the range of the Equation, as well as they did not divided by the number of plots with the used equation. This last case leads to assume that old trees have the same biomass accumulation rate than the youngest trees, which is a wrong interpretation.
Alongi estimates AGB. Considering the high amount of BGB in mangroves, and the fact that it is a global estimate, while our area is in a high productive area for mangroves, this is not an unreasonable estimate. The trees are most productive from 15 years and forward. And this is only the ex-ante estimation and not ex-post estimation where actual credits are issued. Therefore the above argument is not valid. The calculations are supported by the carbon assessment conducted in the study area (Refer report by Joacim Kontny titled Measurements of biomass in Thor Heyerdahl Climate Park (THCP)).

Comments about estimation of carbon stocks in soil
The soil carbon accumulation rate used in this PD is overestimated (13,23tC /ha/year). Why do they assume that the average C stock in those mangroves (640,92 t C /ha) were accumulated in 50 years? The value reported by this study are much higher than default values allowed by the methodology (0,5tC/ha/year). Likewise, is almost eight times the average value reported by (Alongi 2014) for mangrove ecosystems (1,63tC/ha/year). Lovelock (2008) found for Australia, Caribbean and New Zeland mangroves a range from 1,51 to 6,34 tC /ha/year (mean 4,10 ± 45 tC /ha/year). Finally, for Pacific and the Indian Ocean, Chmura et al. (2003) reported soil carbon allocation rates between 0,26tC/ha/year to 3,36 tC/ha/year.
In comparison with estimations made with IPCC default value, the overestimation is 30%. Compared with the estimation made with methodology default vale, the overestimation is 96%.

We consider the presented rate (13,23tC/ha/year) does not meet the methodology requirement: "*The default value of 0,5tC/ha/year is used, unless the transparent and verifiable information can be provided to justify a different value"*.
Soil assessment was conducted by a team from Pathein University led by Professor HtayAung (report titled: Soil Carbon Measures In Magyi's Mangrove Forest, April 2015). The team referred the following document for their study - Howard, J., Hoyt, S., Isensee, K., Telszewski, M., Pidgeon, E. (eds.) (2014). Coastal Blue Carbon: Methods for assessing carbon stocks and emissions factors in mangroves, tidal salt marshes, and seagrasses. Conservation International, Intergovernmental Oceanographic Commission of UNESCO, International Union for Conservation of Nature. Arlington, Virginia, USA.

Soil samples were collected using a soil core sampler along the Magyi channel and U-To channel where a forest carbon project is being developed to restore degraded mangrove lands. GPS coordinates were

recorded and a soil depth probe was used to measure the soil depth. In each location, three (3) samples were collected in soil under Bruguiera spp., Ceriops spp. and Rhizophora spp which are the dominant mangrove species in the study area. Three (3) soil samples were collected at every 30 centimeter depth from each location thus giving 9 soil samples from each sample plot. The organic carbon content of the soil samples were measured using the Loss on Ignition (LOI) method. This method uses combustion and empirical relationships between organic carbon and organic matter. Laboratory tests were done at the Yangon University.

The soil organic carbon in the plots varied from 575.85 t/ha to 886.52 t/ha. The average soil organic carbon content in the studied soil was 732.26 t/ha. IPCC (2013) soil organic carbon stock for mangroves varies between 55 to 1376 t/ha. Dry bulk density of the soil was calculated as 0.64 g/cm^3.
The rate of soil accretion in mangrove forests averages 5 mm year^{-1}, with 94 measurements out of a total of 139 ranging from 0.1 to 10.0 mm year^{-1}. The median value is 2.7 mm year^{-1} with a few measurements showing net erosion (minimum value = -11.0 mm year^{-1}) or massive accretion (46.3 mm year^{-1}) in highly-impacted estuaries, such as those in southern China (Alongi, 2014).
According to studies done by the Pathein University, Sedimentation rate in mangrove for the Magyi area is about 10-20 mm per year. A conservative value of 10mm/year was applied.
Assuming a conservative period of 100 years, rate of change in SOC stocks within the project boundary is 7.32 tC/ha/year. Therefore there is no need to use the default value of 0.5 tC/ha/year which is only going to under-estimate the actual soil carbon content in the project area.

Comments about Baseline
Differentiating between old and new trees. The differentiation between the existing trees before project start date is necessary. They did not mention that activity in the project description. The inclusion of already existing trees leads to overestimation. The photos on page 15 and page 27 (Fig 7) show the existence of individuals already established in the baseline.
PP has already established 300 sample plots in Magyi area (100 each for planting years 2015, 2016 and 2017). Only a % of this will be established as permanent sample plots for the VCS project but the rest will also be monitored for research purposes. Existing trees are all well documented in these sample plots and will NOT be included in the carbon calculations therefore there will be no over-estimation of carbon.
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 landuse 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

Severely degraded mangrove areas, bare lands and shallow water areas will be replanted with a density of 5000 plants per hectare. Degraded mangrove areas will be restored using approximately 2000 plants per hectare since there are mangrove plants which fall below the forest threshold but still remain as plants. 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.

Pag. 13. The amount of carbon remove due to the preparation activities were not discounted (shrubs: *Acanthus ilicifolius, Dalbergiaspinosa.*).

Site preparations do not lead to any significant GHG emissions. There will not be any harmful site preparation techniques such as chemical or aerial site preparation in this reforestation project activity. The planting is done manually and will consist in preparing a small hole for the roots of the seedling, respecting the complete structure of the soil. There is no fertilization or burning of pre-existing vegetation, therefore, the project does not lead to GHG emissions by sources. In the applied methodology (AR Large-scale methodology (AR-AM0014) Afforestation and reforestation of degraded mangrove habitats Version 03.0) the only source of project emission is biomass burning but as is shown in the following table and mentioned in the VCS PD, this is not a source of emission in this project case.

Pag. 21. The photo shows a high presence of stumps in the planting area. In this kind of baseline, it is possible to plant more than 4000 plants/ha? There is enough space?

The stumps do not take up more than 20 %(or so) of the area, so there will be no problem to plant in between them. This situation has been studied by Mr. Win Maung (project manager) who is also the former Director of the Forest Department and has over 30 years of experience in mangrove plantations and confirmed that it is possible to plant mangroves with the said density.

Pag. 44. How they classified the different land use types in the baseline? It is not clear.

LandSat images of 2003 were used to assess the landuse condition 10 years prior the start date and LandSat images of 2013 were used to assess the landuse condition at the start date. Since clear images of 2004 or 2014 were not available, PP had to use maps of 2003 and 2013 respectively.

Pag. 44. “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”: In the monitoring plan, they must describe how they plan to carry out it.

In the methodology AR-TOOL 14 it says:

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.

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.

Comments about other issues

Pag.4. "Mangrove restoration will further increase fish resources with up to 50%": Source

Increase of sea food stock. It is commonly acknowledged an average increase of 50% after restoration of mangrove forests. (Ref. reports by CIFOR/ FAO/UN Environment and various scientific research documents). Specifically, 80% of all commercial or recreational species in Florida are mangrove dependent (Hamilton and Snedaker 1984). Mangroves are crucial for 72% of the commercial fish catch in the Philippines (Paw and Chua 1991). This ecosystem service that mangroves provide has considerable economic value, in excess of US $18,000 per ha in the most productive locations (de Groot et al. 2012).

Pag. 4. "Establishment of the first mangrove gene bank with 64 species be followed with long-term research": First mangrove gene bank for Myanmar or the Indopacific? They only include in their project the planting of four species. How will they plan to get 64 species?

This is the first gene bank in Myanmar. We have no knowledge of similar projects in other countries and can therefore only refer to Myanmar.

There are 29 existing species in the gene bank area (25 acres) and 22 species which is now being planted in the gene bank by transplant from near gene bank area. Besides, we have already collected and prepared for 13 species from other townships, Pyar Pone area. Therefore the total species number is 64. All of them are both true mangrove species and associate species. Please see the attach file of the name of the species.

Comment	Number	Species name	True Mangrove/ Associate mangrove
Existing Species in Gene Bank by 20 September 2017	1	*Avicennia alba*	TRUE
	2	*Avicennia marina*	TRUE
	3	*Avicennia officinalis*	TRUE
	4	*Bruguiera cylindrica*	TRUE
	5	*Bruguiera gymnorhiza*	TRUE
	6	*Bruguiera parviflora*	TRUE
	7	*Ceriops tagal*	TRUE
	8	*Ceriops decandra*	TRUE
	9	*Excoecaria agallocha*	TRUE
	10	*Lumnitzera littorea*	TRUE
	11	*Lumnitzera racemosa*	TRUE
	12	*Rhizophora apiculata*	TRUE
	13	*Rhizophora mucronata*	TRUE
	14	*Sonneratia alba*	TRUE
	15	*Scyphiphora hydrophilacae*	TRUE
	16	*Xylocarpus granatum*	TRUE
	17	*Xylocarpus moluccensis*	TRUE
	18	*Acanthus ilicifolius*	TRUE
	19	*Phoenix paludosa*	TRUE

	20	*Nypa fruticans*	TRUE
	21	*Finlaysonia obovata (synonym: Finlaysonia maritima)*	Associate
	22	*Dolichandrone spathacea*	Associate
	23	*Ipomoea tuba*	Associate
	24	*Pongamia pinnata*	Associate
	25	*Acrostichum speciosum*	TRUE
	26	*Acrostichum aureum*	TRUE
	27	*Clerodendrum inerme*	Associate
	28	*Heritiera litoralis*	TRUE
	29	*Premna obtusifolia*	Associate
	30	*Bruguiera sexangula.*	TRUE
Transplanting near Gene Bank	31	*Acanthus volubilis Wall.*	TRUE
	32	*Sesuvium portulacastrum*	Associate
	33	*Crinum asiaticum L.*	Associate
	34	*Eclipta alba*	Associate
	35	*Pluchea indica (L.) Less.*	Associate
	36	*Terminalia catappa L.*	Associate
	37	*Ipomoea pes-caprae*	Associate
	38	*Derris scandens*	Associate
	39	*Derris trifoliate Lour.*	Associate
	40	*Scaevola taccada*	Associate
	41	*Cynometra ramiflora L.*	Associate
	42	*Aegiceras corniculatum*	TRUE
	43	*Pandanus odoratissimus*	Associate
	44	Aegialitis rotundifolia	TRUE
	45	*Bruguiera hainesii*	TRUE
	46	*Morinda citrifolia*	Associate
	47	*Sonneratia apetala*	TRUE
	48	*Heritiera fomes*	TRUE
	49	*Brownlowia tersa*	TRUE
	50	*Stachytarpheta jamaicensis*	Associate
	51	*Hygrophila obovata*	Associate
Species from other township	52	*Cerbera odollam*	Associate
	53	*Intsia bijuga*	Associate
	54	*Calophyllum inophyllum L.*	Associate
	55	*Hibiscus tiliaceus L.*	Associate
	56	*Thespesia populnea*	Associate
	57	*Amoora cuculata*	Associate
	58	*Kandelia candel*	TRUE
	59	*Merope angulata*	Associate
	60	*Sonneratia griffithii*	TRUE

	61	*Sonneratia caseolaris*	TRUE
	62	*Barringtonia racemosa*	Associate
	63	*Acanthus ebracteatus*	TRUE
	64	*Brownlowia argentata*	TRUE

Pag. 20. The map shows three zones but without explanation.
Explanation has been inserted

Pag 30. In the WIF web page there is a strategy to adopt a tree. What kind of certification receive the buyer? It is important to clarify this point to avoid double count.
The strategy to adopt a tree was introduced only for those who are interested in making a difference by supporting mangrove restoration. The ownership of the tree or land or carbon rights are NOT transferred to any person who wish to adopt a tree. The cost of adopting is 88 Kr (about 10 USD) and is only charged 1 time over the life of tree and is NOT related to any carbon rights. Therefore this process is not double counting.

Pag 30. It is important to monitor the leakage management to include the discount of emission due to the charcoal production displacement. In this section, the PO establish they will monitor this variable, but in the monitoring plan, it was not included.
We are involving all the local people to make sure there will be no illegal logging in the area.

Also we are in the process of establishing a mangrove protection and monitoring committees with the intention of monitoring any illegal activities within the project. These committees are responsible for routine check-up and report on future occurrence of any such leakage related issues. Monitoring plan is updated with the above information
Pag. 45. Legend and tables in maps are inconsistent.
This has been corrected

Pag 46-47. Maps show the project area includes other land uses, which demonstrates that a better delimitation of eligible areas is necessary.
This has been corrected. Parcel boundaries are now clearly demarcated. Each plot is uniquely identified and labelled. An excel sheet showing latitude, longitude, plot area, type of land, etc. are prepared to avoid any ambiguity in the area included in the project activity.

Pag. 65. The final estimations do not reflect the results of the non-permanence risk tool. There is not a discount because of the buffer.
This has been done and the Non-permanence risk assessment is available.

Pag 73- They propose the periodical update of some parameters related to disturbances. They did not describe how to monitor those parameters.
This will be monitored in different ways,

- **Unpredicted disturbance occurring during the crediting period**
  This will be measured in the counting of the sample-plots
- **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;**
  This will also be done during the recounting, and with the help of national and international data.

- **Mangrove forest establishment (planting, re-replanting) may be implemented at different intensities, dates and spatial locations than mentioned in the PD;**
  This will have to be done as we see the survival-rate.

Pag. 76. Explain how the project is going to achieve the increase of family income in 100% during the next 5 five years.

Baseline survey of all communities was done from the start. This and consultation with the communities is the basis for planning livelihood creation and sustainable community development. WIF has 35 years experience in this field and started participatory planning with the communities at an early stage. Several livelihood projects have already been implemented providing alternative jobs to the charcoal burners and other low income groups (majority of the population is landless laborer earning average 60-70 USD per month. To increase this with 100% within 5 years is a doable by utilizing renewable local resources on land and sea.A comprehensive plan is completed and in implementation stage. After one year, more than 100 family earners people (70% women) have been provided sustainable income which is over 100% of average pre project period. This also includes infrastructure like community solar grids, wind mills, energy forest etc. and support to the fishermen with ice plant, cool rooms etc. (40% of catches are lost due to lack of proper pre-harvest facilities). The same goes for agricultural production like processing of cashew nuts etc. and for value addition of coconut harvests by establishing a processing plant for virgin coconut oil and other coconut products providing over 50 additional jobs. More on this comprehensive plan on request.