NON-PERMANENCE RISK REPORT REFORESTATION AND RESTORATION OF DEGRADED MANGROVE LANDS, SUSTAINABLE LIVELIHOODS AND COMMUNITY DEVELOPMENT IN MYANMAR

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1 INTERNAL RISK

1.1 Project Management

The application of each risk factor to the project is explained below:

a) The species identified for this reforestation project are *Rhizophora mucronata, Rhizophora apiculata, Bruguiera gymnorrhiza, Bruguiera cylindrica, Bruguiera sexangula and Ceriops tagal*. These species are naturally occurring mangrove species in Myanmar. World Widlife Fund (WWF) has documented that these species are distributed in the country predominantly in three regions: the Ayeyarwady, Rakhine and Taninthayi[1] (Annex 1). The risk rating for this factor is 0. Thus no change since validation and previous verification.

According to WWF, the mangrove flora consists of three separate regions: the Rakhine mangroves, Irrawaddy mangroves, and Taninthayi mangroves. The Rakhine mangroves are made up primarily of *Rhizophora mucronata, R. candelria, Sonneratia spp., Kandelia rheedeii, Bruguiera spp., Xylocarpus granatum, X. moluccensis, Nipa fruticans,* and *Phoenix paludosa*. The Irrawaddy mangroves consist of *Rhizophora mucronata, R. conjugata, Bruguiera parviflora, B. gymnorhiza, B. cylindrica, Heritiera formes, Sonneratia apetala, S. griffithii, S. caseolaris, Xylocarpus granatum, X. molluccensis, Ceiops roxburghiana, C. mimosoides, Avicennia officinalis, Kanddelia rheedii,* and *Excoecaria agallocha*. Finally, the *Taninthayi mangroves contain Rhizophora spp., Sonneratia caseolaris, Ceriops tegal, Xyloxarpus granatum, Avicennia officinalis,* and *Bruguiera spp.*

b) PP get the support of the Forest Department officials for the regular monitoring of the area for encroachment. The agreement with the village tracts also ensure sufficient staff be able to take care the plants and in this manner the encroachment of outside players that could intentionally or unintentionally damage the planted areas is avoided. Agreements with the village tract chairmen of each village are provided as evidence. The risk rating for this factor is 0. Thus no change since validation and previous verification.

c) The management team responsible for day-to-day activities is from Worldview International Foundation (WIF). Their country office is in Yangon and their field office is in Pathein. Mr Bo Ni, the Managing Director is the former Director of the Watershed Management Division of the Forest Department with over 40 years of experience. Mr. Win Maung, the Project Director is the former Director of the Forestry Department. He has over 30 years working experience in mangrove conservation as a government official; researcher and Project Manager of NGO/UN-LIFT projects. Mr. Maung Maung Pyone who is the Assistant manager has over 25 years experience in forestry and mangrove restoration with specialty in mapping, GPS locations and social mobilization.

[1] https://www.worldwildlife.org/ecoregions/im1404

Professor Htay Aung is the scientific advisor and field controller in charge of liaison with Pathein University and local communities. He has over 20 years experience in marine science research in the project area. Suraj A. Vanniarachchy as the main carbon consultant was not involved in the daily management of the project but provided technical assistance for carbon related measurements. Overall supervisory was done by Dr. Arne Fjortoft, Secretary General of WIF. Annex 2 describes the capacity and experience of the organization and staff to manage the project area. The risk rating for this factor is 0. Thus no change since validation and previous verification.

d) The management teams are located in the country and are able to reach the project within a 4 hour drive from the Yangon. Country office is located in the Yangon and the branch office is within the project area. Contact information for the management team is presented in the Project Description (PD). The risk rating for this factor is 0. Thus no change since validation and previous verification.

e) Suraj A. Vanniarachchy was involved in the project design and development as well as the monitoring. Suraj is a AFOLU carbon project development specialist for CDM, VCS and ACR projects in Southeast Asia and involved in REDD+ project design and development in the region hence have the expertise. He was assisted by Aung Mynt (GIS and mapping expert) for the monitoring by providing updated maps of the project area. The risk rating for this factor is -2.

f) WIF has taken several adaptive measures to mitigate project management risks. Their staff consist of ex-forest department officials who were having over 30 years of experience in mangrove planting and management. Their younger staff are graduates from the University of Forestry who have sound knowledge on forest management practices. The species selection was also done after a 3 year research on trial plots. WIF maintains a surplus of planting material (seedlings and propagules) for patching during the following years after the initial planting. Joint operations conducted with the Forest Department is also considered an adaptive management practice.

Total project Management risk rating is -4.

Project Management		
a)	Species planted (where applicable) associated with more than 25% of the stocks on which GHG credits have previously been issued are not native or proven to be adapted to the same or similar agro-ecological zone(s) in which the project is located.	0
b)	Ongoing enforcement to prevent encroachment by outside actors is required to protect more than 50% of stocks on which GHG credits have previously been issued.	0

c)	Management team does not include individuals with significant experience in all skills necessary to successfully undertake all project activities (ie, any area of required experience is not covered by at least one individual with at least 5 years experience in the area).	0
d)	Management team does not maintain a presence in the country or is located more than a day of travel from the project site, considering all parcels or polygons in the project area.	0
e)	**Mitigation:** Management team includes individuals with significant experience Management team includes individuals with significant experience in AFOLU project design and implementation, carbon accounting and reporting (eg, individuals who have successfully managed projects through validation, verification and issuance of GHG credits) under the VCS Program or other approved GHG programs.	-2
f)	**Mitigation:** Adaptive management plan in place	-2
Total Project Management [a + b + c + d + e + f]		-4

1.2 Financial Viability

The proposed project is implemented by Worldview International Foundation (WIF). WIF is an INGO and other partners involved are the University of Pathein and local communities from three village tracts. There is no financial return from mangrove reforestation other than the carbon credit benefits. Therefore the internal rate of return (IRR) is not applicable for this non-profit project activity. However the cash flow breakeven point is greater than 10 years hence the section Financial Viability risk is calculated to be 3.

Total Financial Viability risk is 3.

Financial Viability		
Q	How many years does it take for the cumulative cashflow to break even?	a)
Q	What percentage of funding is needed to cover the total cash out before the project breaks even has been secured?	
a)	Project cash flow breakeven point is greater than 10 years from the current risk assessment	3
b)	Project cash flow breakeven point is between 7 and up to less than 10 years from the current risk assessment	0

c)	Project cash flow breakeven point between 4 and up to less than 7 years from the current risk assessment	0
d)	Project cash flow breakeven point is less than 4 years from the current risk assessment	0
e)	Project has secured less than 15% of funding needed to cover the total cash out before the project reaches breakeven	
f)	Project has secured 15% to less than 40% of funding needed to cover the total cash out required before the project reaches breakeven	
g)	Project has secured 40% to less than 80% of funding needed to cover the total cash out required before the project reaches breakeven	
h)	Project has secured 80% or more of funding needed to cover the total cash out before the project reaches breakeven	
i)	**Mitigation:** Project has available as callable financial resources at least 50% of total cash out before project reaches breakeven	
Total Financial Viability [(a, b, c or d) + (e, f, g or h) + i]		3

1.3 Opportunity Cost

According to the additionality assessment, the 2 plausible alternative land use scenarios for the project area are as follows:
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

The following is a description of the net positive community impacts of the project. (Source: VCS PD of the project): The aim is to increase family income 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 619 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.

A series of stakeholder meetings were held in all townships together with village communities, village leaders, government officials and university academics. The objectives of the project, planned activities

and the benefits of carbon credits were presented to the community. The importance of protecting the mangroves and their role in carbon sequestration was explained in different ways.

There is no displacement occurring due to the project activity. Therefore surrounding communities 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 is 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 promotes 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

During this monitoring period a 10 month training program for 24 candidates was organized on social entrepreneurship. Upon successful training, they were requested to propose new enterprises in the area. Ideas like bee honey production, clams production, a small yard for boat building, production of energy saving stoves, sea weed production, virgin coconut production, ice plant for fishing industry, aquaculture projects with emphasis on crab farming will be followed up for implementation. As part of the follow up process, a crab hatchery is under construction and technicians have been sent to Vietnam for training. Construction of the hatchery has been delayed due to the COVID-19 pandemic. Another 3 sites for ice plants have been identified and technical details completed in cooperation with an ice plant specialist. A plan for sea weed production completed. The consultant for the project is presently stuck in Abu Dhabi due to lack of flight to Myanmar. He has been on a short time engagement for FAO and was ready to start work in May. The project will start as soon as he is back in the country.

A small boat yard started in December and has produced its first fiberglass boat. 2 energy forests have been established and solar panels mounted on school roofs in 2 communities, followed by computer labs with training. 300 solar lamps were distributed to school children and a printer was donated to the school. Because this assessment indicates that the community impacts will be positive, the corresponding risk score is 0.

The PP, WIF, is an NGO, and there is no commercial return from planting mangroves. Therefore, while there are positive social benefits involved as mentioned above, this project does not provide any revenue associated with harvesting mangroves. Thus, this risk factor is not applicable.

1.4 Project Longevity

WIF has signed legally binding contracts with the University of Pathein and Village tract committees for a period of 30 years. The contracts can be further extended for another 30 years and expand more. Three separate agreements between the Government of Myanmar and Project Participants (University of Pathein and Village Tract Committees) provide the commitment of mangrove restoration for over 100 years. The MoU signed between WIF and the Government of Myanmar (Forest Department) provide a legally binding commitment of 100 years for restoring and maintaining the lands. Therefore the scenario creates the legally binding commitment of WIF, University of Pathein and two village tract committees to restore and conserve the project area for 100 years. The relevant documents were reviewed by the DOE during validation and subsequent two verifications and verified to be true. No change since the validation and verification.

The risk rating for this factor is 0.

Project Longevity		
Q	Does the project have a legally binding agreement that covers at least a 100 year period from the project start date?	Yes
Q	What is the project Longevity in years?	30
Q	Legal Agreement or requirement to continue management practice?	Yes
a)	Without legal agreement or requirement to continue the management practice	0
b)	With legal agreement or requirement to continue the management practice	15
Total Project Longevity		0
Note: Total may not be less than zero. Any project with a legally binding agreement that covers at least a 100 year period from the project start date will be assigned a score of zero. Any project with a project longevity of less than 30 years fails the risk assessment		

Total Internal Risk (PM + FV + OC + PL)	0

2 EXTERNAL RISK

2.1 Land Tenure and Resource Access Impacts

The lands that will be restored under the project belong to Magyi, Thabawkan and Thaegone village tracts. The ownership of these lands lies with the Government of Myanmar. The Government has given the lands of Magyi village tract to University of Pathien for a period of 30 years. Lands in Thabawkan and Thaegone have been given to their respective Village Tract Committees for a period of 30 years. This period can be extended for another 90 years. The University of Pathein and the Village Tract Committees of Thabawkan and Thaegone have agreements with WIF for the development of mangrove reforestation/ restoration project. WIF, on behalf of University of Pathein and the Village Tract Committees of Thabawkan and Thaegone will develop the project as a forest carbon project and aim to register the project under the VCS standard. (Agreements between Government and the University and the Village Tract Committees of Thabawkan and Thaegone) and the MoU with WIF was provided during validation and will be provided during verification).

Therefore the ownership and use rights are held by different entities (b). However the project is protected by a legally binding commitment to continue management practices that protect carbon stocks over the length of the project crediting period.

Therefore total risk rating for Land Tenure is 5.

Land and resource tenure		
Q	Are the ownership and resource access/use rights held by the same of different entities?	Different
a)	Ownership and resource access/use rights are held by same entity(s)	0
b)	Ownership and resource access/use rights are held by different entity(s) (eg, land is government owned and the project proponent holds a lease or concession)	2
c)	In more than 5% of the project area, there exist disputes over land tenure or ownership	0
d)	There exist disputes over access/use rights (or overlapping rights)	0
e)	WRC projects unable to demonstrate that potential upstream and sea impacts that could undermine issued credits in the next 10 years are irrelevant or expected to be insignificant, or that there is a plan in place for effectively mitigating such impacts	5

f)	**Mitigation:** Project area is protected by legally binding commitment (eg, a conservation easement or protected area) to continue management practices that protect carbon stocks over the length of the project crediting period	-2
g)	**Mitigation:** Where disputes over land tenure, ownership or access/use rights exist, documented evidence is provided that projects have implemented activities to resolve the disputes or clarify overlapping claims	
Total Land Tenure [(a or b) + c + d + e + f +g)]		**5**

2.2 Community Engagement

Lands belonging to the project have been categorized as severely degraded and not containing any forest by the Regional Ministry of Agriculture, Livestock, Natural Resources & Environment. The project generates net positive impacts on the social and economic well-being of the local communities as mentioned in Section 1.3. The VCS PD and subsequent two Monitoring Reports provides further evidence and hence the risk rating for this mitigation factors is -5.

During the year 2019/2020 the following community engagement activities were conducted (Annex 9)

1. 10 months training program for 24 candidates from the local communities in Social Entrepreneurship. After successful training the candidates were requested to propose new enterprises in the area. Ideas like bee honey production, clams production, a small yard for boat building, production of energy saving stoves, sea weed production, virgin coconut production, ice plant for fishing industry, aquaculture projects with emphasis on crab farming will be followed up for implementation.
2. As part of the follow up process, a crab hatchery is under construction and technicians have been sent to Vietnam for training. Construction of the hatchery has been delayed due to the COVID-19 pandemic.
3. 3 sites for ice plants have been identified and technical details completed in cooperation with an ice plant specialist. Ready for implementation as soon as electricity is available by end of 2020.
4. A plan for sea weed production completed. The consultant for the project is presently stuck in Abu Dhabi due to lack of flight to Myanmar. He has been on a short time engagement for FAO and was ready to start work in May. The project will start as soon as he is back in the country.
5. One small boat yard started in December and has produced its first fibre glass boat.
6. Several other projects are in the pipeline. In addition, 2 energy forests have been established and solar panels mounted on school roofs in 2 communities, followed by computer labs with training.
7. 300 solar lamps distributed to school going children. Discussion in establishing 1 health center in Polong community completed with plan to start by end of 2020.
8. Underwater drone for monitoring of sea grass project has been purchased, followed up with training.
9. Ongoing discussions with social entrepreneurs completed training in progress for several potential projects.

Community Engagement		
a)	Less than 50 percent of households living within the project area who are reliant on the project area, have been consulted	0
b)	Less than 20 percent of households living within 20 km of the project boundary outside the project area, and who are reliant on the project area, have been consulted	0
c)	**Mitigation:** The project generates net positive impacts on the social and economic well-being of the local communities who derive livelihoods from the project area	-5
Total Community Engagement [a + b + c]		**-5**

Total Community Engagement Risk Factor is -5.

2.3 Political Risk

According to the historical record of the governance indicators as applied to Myanmar, the average score over the last five years is -1.004. The scores and calculations are presented in Annex 3 and a summary is presented in following table. The rating for this risk factor is 4.

The World Bank Institute Worldwide Governance Indicators are available at:
https://info.worldbank.org/governance/wgi/#home

Indicator	Scores					
	2014	2015	2016	2017	2018	5-year average
Voice and Accountability	-1.40	-1.22	-0.80	-0.87	-0.89	-1.036
Political Stability and Absence of Violence	-1.10	-1.17	-0.80	-1.08	-1.31	-1.06
Government Effectiveness	-1.28	-1.24	-0.98	-1.05	-1.07	-1.092
Regulatory Quality	-1.39	-1.22	-0.87	-0.83	-0.75	-1.16

Rule of Law	-1.19	-1.24	-0.89	-0.95	-1.03	-1.124
Control of Corruption	-0.88	-0.84	-0.62	-0.57	-0.59	-0.78
Annual mean	-1.21	-1.15	-0.83	-0.89	-0.94	-1.004

Source of data: World Bank

Political Risk		
Q	What is the country's calculated Governance score?	-1.004
a)	Governance score of less than -0.79	6
b)	Governance score of -0.79 to less than -0.32	0
c)	Governance score of -0.32 to less than 0.19	0
d)	Governance score of 0.19 to less than 0.82	0
e)	Governance score of 0.82 or higher	0
f)	**Mitigation:** Country implementing REDD+ Readiness or other activities such as: a) The country is receiving REDD+ Readiness funding from the FCPF, UN-REDD or other bilateral or multilateral donors b) The country is participating in the CCBA/CARE REDD+ Social and Environmental Standards Initiative c) The jurisdiction in which the project is located is participating in the Governors' Climate and Forest Taskforce d) The country has an established national FSC or PEFC standards body e) The country has an established DNA under the CDM and has at least one registered CDM A/R project	-2
Total Political [(a, b, c, d or e) + f)]		**4**

f) Myanmar is a UN-REDD partner country since December 2011. Myanmar received UN-REDD targeted support in 2013 to develop a REDD+ Readiness Roadmap and used this Roadmap to develop a funding proposal in November 2013 based on a full UN-REDD National Programme[2] (Annex 4). Myanmar has a DNA (Ministry of Environmental Conservation and Forestry). Therefore, the rating for this mitigation factors is -2.

[2] http://www.unredd.net/regions-and-countries/asia-pacific/myanmar.html

Total Political Risk factor is 4.

3 NATURAL RISK

The following description was in the Non-Permanence Risk Report for the registration, 1st and 2nd verifications and have not changed since. There have not been reported any natural disasters during this verification period hence remains same.

As confirmed in the Fourth Report of the Intergovernmental Panel on Climate Change (IPCC), the increase in the mean temperature of the planet is a fact, and its effects are accelerating (IPCC, 2007d). These changes in the climate are seen worldwide and are translated into storms, hurricanes, floods, droughts, and heavy rains. These processes have repercussions on the dynamic of natural systems, especially on those components linked with human beings and their quality of life (Delgado *et al*., 2004). Recent investigations confirm that in recent decades, the frequency and intensity of these events has increased in comparison with the first decades of the 20th century (Emanuel, 2005; Stern, 2007).

Myanmar is vulnerable to natural disasters such as flooding, drought, earthquakes, cyclones, and communicable and infectious disease outbreaks. Myanmar ranks as one of the most vulnerable countries to the effects of climate change and the impacts of natural disasters are expected to increase in the immediate future.

The country has made significant progress in its disaster management policies, plans, and procedures since 2008, when Cyclone Nargis impacted the country leaving devastation in its aftermath. The Government of Myanmar (GoM) has modified the government structure and created new authorities and plans to improve the effectiveness of disaster management at all levels[3] (Annex 5).

The objectives of this section are:

1) To identify the principal natural phenomena that presents a risk for the implementation of the project

2) To determine the principal risk mitigation measures for the most important phenomena

Myanmar has a monsoon climate, which produces three main seasons, the summer, rainy, and winter seasons. Extreme temperatures are rare, but the directions of winds and depression bring rain. Although rain is heavy in the coastal areas during monsoon season, it seldom creates hardships[4].

1.1 Natural Risk - Fire

1.1.1 Significance

Mangroves are grown in coastal saline or brackish water. The mangroves in the Ayeyarwady Region have not been affected by any forest fire in the past.

[3] http://reliefweb.int/report/myanmar/myanmar-disaster-management-reference-handbook-2017

[4] http://reliefweb.int/sites/reliefweb.int/files/resources/disaster-mgmt-ref-hdbk-burma.pdf

1.1.2 Likelihood

1) Since the ecosystems where mangroves are grown are not susceptible to forest fire, the risk of fire is not applicable to the project area.

1.1.3 Score (LS)

Natural Risk Score (LS)						
		Likelihood				
		Less than every 10 years	Every 10 to less than 25 years	Every 25 to less than 50 years	Every 50 to less than 100 years	Once every 100 years or more, or risk is not applicable to project area
Significance	Catastrophic (70% or more loss of carbon stocks)	FAIL	30	20	5	0
	Devastating (50% to less than 70% loss of carbon stocks)	30	20	5	2	0
	Major (25% to less than 50% loss of carbon stocks)	20	5	2	1	0
	Minor (5% to less than 25% loss of carbon stocks)	5	2	1	1	0
	Insignificant (less than 5% loss of carbon stocks) or transient (full recovery of lost carbon stocks expected within 10 years of any event)	2	1	1	0	0
	Minor (5% to less than 25% loss of carbon stocks)	2	1	1	0	0
	No Loss	0	0	0	0	**0**

1.1.4 Mitigation

Since the risk rating is 0, no mitigation activities are discussed here.

1.2 Natural Risk – Pest & Disease outbreaks

Pests and diseases are insects or pathogens that cause mechanical or physiological damage to trees such as deformations, growth reduction, weakening or even death, resulting in very important ecologic, economic and social impacts. Although they are considered one of the principal causes of disturbance to the plantation sector in the country there are no known pest and disease outbreaks applicable for mangroves in the area.

1.2.1 Significance

There are no reported pest attacks in the coastal mangrove area. However there have been few pest attacks in Sonneratiaceae family and Avicenniaceae family in the delta mangrove area. There is no reported insect 'tide watching mangrove moth' Aucha velans. There are reports of some propagules and seedlings in young stage being attacked by crabs but the significance is insignificant.

1.2.2 Likelihood

As a conservative measure it is estimated that there is likelihood for a pest or disease outbreak to occur in less than every 10 years time.

1.2.3 Score (LS)

Natural Risk Score (LS)						
		Likelihood				
		Less than every 10 years	Every 10 to less than 25 years	Every 25 to less than 50 years	Every 50 to less than 100 years	Once every 100 years or more, or risk is not applicable to project area
Significance	Catastrophic (70% or more loss of carbon stocks)	FAIL	30	20	5	0
	Devastating (50% to less than 70% loss of carbon stocks)	30	20	5	2	0
	Major (25% to less than 50% loss of carbon stocks)	20	5	2	1	0
	Minor (5% to less than 25% loss of carbon stocks)	5	2	1	1	0
	Insignificant (less than 5% loss of carbon stocks) or transient (full recovery of lost carbon stocks	**2**	1	1	0	0

	expected within 10 years of any event)					
	Minor (5% to less than 25% loss of carbon stocks)	2	1	1	0	0
	No Loss	0	0	0	0	0

1.2.4 Mitigation

Pest and disease outbreaks are also preventable using proper measures. The staff of WIF has experience in implementing mitigation activities, which will be the following:

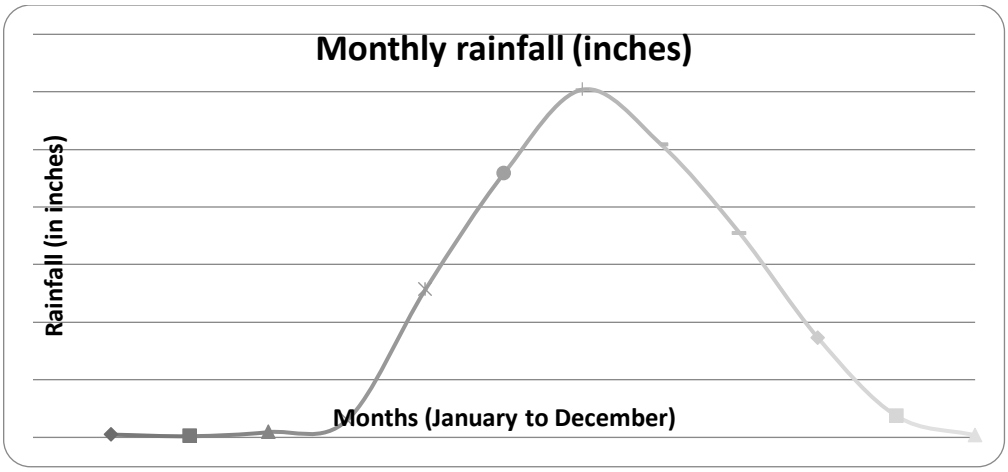
a. Training - Training regarding the identification of the principal species that affect the health of the planted trees. Training will be conducted by personnel with experience in the identification of pests and diseases that harm mangroves.
b. Monitoring – Project proponent will be in charge of monitoring the health of the planted trees. In addition, annual monitoring activities will be implemented. The objective is to identify the presence of pests and diseases in the planted trees.
c. Evaluation - The incidence and severity of pests and diseases identified in the field will be determined during annual monitoring.

Due to the implementation of these activities, a mitigation factor of 0.50 is selected, resulting in a risk rating of 1.00 for pest and disease outbreaks.

1.3 Natural Risk – Extreme Weather

1.3.1 Significance

Rain & Floods - 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. Heavy rains with thunder usually occur in the coastal region during the afternoons and late nights of April and May.



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

Flooding has always been one of the major hazards in Myanmar, accounting for 11% of all disasters, second only to fire. Between 1910 and 2000, there were 12 major floods.

Different types of floods can be seen in different areas of Myanmar:

- ***Riverine floods*** in the river delta;
- ***Flash floods*** in the upper reaches of the river systems, normally the mountainous areas, caused by the heavy rainfall striking at head water region for considerable period of 1-3 days.
- ***Localized floods*** in urban area due to a combination of factors such as cloudburst, saturated soil, poor infiltration rates and inadequate or poorly built infrastructure (such as blocked drains) and in rural areas due to the breakage of water resistance structures as dams, dykes and levees
- ***Flooding due to cyclone and storm surge*** in the coastal areas

In general, the catchment areas of major rivers in the north and central zone are prone to riverine floods. The Southern Delta faces riverine floods when there is flood tide and high river water flow at the same period. In these areas, the lands are protected from floods by earthen dykes, but there were times when flood overpower the dykes and cause losses of lives and properties.

Following table indicates the past major flood events from 1997 to 2007. None of these floods have affected the project area and nearby.

S/N	Location	Date	No. of Affected Village Tracts and Villages	No. of Affected Households	No. of Affected Families	Affected Population	Deaths	Loss X 100,000 kyats
1	Homalin, Sagaing Division	8/7/97	5 villages in 2 wards	9,916	9,950	59,594	-	99(9000 USD)
2	Homalin, Sagaing Division	25/9/97	63 villages	3,867	3,867	28,399	-	238(21,636 USD)
3	Paungpyin Sagaing Division	11/7/97	5 villages	6,652	6,652	44,143	2	-
4	No. 2 Myoma Ward, Mawlaik, Sagaing Division	13/7/97	16 villages	3,622	36,22	21,897	-	-

5	No. 10 Myopaw Ward, Myikyina Township, Kachin state	9/7/97	10 villages	4,254	4,471	30,615	4	33(3,000 USD)
6	Kayan Township Yangon Division	7/6/97	-	1,189	1,189	5,878	-	-
7	Bago Division	7/7/97	All villages in 6 townships	6,629	6,629	33,768	50	-
8	Kayin State	1/8/97	All villages in 5 Townships	18,804	18,855	109,840	-	-
9	Hpa-an, Kayin State	13/8/91	6 villages	2,669	2,669	14,488	-	-
10	Kyauktaw, Rakhine State	10/7/97	-	1,030	1,030	5,983	-	50(4,545 USD)
11	Wundwin, Mandalay Division	2/6/01	Thetaw village	463	1,164	2,172	42	-
12	Monywa, Sagaing Division	18/8/02	-	9,178	9,460	48,746	-	2,535 (213,909 USD)
13	Salingyi Township Sagaing Division	18/8/02	-	1,647	1,702	10,216	-	-
14	Kani Township, Sagaing Division	19/8/02	-	2,042	2,207	12,048	-	2,447(222,454 USD)
15	Kyaikmaraw Township, Mon Division	19/8/02	-	829	829	4,686	-	414(37,636 USD)
16	Hta/16 Ward,	8/9/02	-	886	886	4,541	-	-

	Shwepyithar, Township, Yangon Division							
17	Hkamti Township, Sagaing Division	3/7/03	-	1,230	1,536	8,131	-	-
18	Kyaukse District, Mandalay Division	9/10/06	All villages in 4 wards	1,443	1,763	7,045	-	351(31,909 USD)
19	Sagaing Division	11/9/06	6 villages near Yaymyetgyi Lake	770	791	5,372	-	-
20	Kyaukpadaung Township, Mandalay Division	9/10/06	2 villages	14	18	97	16	-
21	Bhamo, Shwegu, Myitkyina Townships, Kachin State	24/7/07	-	600	600	3,167	-	-

Cyclones

Cyclones have historically caused the most destruction of natural disasters in Myanmar. During the period of 1947 to 2007, 34 cyclones crossed Myanmar coast, of which 7 cyclones claimed lives (Hazard Profile of Myanmar, 2009). Strong winds and storm surges (flooding) associated with the cyclones have caused the most damage. Of the cyclones that caused the greatest disaster, 11 of them made landfall in Rakhine State and 2 in the Ayeyarwady Delta Region. The most devastating cyclone by far was Cyclone Nargis of 2008.

Cyclone risk is highest during the month of May; though, during the last 100 years cyclones also have occurred during April, October, November and December.

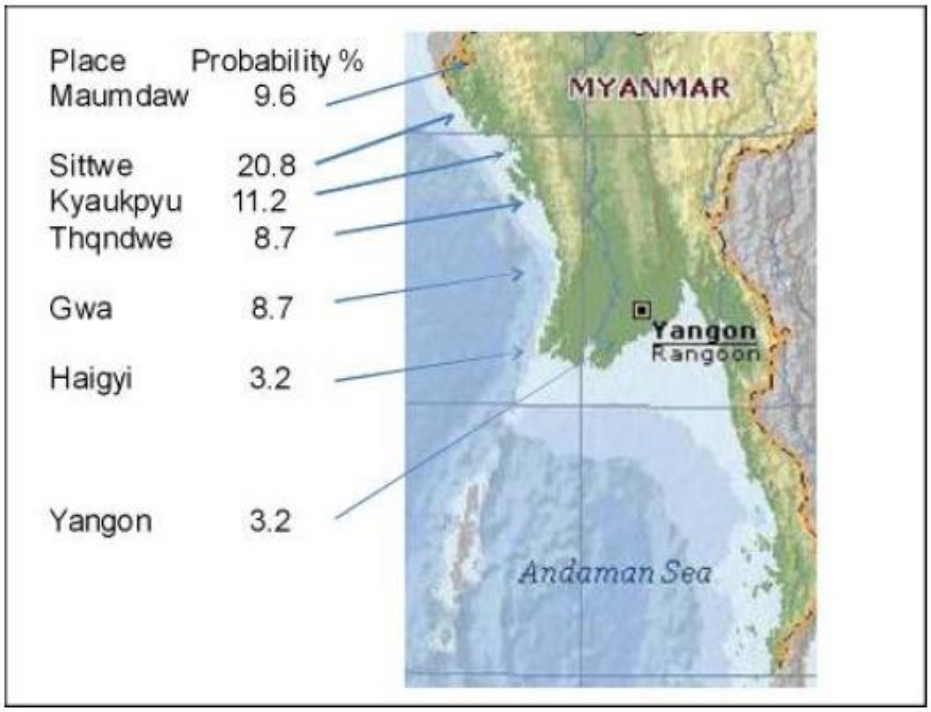
Summary of Existing Investigations of Cyclone in Ayarwady Region and Rakhine coastal region

Date	Location	Cyclone Name
May, 2013	Northen coast of Rakhine	Viyaru
October, 2010	Northen coast of Rakhine	Giri
May, 2008	Ngapadudaw, Labutta, Mawlayeinkyine	Nargis
May, 2007	Northen coast of Rakhine	Akash
April, 2006	Irrawaddy, Southen coast of Rakhine	Mala
May,1975	Pathein	Pathein

1.3.2 Likelihood

Referring to scientific data and publications, it is likely that the region may affect from cyclones and other extreme weather conditions. To be conservative it is expect an extreme weather event once in every 10 - 25 years.

Cyclone landfill probability along Myanmar Coast (1947 – 2008)



Storm surge –

Storm surge is an extraordinary flooding due to a storm. It generally occurs due to waves generated by the strong wind in tropical revolving storms. The slope of the coastline is considered as one of the important factors controlling the intensity of storm surge.

According to the distribution of Storm surge hazard potential (in percent) of Townships in Ayeyarwady Division in the report Hazard Profile of Myanmar (2009) the project area (Pathein) has a 90% of low hazard potential due to storm hazard.

Hazard Zones	Low	Moderate	High	Very High
Ayeyarwady Division				
Bogale	0	15	60	25
Einme	100			
Kangyidaung	100			
Kyaiklat	55	45		
Kyaunggon	100			
Laputta	15	20	40	25
Maubin	100			
Mawlamyinegyun	50	30	20	0
Myaungmya	95	5		
Ngaputaw	60	12	15	13
Pantanaw	100			
Pathein	90	10		
Pyapon	0	25	55	20

1.3.3 Score (LS)

Natural Risk Score (LS)						
		Likelihood				
		Less than every 10 years	Every 10 to less than 25 years	Every 25 to less than 50 years	Every 50 to less than 100 years	Once every 100 years or more, or risk is not applicable to project area
Significance	Catastrophic (70% or more loss of carbon stocks)	FAIL	30	20	5	0

	Devastating (50% to less than 70% loss of carbon stocks)	30	20	5	2	0
	Major (25% to less than 50% loss of carbon stocks)	20	5	2	1	0
	Minor (5% to less than 25% loss of carbon stocks)	5	2	1	1	0
	Insignificant (less than 5% loss of carbon stocks) or transient (full recovery of lost carbon stocks expected within 10 years of any event)	2	1	1	0	0
	Minor (5% to less than 25% loss of carbon stocks)	2	1	1	0	0
	No Loss	0	0	0	0	0

1.3.4 Mitigation

Mangrove species are quite adaptable for extreme weather events such as cyclones. An article published by Bahinipati & Sahu (2012) mention that studies have emerged at the global level, particularly following the aftermath of the 2004 Indian Tsunami, showing the importance of coastal vegetation in the context of reducing physical impacts. Tri et al. stated that mangrove planting is a 'win-win' solution for reducing future cyclonic risk and minimizing vulnerability in Vietnam. Adger et al. highlighted that the force of Tsunami waves was reduced by natural barriers like mangroves in Sri Lanka. Further, Dahdouh-Guebas et al. assert that the mangroves play a critical role in storm protection that based on their post-tsunami observations; they argued that it depends on the quality of the mangrove forests[5](Annex 6).

Darryl E. Marois & William J. Mitsch (2015) in their review of coastal protection from tsunami and cyclones provided by mangroves highlighted the results from several numerical and physical models support the mitigating capabilities of mangroves for cyclone storm surges and small tsunamis. Studies on the economic valuation of mangroves have estimated coastal protection to be a major portion of their total value[6].

[5] http://www.indiawaterportal.org/sites/indiawaterportal.org/files/ajedm_paper_chandra_and_nirmal_0.pdf

[6] http://www.tandfonline.com/doi/full/10.1080/21513732.2014.997292

Therefore it is evident that planting mangroves itself is a adaptation measure to reduce the impact of extreme weather events in the project area. The tree replacement program contemplates planting additional mangrove trees to compensate for expected mortality.

The implementation of these measures permits the utilization of a mitigation factor of 0.50, because of which the meteorological risk will be 5.00 x 0.5 = 2.50.

1.4 Natural Risk - Earthquakes

Earthquakes in Myanmar have resulted from two main sources namely:

- The continued subduction (with collision only in the north) of the northward-moving Indian Plate underneath the Burma Platelet (which is a part of the Eurasian Plate) at an average rate of 3.5 cm/yr; and
- The northward movement of the Burma Platelet from a spreading centre in the Andaman Sea at an average rate of 2.5–3.0 cm/yr (Bertrand et al., 1998; Curray, 2005).

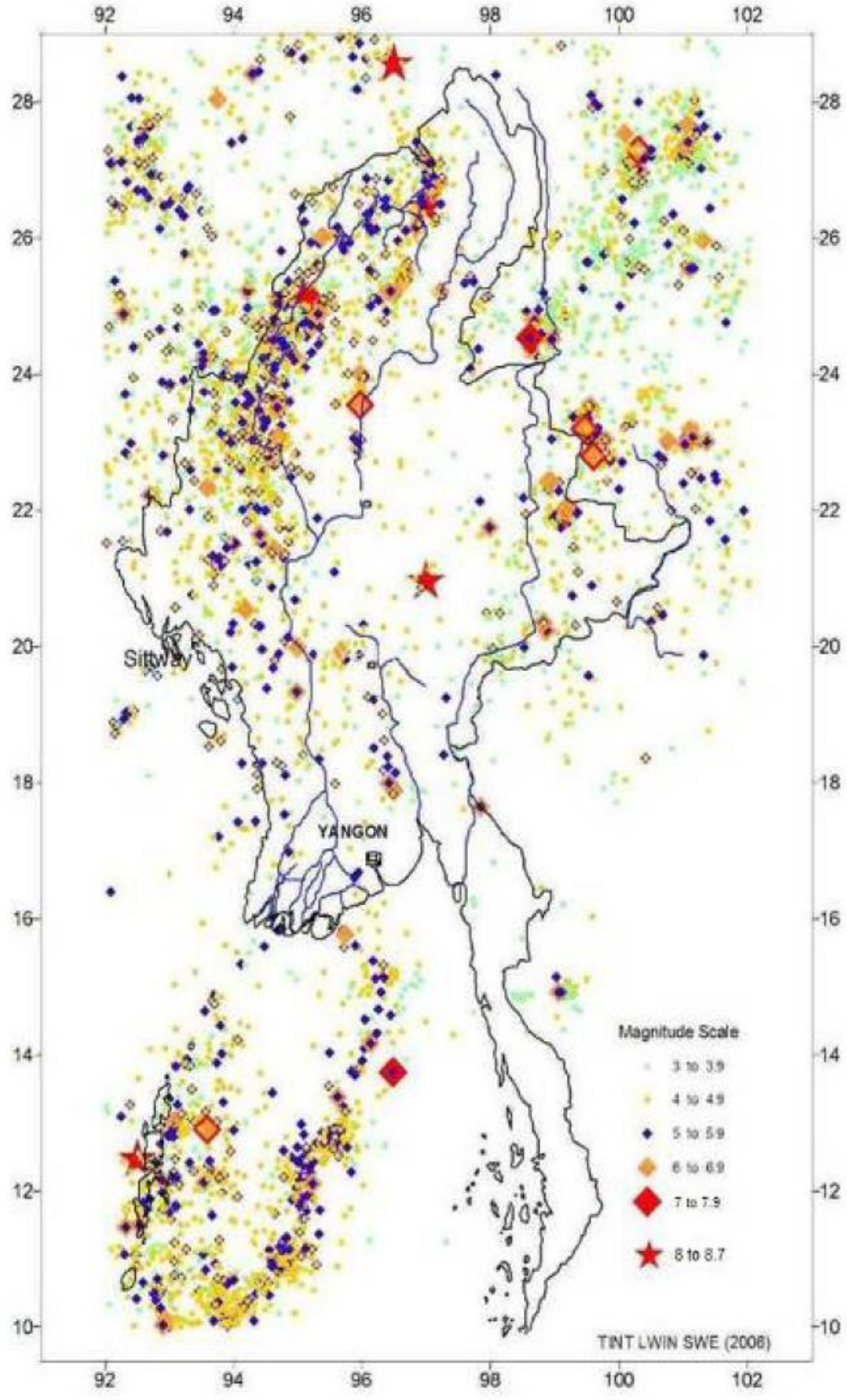
The following map indicates earthquake occurrences in the Myanmar region (Annex 7: Hazard Profile of Myanmar, 2009)

The seismic records show that there have been at least 16 major earthquakes with Richter Scale (RS) ≥ 7.0 within the territory of Myanmar in the past 170 years. The highest intensity zone designated for Myanmar is the Destructive Zone, which is equivalent to Modified Mercalli (MM) class IX. There are four areas in that very vulnerable zone; namely, Bago-Phyu, Mandalay-Sagaing-Tagaung, Putao-Tanaing, and Kale-Homalin areas. Although the latter two have major earthquake hazards, they may be less vulnerable as are sparsely populated.

Important cities and towns that lie in Zone IV (Severe Zone, with probable maximum range of ground acceleration 0.3 – 0.4 g) are Taungoo, Taungdwingyi, Bagan-Nyaung-U, Kyaukse, Pyin Oo Lwin, Shwebo, Wuntho, Hkamti, Haka, Myitkyina, Taunggyi, and Kunglong. Yangon spans the boundary between Zone II and Zone III, with the old and new satellite towns in the eastern part in Zone III, and the original City in Zone II.

Based on scientific studies it can be conservatively concluded that although Myanmar has the risk of earthquakes, the project area has not had any affects from earthquakes during the past hence this natural risk has not been considered.

Earthquake occurrences in the Myanmar region



Earthquake data: from NEIC for 1964 – 2004; from other sources for 1912 – 1963; data are in Richter Magnitude (modified after Tint Lwin Swe, 2006)

1.4.1 Significance

The risk of earthquakes is not applicable to the project area.

1.4.2 Likelihood

The likelihood is not applicable.

1.4.3 Score (LS)

Natural Risk Score (LS)						
		Likelihood				
		Less than every 10 years	Every 10 to less than 25 years	Every 25 to less than 50 years	Every 50 to less than 100 years	Once every 100 years or more, or risk is not applicable to project area
Significance	Catastrophic (70% or more loss of carbon stocks)	FAIL	30	20	5	0
	Devastating (50% to less than 70% loss of carbon stocks)	30	20	5	2	0
	Major (25% to less than 50% loss of carbon stocks)	20	5	2	1	0
	Minor (5% to less than 25% loss of carbon stocks)	5	2	1	1	0
	Insignificant (less than 5% loss of carbon stocks) or transient (full recovery of lost carbon stocks expected within 10 years of any event)	2	1	1	0	0
	Minor (5% to less than 25% loss of carbon stocks)	2	1	1	0	0
	No Loss	0	0	0	0	**0**

1.4.4 Mitigation

Since the risk rating is 0, no mitigation activities are discussed here.

1.5 Natural Risk - Tsunami

1.5.1 Significance

The tsunami induced by the 2004 Sumatra Earthquake (M9.1) caused around 60 missing and dead in the delta area of southern Myanmar. It also caused USD 500 million in losses, corresponding to 1.25% of the GDP at that time. There are other records of tsunamis induced by earthquakes in 1750 and in 1930. The tsunami in 1930 affected around 500 victims in Myanmar[7].

1.5.2 Likelihood

Following is a summary known tsunami that affected the *Ayeyarwady Delta* area.

Date/ Year	Affected Region
1750	Myanmar coast
1930	Myanmar coast
Dec.2004	The delta area of southern Myanmar

According to the reference, likelihood for a tsunami affecting the area is once in 100 years or more.

1.5.3 Score (LS)

Natural Risk Score (LS)						
		Likelihood				
		Less than every 10 years	Every 10 to less than 25 years	Every 25 to less than 50 years	Every 50 to less than 100 years	Once every 100 years or more, or risk is not applicable to project area
Significance	Catastrophic (70% or more loss of carbon stocks)	FAIL	30	20	5	0
	Devastating (50% to less than 70% loss of carbon stocks)	30	20	5	2	**0**
	Major (25% to less than 50% loss of carbon stocks)	20	5	2	1	0

[7] ADB (2005). From Disaster to Reconstruction: A Report on ADB's Response to the Asian Tsunami

EM-DAT: The OFDA/CRED International Disaster Database – www.emdat.be

Japan International Cooperation Agency (JICA) (2012): "Data Collection Survey on ASEAN Regional Collaboration in Disaster Management"

UNDP (2011). Multi-hazard Risk Assessment in the Rakhine State of Myanmar

UNDP (2012). Multi-hazard Risk Assessment in Nargis Affected Areas, Myanmar

	Minor (5% to less than 25% loss of carbon stocks)	5	2	1	1	0
	Insignificant (less than 5% loss of carbon stocks) or transient (full recovery of lost carbon stocks expected within 10 years of any event)	2	1	1	0	0
	Minor (5% to less than 25% loss of carbon stocks)	2	1	1	0	0
	No Loss	0	0	0	0	0

1.5.4 Mitigation

Since the risk rating is 0, no mitigation activities are discussed here.

Overall Non-Permanence Risk Rating and Buffer Determination

Risk Category		Rating
a)	Internal risk	0.00
b)	External risk	4.00
c)	Natural Risk	3.50
Overall risk rating (a + b + c)		**10**
Note: Overall risk rating shall be rounded up to the nearest whole percentage The minimum risk rating shall be 10, regardless of the risk rating calculated If the overall risk rating is over 60 then the project fails the entire risk analysis		
Total Risk Assessment		**10%**

Annexes

- Annex 1 Species distribution
- Annex 2 Management structure
- Annex 3 World Governance Index for Myanmar
- Annex 4 Proof for UNREDD partner country
- Annex 5 Myanmar Disaster Management Reference Handbook 2017
- Annex 6 Mangrove Conservation as Sustainable Adaptation to Cyclonic Risk
- Annex 7 Hazard Profile of Myanmar 2009
- Annex 8 VCS Risk Report Calculation Tool, v3.1
- Annex 9 New Livelihood Initiatives 2019/2020
- Annex 10 Bee keeping training report