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AFoCO Project Document

Project code	*AFoCO/014/2020*

Project Profile			
Project title	**Integrated Pest and Disease Management in Teak Plantations in Bago Region, Myanmar**		
Project duration	Estimated start date: 1 October 2020 Estimated end date: 30 September 2025		
Implementing Agency	Forest Research Institute, Forest Department		
Participating countries	Myanmar		
Project site	West Bago Yoma Region (Pyay and Tharyarwaddy Districts)		
Main objective	To contribute healthy forests and vitality of West Bago Yoma Region through exploring pest and disease lists, their possible control and prevention measures, and enhancing capacity building programme for all stakeholders		
Target Area[1]	Primary Target Area: Priority 3: Introducing systematic management on forest-related disasters Secondary Target Area: Priority 2: Supporting research and development in climate change adaptation approaches		
Budget and source of finance	Total: US$ 955,360 - AFoCO: US$ 955,360 - National: US$ _____ - Others: US$ _____ (to be specified)		
Proponent Profile			
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[1] Refer to the list of target areas which is in accordance with the objectives and prevailing strategic plan of AFoCO (provided by the Secretariat).

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Abbreviations and Acronyms

AFoCO	Asian Forest Cooperation Organization
FRI	Forest Research Institute
PPD	Plant Protection Division
MSDP	Myanmar Sustainable Development Plan
NTFPs	non-timber forest products
FD	Forest Department
NPPO	National Pest Protection Organization
ToRs	Terms of References
RETC	Regional Education and Training Center, AFoCO
UNCED	United Nations Conference on Environment and Development

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SUMMARY

Teak (*Tectona grandis*) naturally grows throughout Myanmar, especially Bago Yoma region, and Teak plantations have been widely established with the Myanmar Reforestation and Rehabilitation Programme. Private sectors have been were allowed to establish teak plantation since a decade, but they are still insufficiently aware of pests and diseases and their impacts. Many records of devastating pest losses are reported in Teak plantations in Myanmar.

In this context, exploring reliable control measures against those pests and diseases, monitoring system and capacity building programme are urgently needed to conduct. Accordingly, the development objective of this project is to contribute to healthy forests and vitality of West Bago Yoma Region through exploring pest and disease lists, their possible control and prevention measures, and enhancing capacity building programme for all stakeholders.

The specific objectives of this project are:

1) To manage sustainably Teak forests through effectively integrated pest and disease management;
2) To improve capacity and facilities for pest and disease research and management for Teak forests; and
3) To create a network for Teak pest and disease management.

The expected outputs are:

1) Seasonal incidence, level of severity and relationship between the outbreaks of pests and diseases with environmental, factors have been investigated;
2) Possible control measures for individual pests and diseases, and monitoring system have been developed;
3) Capacity on the systematic pest and disease management has been built;
4) Diagnostic laboratory and museum in Forest Research Institute (FRI) has been upgraded, and researches have been conducted; and
5) Teak forest pest and disease management Working Group has been formed.

SECTION A. PROJECT CONTEXT

1. Background

Teak is known to be infested by various kinds of insects including leaf feeders and stem borers (Beeson, 1941: Sudheendrakumar, 1994). The most common insect pests that cause severe damage are leaf feeders, sap sucking bugs, shoot borers, stem borers and termites especially in young plantations. The major pests are the teak defoliator *Hyblaea puera* (Lepidoptera: Hyblaeidae) and *Eutectona machaeralis* (Lepidoptera: Pyralidae) (or the closely related *Paligadama stesalis* in some countries), Shoot borer *Zeuzea coffeae* Nietner (Lepidoptera: Cossidae), the sapling borer *Sahyadrassus malabaricus* Moore (Lepidoptera: Hepialidae), and canker grub borer *Acalolepta cervinus* Hope (Coleoptera: Cerambycidae) (Beeson, 1941, Mathur and Singh 1960). Shoot borer *Zeuzera coffeae* causes severe damage; in young plantations (1-5 years old) damaged trees may die back or top break causing a reduction in growth rate and stem quality (Kaosa-ard, 1986). Some fungi and insects are pests of tree seedlings in nurseries.

Myanmar is one of the top ten Teak (*Tectona grandis* Linn.f.) planting countries and in the plantation sector, intensive management is not practiced, apart from weeding during the initial years of establishment and thinning operations. Even-aged, single-species plantations become increasingly susceptible to insect pest infestations as they age. Teak plantations often suffer severe damage from insect and disease attack and outbreak of infestation have been occasionally reported in Myanmar. Research findings, appropriate control measures about those pests and diseases attacked to Teak plantations are still limited although occurrences of those insects might be tremendous. As climate changes over time, outbreaks of new unidentified species of insects and pests might occur in Teak plantations in response to changing climate. In this context, identification of those species and exploring reliable control measures are also urgently needed. Therefore, integrated Teak pest and disease management system is needed to develop by including active participation and collaboration of all relevant stakeholders.

2. Conformity with AFoCO's objectives and strategic priorities

The project will be addressed specifically in consistency with of the objective of AFoCO "To undertake projects and translate sound forest policies and proven technologies into action with a mission to rehabilitate degraded forest land to prevent deforestation and forest degradation in the context of sustainable forest management as well as under scope of addressing the impact of climate change".

Regarding with priority area, this project is in line with strategic priority area 3 "Introducing systematic management on forest-related disasters" and strategic priority area 2 "Supporting research and development in climate change adaption approaches".

The Project proposal focuses on the strategic priority areas of AFoCO, especially the project will cover the following areas:

- Sustainable forest management, biodiversity conservation, maintenance and enhancement of ecosystem services as well as reforestation and forest rehabilitation;
- Capacity building of stakeholders through research and development, sharing experiences, and the transfer of technology as well as education and exchange programs; and
- Reduction of deforestation, forest degradation and the mitigation of the impact of forest-related disasters.

3. Regionality

The project is regional in nature. In the region, key constraints to the management of pest and disease are lack of coordinated body to implement, fund monitoring, control and management activities, insufficient awareness of pest and diseases impacts, and a shortage of research capacity. The project launching and closing workshops could reach all relevant stakeholders with information on the relevance of the project and its contribution to integrated pests and diseases management system improvement for regional communities.

Research findings, publications and technical guidelines from the project will be distributed to relevant target groups such as private sectors of established Teak plantations. Forest Department staff in the region and academic institutions as well. In addition, software for National Information Forest Pest and Disease Management System will be developed to create a network/platform among all stakeholders to effectively implement pest and disease management in the region. In addition, as the people are aware of the role of natural enemies for the bio control of insect pests and diseases, the use of chemical insecticides will be reduced and unwanted outcomes such as insecticide resistance could be overcomed, thus promoted environmentally friendly control methods for pests and diseases. The Project is also very much in line with the *Strategic Plan of Action for ASEAN Co-operation in Forestry (2016-2025) particularly direct related to* ***Strategic Thrust 4-*** *Increase resilience to climate change, natural disasters and other shocks;* ***Strategic Thrust 6-*** *Strengthen ASEAN joint approaches on international and regional issues including forest pests and diseases; and* ***Strategic Thrust 7-*** *Promote sustainable forest management*

In view of the importance of the Myanmar Forestry Sector in ensuring ecological balance and environmental stability, the 1995 Myanmar Forest Policy was formulated in a holistic and balanced manner within the overall context of the environment and sustainable development taking full cognizance of the forestry principles adopted at UNCED. It has identified six imperatives; (a) Protection; (b) Sustainability; (c) Basic needs; (d) Efficiency; (e) Participation; and (f) Public awareness. Moreover, it identified ten important objectives of which the following objectives are particularly relevant to the proposed project.

(a) Forest Research
(b) Forestry Planning
(c) Institutional Strengthening
(d) People's participation and Public awareness

In addition, this project is related the Plant Pest Quarantine Law (2017) under the Plant Protection Division (PPD), Department of Agriculture, the Ministry of Agriculture, Livestock and Irrigation. The objectives of this law are; (a) To prevent quarantine pests from entering into Myanmar by any mean; (b) To suppress effectively the spread of quarantine pests; and (c) To carry out, if necessary, disinfestation, disinfection treatment of plant or plant product to be exported and the issuance of phytosanitary certificate.

The Forestry Sector in Myanmar is an important role in providing environmental protection particularly those related to climate change. The Myanmar Sustainable Development Plan (MSDP) (2018-2030) provides a long-term vision; a vision that finds resonance in the global sustainable development agenda. The MSDP is structured around 3 Pillars, 5 Goals, 28 Strategies and 251 Action Plans. Pillar 3: People & Planet and Goal 5: Natural Resource & the Environment for Posterity of the Nation will be relevant to our proposed project because it focuses on the legal, institutional and policy frameworks required to better protect and manage our natural environment and ecosystems, through strengthened conservation efforts, improved development and infrastructure planning, and increased enforcement against illegal natural resource related practices, pollution and other harmful activities.

4. Information on project target area

4.1. Geographic information

The principal target project site would be West Bago Yoma Region which covers two main Districts; Tharyarwaddy District and Pyay District. Tharyarwaddy District is located in Bago Region of West Bago Yoma (between the latitude 17° 28' to 18° 48' N and longitude 95° 09' to 96° 05' E), Myanmar. It is 1,794,151ac (726,067 ha) in size and is composed of 8 Townships, namely; Tharyarwaddy, Letpadan, Minhla, Monyo, Okhpo, Gyobingauk, Zigon and Nattalin Townships. Pyay District is also located in Bago Region of West Bago Yoma (between the latitude 18° 20' to 19° 22' N and longitude 95° 06' to 97° 66' E), Myanmar. It is composed of 6 Townships, namely; Pyay, Paukkhaung, Padaung, Paungde, Thegon and Shwedaung Townships covering an area of 1,898,456 ac (768,278 ha). The project area will include 8 different areas, 4 areas in Tharyarwaddy District and 4 areas in Pyay District. The main criteria for selecting different plantation areas will be based on the age of plantations (young and old plantation) and the types of plantation (Government or Private Teak plantation).

The altitude of the project site is between 300 m and 800 m. The geographical formation of Bago Yoma Region consists mainly of tertiary sedimentary rock. The region consists of beds of slate-clay and sandstone. The slate-clays weather easily and form a clayey soil, which dries out and becomes hard in the weather. The sandstone varies from a yellow soft stone, which appears to yield a soil very suitable for Teak, to a much more resistant greenish micaous homogenous rock. Throughout the Bago Yoma Region, the rocks are folded and dip in all directions. Most of the forest soils on the top are therefore of a skeletal nature. On the lower slopes, the soils are deeper, moister and more fertile because of accumulation of wash from the top and slopes.

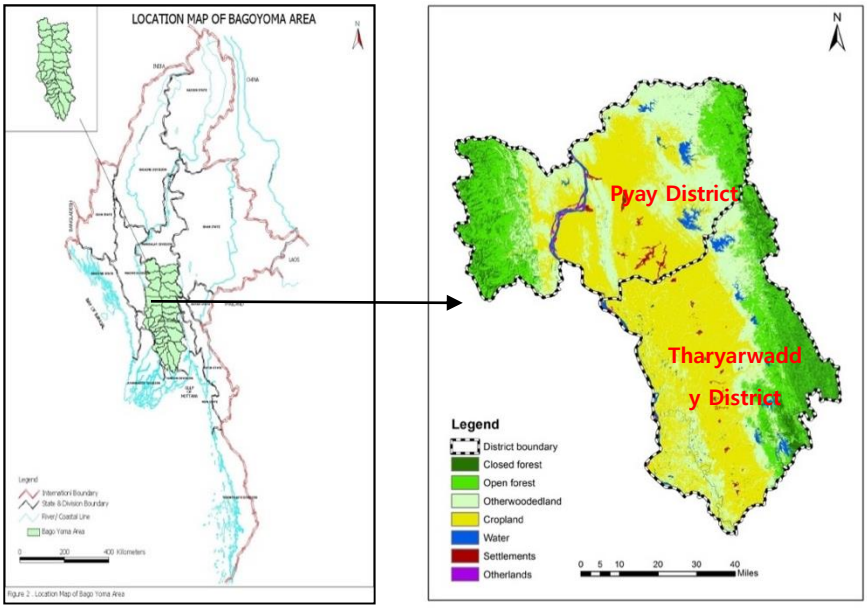

Figure 1. Location Map of Project Site

4.2. Environmental information

The project site has a tropical monsoon climate with a rainy season and a pronounced dry season. There is pronounced rainy season from May to October with ample rainfall coming from the Bay of Bengal. There are 6 well-marked dry months from November to May in the study site while wet from the end of May to October with a maximum rainfall in July and August. In Tharyarwaddy District, average rainfall is about 84.33 inches (2,141. 98 mm) and average temperature is about 27.02 ºC while average rainfall is about 62.04 inches (1,575,82 mm) and average temperature is about 32.45 ºC in Pyay District.

Deciduous forest is a major forest type in the project site. However, within this type of forest an intricate mosaic pattern of moist deciduous forest, semi-evergreen forest and patches of dry deciduous forest areas can also be found. The different forest types and dense forest cover contribute to the biological diversity and enhancing ecosystem services. Total forest land use percentages to the whole area of District of Tharyarwaddy and Pyay are 36.89 % and 35.40 % respectively (Forest Department, 2015). The total existing plantation area of Tharyarwaddy and Pyay Districts is shown in Table (1)

Table 1. Plantation area of Tharyarwaddy and Pyay Districts

No.	Plantation Types	Tharyarwaddy (1981-2015)		Pyay (1957-2015)	
		Area (ha)	Area (%)	Area (ha)	Area (%)
1.	Village Supply	6,394	10.19	8,809	13.51
2.	Watershed	6,333	10.09	10,704	16.41
3.	Industrial	385	0.61	4,700	7.21
4.	Commercial (Hardwood)	3,535	5.63	1,773	2.72
5.	Commercial (Teak)	41,338	65.86	36,644	56.19
6.	Private (Teak)	4,217	6.72	2,388	3.66
7.	Private (Hardwood)	491	0.78	201	0.30
8.	Private (Rubber)	69	0.12	-	-
	Total	62,762	100	65,219	100

Source; Forest Department, 2015

Myanmar is playing a significant role in the global Teak trade. After India and Indonesia, the country has the third-largest planted Teak area in the world (about 390,000 ha), which accounts for more than 40 percentage of the global Teak. Teak trading is important for Myanmar but in some Teak plantation areas, the quality of Teak declines due to the outbreak of pest and disease.

4.3. Socio-Economic information

According to 2014 Census, the total population of Tharyarwaddy District is about 911,936 with total number of 399 villages and 226,085 households. The male population constitutes 47.89 % while the female takes 52.11 %. In Pyay District, the total population is about 910,902 with total number of 289 villages and 176667 households. The percentage of male and female population is 47.71 % and 52.29 % respectively. There are more male-headed households than female-headed households; males are seldom recorded as spouses. Literacy is an important indicator of social development and such high levels of literacy across the Districts indicate development in most parts of the region because every village has at least primary school and Buddhist monastery. Therefore, literacy rate is as high as 95 percent in the Districts like other parts of the country. Every community has a chief and his elders which is hereditary. They also have elected Community Committee members with the guidance of elders, Buddhist monks and authority.

The mainstay in the rural area is subsistence farming. The average farm sizes of agricultural crops range between one and ten acres. The major food crops grown are rice, variety of beans, sugarcane, groundnut and sesame. Rural communities in the area are largely dependent on forest resources for their livelihood. Most of the local people collect fuelwood, poles and posts, non-timber forest products (NTFPs), bamboos, medicinal plants, etc. from the forests for subsistence consumption. Moreover, the communities living around and close to the forest areas are directly involving in forest-based jobs such as logging activities, plantation establishment and other restoration activities. In fact, the economy of the project site is mixed consisting of large traditional agricultural sector made up of mostly small-scale peasant farmers, also dependent on NTFPs harvesting and processing, a growing informal sector of small

business, artisans and technicians and an insignificant proportion in the processing and manufacturing sector.

SECTION B. RATIONALE AND OBJECTIVES

1. Rationale

1.1. Stakeholder analysis

Many records of devastating pest and disease losses are reported in Teak plantations. Problems encountered in Teak plantations such as insects, pests, diseases and natural disasters should be aware by all stakeholders of private Teak plantations. Active participation of all stakeholders in pest and disease control and extension activities is essential. Nowadays, pest and disease management affect different sectors of society and must be implemented by a range of stakeholders. Although Forest Research Institute and Forest Department as responsible governmental organizations are major players for forest health and pest & disease management, other line governmental organizations, private sector and local communities should also be recognized as important actors. Awareness of all stakeholders should be raised and their participation should be enhanced in the implementation process of this project. Distributions from the proposed project would also be beneficial to all tree growers for development of healthy Teak plantations in order to support economic development of the country. All Teak plantation growers from different Regions/States who are encountering similar pest and disease problems could be engaged in the training, workshop, extension and visiting the study sites under the project.

Stakeholder mapping and analysis was conducted by group of researchers who have experienced in the pest management through identifying stakeholders, categorizing stakeholders, and investigating relationships between stakeholders. A matrix of stakeholder analysis is as follows;

Table 2. Stakeholder analysis table

Stakeholder group	Characteristics	Problems, needs, interests	Potential benefits	Involvement in the project
Primary stakeholders				
Ministry of Natural Resources and Environmental Conservation	Key element in the whole management of planted teak forests	Limited human resource capacity, limited technology, need to develop forest pest and disease management system, interest in contributing healthy forests and vitality	Decision maker, key player for planning and decision-making processes	Facilitate discussion, preparation and formulation of project proposal, provide general guidelines for overall management, take leading role in implementing and disseminating project

Stakeholder group	Characteristics	Problems, needs, interests	Potential benefits	Involvement in the project
				outcomes
Forest Research Institute (FRI) /Forest Department (FD)	Key element in the technical aspect of whole project	Limited human resource capacity, gap generation, limited technology, limited budget, need to upgrade researcher's capacity and to develop forest pest and disease management system, interest in developing healthy Teak forests management through international organization	Key role in research and educational development in forestry sector	Take as leading organization for all proposed project activities (facilitate discussion, preparation and formulation of project proposal, take leading role in the dissemination of project findings as lessons learned for other sites, etc.)
Private Teak Plantation Companies	Key element in the management of private teak forests	Poor knowledge and skills, low level of awareness about pest and diseases, need to know the control measures and monitoring system for pest and disease, Interest in successful establishment of healthy Teak plantations	Key role in investment for reforestation and afforestation programme	Cooperation in the operational activities particularly in establishing demonstration plots, survey, monitoring, and participating in capacity building program for pest and disease management system
Secondary stakeholders				
Local Communities (communities	Involving in teak plantation establishment	Lack of knowledge and skills, lack of	Important player to implement	Involve in capacity building

Stakeholder group	Characteristics	Problems, needs, interests	Potential benefits	Involvement in the project
living in the surrounding area of West Bago Yoma Region)	and maintenance process	awareness about pest and diseases, less opportunities to communicate with Government officials, need to know the control measures, Interest in healthy Teak plantations establishment and getting knowledge	project and inspect pest and disease problems	program, help in surveying, demonstration plot establishment and monitoring pest and disease management
University of Forestry and Environmental Science	Prominent institution in the exchange of knowledge, technologies	Limited research facilities, Need to access updated information, Interest in exchanging knowledge and technologies for pest and disease management,	Important role to produce well-trained foresters to manage healthy forests	Involve in the technical cooperation and coordination required for pest and disease management, participate in conducting research
AFoCo RETC/ Central Forestry Development Training Centre	Prominent institutions in the development of technologies, methodologies, capacity building center	Limited capable resource persons, need to access to updated information and resource persons to teach trainees, Interest in developing technical guidelines and knowledge sharing	Important role to produce well-trained Government staff and Private to manage healthy forests	Involve in the technical cooperation and coordination required for pest and disease management, involve in developing technical guidelines, involve in establishment of demonstration site

Stakeholder group	Characteristics	Problems, needs, interests	Potential benefits	Involvement in the project
Department of Agriculture	Participation in forest related pest and disease management	Weak coordination and cooperation with other ministries and agencies, need to exchange technologies, and management system, interest in pest and disease management in forestry sector	High potential to cooperate with Forest Department in transferring technologies, methodologies for pests and disease problems	Involve in identification of pest and disease, exchange technologies, and extension activities, involve in developing technical guidelines
Small growers managing Teak forests	Involving in Teak forests management	Low level of awareness, knowledge and skill about Teak pest and disease, need to know the control measures and monitoring system for Teak pest disease problems, Interest in healthy Teak forests establishment and maintenance	High potential in more investment on Teak forests establishment	Involve in capacity building program, surveying, controlling and monitoring pest and disease
Tertiary and other stakeholders				
Primary/Middle and High Schools in West Bago Yoma Region	Active participation in environmental conservation	Limited knowledge, low level of awareness about pests and diseases, interest in forest pest and diseases	High potential, new generation to conserve healthy forests and enhance economic development from Teak forests	Involve in forest and education programs (public talk, extension, poster and seminar)

Stakeholder group	Characteristics	Problems, needs, interests	Potential benefits	Involvement in the project
Local Authority	Authorized body to monitor and coordinate every affair including forestry-related matters	Limited knowledge, low level of awareness about pest and disease, need to understand pest impacts, control measures and management system, Interest in local development through project	Key player to coordinate relevant Ministries, organizations and stakeholders	Involve in the coordination mechanism among different stakeholders

1.2. Problem analysis

Teak (*Tectona grandis*) is one of the most well-known timbers of the world. It is native to the Indian-Burmese floristic region and found naturally in India, Myanmar, Thailand and Lao (Mehn Ko Ko Gyi, 1972). Due to its high timber qualities, market demand, ease of domestication and cultivation, Teak plantations have been widely established throughout the tropics. Myanmar has launched a Special Teak Plantation Program in 1998 which has an annual plantation target of 8,000 ha in addition to the normal plantation scheme (Forest Department, 2000). With the private sector coming in a big way into Teak cultivation in the 2010s, many intensively grown Teak plantations came into existence. Being the nature of monoculture, Teak plantations have been facing with the infestation of various pest and disease as tree grows.

Pest and disease damage are a serious problem, and it has the potential to destroy Teak plantations if no measures are taken to manage it. The most common insects which cause severe damage are defoliators, stem borers, and beehole borer. The teak defoliator, *Hyblaea puera*, recorded in three of the selected countries (India, Indonesia and Thailand) is also a pest in Australia, Bangladesh, Cambodia, China, Fiji, Japan, Lao People's Democratic Republic, Malaysia, Myanmar, Nepal, Papua New Guinea, the Philippines, Samoa, the Solomon Islands, Sri Lanka and Viet Nam (Nair, 2001; Chandrasekharet al., 2005). After outbreaks of defoliators, the plantation growth rate may be reduced by as much as 75% (Chaiglom, 1963). Stem borers cause severe damage in young plantations (1-5 years old). A pest of naturally regenerated and planted forests, the beehole borer, *Xyleutes ceramica*, was recorded in Indonesia and Thailand and is also known to be a pest in Myanmar. The beehole borer (*Xyleutes ceramicus*) is a serious pest in Myanmar and Thailand (Beeson, 1941), which also attacks *Gmelina arborea*. Diseases such as stem canker and foliage diseases, mainly leaf rust and yellowing were common. Besides, incidence of basal root disease was reported in Teak plantations (Departmental Report, 2017 and 2018). The disease was observed to aggressively kill the trees. At present, there is

still lack of research findings/studies which can prove the impacts of pest and disease problems on the Teak plantation establishment in the ways of economic, social and environmental aspects. Silvicultural, systemic chemical, biological control methods, and all combined control measures would apply to control and prevent the damages of pest and diseases.

As climate changes over time, outbreaks of new unidentified species of insects and pests might occur in Teak plantations in response to changing climate. In this context, identification of those species and exploring reliable control and prevention measures are also urgent needs in Myanmar. On the other hand, it could be found that there is also lack of systematic monitoring for pest and disease problem in both Government and Private plantations. Moreover, the plantation growers are still insufficiently aware of pest and disease impacts, and control methods for that. Other key constraints to the management of pest and disease are lack of coordinated body to implement, fund monitoring and management activities.

In Myanmar, Plant Protection Division, NPPO (National Pest Protection Organization) under Ministry of Agriculture, Livestock and Irrigation has signed to IPPC (International Plant Protection Convention) in 2006 and is acting as national repository for plant pest records. The major task is to undertake food safety and phytosanitary measures, pesticides management and control, pest management and extension education and field services. Our Ministry of Natural Resources and Environmental Conservation is one of the members of Pesticide Registration Board which has been formed in 1992. Even though NPPO is mainly focusing on agricultural pests, they should also be responsible for gathering and maintaining information of forest pest and disease from Forest Department, research institutions, land managers and public. Here, Forestry Sector need to provide a variety of up-to-date data sources through monitoring pest and disease conditions, and reporting to the NPPO. In order to support this effort, a well-organized network within public, private and Government is needed.

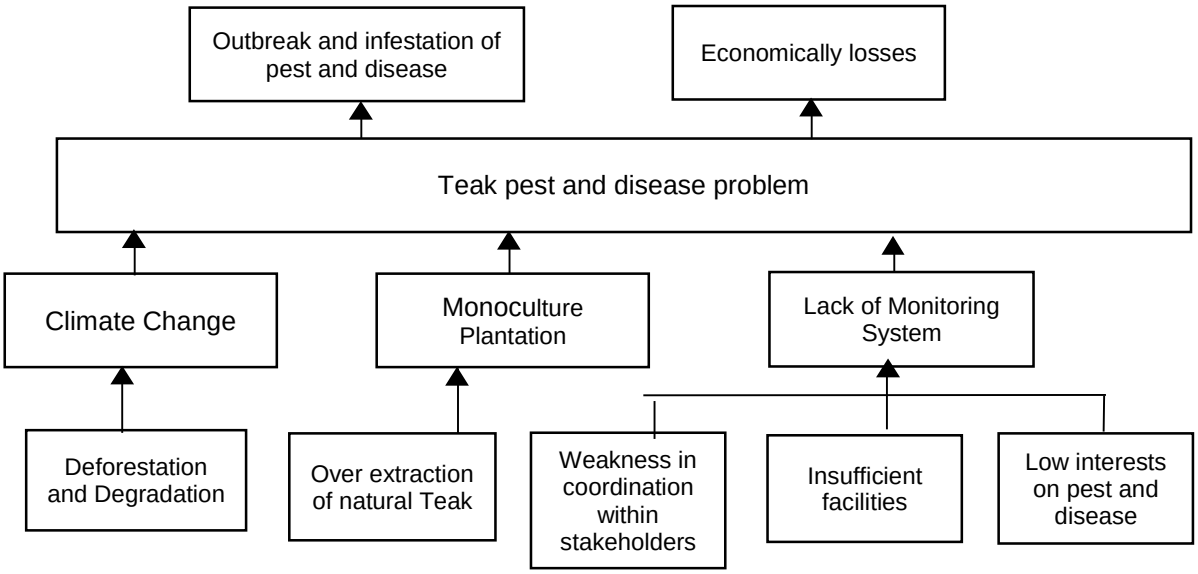

Figure 2. Problem tree

1.3. Logical framework matrix

Table 3. Logical framework matrix

	Narrative	Objectively Verifiable Indicators	Means of Verification	Assumptions
Activities	1.1 Carry out preliminary survey and identification of pests and diseases 1.2 Develop Teak pest and disease list including damage symptoms, level of severity and their relationship with environmental factors 2.1 Carry out regular pest survey 2.2 Manage outbreak, detect, and monitor pests and diseases 2.3 Establish demonstration plots 2.4 Prepare and publish technical guidelines for control and prevention of pests and diseases 2.5 Develop software for National Information Forest Pest and Disease Management System 3.1 Build capacity for integrated pest and disease management through workshops, trainings, study tour and lesson learned 3.2 Prepare and develop pest and disease management curriculum for training institutions 3.3 Develop publications on forest pest and disease management in Myanmar			Full and effective participation of all relevant stakeholder in each activities of this project

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	Narrative	Objectively Verifiable Indicators	Means of Verification	Assumptions
	3.4 Facilitate equality of women and men with regard to participation and implementation 4.1 Update Forest Protection Lab, Forest Protection Museum of FRI 4.2 Conduct research activity and disseminate findings to Forest Department and private sector 5.1 Form Working Group for pest and disease management			
Outputs	1. Seasonal incidence, level of severity and relationship between the outbreaks of pests and diseases with environmental, factors have been investigated. 2. Possible control measures and prevention for individual pests and diseases, and monitoring system have been developed	i. Survey and identification of pest and disease conducted by first year ii. Pest and disease list, developed by second year i. Regular survey and outbreak management carried out from second year to final year ii. Demonstration plot established by second year iii. Software for monitoring and reporting pest problems developed by final year iv. Technical guideline prepared and published by	i. List of pest and disease ii. Survey report i. Survey report ii. Demonstration plots iii. Software development iii. Technical guideline development	All relevant stakeholders are willing to support in surveying and exploring pest and disease lists. Well understand among stakeholders on identification of pest and disease species and choose possible protection methods

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	Narrative	Objectively Verifiable Indicators	Means of Verification	Assumptions
		third year		
	3. Capacity on the systematic pest and disease management has been built.	i. Series of trainings, workshops, study tour and field visits organized ii. Pest and disease management curriculum developed by second year iii. Publications on forest pest and disease management in Myanmar developed by final year iv. Gender equality strengthened in participation and implementation	i. Completion report on trainings, workshops, study tour and field visits ii. Curriculum development iii. Publications	All relevant stakeholders are supportive and cooperative Related intuitions are participated in developing curriculum
	4. Diagnostic laboratory and museum in FRI have been upgraded, and researches have been conducted.	i. Diagnosis laboratory and museum in FRI upgraded by first year ii. Researches conducted by second, third and fourth year	i. Upgrading lab ii. Renovating buildings iii. Upgrading museum iv. Paper published	Researchers and related institutions are supportive and cooperative
	5. Teak forest pest and disease management Working Group has been formed and effectively operated.	i. Working Group for pest and disease management formed by third year	i. Forming Working Groups ii. Terms of References (ToRs) ii. Roundtable meetings Reports	All relevant stakeholders are willing to participate in Working Group formation
Objective	1. To manage sustainably Teak forests through effectively integrated pest and disease management	i. Control and prevention programme for the high-impact, high-risk pests and diseases	i. Completion report ii. Pest and disease list iii. Control and prevention programme	Partnerships among key stakeholders are increased in participating

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	Narrative	Objectively Verifiable Indicators	Means of Verification	Assumptions
		would have been established. ii. By 2024, National Information Forest Pest and Disease Management System would have been developed.	iv. Software development for Pest and Disease Management System	in the project activities
	2. To improve capacity and facilities for pest and disease research and management for Teak forests	i. By 2020, Forest Protection Laboratory would have been upgraded. ii. Capacity of FD and that of relevant stakeholders would have been built. iii. Researches for pest and disease would have been conducted.	i. Upgrading of Forest Protection Laboratory ii. Training, workshop, seminar completion reports and proceedings iii. Curriculum development iv. Publication v. Research Papers	Partnerships among key stakeholders are increased in participating in the project activities
	3. To create a network for Teak pest and disease management	i. By 2023, Working Group for pest and disease management would have been formed. ii. By 2024, network between Working Group and NPPO would have been initiated.	i. Formation of Working Group ii. TORs iii. Roundtable meeting and field visit reports	Partnerships among key stakeholders are increased in participating in the project activities
Goal	To contribute to healthy forests and vitality of West Bago Yoma Region through exploring pest and disease lists, their possible control and prevention measures, and enhancing capacity building	i. Outbreak of pests and diseases in Teak plantations and nurseries would have been reduced by at least 50% in 2023.	i. Completion report ii. Collaborative management is run continuously in inclusive manners	All key stakeholders are active to participate and support to systematic pest and

	Narrative	Objectively Verifiable Indicators	Means of Verification	Assumptions
	programme for all stakeholders	ii. Healthy Teak plantation establishment in West Bago Yoma Region would have been developed and practiced by at least 20% in 2025.		disease management

1.4. Justification

In line with the objectives of the project, all activities are designed to address the key problems for the development of integrated pest and disease management through upgrading laboratory, supporting laboratory facilities, exploring pest and disease infestation and their possible control measures, and holding series of trainings, workshops, study tour and awareness raising programme for all relevant stakeholders.

The project will improve technical, methodological and research capacity of researchers from Forest Research Institute and will also develop a well-organized diagnostic laboratory. In addition, the project will be a demonstration of systematic Teak pest and disease management for not only Forest Department staff but also private plantation owners. It is envisaged that this project will ultimately lead to healthy Teak plantation establishment in Tharyarwaddy and Pyay Districts of West Bago Yoma Region. The project in particular will develop the establishment of a sustainable forest pest and disease management system which can contribute to the national information system of the forest pests and diseases. The project will also build the capacity of Forest staff and private plantation owner, and also raise awareness among all relevant stakeholders in the project site on integrated forest pest and disease management. In order to support up-to-date sources of forestry pest and disease management to NPPO, Working Group will be formed and ToRs will be developed under the project.

2. Objectives

2.1 Main objective (development objective)

The development objective of this project is to contribute to healthy forests and vitality of West Bago Yoma Region through exploring pest and disease lists, their possible control and prevention measures, and enhancing capacity building programme for all stakeholders.

Forest health and vitality is one of the globally agreed criteria for sustainable forest management. The maintenance of forest health and vitality is dependent upon the ability of the ecosystem's functions and processes to recover from or adapt to disturbances. Decline in forest

ecosystem health and vitality may have significant economic and ecological consequences for society including a loss of forest benefits and the degradation of environmental quality. To prevent from pest and disease affecting the quantity, quality and ultimately, the marketability of the trees grown, effective, economical and safe long-term pest and disease management is urgently needed in Myanmar. This aspect is the key area being addressed under this project.

2.2. Specific objective(s) and success criteria & indicators

The specific objectives of this project are to manage sustainably Teak forests through effectively integrated pest and disease management; to improve capacity and facilities for pest and disease research and management for Teak forests; and to create a network for Teak pest and disease management.

The project will gather information about the pests and diseases, their biology, the type of damage, symptoms, severity percentage in Teak plantation areas and nurseries in order to record occurrence, infestation, relationship between outbreak of pests and environmental, ecological factors, and develop pest and disease lists. The diagnosis of various Teak diseases under the microscope in the laboratory will also be included in this project. Based on the level of infestation, environmentally sensitive and sustainable methods of control (silvicultural, mechanical, biological and systemic chemicals methods) appropriate to plantations and nurseries will be decided and applied to reduce pest and disease population and subsequent losses. The project will also launch series of capacity building activities such as seminars, trainings and workshops. Sound reporting and monitoring system for National Information Forest Pest and Disease Management System will be developed to get direct cooperation among all stakeholders to effectively implement pest and disease management. Moreover, Working Group for forest pest and disease management will be formed to support NPPO in concerned with pest problems is Forestry Sector.

Success criteria and indicators are as follows:

- By 2021, Forest Protection Lab and Museum in Forest Research Institute would have been upgraded.
- By 2022, Teak pest and diseases list would have been developed.
- By 2023, Working Group for forest pest and disease management would have been formed.
- By 2022 and 2024, Technical guidelines for Teak pest and disease control and suitable & appropriate curricula on pest and disease would have been designed.
- By 2025, Software development for National Informational Forest Pest and Disease Management System would have been set.

Capacity of Forest Department staff, private plantations owners and that of relevant stakeholders would have been built.

[Attachment-A]

SECTION C. DESCRIPTION OF PROJECT INTERVENTIONS

1. Work Plan and Schedule

Outputs	Performance Indicator	Responsible Person/Body	Annual Timeline																								Remarks
			2020				2021				2022				2023				2024				2025				
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
Objective 1. **To manage sustainably Teak forests through effectively integrated pest and disease management**																											
Output 1. Seasonal incidence, level of severity and relationship between the outbreaks of pests and diseases with environmental, factors have been investigated.																											
A.1 Carry out preliminary survey and identification of pests and diseases	Regular report, Survey report, Training report	FRI FD Private plantation				■	■	■	■																		
A.2 Develop Teak pest and disease list including damage symptoms, level of severity and their relationship with environmental factors	Comprehensive description of pest and disease list	FRI									■	■															
Output 2. Possible control measures for individual pests and diseases, and monitoring system have been developed.																											
B.1 Carry out regular pest survey	Regular report, Survey report, Training report,	FRI FD Private plantation Local community							■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
B.2 Manage outbreak, detect, and monitor pests and	Application of different	FRI FD							■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		

[Attachment-A]

Outputs	Performance Indicator	Responsible Person/Body	Annual Timeline																								Remarks
			2020				2021				2022				2023				2024				2025				
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
diseases	control measures, monitoring system for pest and disease population dynamics, Regular report	Private plantation Local community																									
B.3 Establish demonstration plots	Demonstration plots, Regular report	FRI FD Private plantation																									
B.4 Prepare and publish technical guidelines for control and prevention of pests and diseases	Technical guidelines publication	FRI																									
B.5 Develop software for National Information Forest Pest and Disease Management System	Software development	FRI FD Relevant stakeholders																									
Objective 2. **To improve capacity and facilities for pest and disease research and management for Teak forests**																											
Output 3. Capacity on the systematic pest and disease management has been built.																											
C.1 Build capacity for integrated pest and disease management through	Training, workshops and study tour	FRI All Stakeholders																									

[Attachment-A]

Outputs	Performance Indicator	Responsible Person/Body	Annual Timeline																								Remarks
			2020				2021				2022				2023				2024				2025				
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
workshops, trainings, study tour and lesson learned	completion report and proceedings																										
C.2 Prepare and develop pest and disease management curriculum for training institutions	Curriculum development, Training report	FRI Academic Institutions AFoCO RETC																									
C.3 Develop publications on forest pest and disease management in Myanmar	Publication on pest and disease management in Myanmar	FRI FD																									
C.4 Facilitate equality of women and men with regard to participation and implementation	Equal number of male/female representatives in trainings/ workshops/ study tour, Regular report																										
Output 4. Diagnostic laboratory and museum in FRI have been upgraded, and researches have been conducted.																											
D.1 Update Forest Protection Lab, Forest Protection Museum of Forest Research Institute	Upgrade lab, museum, and strengthening capacity of	FD FRI																									

[Attachment-A]

Outputs	Performance Indicator	Responsible Person/Body	Annual Timeline																								Remarks
			2020				2021				2022				2023				2024				2025				
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
	researcher, Regular report																										
D.2 Conduct research activity and disseminate findings to Forest Department and private sector	Research paper publications	FRI Academic Institutions																									
***Objective 3.* To create a network for Teak pest and disease management**																											
Output 5. Teak forest pest and disease management Working Group has been formed and effectively operated.																											
E.1 Form Working Group for pest and disease management	Working Group, ToRs	FRI All relevant Stakeholders																									

2. Budget (USD)

Activity	Budget Allocation by Year (USD)									
	Unit	Unit Cost	Quantity	Total	2020	2021	2022	2023	2024	2025
Objective 1. **To manage sustainably Teak forests through effectively integrated pest and disease management**										
Output 1. Seasonal incidence, level of severity and relationship between the outbreaks of pests and diseases with environmental, factors have been investigated.										
A.1 Carry out preliminary survey and identification of pests and diseases				*27,500*	*3,125*	*24,375*				
A.2 Develop Teak pest and disease list including damage symptoms, level of severity and their relationship with environmental factors				*2,500*			*2,500*			
Sub-total (Output 1)				***30,000***	***3,125***	***24,375***	***2,500***	***0***	***0***	***0***
Output 2. Possible control measures for individual pests and diseases, and monitoring system have been developed										
B.1 Carry out regular pest survey				*31,000*		*6,000*	*9,000*	*9,000*	*4,000*	*3,000*
B.2 Manage outbreak, detect, and monitor pests and diseases				*76,000*		*4,750*	*19,000*	*19,000*	*19,000*	*14,250*
B.3 Establish demonstration plots				*30,000*			*15,000*	*15,000*		
B.4 Prepare and publish technical guidelines for control and prevention of pests and diseases				*3,500*			*250*	*3,250*		
B.5 Develop software for National Information Forest Pest and Disease Management System				*11,000*					*1,500*	*9,500*
Sub-total (Output 2)				***151,500***	***0***	***10,750***	***43,250***	***46,250***	***24,500***	***26,750***

[Attachment-A]

Activity	Budget Allocation by Year (USD)									
	Unit	Unit Cost	Quantity	Total	2020	2021	2022	2023	2024	2025
Objective 2. **To improve capacity and facilities for pest and disease research and management for Teak forests**										
Output 3. Capacity on the systematic pest and disease management has been built.										
C.1 Build capacity for integrated pest and disease management through workshops, trainings, seminars and lesson learned				*66,000*	*7,000*		*5,000*	*17,000*	*10,000*	*27,000*
C.2 Prepare and develop pest and disease management curriculum for training institutions				*24,500*		*600*	*600*	*7,725*	*6,975*	*8,600*
C.3 Develop publications on forest pest and disease management in Myanmar				*3,500*					*125*	*3,375*
C.4 Facilitate equality of women and men with regard to participation and implementation										
Sub-total (Output 3)				***94,000***	***7,000***	***600***	***5,600***	***24,725***	***17,100***	***38,975***
Output 4. Diagnostic laboratory and museum in FRI have been upgraded, and researches have been conducted.										
D.1 Update Forest Protection Lab, Forest Protection Museum of Forest Research Institute				*190,000*	*41,020*	*113,980*	*24,000*	*4,000*	*4,000*	*3,000*
D.2 Conduct research activity and disseminate findings to Forest Department and private sector				*19,500*		*6,500*	*6,500*	*6,500*		
Sub-total (Output 4)				***209,500***	***41,020***	***120,480***	***30,500***	***10,500***	***4,000***	***3,000***
Objective 3. **To create a network for Teak pest and disease management**										
Output 5. Teak forest pest and disease management Working Group has been formed and effectively operated.										

[Attachment-A]

Activity	Budget Allocation by Year (USD)									
	Unit	Unit Cost	Quantity	Total	2020	2021	2022	2023	2024	2025
E.1 Form Working Group for pest and disease management				*33,000*		*5,000*	*5,000*	*9,000*	*5,000*	*9,000*
Sub-total (Output 5)				***33,000***	***0***	***5,000***	***5,000***	***9,000***	***5,000***	***9,000***
Consumable items				*37,500*	*3,315*	*7,500*	*6.060*	*7,500*	*7,500*	*5,625*
Capital Items				*147,500*	*118,500*	*6,250*	*5,000*	*9,000*	*5,000*	*3,750*
Project personnel				*99,000*	*4,950*	*16,200*	*27,000*	*27,000*	*16,200*	*7,650*
Miscellaneous				*20,000*	*1,000*	*4,000*	*4,000*	*4,000*	*4,000*	*3,000*
Project Monitoring and Evaluation				*31,000*	*4,000*	*4,000*	*4,000*	*11,500*		*7,500*
Subtotal (Consumable, Capital and Personnel)				***335,000***	***131,765***	***37950***	***46,060***	***59,000***	***32,700***	***27,525***
In-kind and cash contributions from National and others (Land, office, staff)										
Subtotal (Objective)				***853,000***	***182,910***	***199,155***	***132,910***	***149,475***	***83,300***	***105,250***
Program support (12% of subtotal)				***102,360***						
Grand Total				***955,360***						

SECTION D. IMPLEMENTATION ARRANGEMENTS

1. Organizational structure

The Implementing Agency of the project will be Forest Research Institute, Forest Department of the Ministry of Natural Resources and Environmental Conservation which will be responsible to coordinate with all relevant stakeholders and implement the project activities and also managing the AFoCo fund. The Implementing Agency will be involved in the project from the preparation until completion of the project. The Director General of the Forest Department will provide close supervision and continuous guidance to the implementation team to achieve the project objective.

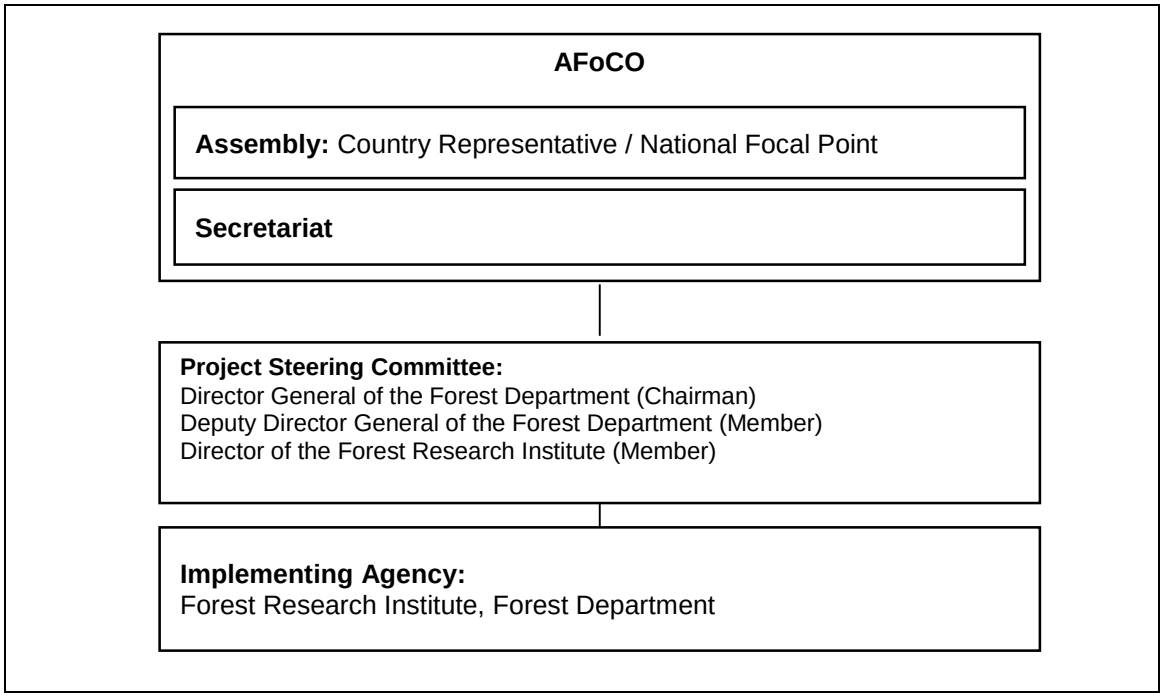

Figure 3. Organizational chart

2. Staff resource plan

The project implementation team will be formed with experts and scientists from Forest Research Institute, Forest Department staff and private Teak plantation owner from project area under the close supervision of Project Steering Committee. There are three teams in the implementation process; Teak Disease and Pathogens Team, Teak pests Team and Project Secretariat Team to achieve the project objective. Other relevant stakeholders from above mentioned stakeholder analysis table will be coordinated and included in exchange of technologies, methodologies of pest and disease management, and extension activities.

3. Reporting and monitoring arrangements

3.1. Reporting

a) Regular Reports

Periodic regular reports of the project will be made available to AFoCO twice a year.

Assuming the project starts at 1st July in Year 1, tentative month of submission of progress reports to AFoCO will be as follows.

1st Project Progress Report	June, Year 1
2nd Project Progress Report	December, Year 2
3rd Project Progress Report	June, Year 2
4th Project Progress Report	December, Year 3
5th Project Progress Report	June, Year 3
6th Project Progress Report	December, Year 4
7th Project Progress Report	June, Year 4
8th Project Progress Report	December, Year 5

b) Project Financial Report

The project financial reports will be submitted to AFoCO twice a year for the periods from 1 January to 30 June and 1 July to 31 December, no later than 15 January and 15 July each year.

c) Mid-year Report

The mid-year report will be submitted a mid-year which covers the period from 1January to 30 June, no later than 15 July each year.

d) Annual Report

The project annual report will be submitted for the period from 1 January to 31 December, not later than 31 January of the next year.

e) Special Reports

Project technical report and workshop proceedings will be submitted during or after completion of the project to the Secretariat.

f) Completion Report

The completion report and the financial audit report to the Secretariat within three months from the completion date of the project.

3.2. Monitoring

The project will be subject to monitoring by AFoCO representatives according to the AFoCO guidelines. For regular projects, the PSC is responsible for conducting regular project monitoring. A project monitoring team is comprised of two members; one from external expert and one from member nominated by the Secretariat. Monitoring will be carried out one-month prior to annual PSC meeting. If necessary, on-site monitoring will be conducted.

4. Risk management and sustainability

4.1. Assumptions and risks

The success of the project will be dependent on a number of assumptions. Among them are:

- All relevant stakeholders including Forest Department staff, private plantation owners, researchers and decision makers will come to aware the important role of pest and disease control and thus see the need to implement integrated management of pests and diseases;
- All relevant stakeholders and decision makers will be supportive to the implementation of project activities;
- All relevant stakeholders will show interest in the project and become cooperative in the implementation of the project activities;

Regard with potential risk, there might be conflicts between interest and non-interest persons, project participants and non-participant. Above mentioned assumptions also pose risks to the success of the project. If any of the assumptions fail, it will present setbacks to achievement of project objectives. In order to curtail any such occurrence, efforts will be made to obtain the commitment of the other relevant stakeholders of the project. To meet this end, since the beginning of the project, extension activities, consultation meetings process need to be designed well to let all stakeholders have much room to take part actively in it.

Natural disasters such as forest fire, extreme climatic conditions might also be potential risks of the project. The process of identification and studying the whole life cycle of new pests will also take long time. Efficient and effective collaboration of experts and technicians will be supportive to address these risks. The process of institutional set up and monitoring need deliberate precaution measures against to those risks. The active participation of all stakeholders during the national workshops gives assurance that the risks are manageable.

4.2. Sustainability

The project will mainly use the existing assets owned by respective institutions. To develop integrated pest and disease management, required facilities including computer hardware, computer accessories, pest survey equipment, etc. will be procured using project funds. The assets organized by the project will become the property of the Government of Myanmar (Ministry of Natural Resources and Environmental Conservation). After project completion, institutional capacity on Integrated Forest Pests Management will be built and continuously strengthen using the facilities including demonstration plots created by the project which will be upgraded as necessary. In addition, the capacity of researchers will become increased and could contribute applied pest and disease research for healthy forest conservation.