



PROJECT COMPLETION REPORT

<Project Profile>

Project Code	AFoCO/010/2016
Project Title	Domestication of Endangered, Endemic and Threatened Plant Species in Disturbed Terrestrial Ecosystem in Malaysia and Thailand
Project Duration	Start Date: 19 May 2016 End Date: 31 December 2022
Implementing Agency	Forest Research Institute Malaysia (FRIM), Malaysia Royal Forest Department (RFD), Thailand
Participating Countries	Malaysia and Thailand
Project Site	FRIM Research Station in Bidor, Perak, Malaysia Mae Moh Mine, Lampang Province, Thailand Phangnga Forestry Research Station, Phangnga Province, Thailand
Target Area	Primary target area: PA 2 (Supporting Research and Development in Climate Change Adaptation Approaches)
Budget and Source of Finance	Total: US\$ 5,293,919 - AFoCO: US\$ 1,200,000 (MY: US\$600,000, TH: US\$600,000) - National in-kind contribution: US\$ 4,093,919 (MY: US\$2,947,470, TH: US\$ 1,146,449) - Others: Nil

<Implementing Agency Profile : Malaysia>

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Project Staff	Ms. Tang Lai Kuen	Mapping and measurement of trees, analysis of site properties, preparation of statement of expenditures

<Implementing Agency Profile : Thailand>

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	Mr. Supachai Nuchit	Tending plots; Collecting and analysis of data, Tending plots; Collecting and analysis of data
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	Ms. Suphansa Chatmueang	Project documentation preparation; assist in organizing of seminar/workshop, assist in financial reporting

Notes to the Authors & Readers

The project completion report is a formal document, which presents all the relevant information about the project implementation. The report should be written in an accessible language, avoiding very technical terms. The use of graphical information, such as maps, tables and graphs, is an effective way of improving communication.

The following table of contents presents a sample list of items to be included in the completion report; however, the addition or revision of those items is recommended in pursuit of more effective and transparent delivery of the project results.

Draft of this completion report should be presented at the Final Coordination and Evaluation Meeting. The final version of this completion report should be submitted to the Secretariat within 3 months from the completion the date of the project together with the financial audit report.

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Summary

(This summary should be written in an accessible and non-technical language and include pertinent information on the purpose and need for the proposed activity, the issues and alternatives considered, the existing environment, and the results and conclusions. Less than 1,000 words)

Tin mining was a lucrative industry in Malaysia in the late 19th to early 20th century that spurred the economy of the country but also sculptured the landscape of mining areas. During mining operations, soils were separated using gravitational method to obtain the tin ores resulting in two major soil types namely, sand and slime tailings. The former has low nutrient, low water retention capacity, and when compounded with high silica in the sand that causes high, this type of tailings can be detrimental to any seedlings trying to establish in the area. Meanwhile the latter can be water-logged during rainy season.

Thus, ex-tin mine is notorious for its poor site quality for growing trees. High operational costs for fertilizers and irrigation required for turning ex-mines into agriculture purpose may limit the large-scale and long-term use. In addition, with the discovery of high concentrations of potentially toxic elements including heavy metals that exceed safe consumption levels in food crops grown on tin tailings has rendered it an unsuitable site for food production. On the other hand, these unproductive ex-tin mines away from in urban areas are usually abandoned or used for cattle grazing which cannot recover into forest naturally due to adverse changes brought to this ecosystem by mining activities. These adverse changes include i) the lack of mother trees or seed sources, ii) hostile microclimate and unfavorable soil properties, and iii) repeated disturbances by the same agents (for instance grazing) that precludes the process of regeneration.

Mae Moh Lignite Mining area involves the extraction of coal from open pit mines. The Mae Moh Lignite Mining area is located in Lampang province, the northern part of Thailand and is home to a significant amount of forested land. The open pit mining process involves the removal of trees and other vegetation from the area. This can have a significant impact on the local ecosystem as it disrupts the natural habitat of many plant and animal species. The impacts of lignite mining on biodiversity in the Mae Moh Lignite Mining area are also significant. The removal of vegetation and disruption of soil can lead to the loss of habitat for many species of plants and animals. Efforts have been made to mitigate the impact of lignite mining in the Mae Moh Lignite Mining area. For example, rehabilitation efforts have been undertaken to restore areas that have been impacted by mining activities.

Afforestation of the degraded land with timber tree species is a better option of land use and would improve the soil properties besides as a wood production area to reduce the pressure on natural forests. Once the land is designated for development in forestry, appropriate approaches shall be employed to green the ex-mine. Alternatively, restoration-reclamation interventions could be redirected towards re-establishing ecosystem health and services. Active rehabilitation models will permit the accelerated restoration of ecological processes for example nutrient cycling and carbon sequestration besides restoration of habitat for biodiversity with endangered, endemic and threatened tree species (EETs).

Land degradation, including forest areas, is a global threat that is taking place at an alar

ming rate as influenced by natural and anthropogenic factors. It usually results in reduced food production, exacerbate natural disasters, biodiversity loss, besides loss of soil organic carbon and ecosystem services. Across the world, land degradation and desertification has caused huge economic loss estimated at US\$ 6.3 to 10.6 trillion or US\$ 870 to 1,450/person/year (ELD, 2015). In view of this, it is pertinent to protect the biological diversity through *ex-situ* conservation particularly the EETs.

Malaysia is blessed to be ranked the 12th most megadiverse country in the world according to the National Biodiversity Index (CBD, 2022) while Thailand is one of the most biodiversity-rich countries in Southeast Asia with around 15,000 plant species, representing 8% of the world's total. With the threats of current land use changes, it is vital to protect, manage and sustainably use our forest resources. Due to the scarcity of land, this brings us to the use of degraded or problematic soil areas for forestry. These areas can thus be used not only for production through plantation forests but also as repositories for conservation of EETs. However, the limitations of ex-tin mines caused by soil and microclimate problems are challenges towards the establishment of trees. Therefore, suitable soil amelioration and choice species must be carefully studied prior to planting. In addition, associated risks must also be anticipated to avoid the loss of precious planting materials especially seedlings of EETS.

This 6-year project beginning 2016 is a strategic partnership among Malaysia, Thailand and the Republic of Korea through a tripartite Memorandum of Agreement represented by Forest Research Institute Malaysia (FRIM), Royal Forest Department Thailand (RFD) and Korea Forest Service (KFS), and facilitated by the AFoCO Secretariat. The project aims to domesticate Red List tree species in Malaysia and Thailand besides exchange of knowledge in rehabilitation of ex-mining areas and conservation. Since the commencement of the project, it has witnessed the successful establishment of an area amounting to 7.6 ha in Malaysia planted with 3,650 trees from 24 species of EETS on an ex-tin mine and 9.68ha in Thailand with 9,315 trees from 12 species of EETS in the two project sites including the ex-mining. This achievement is in accordance to the project target of domesticating 2 to 5 species per year for each country. In addition, the project has also organized 1 national and 3 regional workshops/seminar other than a promotional video and numerous publications in Malaysia and 2 national and 1 regional workshops in Thailand.

Effort in domestication of EETS in Malaysia and Thailand has also encountered several challenges from both biotic and abiotic factors. In Malaysia, the planted seedlings were attacked by wildlife, for instance wild boar, resulting in mortality or pests which affects growth performance. The severe dry weather conditions during the dry season from November to April in northern Thailand has influenced the growth of the planted seedlings and their survival rate. A later challenge is the Covid-19 pandemic which has inevitably led to limited mobility and changed ways of meetings or seminars towards online methods. Thus, adjustments in budget and work plan have to be made under the guidance of AFoCO Secretariat.

Nevertheless, all committed targets in the project have been achieved. The project owes its success not only to the dedication of project members but also the continuous support from FRIM management, Ministry of Energy and Natural Resources in Malaysia, RFD, Ministry of Natural Resources and Environment in Thailand, Korea Forest Service (KFS) and AFoCO Secretariat.

1. Introduction

(This section should briefly describe the social, economic and environmental context as well as relevant national and regional policies and programs. This text may comprise extracts from the Project Document. Less than 200 words.)

Malaysia has been undergoing rapid economic development attributed to the rich natural resources in the country. Malaysia has an estimated 15,000 species of vascular plants, 306 species of mammals, 742 species of birds, 242 species of amphibians, 567 species of reptiles, over 449 species of freshwater fish, over 500 species of marine fish and more than 150,000 species of invertebrates. Therefore, with both renewable and unrenovable resources under threat of overexploitation and unsustainable use, the need to sustainably utilise these resources and at the same time conserve them is of great importance to human well-being and for generations to enjoy its benefits. In one of Malaysia's many efforts, we have committed to maintain at least 50% of forest and tree cover as pledged at the 1992 Rio Earth Summit. This is in addition to another 10.6% of Malaysia's land area that is designated as terrestrial protected areas. In Malaysia's National Policy on Biological Diversity 2016–2025, Target 9 aims to prevent the extinction of known threatened species by 2025, as well as to improve and sustain their conservation. In relation to this, FRIM is also actively supporting the achievement of Aichi Biodiversity Targets (Target 12).

Thailand has land area of 513,120 square kilometers with a population of 66 million. As an upper-middle income economy, Thailand is endowed with a rich ecosystem and biodiversity which are important to the livelihoods of local communities and for national development. It is one of the most biodiverse countries in Southeast Asia, and derives large benefits from the ecosystems, landscapes and habitats that support its unique biodiversity. 9% of all species currently known are found in the country. Thailand has approximately 15,000 plant species. Thailand's historically vast forest coverage has had substantial effects on the sustenance of agriculture and in fulfilling water and power needs. Thailand had 163,974.52 km² of forest areas, covering 31.68% of the total land area, including national parks, wildlife sanctuaries and other conservation reserve areas. However, Thailand is the country sixth most impacted by climate change in the past 20 years (source: <https://www.biofin.org/thailand>). According to the IUCN List of Threatened Plants (Walter & Gillett 1998), Thailand has 27 endangered (E), 21 vulnerable (V) and 33 rare (R) species but these figures could be greatly underestimated due to the lack of data on many plant groups.

12 and 24 species of the endangered, endemic and rare tree species from the list stated in the Appendix I and Appendix II were domesticated in this project by Thailand and Malaysia, respectively. Technology developed in biodiversity conservation through collaboration in activities between Malaysia and Thailand in disturbed terrestrial ecosystem can be used for enhancing capacity of AFoCO member countries.

2. Background and Objectives

(This section should include the origin and the main problem addressed by the Project, highlighting the immediate objectives, expected output, and identified assumptions and risks required for the achievement of the objectives through the series of activities planned. Texts for this section may comprise extracts from the Project Document. Less than 400 words.)

2.1. Project rationale

Malaysia and Thailand have mega-biodiversity landscapes but rapid development and climate change had inevitably cause degradation of terrestrial ecosystems. The problem of forest degradation and potential biodiversity loss is critical whereby Malaysia and Thailand are actively addressing these problems through research and development activities. Domestication of endangered, endemic and threatened species (EETS) is one of the effective approaches to conserve plant germplasm. This project aims to strengthen bilateral cooperation between the two nations focusing on biodiversity conservation and domestication through pilot testing, workshops on best practices and, technology transfer and capacity development funded by AFoCO. The project sites will also potentially become seed production areas of EETS.

2.2. Project objectives

- To domesticate national red-list species in both countries
- To strengthen cooperation between Malaysia-Thailand on conservation of biodiversity, domestication techniques and technology transfer.
- To exchange knowledge and lessons learned on best practices in rehabilitation and biodiversity conservation.

2.3. Assumption and risks

Both technical and financial risks were considered low (based on the AFoCO Guidelines for Environmental and Social Safeguards (ESS))

Technical risks:

- Pests and diseases as well as encroachment by cattle may affect plant mortality and growth
- Procedures for procurement in accordance to rules and regulations in Malaysia and Thailand may incur risk on timing
- Drought weather and quality of seedlings may affect the growth and survival rate of planted seedlings

Financial risks:

- Changes in financial support may affect achievement of targets

3. Project Management

(This section should include a brief description of the implementation bodies and decision-making process established for implementation of project activities. It is also required to provide the final version of the work plan and schedule for readers to grasp the overall scheme of the project.)

3.1. Management structure

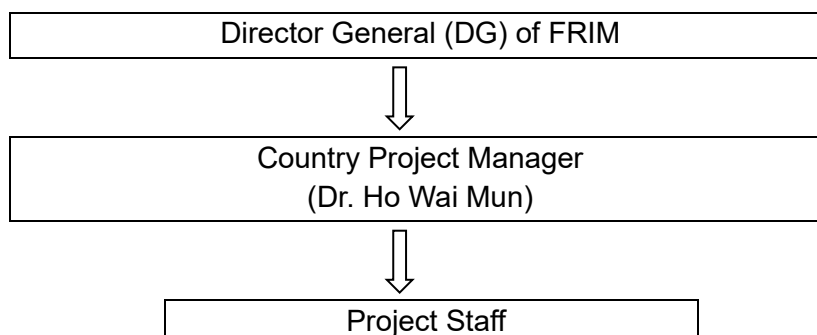
3.1.1 Malaysia

In Malaysia, the project is implemented by Forest Research Institute Malaysia (FRIM) under the Ministry of Energy and Natural Resources. The project was led by Dr Lai Hoe Ang (19 May 2016 till 6 November 2021) and then by Dr Wai Mun Ho (23 November 2021 till 31 December 2022). The project also employed one staff, Ms Lai Kuen Tang, from 2019 with the position as an Assistant Research Officer until September 2022. Work plan of the project is proposed by Project Leader and approved during Project Coordination Meeting (PCM) held twice annually since 2019. There was only one PCM each year from 2016 till 2018. Both technical and financial achievements of the project are evaluated once a year by a panel appointed by FRIM through the Project Evaluation and Monitoring Meeting (PEM). Results of the last evaluation on 23 November 2021 is presented in Table 1.

Table 1: Summary of assessment by evaluation panel in 2021

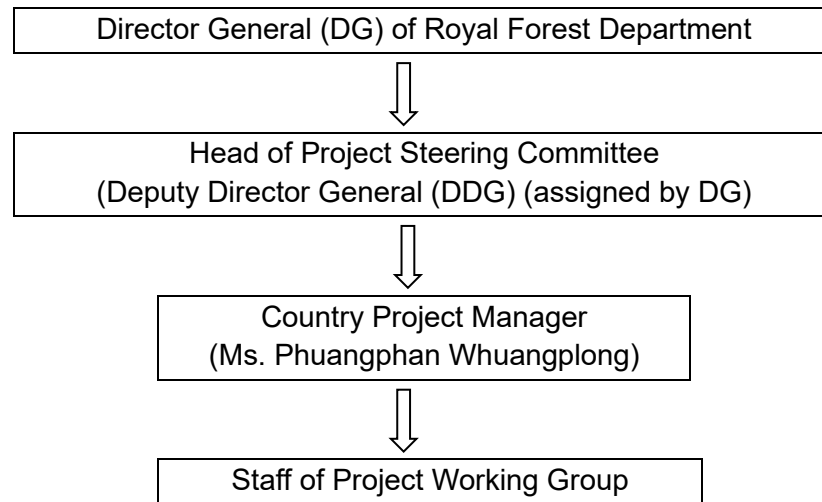
Summary of assessment for individual project					
Project Leader	Achievement on project objectives	Timing performance	Financial performance	Project outcome	Overall assessment
Dr Ho Wai Mun	5	4	5	NA	5
Suggestions and recommendations by the evaluation panel					
VIVA ASSESSMENT FORM MOU/ AGREEMENT					
Project leader	Dr Ho Wai Mun	Project number	FRIM(S).600-1/25/51		
Project title	AFoCo - Domestication of Endangered, Endemic and Threatened Plant Species in Disturbed Terrestrial Ecosystem in Malaysia and Thailand				

The organogram for the project management in Malaysia



3.1.2 Thailand

The Implementing Agency in Thailand is Royal Forest Department (RFD). RFD will be fully responsible for the coordination and implementation of the activities in Thailand.



3.2. Work plan and schedule

3.2.1 Malaysia

Work plan and schedule is provided in a separate attachment (Appendix 1.1).

3.2.2 Thailand

Work plan and schedule is provided in a separate attachment (Appendix 1.2).

4. Performance

(The purpose of this section is to highlight critical differences between planned and actual project implementation of activities using the original Project Document as reference and issues and constraints encountered during the implementation of the project. It is highly recommended to include a comprehensive writing of the technical methods applied and comparison tables for presenting any deviation from the plan.)

During the Inception Meeting held in 2016, the Meeting had agreed that planting should be conducted earlier to enable proper maintenance and adequate time for establishment of seedlings. Since the commencement of the project, it has witnessed the successful establishment of an area amounting to 7.6 ha in Malaysia planted with 3,650 trees from 24 species of EETS on an ex-tin mine and 9.68 ha in Thailand with 9,315 trees from 12 species of EETS in two ex-mining sites (lignite and tin). These achievements have exceeded the project target of domesticating 2 to 5 species per year for each country. In addition, the project has also organized 1 national and 3 regional workshops/seminar other than a promotional video and numerous publications in Malaysia and 2 national and 1 regional workshops in Thailand.

Overall, the project was able to achieve all committed targets. The project owes its success not only to the dedication of project members but also the continuous support from FRIM management, Ministry of Energy and Natural Resources in Malaysia, RFD, Ministry of Natural Resources and Environment in Thailand, Korea Forest Service (KFS) and AFoCO Secretariat. Planned and actual implemented activities are listed as follows:

4.1 Planned vs. actual implementation

4.1.1 Malaysia

Output/ activity	Planned Target	Accomplishment	Remarks/ Explanation
A. Site Characteristics			
Establishment of model plots (Site preparation, planting stock, planting, tending, monitoring)	3 ha in 2017	3 ha planted in 2017	Domestication of 14 EETS species with 1,500 seedlings planted
	3 ha in 2019	3.6 ha planted in 2019	Domestication of 18 EETS species with 1,650 seedlings planted
	1 ha in 2021	1.0 ha planted in 2021	Domestication of 10 EETS species with 500 seedlings planted
Producing site locality map	3 ha in 2017	3 ha mapped in 2017	GIS map produced with species list
	3 ha in 2019	3.6 ha mapped in 2019	GIS map produced with species list
	1 ha in 2021	1.0 ha mapped in 2021	GIS map produced with species list
	-	9.6 ha of naturally regenerated area mapped (additional achievement)	GIS map produced
Documentation	6 ha in 2017	6 ha of soil surveyed and	Soil analyzed and report

of biophysical site properties		sampled for analysis	produced
B. Regional Seminar			
Regional seminar/ workshop on domestication of EETS	-	National Workshop on Domestication of Climax Rainforest Species in Problematic Sites 15-17 November 2016	Attended by 25 participants with 11 papers presented and a site visit to FRIM Research Station in Bidor
	1 regional seminar	Regional Seminar on Reclamation, Rehabilitation and Restoration of Disturbed Sites: Planting of National and IUCN Red List Species 15-17 August 2017 Proceedings of the Seminar on Reclamation, Rehabilitation and Restoration of Disturbed Sites: Planting of National and IUCN Red List Species. 2017. FRIM Proceedings No. 14. Forest Research Institute Malaysia, Kepong. Ho WM, Jeyanny V, Sik HS & Lee CT (eds). Pp. 155. eISBN978-967-2149-08-8. Available online: https://info.frim.gov.my/infocenter_applications/downloadDocs/index.cfm	Attended by 40 participants with 2 keynote papers, 16 oral papers and 21 posters presented, and a site visit to FRIM Research Station in Bidor
	1 regional workshop	Regional Workshop on Domestication of Endangered, Endemic and Threatened Species in Disturbed Terrestrial Ecosystems 7-8 November 2019	Attended by 20 participants with 13 oral papers presented and a site visit to FRIM Research Station Bidor
	1 regional webinar	Regional Webinar on <i>Ex-situ</i> Conservation and Carbon Sequestration Potential of Red List Tree Species 20-21 October 2021 Available on Youtube: Day 1: https://youtu.be/98p0CIJQ4JM	Attended by 130 participants with 3 keynote papers, 24 oral papers and 8 posters.

		<p>Day 2: https://youtu.be/4Tm2MhYy9w</p> <p>Proceedings of Regional Webinar on <i>Ex-situ</i> conservation and carbon sequestration potential of red list tree species. FRIM Proceedings No. 21. Forest Research Institute Malaysia, Kepong. eISBN 978-967-2810-16-2. Pp. 79.</p> <p>Available online: https://info.frim.gov.my/info-center/applications/regOnline/proceedings/3/index.cfm</p>	
C. Technology Transfer and Capacity Development			
Cross visits	10 cross visits	<p>8 Cross visits</p> <p><u>2016:</u></p> <ul style="list-style-type: none"> -Thailand -Singapore <p><u>2017:</u></p> <ul style="list-style-type: none"> -Singapore <p><u>2018:</u></p> <ul style="list-style-type: none"> -Indonesia -The Philippines <p><u>2019:</u></p> <ul style="list-style-type: none"> -Indonesia -Thailand -Republic of Korea 	<p>Visits focused on national botanic gardens, degraded areas that have been rehabilitated and plant conservation areas. Only 8 out of 10 cross visits were carried out due to the outbreak of Covid-19 pandemic in year 2020. Fund not spent in this activity has been transferred for publication of 1 book and 1 promotional video.</p> <p>View video at: https://drive.google.com/file/d/10y2E-wYWBjgOa3icy-IYOTTxl8_ICpMw/view</p>
Publications	<p>(13 as a plan)</p> <ul style="list-style-type: none"> -3 books -4 research papers -3 leaflets -2 posters -1 website 	<p><u>(36 in total)</u></p> <p><u>2016:</u></p> <ul style="list-style-type: none"> -1 journal -2 oral papers <p><u>2017:</u></p> <ul style="list-style-type: none"> -1 e-book -3 proceeding papers -1 oral paper -3 posters -1 blog <p><u>2018:</u></p> <ul style="list-style-type: none"> -1 journal -1 proceeding paper -1 leaflet -1 oral paper 	<p>Publication of 1 leaflet has been changed to 1 booklet in 2022</p>

		-1 poster <u>2019:</u> -3 oral papers -1 poster <u>2020:</u> -1 proceeding paper <u>2021:</u> -1 book -1 e-book -1 oral (keynote) paper -3 proceeding papers -1 leaflet -1 article -1 video <u>2022:</u> - 1 book - 4 oral papers 1 book	
D. Local Operation			
External audit	2017 (1)	Audit reports for 2016 and 2017	External audit conducted by Malaysia in 2018
	2019 (1)	Audit reports for 2018 and 2019	External audit conducted by Thailand in 2020
	2022 (1)	Audit reports for 2020, 2021 and 2022	External audit conducted by Malaysia in 2022
Attending meetings	2016 (2)	2016 (1) Soil Science Conference of Malaysia, Malaysia	Attended by Ms Tang
	2017 (1)	2017 (2) 3 rd Global Forum of Ecological Economics in Forestry, Beijing (funded by FAO)	Attended by Dr Ho
		3 rd Restoring Forests Congress, Sweden	Attended by Dr Ang and Dr Ho
	2018 (2)	2018 (4) 10 th International Symposium on Plant-Soil Interactions at Low pH, Malaysia	Attended by Dr Ang
28 th Malaysian Society of Plant Physiology Conference		Attended by Ms Tang	
7 th Kuala Lumpur International Agriculture, Forestry and Plantation Conference, Malaysia		Attended by Dr Ho	

		Regional Workshop, Chiang Mai, Thailand	Attended by Dr Ang, Dr Ho and Ms Tang
	2019 (3)	2019 (2) Malaysian Society of Plant Physiology Conference International Forest Cooperation Capacity Building Workshop, 19 December 2019 (ROK)	Attended by Ms Tang Attended by Dr Ang, Dr Ho and Ms Tang
	2020 (1)	2020 (1) Soil Science Conference of Malaysia 2020	Attended by Dr Ang
	2021 (0)	2021 (1) 3rd International Conference on Tropical Silviculture, Online	Attended by Dr Ang
	2022 (3)	2022 (6) Malaysian Conservation Conference 2022, Kuching (Hybrid) AFoCO Annual Technical Workshop 2022 Asia Forest Forum, World Forestry Congress 2022, ROK Bengkel Hala Tuju Industri Mineral Negeri Perak, Putrajaya SANFRI Workshop on Protection and Sustainable Management of Forest Resources Simposium Agrobiodiversiti dan Agropersekitaran (ABES)	Attended physically by Dr Mohd Zaki and online by Dr Ho Attended by Dr Mohd Zaki, Dr Ho and Ms Tang Attended by Dr Mohd Zaki, Dr Ho and Ms Tang Attended by Dr Ho Attended online by Dr Ho Attended by Dr Ho

4.1.2 Thailand

Output/ activity		Planned Target	Accomplishment	Remarks/ Explanation
A Site characterization				
A.1	Selection of planting sites in denuded and disturbed forest, and identification of EETS for domestication	6 ha	9.68 ha (8.68 ha at Mae Moh Project Site 1 ha at Takuapa Project Site)	<ul style="list-style-type: none"> • Site selection and identification of EETS for domestication • GPS mapping • Producing Site Locality Map
A.2	Procurement of EETS	6,780 seedlings	9,315 seedlings	<ul style="list-style-type: none"> • Purchase of seedlings or saplings (with nursing plant 3,500 seedlings)
A.3	Establishment of Model plots	1 Project site	2 Project sites	<ol style="list-style-type: none"> 1. Site preparation, planting stock, planting, tending, monitoring 2. Irrigation / Watering 3. Fire protection line and inspection road 4. Demarcation and wind protection 5. Planting & Tending 6. Tending of 2016-2017 Planting 7. Tending of 2018 Planting 8. Regeneration Study in PhangNga 9. Monitoring/supervising of site preparation, planting and tending (DSA) 10. Water Tank for Takuapa site, PhangNga Province 11. Fertilizer (put and buy compost, chemical budget 2019)
A.4	Documentation of biophysical site properties, planting techniques and assessment of growth	54 sample 5 sets 2 vertex - 4 tapes	163 sample 5 sets 2 vertex 1 shredder 6 tapes	<ul style="list-style-type: none"> • Soil analysis • Purchase of microclimate sensors / rain gauge • Purchase of height meter (vertex) • Purchase of shredder machine

		- 1 camera	2 items 2 camera	<ul style="list-style-type: none"> • Purchase of diameter tapes • Insect sprayer • Purchase of high resolution digital camera
B Regional workshop				
B.1	Domestication of EETS in ASEAN countries	2	1	Country Report (Original 2 workshops due to COVID-19 2nd workshop change to Domestic workshop B.2)
B.2	National Workshop	0	2	Workshop (replace 1 regional workshop, 2019 RFD and Saraburi, 2020 PhangNga)
B.3	PSC meeting (Thailand)	3	2	Country level PSC Meeting (5Feb.2020, 3 Aug 2020)
C Technology transfer and capacity development				
C.1	Cross visits	4	3	Singapore Philippines Republic of Korea
C.2	Knowledge and technology transfer	3 3 30 roll up 1	3 3 30 roll up 1 with different domain	<ul style="list-style-type: none"> • Manual of Weed species, EETS Species, Soil Analysis • Leaflet • Poster and roll up • Website development(2016 established, 2017-2018 subscription) (2019-Present RFD domain)
D Local Operation				
D.1	External Auditing	1	1	Auditing Report
D.2	Attending overseas meetings	3	3	IUFRO, China CBD, Egypt WFC, ROK
D.3	Inception Meeting	1	1	Inception meeting
D.4	Annual Report	6	6	2016, 2017, 2018, 2019, 2020, 2021
D.5	Miscellaneous	1	1	Project Staff
D.6	PCM Meeting	6	11	
D.7	Stakeholder Meeting	2	2	Mae Moh Project Site Takuapa Project Site
D.8	Completion report	1	1	

4.2 Finance

4.2.1 Malaysia

Output/ activity	Planned (USD)	Expenditure USD	Remarks/ Explanation
A. Site Characteristics	348,455.00	405,356.36	Increment of additional 1 ha of planting area
A.1 Site characterization	30,540.00	29,494.40	
A.2 Procurement of EETS	130,485.00	106,619.43	
A.3 Establishment of model plots	146,130.00	203,273.77	
A.4 Documentation of site properties	41,300.00	65,968.76	
B. Regional Workshop	48,390.00	27,158.88	Reduced expenses due to a change from physical to online webinar
C. Technology Transfer and Capacity Development	68,805.00	36,189.09	
C.1 Cross visits	47,155.00	16,883.31	Publication of 1 book (RM5,863.70) and 1 video (RM4,917.40) Reduction in the expenditure of cross visits due to Covid-19 pandemic.
C.2 Knowledge and technology transfer	21,650.00	19,305.78	
D. Local Operation	134,850	118,286.13	
D.1 External auditing	7,028.00	7,010.66	
D.2 Attending meetings	39,255.00	31,504.42	
D.3 Inception Meeting / Project Coordination Meeting	26,367.31	13,998.81	
D.4 Annual report	1,400.00	127.58	
D.5 Miscellaneous	3,599.69	315.61	
D.6 Project staff	57,200.00	65,329.05	Project staff budgeted from year 2019
F. Bank Charges	0	53.60	
Total	600,500.00	587,044.06	

4.2.2 Thailand (as of 30 September 2022)

Output/ activity	Planned (USD)	Expenditure (USD)	Remarks/ Explanation
A Site characterization			
A.1 Selection of planting sites in denuded and disturbed forest, and identification of EETS for domestication	35,600	24,285	Finished
A.2 Procurement of EETS	77,640	75,418	Finished
A.3 Establishment of Model plots	177,214	186,828	Finished
A.4 Documentation of biophysical site properties, planting techniques and assessment of growth	29,160	26,719	Finished
B Regional workshop			
B.1 Domestication of EETS in ASEAN countries	36,855	13,529	Finished
B.2 Domestic Workshop	10,970	9,861	Finished
B.3 PSC meeting (Thailand)	0	2,542	Finished
C Technology transfer and capacity development			
C.1 Cross visits	46,100	37,517	Finished
C.2 Knowledge and technology transfer	18,252	17,649	Finished
D Local Operation			
D.1 External Auditing	6,000	5,344	Finished
D.2 Attending overseas meetings	13,021	23,859	Finished
D.3 Inception Meeting	6,130	6,421	Finished
D.4 Annual Report	5,250	5,552	Finished
D.5 Miscellaneous	59,945	66,186	Finished
D.6 PCM Meeting	18,104	13,170	Finished
D.7 Stakeholder Meeting	8,275	7,824	Finished
D.8 Completion report	0	-	Finished
F Contingency/Other expenditure (Bank charge/Adjustment of cash transaction)			
	0	136	
Total	548,516	522,854	

4.3. Implementation issues and constraints

4.3.1 Malaysia

Overall, there were no serious issues that affected the implementation of the project. The outbreak of Covid-19 pandemic had affected some activities for instance organizing physical seminar but this issue was solved using online video conference. Budget for attending overseas meetings and remaining budget from organizing physical regional workshop (changed to webinar) was revised and changed to publication of a book, production of a promotional video and planting an additional 1 ha plot in 2021. In terms of procurement, there were some slight problems encountered. Although the procurement of microclimate station was delayed due to procurement procedures, it was completed at the end of year 2021. Contractor for maintenance who stopped work during Covid-19 pandemic was quickly re-appointed with another more competent contractor.

4.3.2 Thailand

During the project implementation, the equipment was procured based on the annual work and budget plan approved at the Project Coordination Meeting. However, due to the government procurement regulation in Thailand, the domestic clearance processes were slow and resulted in project activities postponed.

Project Director and Deputy Project Director were changed quite often and the project progress was also affected since it took time for new comer to understand the project.

The drought in the dry season for several years lasted longer than normal conditions. This had directly impacts on the survival rate of seedlings in the project sites. The project team provided more project maintenances activities (i.e. more watering activity, fire protection etc.) to increase the survival rate of the seedlings and conducted the supplementary planting to change the dead seedlings.

Due to the COVID-19 pandemic, the project activities could not be implemented on site and some activities were conducted through on-line platform.

5. Impact Analysis

(This section should describe impacts of the implemented activities and outputs. It is advised to elaborate on the extent to which the project objectives were achieved, describe the internal and external conditions remained at project completion as those compared to the pre-project stage, describe applicability and adaptability of project intervention in local conditions and sustainability of activities after project completion. It is highly recommended to refer to relevant parts of the Project Document.)

5.1. Outputs and outcomes

5.1.1 Malaysia

No.	Outputs	Outcomes
1.	7.6 ha of planted with 3,650 of from 24 species of EETS	<ol style="list-style-type: none"> 1. A model of domestication of EETS on ex-tin mine 2. The model is adopted for future afforestation projects on ex-tin mines 3. A repository of EETS and potential seed source 4. A research and education site for students, academics, researchers, decision-makers, private and public sectors as well as general public
2.	1 national and 3 regional workshops/ seminar/ webinar	<ol style="list-style-type: none"> 1. A total of 215 participants from ASEAN and other countries have benefitted from the 1 national and 3 regional workshops/ seminar/ webinar 2. AFoCO project site as a physical reference or demonstration plots during site visits 3. Video on FB for webinar has reached >1,900 views
3.	Publications <ol style="list-style-type: none"> i. 2 books ii. 2 e-books available online with free access iii. 2 papers published in international journals iv. 8 proceedings papers, 1 article, 12 oral papers, 4 posters and 2 leaflets 	<ol style="list-style-type: none"> 1. Publications in print and online have reached both national and international readers. 2. Papers presented at conferences/ seminars/ workshops have also reached over 300 audiences.

5.1.2 Thailand

No.	Outputs	Outcomes
A.	9.68 ha of planted with 9,315 of the seedlings from 12 species of EETS	<ol style="list-style-type: none"> 1. A model of domestication of EETS on ex mine was established (ex-tin mine and lignite mine). 2. The model is adopted for future afforestation projects on ex mines 3. A repository of EETS and potential seed source were secured. 4. A research and education site was established for students, academics, researchers, decision-makers, private and public sectors as well as general public

B.	2 national and 1 regional workshops	<ol style="list-style-type: none"> 1. A total of 88 participants from ASEAN and ROK have benefitted from the 2 national and 1 regional workshops. 2. The potential development of similar projects in other AFoCO Member Countries.
C	3 Cross Country Visit in Singapore, Philippines and Republic of Korea 1 manual of weed species 1 manual of EETS species 1 manual of soil analysis 3 leaflets 30 poster and roll-up Website development	<ol style="list-style-type: none"> 1. Publications provided the opportunities for both national and international readers to promote the project achievements and exchange views. 2. Knowledge transfer and capacity development was achieved through the public awareness activities.

5.2. Internal & external impacts

5.2.1 Malaysia

Internal:

The project sites were once planted with *Hopea odorata* and *Acacia mangium* but due to lack of maintenance, most of the trees did not survive and the sites were overgrown with weeds and some pioneer species with no economic value. However, the surviving trees of *H. odorata* and *A. mangium* as well as the pioneer species provided partial shade crucial for the establishment of more shade-tolerant species including the EETS that were planted in this project. The project thus provided great opportunities not only for enriching the biodiversity of tree species but the funds also enabled the maintenance of these sites.

In addition, seminars or workshops organized through this project have benefited over 200 participants from the academic, research, public agencies, private sector and the general public interested in rehabilitation and conservation. Project members were also provided the opportunities to learn from various seminars and cross-visits organized under AFoCO. This project has also reinforced the relationship between Malaysia and Thailand through sharing of knowledge, experience and culture from development of the project proposal, throughout the duration of the project and beyond.

External:

After project completion, the planted sites will continue to be maintained with the support from FRIM as these are important research and education plots which have benefited both local and international visitors. The planting of various EETS including valuable Dipterocarps has also raised interest in the study of characteristics of juvenile trees, carbon sequestration capacity and, pests and diseases (P&D). Since the FRIM Research Station in Bidor (location of project site), also known as SPF Bidor, has been leased for a total of 99 years by the Perak State Government to FRIM since 1996, all plantings of this project will remain protected within this period which will become an important repository for conserving the germplasm of these EETS.

5.2.2 Thailand

Internal:

The project has high scientific value and results will be reflected in the national policy related to the biodiversity or restoration. Especially, the results in Thailand might influence mining to reforest areas used and abandoned. Publications and knowledge obtained by the Project through seminars and meetings played a role as tools for capacity development of RFD staffs.

There are both priority and policy to conserve and increase biodiversity in Thailand but RFD needs to show this research result and all method or implementation steps to the policy level in order to increase the impacts of the project at the policy level.

External:

This project will also influence the two main conventions of REDD+ and CBD in the future. The project achievement will be utilized as the basic information/data for the relevant project development in the AFoCO member countries.

5.3. Local applicability

5.3.1 Malaysia

The research station has a blueprint whereby it will be developed accordingly for three main purposes, i) research and development (R&D), ii) education and iii) eco-tourism. In terms of R&D and education, the site can be used by researchers and students for research projects in various topics including carbon stock, P&D, natural regeneration and growth performance. The sites can also be turned into a seed production area in the future and local communities can be involved for collecting seeds and raising seedlings of the EETS thus propagating these valuable species. A minimal fee may be imposed on future visitors to FRIM Research Station in Bidor in a move to help sustain the operational cost of this station.

5.3.2 Thailand

This project was designed as a research-based project. There is not much local participation in the national level and regional level. Only at the initial stage of the project, Thailand had an stakeholder meeting with the local communities. After that meeting there are no other meetings with the local communities. In view of the local applicability, it is difficult to engage in the local community during the project implementation.

After the completion of this project, it is required to develop the mechanism to include the livelihoods component or capacity building activity for local communities so that the activities can build capacity at the community level. This type of support strengthens the effectiveness of collaborative forest management and improves communications within and between communities.

5.4. Sustainability

5.4.1 Malaysia

As mentioned in Item 5.3, the project site will continue to be used for R&D, education and eco-tourism. Related activities can be used to sustain not only the importance of this site as a

repository of EETS but extension activities including Communication, Education and Public Awareness (CEPA) programs besides study tours or site visits by conferences/ organizations will add on to the socio-economic as well as ecological values of these plots.

5.4.2 Thailand

From the initial stage of the project implementation, the project has considered and prepared its sustainability. For Thailand, the project sites have been and will be maintained by the partner agencies, EGAT and KUFF. For Mae Moh site, after the project completion the project site will be handed over to EGAT until the concession period ends. The project site management will thereafter be under the responsibility of RFD.

Enhancing sustainability of projects can be accomplished through the development of follow-up activities. The two (2) project site will be used as a research study as well as field trip sites. The plan for further project sustainability will be developed under the guidance of the RFD. The development of the publications or promotional materials will be helpful in the sustainability, given that those materials remain relevant for future activities and could be used in the other AFoCO member countries or projects. As one of the alternative ways for the project sustainability, it is recommended to raise fund in cooperation with private sectors in Thailand or donor of the Republic of Korea.

6. Challenges and Lesson Learned

(Any challenges encountered and the lessons learned thereof are recommended to be described in detail by explicitly identifying how the incompleteness or uncertainty had impacted and the extent/magnitude of impact. The challenges could be classified either internal or external. The internal factors could be further classified either in operational or project formulation aspect while the external factors and their impacts should be described in a separate section. It is highly recommended to refer to relevant parts of the Project Document.)

6.1 Project formulation aspect

6.1.1 Malaysia

There are a number of institutional and national procedures that must be adhered to prior to the approval of the project as it involved multi-country collaboration. The duration of completing these procedures must be taken into consideration prior to project formulation.

Preparation of project proposal involved only one officer. Involvement of researchers from other fields of expertise is important to encapsulate more aspects of consideration like physiology, biodiversity and socio-economic among others. This will also allow a smoother transition if any personnel retires or leaves the project.

6.1.2 Thailand

Since the engagement of the stakeholders became low in the project formulation stages, it is recommended to actively include concerned stakeholders in the project development phase to achieve the project outputs and to ensure that stakeholders understand direct and indirect benefits from their contribution to the project. In case of the research-based project, the project staff/personnel should have expertise in the same or similar field in order to carry on the project smoothly.

A preliminary baseline survey and feasibility study prior to the formulation of the project was helpful to enable before and after scenarios of the project, and to evaluate possible issues and risks. Also, the selection of careful plant species is important based on the project site conditions, and measures must be put in place to reduce possible damage.

A logical framework for the project is a necessary part of the project formulation. Drafting a logical framework provides a structure in which the stakeholders can understand an overview of the outcomes, activities, and anticipated results of the project. It also identifies measurable results that could be monitored.

6.2 Operational aspect

6.2.1 Malaysia

Institutional and national procurement rules took a longer duration in some cases. The prolonged procedure further increased costs and delayed implementation. Application needs to be made at least 6 months in advance.

6.2.2 Thailand

Administrative Structure / Change in National Program Directors and Project staff had an impact on the project implementation. For the smooth project implementation, the strong leadership in the participating country is required. The experts / superiors for the project operational recommended increase in project areas and the number of trees in view of the research-based project.

Cost of seedlings though is market driven and thus is very high. Based on the experience from the project, it is required to establish the nursery or seed stand in the project sites.

The project should maintain a more visible presence during project implementation, in terms of initiating opportunities for project consultations to discuss issues and concerns that need immediate action, and for interim monitoring.

The severe dry weather conditions during the dry season from November to April has influenced the growth of the planted seedlings and their survival rate. In order to investigate the site conditions and species suitable to the project sites, a feasibility study for the project sites in the phase of project formulation should be preceded and watering system should be installed near the project sites to increase the survival rate of the planted seedlings up to the three (3) years.

The project had difficulties in controlling weed during the rainy season as the use of pesticide is prohibited. Therefore, maintenance of the site should be outsourced and carried out more frequently during rainy season to ensure weed control.

Cattles from the local communities often encroached into the project site and caused damages to the EETS seedlings. The wire fence was installed around the project site to protect the plantation. In order to handle this matter, communication and engagement of local communities needs to be improved through stakeholders meeting.

7. Conclusion and Recommendations

(This section should clearly present overall impact and specific impact, if any, made by the project with clear outcomes and evidences. It is recommended to also cover recommendations for application of good practices found and appropriate follow-up actions needed to be pursued under current situation. Limitations or shortcomings of project interventions as well as potential scenarios and suggested actions could be featured.)

7.1 Malaysia

The project had two main aims which were 1) to domesticate endangered, endemic and threatened tree species and 2) to disseminate knowledge through seminars/ workshops. By the end of this 6-year project, a total of 24 endangered, endemic and threatened species have been planted on 3 plots over 7.6 ha in an ex-tin mine. This effort has greatly enhanced both the ecological and economical values of the once barren ex-tin mine by enhancing the biodiversity of this area and increasing the value of this land with commercially valuable timber species. Following the successful development of this domestication model, it will be used as a benchmark of best practices for other upcoming planting projects by multi-national companies.

The 3 planting plots are also expected to become safe research and learning sites for both researchers and students, particularly post-graduates. Vast opportunities are available on-site for studies on impacts of restoration and conservation including consideration on climate change and

Apart from these physical achievements, the project had organized 1 local and 3 regional seminar/workshop(s) which have benefitted all ASEAN countries. Over 200 people from universities, government agencies, private sector and NGOs had taken part in these capacity building programs which have also published 2 online proceedings. Technology developed for domestication of endangered species was documented in proceedings and shared online through FRIM's website with the general public while a promotional video was also produced to capture some highlights of the project.

In conclusion, the planting plots will continue to serve as important grounds for conservation, education and carbon storage. Nonetheless, more studies can be conducted in these plots to further understand development of trees in these mixed stands in addition their ecological impacts on the once barren ex-tin mine. Additionally, the project strongly supports the efforts of Malaysia in the Sustainable Development Goal 15 Life on Land to protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

7.2 Thailand

During the 6-year project implementation, the project conducted the planned activities and achieved the targeted objectives including the establishment of demonstration plots and organization of workshops and seminars. The project has high scientific value and results should strongly influence future REDD+ projects.

In Thailand, the results might influence mining to reforest areas used and abandoned. Publications provide scientific advancement in afforestation, contribute to conservation and to REDD+; knowledge gained by foresters and conservation scientists in both countries through seminars and at international meetings

For application of good practices and appropriate follow-up actions for the project, the followings are recommended:

A phase 2 project is recommended to be developed to expand the knowledge and accomplishments from this project through large-scale restoration using EETS including the establishment of *ex-situ* conservation sites in collaboration with other AFoCO member countries. This proposed phase will prioritize the conservation of EETS and a feasibility study which is recommended at project development stage.

In order to ensure success of a project, active participation of local communities/stakeholders are required in the development/implementation process. The project sites are recommended to be utilized as a referral center and a demonstration site for capacity building of forestry sector and relevant fields in AFoCO member countries. In addition, AFoCO encourages regional cooperation towards achieving the shared SDGs and global forestry objectives in line with AFoCO's strategic plan. It is recommended that Thailand make an effort to ensure that the outputs of this project can be properly reflected in the good practices to support Thailand in achieving National Forest Policy.

8. Photo Documentation

8.1 Malaysia

Activity A. Site Characteristics: Site characterization/ procurement of EETS/ Establishment of model plots/ Documentation of site properties	
	
Site preparation for planting of 2017 plot	Collection of soil samples in 2017 plot for documentation of site properties
	
Site preparation for planting of 2019 plot	Planting of 2019 plot by contract workers
	
Site preparation for planting of 2021 plot	Measurement of total height and diameter at breast height in 2019 plot

Activity B. Regional Seminar
Regional seminar/ Regional workshop/ Local workshop/ Webinar



National Workshop held in FRIM on 15-17 November 2016



Group presentation during National Workshop



Regional Seminar held in Kuala Lumpur on 15-17 August 2017



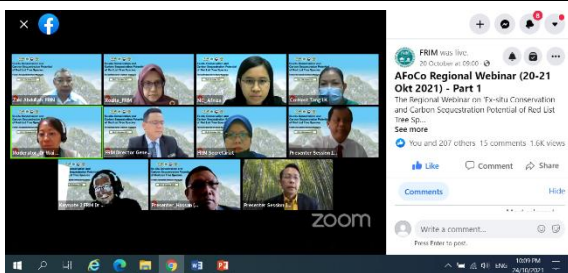
Representatives from ASEAN in the Regional Seminar



Regional Workshop held in FRIM on 7-8 November 2019



Site visit of participants from regional Workshop to AFoCo project planting plot 2019



Regional Webinar held on 20-21 October 2021; also available for viewing in FRIM's official Facebook page



A group photo of presenters and moderators of the Regional Webinar

Activity C. Technology Transfer and Capacity Development
Cross visit/ Knowledge and technology transfer



Visit to Phang-Nga Forestry Research Station, Thailand in 2016



Visit to Singapore Botanic Gardens in 2017



Site visit during 3rd Restoring Forests Conference in 2017 in Lund, Sweden



Participation as Moderator and Panel during Panel Discussion in Chiang Mai Regional Workshop in 2018



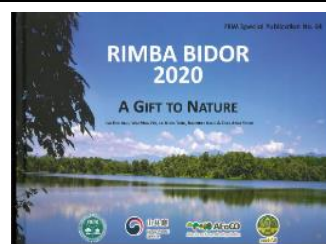
Visit to Makiling Center for Mountain Ecosystems in 2018



Visit to Bogor Botanic Gardens in 2018



Visit to Republic of Korea in 2019



Publication of a coffee table book in 2021



Making of a promotional video in 2021	Online participation in Forest Landscape Restoration in the Asia-Pacific Region Workshop in 2021
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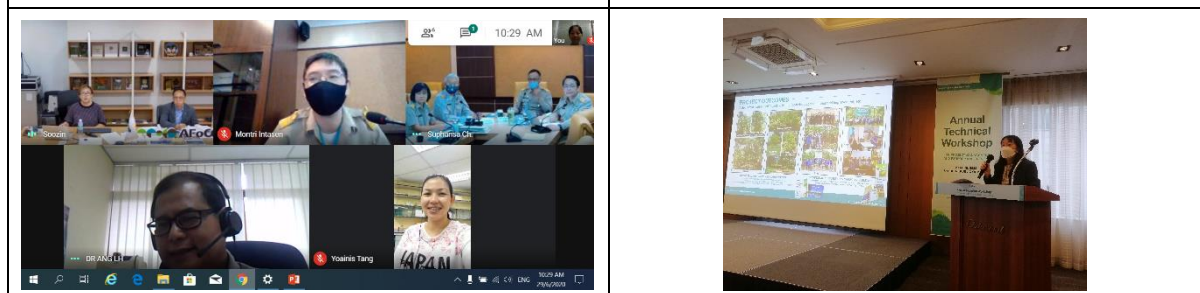
**Activity D. Local Operation:
Attending conferences / Project Coordination Meeting/ Inception Meeting**



Inception Meeting attended by representatives from FRIM, RFD and Interim Secretariat for AFoCO on 26 August 2016.	1 st Project Coordination Meeting hosted by Malaysia and held in FRIM on 18 November 2016
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Dr Ang briefing Ms Kim from Interim Secretariat for AFoCO at 2017 planting plot during site visit of 3 rd Project Coordination Meeting on 22 November 2017.	A visit to 2017 project site on 8 August 2019 during the 5 th Project Coordination Meeting
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7 th Project Coordination Meeting held virtually and hosted by Malaysia on 29 June 2020 due to the outbreak of Covid-19	Participation in Annual Technical Workshop and World Forestry Congress in Seoul, 2022
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8.2 Thailand

8. Photo Documentation

(To provide relevant project photos with proper description. The photos should include project site photos of before, during and after implementation of project activities. The original electronic files of the photos used in this section should also be submitted.)

A. Site Characterization

A.1 Selection of planting sites in denuded and disturbed forest, and identification of EETS for domestication

A.1.1 Site selection and identification of EETS for domestication

There are 2 project sites 1) Mae Moh Mine Project Site which is the lignite mining. The soil is original from the mining pit. The area of this Mae Moh Mine Project Site is 8.68 ha. and 2) Phangnga Forestry Research Station Project Site which is the ex-tin mining area. The area was rehabilitated about 30 years. The area of Phangnga Forestry Research Station Project Site is 1 ha.

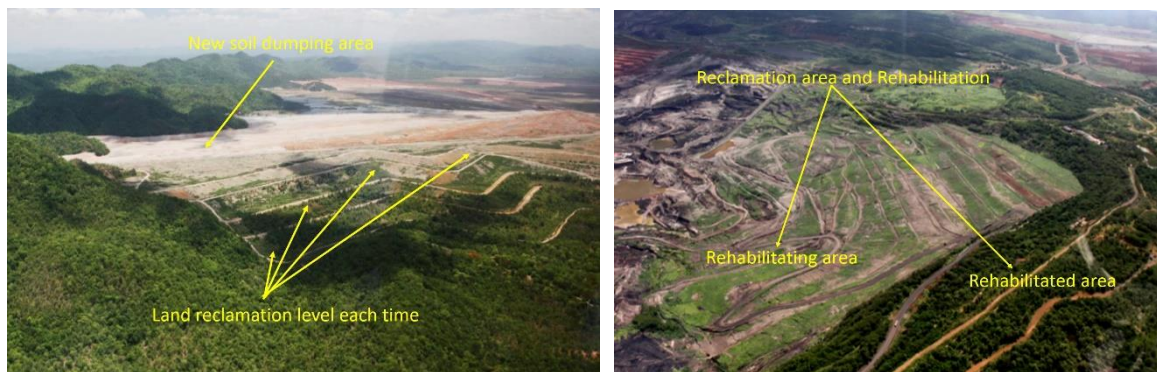


Figure 1: Mae Moh Mine Project Site Characteristic



Figure 2 : Phang Nga Forestry Research Station Project Site Characteristic

A1.2 GPS Mapping

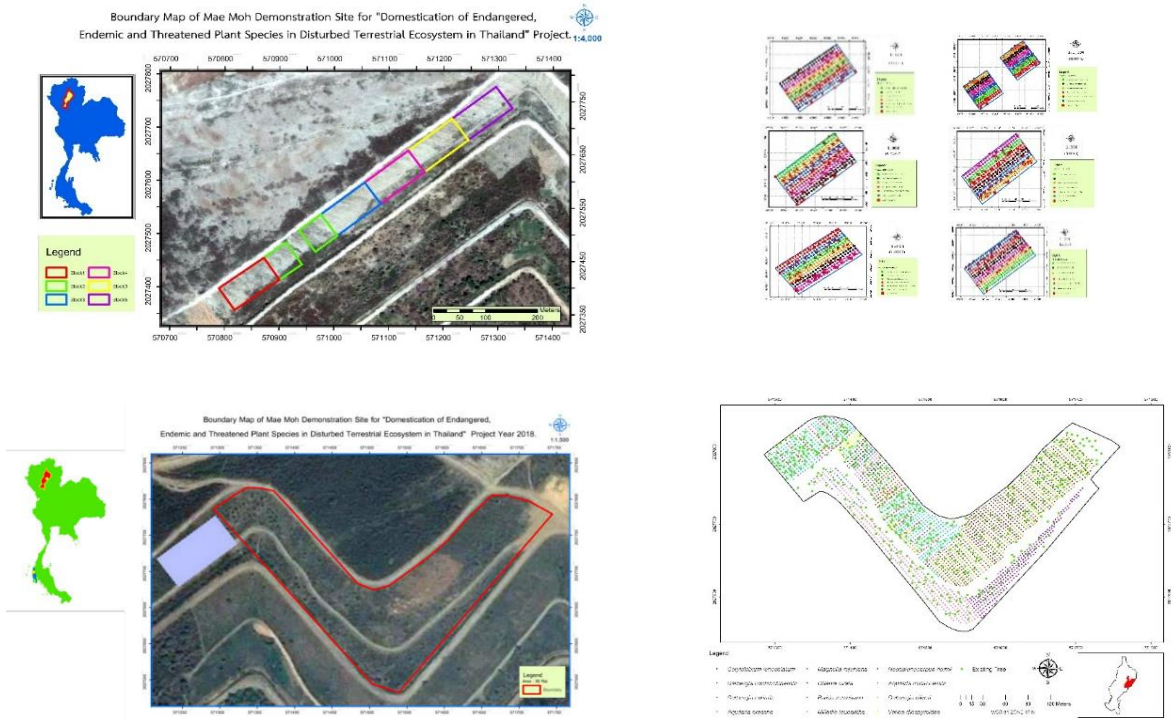


Figure 3: Mae Moh plot site GPS mapping, up) 2016 plot Down) 2018 plot.

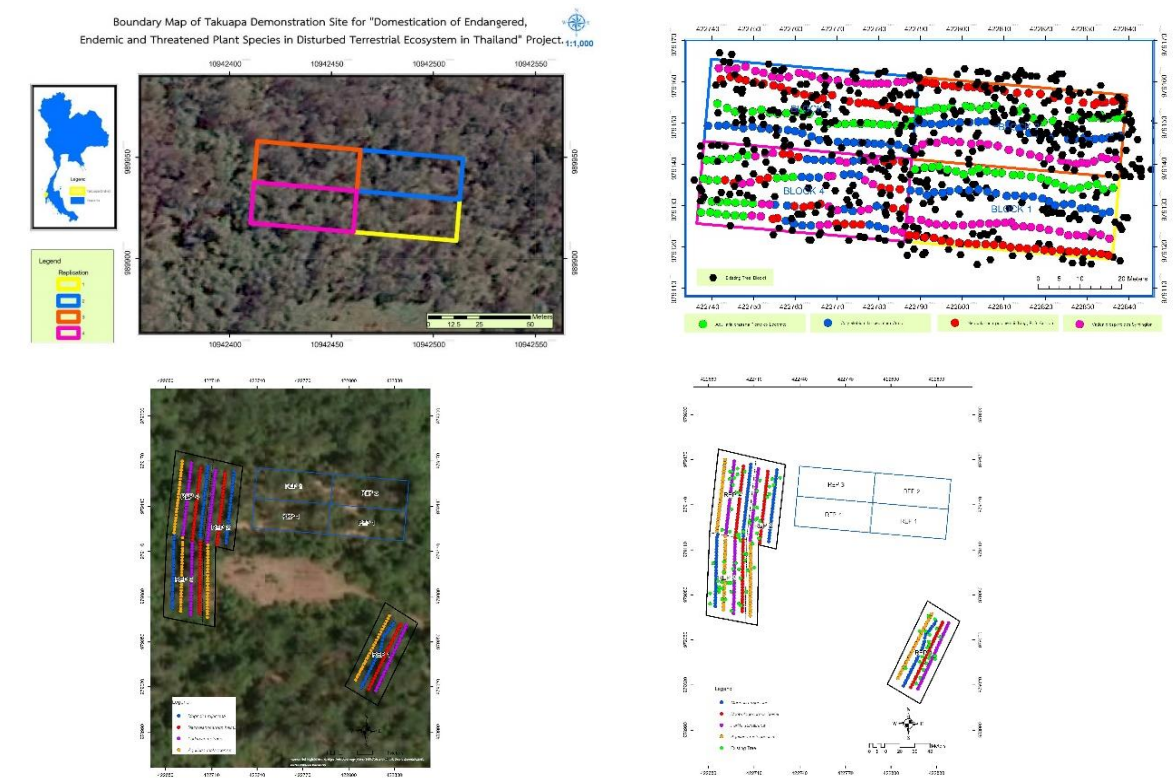


Figure 4: Phang Nga Forestry Research Station plot site GPS mapping, up) 2016 plot Down) 2018 plot.

A.2 Procurement of EETS

12 EETS Seedling preparing



Figure 5: EETS Seedling

A.3 Establishment of Model plots (Site preparation, planting stock, planting, tending, monitoring)

Site preparing

Phang Nga Forestry Research Station Project Site preparing Loosen the compact soil. 1.5 m deep, 2 m wide and 100 meter, 8 strips Each strip spaced at least 5 m and were under the existing trees. Put the pole at spacing between trees is 2 m. mix between compost and coconut husk. The compost was the composition of cow dung and coconut husk .For Mae Moh plot site, staking and digging a hold separated in 6 replications for EETS and planted nurse plant as banana near EETS hold.



Figure 6: Site preparation of Phang Nga Forestry Research Station Project Site.



Figure 7: Site preparation of Mae Moh plot.

A.3.1 Watering

Water systems, Phangnga Forestry Research Station Project Site use dripping irrigation system while Mae Moh site use manual system.



Figure 8: Dripping irrigation system at Phang Nga Forestry Research Station Project Site.



Figure 9: Irrigation system maintenance (fix change ,repairing).



Figure 10: Manual irrigation system at Mae Moh plot site.

A.3.2 Fire protection line and inspection road



Figure 11: Inspection road and fire protection at Mae Moh plot site

A.3.3 Demarcation and wind protecting (Fence)



Figure 12: Fence round at Mae Moh plot site

A.3.4 Planting & Tending

Mae Moh Mine first planted with 6 species each had 6 replicates. Those species are *Aquilaria crassna*, *Cotylelobium lanceolatum*, *Dalbergia cochinchinensis*, *Dalbergia oliveri*, *Neobalanocarpus heimii* and *Vatica diospyroides*

Phang Nga Forestry Research Station Project Site first planted 4 species are *Aquilaria crassna*, *Cotylelobium lanceolatum*, *Neobalanocarpus heimii* and *Vatica diospyroides*

For the second planting, Mae Moh mine species are *Aquilaria crassna*, *Aquilaria malaccensis*, *Cotylelobium lanceolatum*, *Dalbergia cochinchinensis*, *Dalbergia cultrate*, *Dalbergia oliveri*, *Dillinia ovate*, *Magnolia rajaniana*, *Magnolia sirindhorniae*, *Neobalanocarpus heimii*, *Parkia sumatrana subsp. streptocarpa* and *Vatica diospyroides*. For Phangnga Forestry Research Station Project Site species are *Aquilaria malaccensis*, *Magnolia rajaniana*, *Neobalanocarpus heimii* and *Parkia sumatrana subsp. streptocarpa*

Planting



Figure 13: Transplanted and planted EETS at Phang Nga Forestry Research Station Project Site.



Figure 14: Transplanted EETS to Mae Moh plot site.



Figure 15: Mae Moh plot site planted and after planted.



Figure 16: Banana planted as a nurse planted of EETS at Mae Moh plot site.

Tending

Weeding

Weeding every month in rainy season after planted EETS by hoe and mowing machine.



Figure 17: Weeding at Phang Nga Forestry Research Station Project Site.



Figure 18: Weeding at Mae Moh

Open Shade and shade

At Phang Nga Forestry Research Station Project Site the seedling were planted between existing tree. It request to open top for sun light can go though the EETS species that were planted. While Mae Moh Mine there is an open area which requested some shade and also soil moisture keeping such as coconut husk and rice straw



Figure 19: Pruning branch of existing tree to open shade at Takua Pa plot site.



Figure 20: Shading by Shading net At Mae Moh plot site.



Figure 21: Covering the tree base with coconut husk and rice straw at Mae Moh plot in dry season.

Fertilizer

The fertilizer were put one every 3 months. In Phangnga Forestry Research Station Project Site can be both organic and chemical fertilizer while Mae Mon Mine can use only organic due to the restriction of using chemical in the mining area.



Figure 22: Apply fertilizer at Mae Moh plot site.

Measuring

collect survival rate after planted 3 month and growth in Diameter at ground level and total height every 3 month at Takua Pa plot but Mae Moh plot about 6 months because of dry area condition, all trees slowly growing.



Figure 23: Growth collection at Phang Nga Forestry Research Station Project Site.

Growth and percent survival

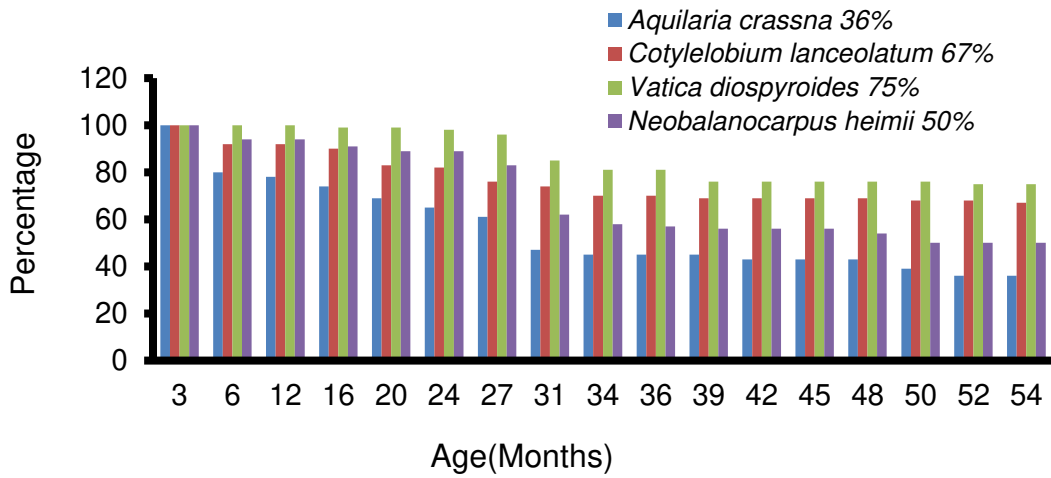


Figure 24: EETS Survival percentage of 2016 Phang Nga Forestry Research Station Project Site during 4.5 years.

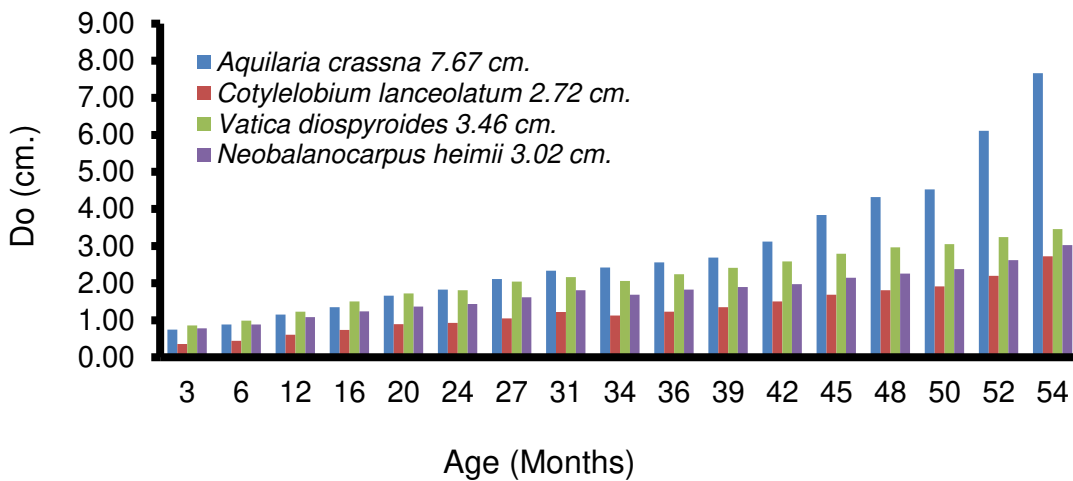


Figure 25: EETS D₀ growth of 2016 Phang Nga Forestry Research Station Project Site during 4.5 years.

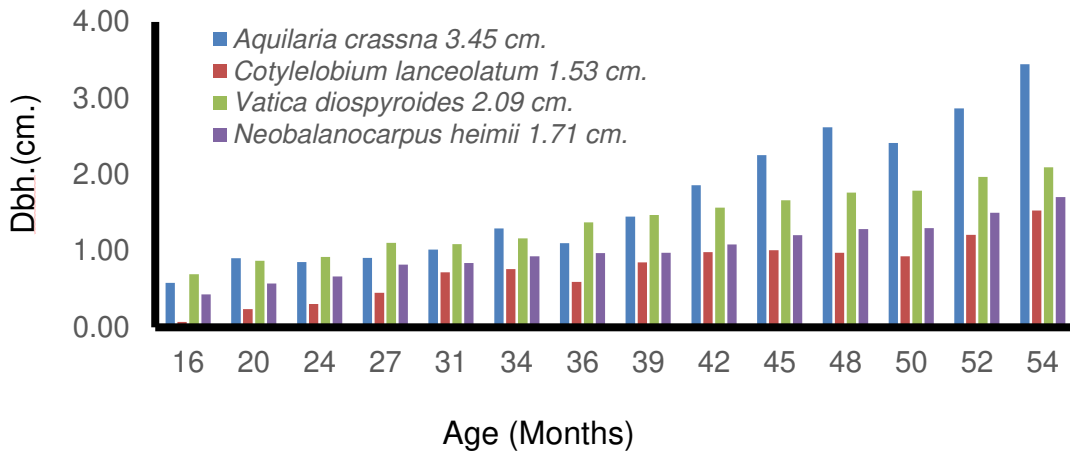


Figure 26: EETS diameter at breath height growth of 2016 Phang Nga Forestry Research Station Project Site during 4.5 years.

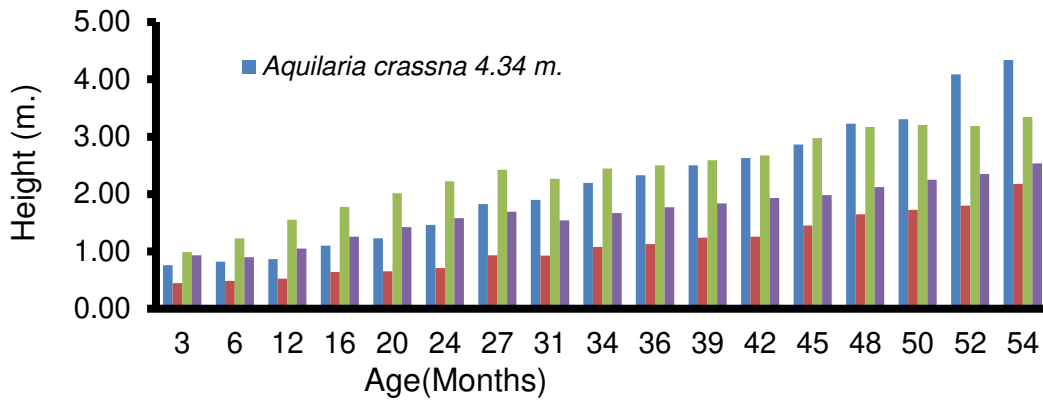


Figure 27: EETS Height growth of 2016 Phang Nga Forestry Research Station Project Site during 4.5 years.

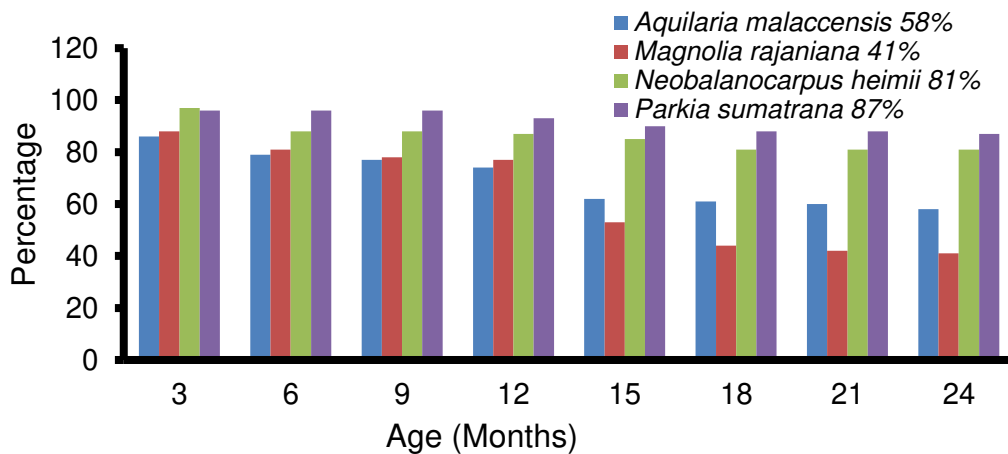


Figure 28: EETS Survival percentage of 2018 Phang Nga Forestry Research Station Project Site during 2 years.

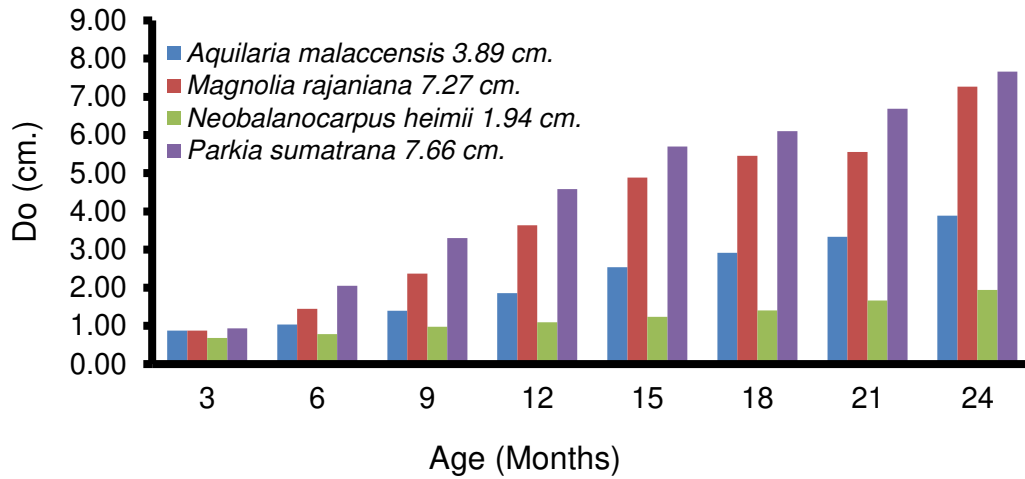


Figure 29: EETS D₀ growth of 2018 Phang Nga Forestry Research Station Project Site during 2 year.

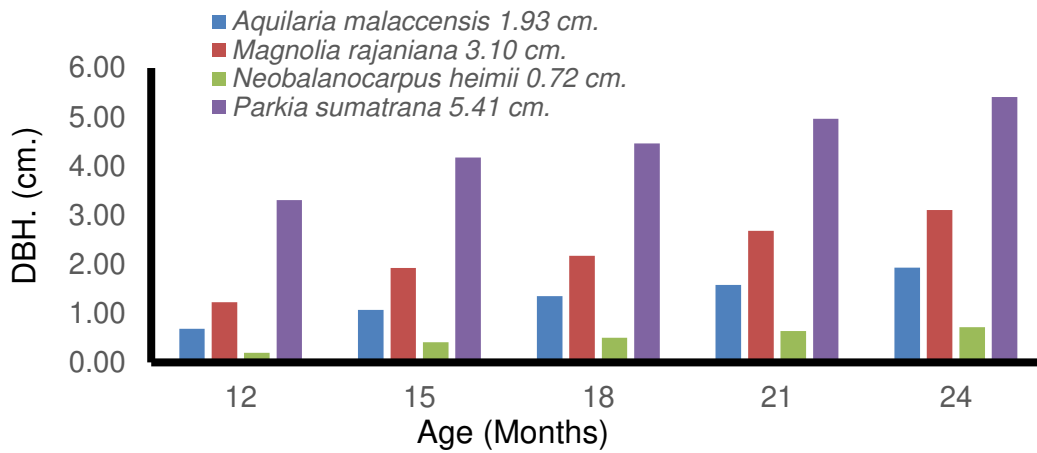


Figure 30: EETS diameter at breast height growth of 2018 Phang Nga Forestry Research Station Project Site during 2 year.

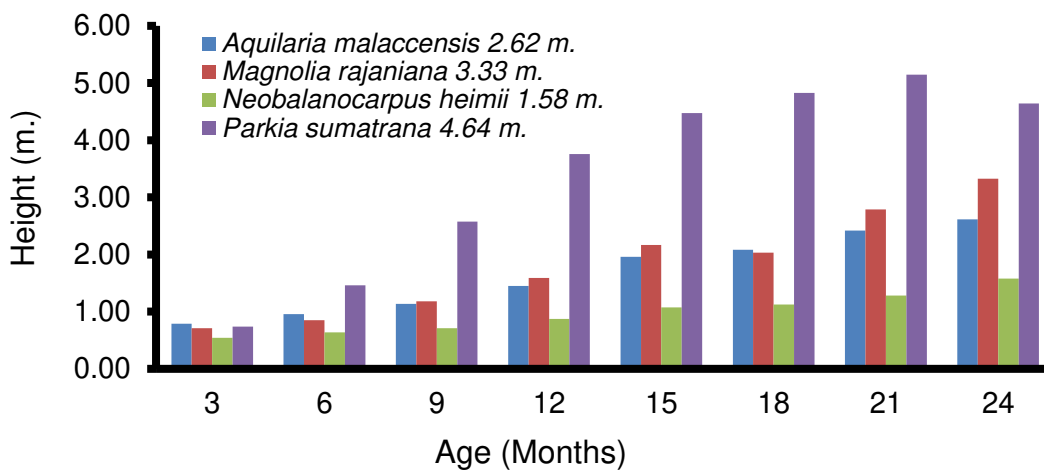


Figure 31: EETS Height growth of 2018 Phang Nga Forestry Research Station Project Site during 2 year.

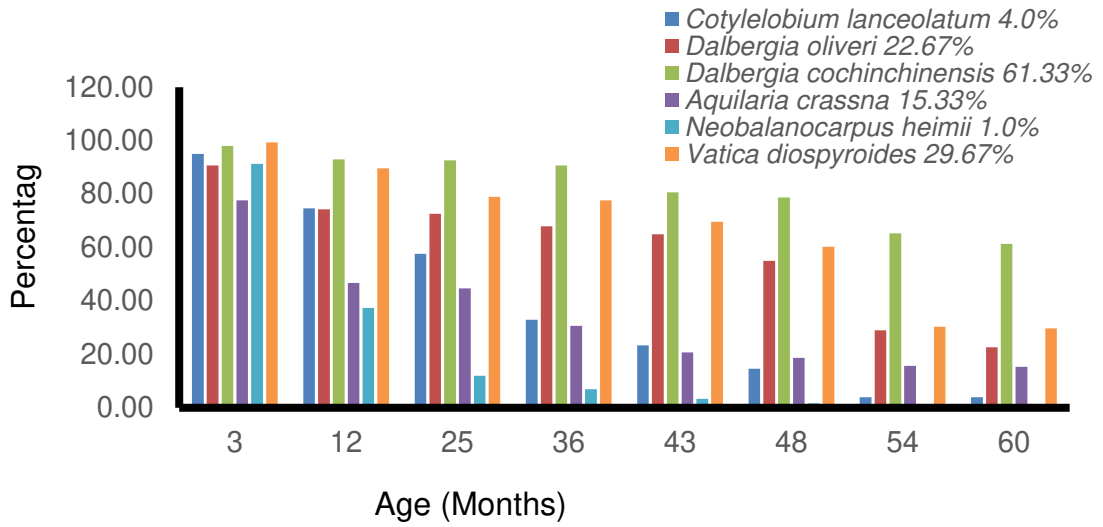


Figure 32: EETS Survival percentage of 2016 Mae Moh plot site during 5 years.

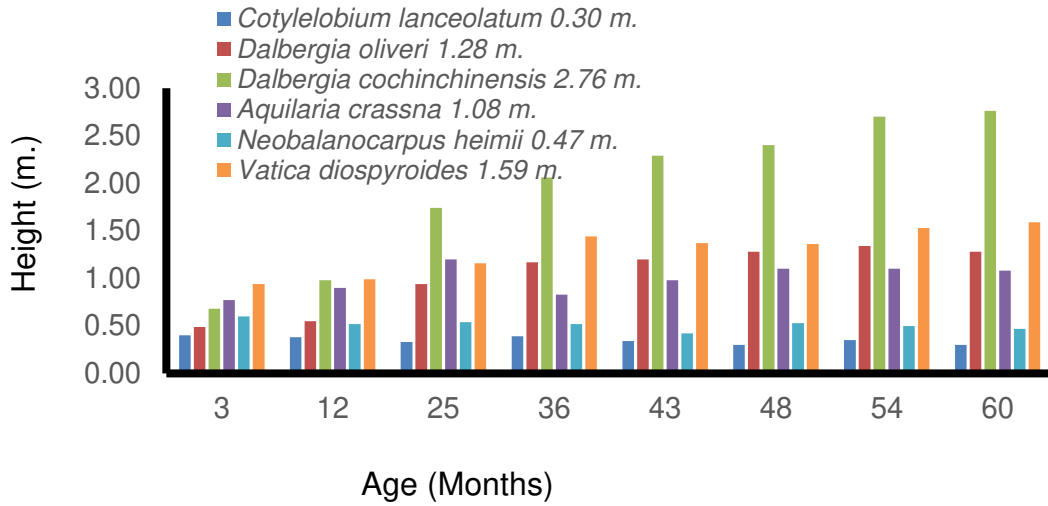


Figure 33: EETS Height growth of 2016 Mae Moh plot site during 5 years.

Growth & Number of Trees (Mae Moh 2018, Nov 2021)												
	Dc	Dcu	Ac	Do	Mr	MI	Psu	Vd	Dov	Ms	Nh	CI
Number (trees)	484	434	146	302	230	220	55	27	2	0	0	19
Do.(cm.)	1.00	1.08	0.67	1.12	1.08	0.68	1.45	0.81	0.55	0.00	0.00	0.94
Ht. (cm.)	66.99	63.75	61.38	56.43	105.95	51.56	121.27	75.85	51.50	0.00	0.00	85.21
Dc	<i>Dalbergia cochinchinensis</i>						Psu	<i>Parkia sumatrana</i>				
Dcu	<i>Dalbergia cultrata</i>						Vd	<i>Vatica diospyroides</i>				
Ac	<i>Aquilaria crassna</i>						Dov	<i>Dillenia ovata</i>				
Do	<i>Dalbergia oliveri</i>						Ms	<i>Magnolia sirindhorniae</i>				
Mr	<i>Magnolia rajaniana</i>						Nh	<i>Neobalanocarpus heimii</i>				
MI	<i>Milleffia leucantha</i>						CI	<i>Cotylelobium lanceolatum</i>				

Figure 34: EETS tree number, D₀ and Height growth of 2018 Mae Moh plot site.

A.3.5 Monitoring/supervising of site preparation, planting and tending

Monitoring and evaluation



Figure 35: Evaluated at Mae Moh plot site.



Figure 36: Evaluated at Phang Nga Forestry Research Station Project Site.

A.4 Documentation of biophysical site properties, planting techniques and assessment of growth

A.4.1 Soil sampling



Figure 37: 5 holes at Phangnga Forestry Research Station Project Site were sampled to collect soil for analysis.



Figure 38: 24 holes of Mae Moh plot site were sampled to collect soil for analysis.

Soil Analysis (Takua Pa 2018)						
Chemical Properties (24 Samples, depth 0-80 cm.)						
	0-15 cm.		15-30 cm.		> 30 cm.	
	Average	Range	Average	Range	Average	Range
pH	5.21 (strongly acid)	4.48-5.90 (extremely-moderately)	5.92 (moderately acid)	5.12-6.96 (strongly-neutral)	5.90 (moderately acid)	4.93-6.99 (very strongly-neutral)
OM (%)	3.65 (low)	1.04-5.92 (very low – moderately low)	0.37 (very low)	0.18-0.55 (very low – very low)	0.19 (very low)	0.12-0.38 (very low – very low)
Avai.P (mg/kg)	211.90 (very high)	2.93-1,201.00 (very low – very high)	5.51 (low)	0.73-11.30 (very low – medium)	1.83 (very low)	0.73-2.33 (very low – very low)
Exch.K (mg/kg)	18.15 (very low)	4.86-36.80 (very low – low)	3.74 (very low)	1.24-4.78 (very low – very low)	2.36 (very low)	1.34-4.33 (very low – very low)
Exch.Ca (mg/kg)	974.63 (very low)	109-4,568 (very low – low)	127.05 (very low)	22.10-349.00 (very low – very low)	99.76 (very low)	19.30-222.00 (very low – very low)
Exch.Mg (mg/kg)	114.76 (very low)	8.25-599.00 (very low - low)	65.24 (very low)	1.45-496.00 (very low - low)	2.51 (very low)	0.12-5.81 (very low – very low)
Exch.Na (mg/kg)	31.24 (medium)	16.60-45.30 (very low – medium)	21.70 (low)	15.70-33.30 (very low – medium)	18.94 (very low)	13.20-24.70 (very low – low)
CEC (Cmol/kg)	7.01 (moderately low)	3.80-17.70 (low – moderately low)	1.88 (very low)	1.20-3.20 (very low – low)	1.44 (very low)	0.50-2.40 (very low – very low)
BS (%)	70.69 (medium)	19.50-158.00 (low – high)	64.08 (medium)	10.60-232.00 (low – high)	47.96 (medium)	9.88-112.00 (low– high)

Figure 39: Soil chemical properties of Phang Nga Forestry Research Station Project Site

Soil Analysis (Mae Moh 2018)		
Physical Properties (15 Samples, depth 0-50 cm.)		
Soil Texture		
	Clay	
Sand (%)	Silt (%)	Clay (%)
24	19	57
(13-39)	(14-24)	(45-69)

Figure 40: Soil physical properties of Mae Moh plot site

Soil Analysis (Mae Moh 2018)		
Chemical Properties (15 Samples, depth 0-50 cm.)		
	Average	Range
pH	7.59 (slightly alkaline)	7.25-7.72 (neutral – slightly alkaline)
OM (%)	6.20 (moderately low)	0.32-9.11 (very low - medium)
Avai.P (mg/kg)	2.15 (low)	0.85-12.25 (very low – moderately low)
Exch.K (mg/kg)	126.28 (high)	67.20-178.00 (medium – very high)
Exch.Ca (mg/kg)	13,559 (high)	8,785-19,939 (medium – high)
Exch.Mg (mg/kg)	804 (low)	487-1,806 (low – medium)
Exch.Na (mg/kg)	63.43 (very low)	27.30-174.00 (very low – low)
CEC (Cmol/kg)	18.87 (moderately high)	15.00-22.30 (moderately high – high)
BS (%)	405 (medium)	184-687 (low – medium)

Figure 41: Soil chemical properties of Mae Moh plot site.

A.4.2 Purchase of microclimate sensors



Figure 42: 5 data loggers and 2 USB with interface cables were purchased.

A.4.3 Purchase of height meter (vertex)



Figure 43: 2 sets of height meter were purchased. Height meter (vertex) (Haglof VERTEX IV)

A.4.4 Purchase of diameter tapes/ shredder machine:



Figure 44: 4 pieces of diameter tapes (Lufkin Executive Pocker D Tape 2 m. long), 1 set of shredder machine were purchased and 2 sets of fog machine.

B. Regional Workshop

B.1 Meeting on Domestication of EETS in ASEAN countries: Thailand managed 1 regional workshop in year 2018 held in Chiang Mai Province. Participants from ASEAN Countries invited.



Figure 45: Participants from ASEAN countries to participated the regional workshop.

B.2 Workshop and national workshop

1) Workshop on Domestication Plant Species and diversity conservation in Disturbed Ecosystem (Tree planted in Mining area). Participants from EGAT (3), Faculty of Forestry (2), RFD (14) and External (Advisor) (2) held in Bangkok 6 February 2020 and 7 February 2020 field trip to SCG Saraburi province.

2) National workshop on How easily to plant EETS? 24 Participants from mine owner or who is concern. 14-16 December 2020 at Phang Nga Forest Research Station Takua Pa District, Phang Nga province.



Figure 46: Workshop on 6-7 February at RFD in Bangkok and field trip to SCG in Saraburi province



Figure 47: Workshop: How to easily to plant EETS? And site visited.

B.3 1st and 2nd PSC meeting (Thailand): Thailand had 2 PSC meeting in 5 February 2020 and 3 August 2020 at RFD Bangkok.



Figure 48: 1st PSC meeting



Figure 49: 2st PSC meeting

C. Technology Transfer and Capacity Development

C.1 Cross visits

1. Visited Philippines in year 2018:nursery Makiling botanical garden and community village.



Figure 50: Visited nursery and Makiling botanical garden.

2. Visited Singapore in year 2016, went to National botanical garden, forest reserve, and Garden by the Bay to study rare species from several origin.



Figure 51: EETS in Singapore

3. Visited Korea in year 2020 Visited Korea national arboretum, National forest seed and variety center, Baekdudaegan arboretum and Pocheon art valley



Figure 52: Visited seed vault at Baekdudaegan arboretum

C.2 Knowledge and technology transfer:

For this Activity has 4 activities such as manual, leaflet, Roll up and website

C.2.1 Manual

3 manuals published as Weed manual in 2018, Soil manual in 2021 and EETS manual in 2022.



Figure 53: Weed manual, Soil manual and EETS manual

C.2.2 Leaflet 3leaflets were printed in year 2016 (1 leaflet) for project recommend and year 2021 (2 leaflets) for GPS recommend of 2 sites.

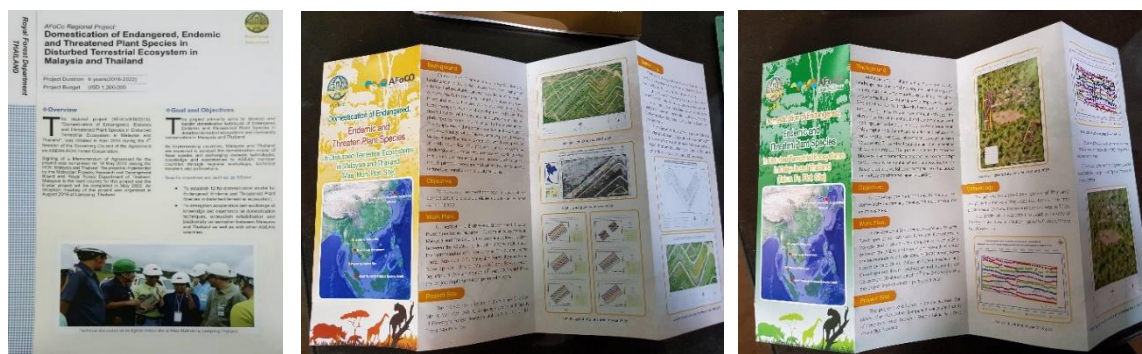


Figure 54: Project leaflets

C.2.3 Poster and roll up: 3 sets of 10 project roll up were printed.



Figure 55: 3 sets of 10 project roll up.

C.2.4 Website:

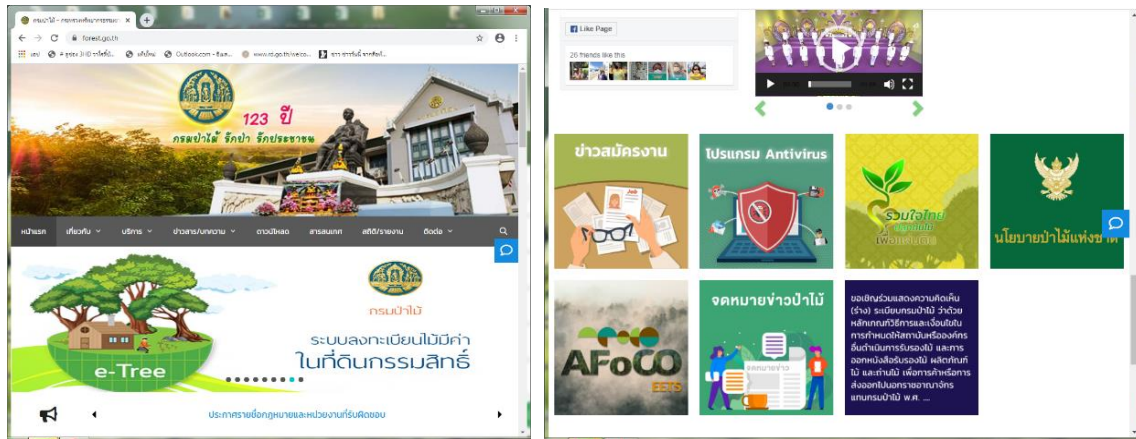


Figure 56: AFoCO Banner in RFD website.

D. Local Operation

D.1 External Auditing: Thailand managed for external auditing 2 years was year 2018 and 2019

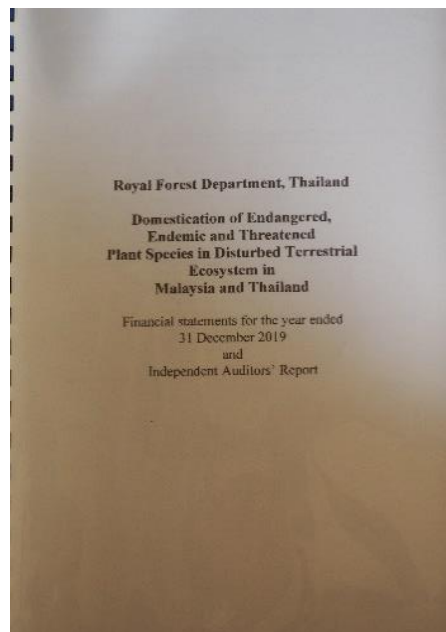
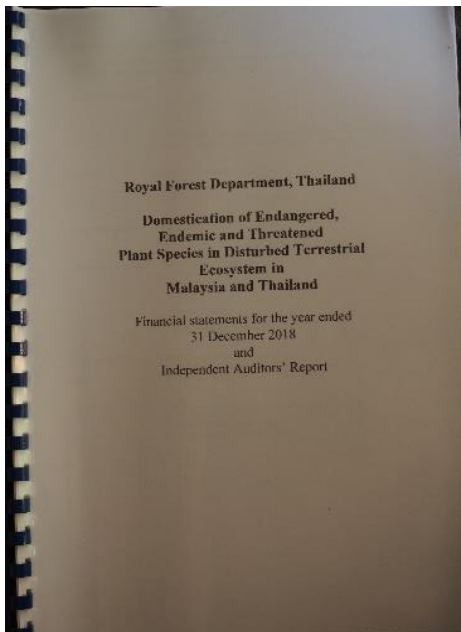


Figure 57: External auditing financial report.

D.2 Attending overseas meetings: 2 times of overseas meetings. IUFRO in China in year 2016 and COP 14 in Egypt in year 2018.



Figure 58: IUFRO meeting in China.



Figure 59: COP 14 meeting in Egypt

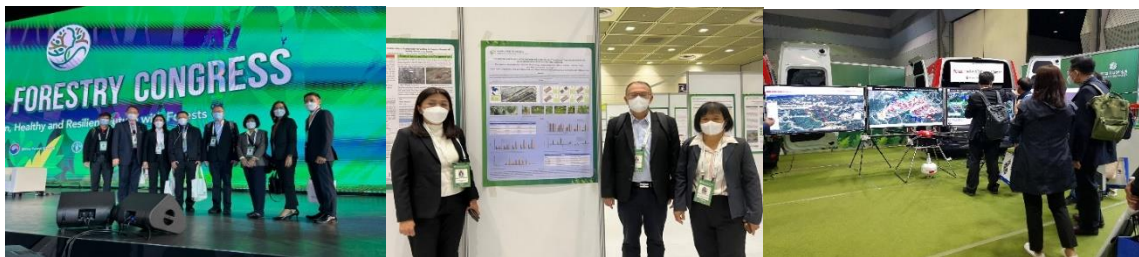


Figure 60: 15th World Forestry Congress in Korea

D.3 Inception Meeting: The Inception meeting was held in Lampang Thailand in year 2016. The Meeting was attended by 11 participants



Figure 61: Field trip to Mae Moh mine.

D.4 Annual report: 6 Annual reports were printed.



Figure 62: Annual reports

D.5 Miscellaneous

D.5.3 Office automation: 2 Notebooks 1 computer screen 2 printers 1 scanner 3 mobile phones 2 mobile speaker phones 3 cameras and 1 overhead projector.



Figure 63: Notebook, Computer screen, Printers and Scanner.



Figure 64: Mobile phone, Mobile speaker phone, Camera and Overhead projector.

D.6 PCC Meeting: 11 PCC meetings in 6 years. Alternate each year between Thailand and Malaysia. 1-6 PCC meeting were on site meeting. 7-11 PCC meeting were teleconference.



Figure 65: Teleconference in 7 PCC meeting

D.7 Stakeholder Meeting

The main objectives :publicize the project to local people and to listen to their views of future forest that they desire. The Meeting was attended by 111 stakeholders at Mae Moh meeting and 36 stakeholders at Takua Pa meeting. The stakeholder from various occupations such as local people around the research station, station officers, and village headman. In the meeting had group discussion and drawing pictures entitled “my forest in the future”



Figure 66: Stakeholder meeting at Mae Moh, Lampang province.



Figure 67: Stakeholder meeting at Phangnga Forestry Research Station Project Site Phangnga province.

9. Sustainable Property Management after the Project

Assets purchased by project funds are as follows:

No.	Asset	Quantity	Remarks	Status
1	GPS	3	2017	Used/broken
2	Height meter pole	4	2017(2), 2021(2) (1 broken in 2021)	In-use
3	Diameter tape	5	2017(3), 2021(2) (1 broken in 2021)	In-use
4	Microclimate station	3	2021	In-use
5	Notebook DELL Latitude 3411	1	2021 (for webinar)	In-use

9.1 Malaysia

All assets above will be used continually for other project operation until these are no longer usable. Assets that are broken and not economical to be repaired will be disposed in accordance to FRIM's rules in management of assets [PK(S).FRIM.KEW.04].

10. References

(This section should list any references used in preparing the report. Any formats for bibliographic information may be used, however, the following elements should at least be included – author(s), title of the publication, the edition, place of edition, the publisher and the year of publication.)

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11. Appendices

1.1 Work Plan of Malaysia

1.2 Work Plan of Thailand

Appendix 1.2 Work Plan of Thailand

UPDATED AT FCEM

No	Activities	Verifiable Performance Indicators	Responsible party	TOTAL (2016-2022)			2016		2017		2018		2019		2020		2021		2022	
				T	A	%	T	A	T	A	T	A	T	A	T	A	T	A	T	A
THAILAND																				
A	Site characterization																			
Activity A.1	Selection of planting sites in denuded and disturbed forest, and identification of EETS for domestication	A project site in both countries that is perpetually used for as the demonstration																		
A.1.1	Site selection and identification of EETS for domestication	Site and EETS	Project staff of Thailand	1 and 12	2 and 12	200	1 and 6	2 and 6	0	0	1 and 6	2 and 10	1 and 6	2 and 10	0	0	0	0	0	
A.1.2	GPS mapping	Ha	Project staff of Thailand	6	9.68	161	3	3.88	0.5	0.5	3	0.0	3	0.0	5.3	5.3	0	0	0	
A.1.3	Producing Site Locality Map	Set	Project staff of Thailand	240	240	100	60	60	60	60	60	0	60	0	0	120	0	0	0	
Activity A.2	Procurement of EETS	Model in domestication of EETS																		
A.2.1	Purchase of seedlings or saplings (@ USD20/seedlings) (EETS 5815 seedlings with nurse plant 3500 seedlings)	Seedling	Project staff of Thailand	6780	9315	137	1,980	4,380	0	0	4,800	0	0	480	0	4,455	0	0	0	
Activity A.3	Establishment of Model plots (Site preparation, planting)	Domestication of germplasm conservation plots established that contained at least 12 to 30 species IUCN or National Red-list species																		
A.3.10	Water Tank for Takau Pa site, Phang-Nga Province	Tank	Project staff of Thailand	0	0	0	0	0	0	0	0	0	0	0	4	0	0	4	0	
Activity A.4	Documentation of biophysical site properties, planting techniques and assessment of growth																			
A.4.1	Soil analysis	Sample	Project staff of Thailand	54	163	302	15	124	0	0	15	0	24	0	0	39	0	0	0	
A.4.2	Purchase of microclimate sensors / rain gauge	pieces (5Temp-Humid Datalogger with 2 USB and Interface cable)	Project staff of Thailand	5(2)	5(2)	100	3(1)	3(1)	2(1)	2(1)	0	0	0	0	0	0	0	0	0	
A.4.3	Purchase of height meter (vertex) / shredder machine	Set	Project staff of Thailand	2	2	100	1	1	0	0	1	1	0	0	0	0	0	0	0	
A.4.4	Purchase of diameter tapes / insect sprayer	pieces	Project staff of Thailand	4	6	150	2	4	0	0	2	2	0	0	0	0	0	0	0	
A.4.5	Purchase of high resolution digital camera	pieces	Project staff of Thailand	1	2	200	1	2	0	0	0	0	0	0	0	0	0	0	0	
B	Regional workshop																			
Activity B.1	Domestication of EETS in ASEAN countries	Country Report (Original 2 workshop due to COVID-19 2nd workshop change to Domestic workshop B.2)		2	1	50	0	0	0	0	1	1	0	0	1	0	0	0	0	
Activity B.2	Domestic Workshop (Budget 2018 (3,878.14))	Workshop (replace 1 regional workshop, 2020 RFD and Saraburi, 2020 Phangnga)		2	2	100	0	0	0	0	0	0	0	0	2	2	0	0	0	
Activity B.3	PSC meeting (Thailand) (Budget 2018 (2,851.17))	Meeting (5Feb.2020, 3 Aug 2020)		2	2	100	0	0	0	0	0	0	0	0	2	2	0	0	0	
C	Technology transfer and capacity development																			
Activity C.1	Cross visits (USD1700/person/trip TH, MY, IN,PH,SG)	Report on cross visit		3	3	100	1	1	1	1	1	0	1	1	0	0	0	0	0	
Activity C.2	Knowledge and technology transfer	Publication and website																		
C.2.1	Manual (budget 2016) Weed species		Project staff of Thailand	1	1	100	0	0	0	0	0	0	1	1	0	0	0	0	0	
C.2.2	Leaflet	topics (copy)	Project staff of Thailand	3(1250)	3(1250)	100	1(500)	1(500)	0	0	0	0	0	0	0	2(750)	2(750)	0	0	
C.2.3	Poster and roll up	10 roll up per set, 3 sets (30pc)	Project staff of Thailand	3(30)	3(30)	100	0	0	0	0	0	0	0	0	0	3(30)	3(30)	0	0	
C.2.4	Website development(2016 established, 2017-2018 subscription)	2016 website www.afoco-thailand-malaysia.com,2019 website https://www.forest.go.th/foreign/โครงการ-afoco/	Project staff of Thailand	1	1	100	1	1	0	0	0	0	1	1	0	0	0	0	0	
C.2.12	Manual (Budget 2018) EETS Species			1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
C.2.13	Manual (Budget 2019) Soil Analasys			1	1	100	0	0	0	0	0	0	0	0	0	0	0	1	0	
D	Local Operation																			
Activity D.1	External Auditing			1	1	100	0	0	0	0	0	0	0	0	1	1	0	0	0	
Activity D.2	Attending overseas meetings	Times		3	3	100	1	1	1	0	1	1	0	0	0	0	0	0	1	
Activity D.3	Inception Meeting/Project coordination meeting	Meeting		1	1	100	1	1	0	0	0	0	0	0	0	0	0	0	0	
D.4	Annual Report	Report		5	5	100	1	1	20	20	1	1	1	1	1	1	1	1	0	
D.5	Miscellaneous			0	0	0														
Activity D.5.4	Local part-time Coordinator (contract)	Contract	Project staff of Thailand	7	7	100	1	1	1	1	1	1	1	1	1	1	1	1	1	
Activity D.6	PCC/PCM Meeting	Meeting report		10	10	100	1	1 (PCM-TH)	1	1 (MY)	1	1 (TH)	2	2 (MY)	2	2 (Thailand Teleconference)	2	2 (MY Teleconference)	1	1 (Thailand Teleconference)
Activity D.7	Stakeholder Meeting	Meeting		2	2	100	1	1	1	1	0	0	0	0	0	0	0	0	0	
Activity D.8	Completion report	Report		1	0	0													1	
F	Contingency/Other expenditure (Bank charge/Adjustment of cash transaction)																			