

# Workshop Report

Regional Workshop on Sustaining Teak Forests in Mekong Basin

**24-27**  
**September 2019,**  
**Yangon, Myanmar**

Co-organizers: International  
Tropical Timber Organization (ITTO),  
Asian Forest Cooperation  
Organization (AFoCO),  
Forest Department of Myanmar,  
Kasetsart University

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# Workshop Report

## Regional Workshop on Sustaining Teak Forests in Mekong Basin

**24-27 September 2019**

Regional Education and Training Center (RETC) – Asian Forest Cooperation Organization (AFoCO), Yangon, Myanmar

Prepared for International Tropical Timber Organization (ITTO) and  
The Federal Ministry for Food and Agriculture (BMEL)

By

The ITTO Teak Project in Mekong

# Regional Workshop on Sustaining Teak Forests in Mekong Basin

24-27 September 2019, RETC-AFoCO, Yangon, Myanmar

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## Acronyms and abbreviations

AFoCO	Asian Forest Cooperation Organization
BMEL	Federal Ministry for Food and Agriculture
CBD	Community based development
CF	Community forestry
CFC	Community forest conservation
CFE	Community forest enterprise
CFI	Community forestry instructions
CFU	Community forestry units
CFNWG	Community Forestry National Working Group
CI	Criteria and indicators
CIFOR	Centre for International Forestry Research
CINFT	Centre for international forest products trade
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CoC	Chain of Custody
DBH	Diameter at breast height
DfID	Department of international development (UK)
DFMP	District Forest Management Plan
DNA	Deoxyribonucleic acid
FA	Forest Administration
FAO	Food and Agriculture Organization
FIO	Forest Industry Organization
FLEGT	Forest law enforcement, governance and trade
FLR	Forest and landscape restoration
FSC	Forest Stewardship Council
GDP	Gross domestic product
GHGs	Greenhouse gases
GIZ	German International Cooperation
ITTO	International Tropical Timber Organization
IUCN	International Union for Conservation of Nature
IUFRO	International Union of Forest Research Organization
JIRCAS	Japan International Research Centre for Agricultural Sciences
KU	Kasetsart University
LEB	Log export ban



MFCC	Myanmar Forest Certification Committee
MIG-seq	Multiplexed ISSR genotyping by sequencing
MOFCOM	Ministry of Commerce of China PR
MRRP	Myanmar Reforestation and Rehabilitation Projects
MTE	Myanmar Timber Enterprise
MTLAS	Myanmar Timber Legality Assurance System
NAFRI	National Agriculture and Forestry Research Institute
NGOs	Non-governmental organizations
PCR	Polymerase chain reaction
PEFC	Program for the endorsement of forest certification
PEPC	Private Forest Plantation Cooperatives
PES	Payment for ecosystem services
RECOFT	Centre for people and forests
REDD	Reducing emissions from deforestation and forest degradation
RETC	Regional Education and Training Center
RFD	Royal Forest Department
RSPO	Roundtable on sustainable palm oil
SDG	Sustainable Development Goal
SFM	Sustainable forest management
SNP	Single-nucleotide polymorphism
TCCM	Timber Certification Committee of Myanmar
TEK	Traditional ecological knowledge
TNC	The Nature Conservancy
UN	United Nations
UNEP	United Nations Environment Program
VAFS	Vietnamese Academy of Forest Sciences
VCF	Value Chain Framework
WRI	World Resource Institute
YPO	Yearly plan of operations





## The Event

Teak (*Tectona grandis*) is one of the most important and valuable hardwood species in the world. The Greater Mekong region contributes with over 70% of the global natural teak forests (about 29 million hectares). In particular, Myanmar accounts for 50% of the total area, followed by Thailand. Unfortunately, the natural teak forest area has been reduced substantially due to overexploitation, agriculture expansion, and unsustainable management. Although teak plantations are found in about 70 tropical countries in Africa, Asia and Latin America, seed sources are generally unknown and most likely originate from roadside plantings. Thus there is a high risk of losing the species' high diversity of genetic traits and wood characteristics.

With the financial support from the Federal Republic of Germany through the Federal Ministry of Food and Agriculture (BMEL), "The International Tropical Timber Organization (ITTO) Teak Project Phase I, Enhancing Conservation and Sustainable Management of Teak Forests and Legal and Sustainable Wood Supply Chains in the Greater Mekong Sub-region (PP-A/54-331)" is being executed by ITTO in collaboration with five agencies, namely Cambodia's Forestry Administration (FA), Lao PDR's National Agriculture and Forestry Research Institute (NAFRI), Myanmar's Forestry Department (FD), Thailand's Royal Forest Department (RFD) and Vietnamese Academy of Forest Sciences (VAFS). Besides, Kasetsart University of Thailand serves as the Regional Activity Manager for coordinating all activities implemented in the five participating countries. The project aims to enhance natural teak forest management, production and marketing through the establishment of legal and sustainable wood supply chains and improve local economy and local communities' livelihood in the Mekong region.



**Gerhard Dieterle**, Executive Director, ITTO, and **Matthias Schwoerer**, Germany, launching the project on Conservation and Sustainable Management of Teak Forests and Legal and Sustainable Supply Chains in the Mekong Region

The organization of the Regional Workshop on Sustaining Teak Forests in Mekong Basin, held at the Asian Forest Cooperation Organization (AFoCO), Yangon, Myanmar on 24-27 September 2019 combined the Technical Conference on 24-25 September 2019 and the 2nd Project Technical Committee (PTC) Meeting with a field visit in various places located in Yangon on 26 September 2019. The Technical Conference aimed at reviewing and sharing experiences in case studies, good practices and policy options to empower local communities and smallholders in teak planting and teak management, and in agroforestry systems to support sustainable livelihoods in the Mekong basin. It included keynote presentations and over 30 presentations from six technical sessions, namely 1) National Report on Natural Teak Forest and Teak Plantation, 2) In-situ and Ex-situ Conservation of Teak Resources in Mekong, 3) Sustainable Management of Teak Forests - R&D in silviculture and best practices, 4) Promoting of Small Holders and Communities in Natural Teak

Forests Management and Establishment of Planted Teak, 5) Legality and Sustainability in Teak supply chains in Mekong, and 6) Value Chains and Demand and Supply in Teak, as well as Panel Discussion on Opportunities and Challenges of Smallholders Teak in Mekong Basin.

At the end, over 40 participants from 14 countries adopted the six key messages for sustainable management of natural teak forests and teak plantations. These messages include 1) enhancing the in-situ and ex-situ conservation of teak genetic resources, 2) improving silvicultural practices in teak plantations by selection of suitable sites, 3) promoting the involvement of smallholders and communities in order to improve livelihood, income generation and job creation, 4) promoting legal and certified value chains of teak timber and timber products, 5) strengthening sustainable supply and consumption of teak timber and timber products through establishment of incentive mechanisms, and 6) scaling up international collaboration in which sustaining teak forests and teak products could contribute to climate change mitigation and the United Nations Sustainable Development Goals (SDGs) 8, 12 and 15

The PTC meeting discussed the results and recommendations of the 1st PSC meeting and formulated them into operative actions on grounds and solving any technical problems encountered. In addition, the planned activities for the 2nd PSC meeting and the National Teak Forum, held in Lo PDR in February 2020 and the participation in the upcoming 4th World Teak Congress held in Ghana in August 2020 were discussed.

The Organizing Committee does hope that the participants and interested agencies and individuals, especially scientists and policymakers, can make use of this report and recall the presentation contents. This Regional Workshop and the report would not have been possible without the valuable inputs and supports of many organizations and individual experts. Key institutions providing facilities and support include AFoCO, ITTO, Myanmar's Forest Department, and Kasetsart University. Our special thanks go to distinguished speakers, panelists and all participants for their active participation and contribution. We express our deep appreciation to Dr. Ye Myint Swe, Deputy Minister of Natural Resources and Environmental Conservation, Myanmar for contributing enthusiastic Opening Remarks; Mr. Sung Ho Choi, Program Officer of AFoCO; Dr. Thaung Naing Oo, Director of Forest Research Institute, Dr. Zar Chi Hlaing and Dr. Mu Mu Aung of Myanmar's Forest Department for a great support of logistic arrangement; and National Coordinators from the five participating countries for support. Mr. Palle Havmoller was helpful to carefully edited English. Finally, we gratefully acknowledge the BMEL and ITTO for financial and technical support, respectively.

**Prof. Dr. Yongyut Trisurat**

*Regional Activity Manager  
ITTO Teak Project in Mekong & Chief Editor*





<b>Date</b>	24 – 27 September 2019
<b>Venue</b>	RETC- AFoCO Headquarter, Hmawbi, Myanmar
<b>Organizers</b>	International Tropical Timber Organisation Asian Forest Cooperation Organization (AFoCO) Forest Department of Myanmar Kasetsart University, Thailand
<b>Collaborators</b>	Forest Administration, Cambodia National Agriculture and Forestry Research Institute, Lao PDR Royal Forest Department, Thailand Vietnamese Academy of Forest Sciences, Vietnam
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<b>Editors</b>	Prof. Dr. Yongyut Trisurat, Dr. Hwan-ok Ma, Dr. Tetra Yanuariadi, Dr. P.K. Thulasidas, Dr. Thaug Naing Oo, Mr. Danny Chheang, Mr. Vongvilay Vongkhamsao, Mr. Sapol Boonsermsuk, Dr. Dong Lam Tran, Mr. Paolo Sartorelli, Ms. Saichon Mutarapat and Ms. Suchanart Suyarat

## Opening session

### Opening remarks

Delivering the opening speech on the occasion of the Regional Workshop on Sustaining Teak Forests in Mekong Basin, H. E. Dr. Ye Myint Swe, and Union Dy. Minister emphasized the commitment of Myanmar government not only to promote sustainable teak forest management but also to solve environmental issues such as global warming, climate change, arresting deforestation and biodiversity loss. Of the total natural teak forests that is occurring the world over, half of it is in Myanmar and we are very much concerned about loss of genetic diversity of our natural teak forests. It is at the appropriate time, ITTO has been supporting teak related projects with a focus on genetic resources conservation and sustainable management of natural and planted teak forests in its natural habitat and assists the governments, local communities and small holders

to enhance natural teak management, production and marketing through the establishment of legal supply chains to improve local economy and local communities' livelihood in Mekong basin. The Ministry has taken steps to support the ITTO initiative in supporting teak management in the Mekong sub-region. The Myanmar Reforestation and Rehabilitation Projects (MRRP) started 10 years back is important for the country to restore degraded forests but also to provide teak timber, protective functions to ensure environmental stability and ecosystem services and community livelihood, recreation and ecotourism.



**HE Dr. Ye Myint Swe,**  
Deputy Union Minister of Natural Resources and  
Environmental Conservation, Myanmar

## Welcome remarks

Dr Ma Hwan-ok, Senior Projects Manager, ITTO, expressed his gratitude for being appointed as general holder for the Regional Workshop in Yangon, Myanmar. This meeting provides great opportunities for new partnerships in the Mekong Sub-region in matters of sustainable supply and consumption of teak products. He emphasized firstly the role of the teak industry in creating new job opportunities for younger generations (particularly smallholders) and, secondly, the key role that sustainable management of teak forests should play. Secondly, Dr. Ma pointed out the need to incentivise the mechanisms which promote

the legal and sustainable supply of teak and its derived products in the Mekong Basin. Additionally, he expressed his intention to increase partnerships which might help to promote the legal and sustainable supply chains of tropical timber products. This new view will enhance investments on landscape restoration, downstream supply chains, marketing and trade of timber and nontimber forests products.



**Dr Ma Hwan-ok, ITTO Projects Managers**



**Mr Sung Ho Choi**, Program Officer, Asian Forest Cooperation Organization (AFoCO), who gently offered the space and the possibility for all of us to meet, pointed out that AFoCO and ITTO will jointly work together for regional partnerships to achieve sustainable development in the greater Mekong Sub-region not only for teak but also for other aspects related to forestry and agriculture.



**Mr Sung Ho Choi**, Program Officer,  
Asian Forest Cooperation Organization (AFoCO)

**Dr Nikhom Laemsak**, Dean, Faculty of Forestry, Kasetsart University, Thailand, is encouraging sustainable forest management and collaborating with international organisations aiming to promote sustainable development in the countries. Furthermore, besides his academic activities at international level, the Dean is promoting efforts in boosting human well-being particularly in rural areas. He explained how KU is committed to coordinate the ITTO Teak project and to provide the necessary logistical support for the successful implementation of the project in the whole Mekong basin.



**Dr Nikhom Laemsak**, Dean, Faculty of Forestry,  
Kasetsart University, Thailand

**Dr. Chansamone Phongoudome**, Deputy Director General, NAFRI, Lao PDR notified that Laos Government has target to increase forest cover at 70% of total area by 2020 and is committed to contribution to international agenda. Teak is one of the important commercial species in Laos both from natural forests and plantation, especially smallholders. Several research and development projects have been conducted on both genetic resources conservation and silvicultural practices. National Agriculture and Forestry Research Institute (NAFRI) is pleased to be a participating agency to implement ITTO-Mekong Teak Project. On behalf of NAFRI, Dr. Chansamone is committed to exchange best experience and learn from another member countries in the region.



**Dr. Chansamone Phongoudome** Deputy  
Director-General, NAFRI, Lao PDR

#### Rapporteur

Dr. P.K. Thulasidas

## Summary of opening remarks

**HE Dr. Ye Myint Swe** pointed out how the high quality teak and its genetic pool are declining at fast rate and that urgent measures are needed to stop the current trend. Dr. Ye Myint Swe said that in Myanmar the main cause of teak reduction is the population pressure and explained how government authorities began to support sustainable teak management together with ITTO, because wood exports have always contributed to the country's economy. Myanmar Reforestation and Rehabilitation Programme (MRRP) started in 2009 aiming to enhance both forest restoration (hence protective function) and teak timber industry.

**Dr. Ma Hwan-ok**, ITTO, believes that this teak workshop will open doors for new partnership among partners working on teak in the Greater Mekong Sub-region. The promotion of teak and the supply chains of derived products from legal and sustainable sources could be promoted by smallholders and the involvement of private sectors.

**Mr. Sung Ho Choi**, focussed on the joint venture between AFoCO and ITTO to set SDG in matter of Teak production.

**Dr. Nikhom Laemsak**, argued how KU is boosting the cooperation between forestry departments and international organisations. KU is leading and providing logistical support to this ITTO project.







## Keynote presentations

**Dr. Thaung Naing Oo**, Director of FRI, Myanmar, stressed the importance of sustainable forest management in Myanmar arguing the importance that his country played in the forestry sector. In the second part of his speech he focused the attention on the need to both follow a direction towards sustainable development and to involve in international organizations in governmental programs.

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**Dr. Suwan Tangmitcharoen**, Thailand's RFD, began his speech mentioning teak as one of the most valuable species and citing as reference the United Nations Food and Agricultural Organisation (FAO). He continued explaining that in Thailand's teak improvement programs started in the early '90s. Both in-situ (e.g., national parks, wildlife sanctuaries) and ex-situ conservation (i.e. areas not included in the former) are currently found in Thailand. For instance the Lampang Province hosts the oldest seed orchards in the world. The total size extends to 784 ha leading to a total seed production of 1000 kg/y. Dr.Suwan pointed out the need to find alternative ways to the teak market and the importance of more research leading to innovative methods to shorten the rotation period of planted teak (25 – 30 years) and increasing the production of good quality stands from which farmers will benefit.

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**Rapporteur**

Prof. Dr. Yongyut Trisurat



## Key messages

### *Sustainable forest management in Myanmar*

1. Sustainable forest management concerns both timber production and provision of forest ecosystem services at local, regional and global scales.
2. Forests in Myanmar cover the 43% of the country surface and they contribute to about 50% of the natural teak forests worldwide.
3. Since 1856 Myanmar has managed natural forests (especially natural Teak-bearing forests) on a sustainable basis. In the last decade, many laws and governmental policies have been reformed to support SFM in Myanmar.

### *Conservation approach of Teak genetic resources in Thailand*

1. Teak is one of the top five species planted in Thailand and it has a high priority for conservation. Remaining natural teak stands are mainly found in protected areas.
2. Besides in-situ conservation (protected areas), tree improvement programs (ex-situ conservation) started in 1965 and the recent programs include seed orchards, provenance trials, progeny tests, clonal tests and gene banks.
3. Delineation of provenance zones, controlled harvest in seed production areas, re-evaluation of clone archives and existing clonal seed orchards and regional/international collaborations are highly recommended strategies for the management and conservation of teak genetic resources.



## Thematic areas

### Session 1: National Report on Natural Teak Forest and Teak Plantation

**Chairman:** Dr. Thaung Naing Oo, Director of FRI, Myanmar

**Presenters:** Mr. Kim Sobon; Mr. Vongvilay Vichtlekarn; Mr. Sapol Boonsermsuk; and Dr. Tran Lam Dong

#### Presentations objectives

There were four national report presentations from Cambodia, Lao PDR, Thailand and Vietnam presented by national Coordinators. The objective of this session was to introduce the audience to some generalities about their own countries with a specific reference to teak forests and teak plantations. All countries face a loss on forest cover due to ineffective management, overexploitation and population pressure; but, in the last years, governments have taken actions aimed to increase forest cover. Governments have, particularly, shown increasing awareness of the dramatic situation concerning what forest loss might lead to, therefore each government sets milestone targets. The main challenges slowing down the processes have been clearly presented. The most common ones, emerged as: the lack of knowledge in management strategies and the not optimal government proposition towards a middle ground between forest conservation and silviculture.

### Session 2: In-situ and Ex-situ Conservation of Teak Resources in Mekong

**Chairman:** Mr. Sapol Boonsermsuk, RFD, Thailand

**Presenters:** Prof. Dr. Yongyut Trisurat; Dr. Anto Rimbawanto; Dr. Tani Naoki; and Dr. Thwe Thwe Win

#### Presentations objectives

Scholars from Thailand, Indonesia, Japan and Myanmar presented the status of teak conservation in and outside the protected areas (i.e. in-situ and ex-situ) in the Mekong Sub-region. A focus on the genetic aspect of teak was given and emerged the need for further studies and detailed analyses on teak DNA and how it is likely to vary under different climatic-edaphic conditions. This factor is gaining importance because the climate change is becoming a limiting factor for teak distribution and conservation. In fact Southeast Asia was described as a climate change hotspot where species (teak included) might be more vulnerable to changes than other places.

### Session 3: Sustainable Management of Teak Forests – R&D in silviculture and best practices

**Chairman:** Dr. Dong Lam Tran, VAFS, Vietnam

**Presenters:** Dr. U Aung Zaw Moe; Dr. Saroj Wattanasuksakul; Mrs. Chumnun Piananurak; Mr. Tosaporn Vacharangkura; Mr. Sylvio Coutinho; and Dr. Nir Atzmon

#### Presentations objectives

Presenters pointed out the main strategies needed in order to achieve good teak forest management and judgemental criteria on teak forest status. From the six presentations emerged, once again, a vital role that detailed studies would play, not only on teak species itself, but also on the areas where plantations are planned to be established (ecosystem level). Teak plantations by smallholders and governments and intensive and innovative and advanced techniques by private sectors (e.g., large scale plantations in Brazil and irrigated teak farms in Cambodia) were presented. All speakers emphasized the need for interdisciplinary experts (e.g., soil scientists, ecologists, physiologists, geneticists) working together with governmental institutions and international organisations, as well as private sector in order to protect the remaining natural teak forest forests and support teak production to meet the growing demand.





#### **Session 4: Promoting of Small Holders and Communities in Natural Teak Forests Management and Establishment of Planted Teak**

**Chairman:** Dr. Chanh Samone Phongoudome, DDG of NAFRI, Lao PDR

**Presenters:** Mr. Choi, Youngtae; Dr. Nopparat Kaakkurivaara; Dr. Oka Hiroyasu; Mr. Suriyan Vichitlekarn; and Dr. Martin Greijmans

##### **Presentations objectives**

Speakers working in Thailand, Myanmar and Japan informed the attendees about the important role of local communities to get involved in teak conservation and teak plantations. Furthermore, special care needs to be given to smallholders, which are often involved in the running of teak plantations. Presenters expressed the necessity for governments to be more flexible towards minor tenants in matters of rules and laws. They should be shaped to specific cases rather than being generalized at country-level.

#### **Session 5: Legality and Sustainability in Teak supply chains in Mekong**

**Chairman:** Dr. Sylvio Coutinho, Private Teak Plantation, Brazil

**Presenters:** Dr. Hwan-ok Ma; Mr. U Min Min Oo; Dr. Nikhom Laemsak; Dr. P.K. Thulasidas (for Dr. Promode Kant)

##### **Presentations objectives**

During this session the attention was moved to the role that sustainability plays not only for teak forest management but also for other valuable species and for the following steps of the supply chain, namely the transformation of the raw material into final products ready for the market. All the four speakers (particularly the ones from Myanmar, Thailand and India) argued about the importance that active actions, even from citizens, would play on the sustainable supply chain. The audience was also informed about how, sometimes, not optimal regulations and guidelines are limiting the success of optimal exchange of wood and wood related products between countries.

#### **Session 6: Value Chains and Demand and Supply in Teak**

**Chairman:** Dr. Nikhom Laemsak, Kasetsart University, Thailand

**Presenters:** Dr. Tetra Yanuariadi; Ms. Dang Hai Ha; Mr. U Kyaw Naing; and Mr. Vongvilay Vichitlekarn (for Prof. Tek Maraseni)

##### **Presentations objectives**

Teak was once again highlighted during the sixth and last session. Participants had earlier been informed about the factors affecting wood products. In session six the objective moved to market price of the main wood based products exported from and imported to Mekong countries. Participants have been informed on how log export ban (LEB) laws negatively affected the market (particularly in Myanmar) and on the need to update guidelines in the matter of timber market. A joint venture between different actors seems to be the best solution to boost both the conservation and the optimisation of the teak products trade.

## Session 1: National Report on Natural Teak Forest and Teak Plantation

### Summary of the presentation

Mr. Kim Sobon, Cambodia's Forestry Administration (FA), started his speech introducing generalities about his country. Cambodia has a surface of 181,035 km<sup>2</sup> with a population of 16 million people, a growth rate of 1.8 %/year and a Gross Domestic Product (GDP) per capita of 1,384.42 US\$. He successively presented how target forests areas are mostly concentrated along the Mekong River (e.g. Aural district, Kampong Speu, Hanchey). The first reforestation attempt took place in Phnom Hanchey, Kampongcham Province (1936) and it consisted of an intercropping system of teak with cotton (*Bombax ceiba*) and maize (*Zea maiz*). Thereafter Mr. Sobon showed how technology advancement increased the productivity of teak plantations by comparing two cases (1936 and 2019). Then he accurately described the main points of the First Yearly Plan of Operations (YPO). The main objective of the first YPO is to demonstrate the legal and sustainable teak supply chains with the engagement of local communities, smallholders and government actors in the Greater Mekong Sub-region. Importantly the organization of Cambodia Component is formed by the involvement of Department of Private Forest and Forest Plantation, Department of Wildlife and Biodiversity, Institute of Forest and Wildlife Research and Development, Royal University of Agriculture and private plantation owners.



3 months old Teak-Aural Kampong Speuin year 2019



Their main roles are: planting and managing small and medium-scale teak plantation; supporting the analysis of teak wood value chain and marketing to enhance legality and added value of exported teak products. The former targets to establish teak nurseries for seed production, while the former aims to contribute and support research and capacity building in the matter of silviculture, forest management, harvesting, transport, efficient wood processing, the establishment of research and demonstration plots to showcase suitable forest management and the benefits of using improved genetic materials. He concluded the speech with two main recommendations, which are hereby reported: 1) to increase the efficiency of those efforts and 2) to facilitate the completion of comprehensive assessments for each participating country with the support from National and Regional Consultants. Those themes include the conservation of Teak genetic resources; the production of good quality planting material; the development of improved management systems for natural Teak forests; considerations of legality, certification, sustainable supply chains, and log tracking; the minimization of harvesting losses; the efficient transport and processing of teak round-wood; analyses of value chains; field training in silvicultural practices, as well as in wood harvesting, transport and processing; forest policies; and information management outreach programs.





Mr. Vongvilay Vongkhamsao, National Agriculture and Forestry Research Institute (NAFRI, Lao PDR), spent a few minutes introducing his country. Lao PDR covers an area of 23.68 million ha and has a population of 6.8 million. The country GDP pro capita is 1,785 US\$ and the agricultural sector contributes 23.5% of the total GDP. The country hosts 49 ethnic groups and nearly 80% of the population lives in rural areas and depends on forest resources.

The total forest cover in Lao PDR is estimated to range from 59% (F-REDD Assessment, 2015) to 69% (FRA, 2015), while the government's forest cover target aims to increase to 70% by 2020, corresponding to 16.6 million ha. Lao PDR government has formulated policies and regulations to support



Natural teak Forest and Plantation in Laos

the implementation of forest strategies aiming to reach the forest cover target next year (2020). The speaker focussed then on natural teak distribution, informing that teak forests are mostly found in Xayabuly and Bokeo Provinces situated in the northern part of the country. He next cited the five main Teak seed sources, namely Luang Prabang, Xayabuly (which received support from ITTO), Salavanh, Sekong, Champasak, and explained how Lao tree seed project (DANIDA) in early 2000 established 102 seed sources, yet now just 76 remained, of which nine are made for teak seed production.



Mr. Vongvilay Vongkhamsao argued that the planted teak stands are spread along roadsides, boundaries and paddies. Smallholders own 50,000 ha of teak plantations of which 98% are managed by themselves. Currently there are several projects focusing on teak (e.g. Lao-Swedish Forestry Program, Laos tree seed project, teak agroforestry system, Enhancing key elements of the value chain for plantation, Forest Science Research, JIRCAS-FCR). In addition, the study on policy improvement for tree plantation in Laos and Vietnam have been conducted. Mr. Vongvilay concluded his presentation listing the common issues and challenges that emerged in those programs, the main ones are: difficulties in protecting mother trees due to long distance from station offices; lack of markets for seeds; no seed networks; teak seed sources converted for other purposes (e.g., infrastructure improvement, roads, buildings, forest fires); lack of regular monitoring and maintenances (weeding, setting up the signboards, marking the boundary of area).

Mr. Sapol Boonsermsuk, Royal Forest Department (RFD), Thailand, started his presentation showing a trend of forest cover, which declined from 53% of the country land area in 1961 to 28% in 1998, then it started increasing again. The recent forest cover monitoring indicated that the remaining forest cover in 2016 was 32% of the country. Concerning teak forests, Thailand hosted more than two million ha back in 1962 and, nowadays, they cover 0.8 million ha and most of them are located in protected areas (i.e. insitu).

The speaker mentioned that the national policy aims to maintain 40% of the country's land area under forest cover, this goal is still far from the current situation. Mr. Sapol then presented the new Forest Act of 2019. This Act allows the planted teak in legal private owned land or permitted areas by the government can be cut, but log removal and transportation require permission from the government. Other forest legislations and policies that have evolved to support teak plantations include: Forest Plantation Act (2016), National Land Management Committee (2018), and Forest Community Act (2019).



Teak Plantations in Thailand

He continued mentioning that the first Teak plantation was established more than 100 years ago. Nowadays teak forests planted by the Forest Industry Organisation (FIO) covers about 80,000 ha. Teak plantations in private plantations, together with other species such as Eucalyptus, Para rubber (*Hevea brasiliensis*), and other minor species, cover more than 156,000 ha. Further Mr. Sapol said that until 1990 private sectors and autonomous farmers owned 2000 km<sup>2</sup> of plantations (FAO, 2000).



Mr. Sapol continued his presentation giving some general guidelines on teak requirements. Teak is a light demanding species quite adaptable to a huge range of temperatures 20 – 48 °C (Kaosaard, 1981), and precipitations 500 – 3,500 mm/year (Kaosaard, 1981). It is mostly found in deep, well drained soils formed from limestone, schist, gneiss and shale (Kulkani, 1951; Kiatpraneet, 1974; Kaosaard, 1981; Srisuksai, 1991) with a pH around neutrality (6.5 – 7.5) (Seth and Yadav, 1959; Kaosaard, 1981; Tewari 1992). Its annual increment varies from 2 to 15 m<sup>3</sup>/ha/y (FAO, 1956; White, 1991; Keogh, 1994).

Natural teak forests in Thailand are decreasing due to insufficient enforcement of protection and conservation measures (Sumantakul and Sangkul, 1995). Besides, people attitude towards conservation and participation is inadequate (Sumantakul and Sangkul, 1995). Furthermore, the origin of seeds for teak plantations is mostly unknown. The presenter continued explaining that management practices outside protected areas (i.e. ex-situ) include the establishment of the first Teak Orchard in Lampang province in 1965, clonal tests, rooted top cutting and tissues culture are common practices. Taungya (intercropping with seasonal species) was adopted in the last 4-5 decades, and state enterprises (Forest Industry Organization-FIO, Thai Plywood Company - TPC, the former with Forest Stewardship Council (FSC) certification) have been established for economic forest production. He went on mentioning the increasing trend in wood demand in Thailand from 2005 to 2037 (respectively 66 million m<sup>3</sup> and 128 million m<sup>3</sup>). Teak is well known as one of the most valuable species and its economic value is likely to increase in the future. Thailand also





imports round-wood and sawn wood from Myanmar, Lao PDR and Malaysia, while processed and added value products are exported to Japan, USA and EU. The presentation was concluded with some future needs to enhance management practices, namely developing a system to certify the legality of timber products (legal supply chain); moving the

government function from regulator to facilitator; decentralizing and Involving public agencies/local leaders in planning processes; genetic improvement and international collaborations; implementing traditional and Indigenous knowledge; enhancing payment for ecosystem services (PES); boosting selective logging and sustainable forest management.



Teak log yard at Thungkwian Teak Plantations in Lampang Province, Thailand

Dr. Tram Lam Dong, Vietnamese Academy of Forest Sciences (VAFS), introduced the current situation in matter of forest plantation in his country. The most common planted species is Acacia (covering 2,142,000 ha), followed by Rubber tree (950,000 ha), Pinus spp. (390,000 ha), Eucalyptus (177,000 ha) and Bamboo (100,000 ha). Last year (2018) the total exported value of forest products was 9.4 billion US\$, mostly coming from furniture and woodchips. Dr. Tham Lam Ding revealed that Vietnam has a relatively young teak history compared to other Mekong countries. In fact, teak was first introduced in 1930 for plantation trials in some plots in the northern and southern Vietnam. Between 1950 and 1953 Vietnamese started to test plantations in Dak Lak province, Central Highland, at 500 m a.s.l. (now there are still five remaining hectares managed for seed production). In the '60s teak has been planted in large scale in the Southeast (about 300 ha in Dong Nai Province, now 230 ha remained and managed for seed production). Between 1975 and 1990, Teak was planted widely in Southern Vietnam and in some provinces in the North, with a total area of roughly 4,700 ha, yet most of them have been harvested. From 1990 teak was mostly planted in the Northwest by state forestry companies, nearby coffee farms (following agroforestry system) through a reforestation program, and smallholders planted this species in some areas in the Southeast and in the Central Highland.



Teak Plantations in Vietnam

Today there is a total teak plantation area of 3,300 ha, mostly concentrated in the Northwest (1,650 ha).



Dr. Tram Lam Dong gave an example of a teak seed production plantation in Dong Nai Province that produces 1,000 – 1,500 kg/y of seeds. Recently, successful testing of enrichment planting in the degraded deciduous dipterocarp forests has been done. Additionally, in the '90s a plantation in Son La Province was established aiming to support livelihood and reforestation projects. The area was once an ex slash-and-burn area, yet now it is used both as a small-scale plantation and as an agroforestry model; the area started to be harvested around five years ago (with a rotation period of 20 to 25 years).

The presenter ended his speech telling that teak is adapted to a wide range of climatic conditions in Vietnam, (distribution 10 – 22o N, up to 700 m a.s.l.). It prefers fertile soils developed on Bazan (red soil), limestone, and alluvial areas. In Vietnam and Thailand, as mentioned before by the Thai speaker, the growth rate varies depending on site conditions. On good sites, it might achieve 9 – 15 m<sup>3</sup>/ha/year for the first 20 years. In addition, Dr Tram Lan Dong explained that despite teak requires long rotation and good soils, it has a high market demand comparing to other timber species.



## Key messages and recommendations

### *Cambodia (Mr. Kim Sobon)*

1. The on-going biodiversity trend in Cambodia is increasing towards conservation.
2. The remaining forests cover is about 48% of the total land and might be divided into permanent, private and protected forests.
3. Cambodian institutions have developed criteria and indicators for the selection of demonstration plots and two of them have high potential to conserve teak's genetic variation. The project team has gathered and mapped geographical locations of mature stands.

### *Lao PDR (Mr. Vongvilay Vongkhamso)*

1. Government of Lao PDR has planned to increase its forest cover to 70% of total land area by 2020.
2. Natural Teak forests are largely distributed in the northern provinces of Xayabuly and Bokeo. The former hosts the largest teak area (10,000 to 20,000 ha).
3. Many teak projects with a focus on silvicultural practices have been carried out and they aimed at improving productivity and local livelihood through agroforestry and tree seeds quality selection, and to enhance market trades.
4. The common issues and challenges faced in teak plantations are: poor seedling quality; planting space availability; no markets for small trees from the 1st and 2nd thinning.
5. Problems in natural teak conservation: selection of good mother trees due to lack knowledge and patrols over the areas; fire occurrence.

### *Thailand (Mr. Sapol Boonsermsuk)*

1. Forest area in Thailand was about 53% of the total land area in 1962, but now it is only about 32%. The national target is to maintain 40% as forest area (20.5 million ha).
2. Teak plantations in Thailand have been established more than 100 years ago and the accumulated area size is about 836,000 ha. Forest Industry Organization (FIO) administers a Teak area of about 80,000 ha.
3. The range of natural teak forests is decreasing due to inadequate protection and conservation measure and knowledge. The remaining natural teak stands are mostly found in protected areas.
4. Future needs for sustainable teak management are: genetically improved materials and vegetative propagation technique; a system to verify the legality of timber products (legal supply chains); transformation of government role from being a regulator to facilitator; decentralizing powers and involving public agencies and local leaders in the planning process; enhancing PES.

### *Vietnam (Dr. Tran Lam Dong)*

1. Teak plantation area in Vietnam is about 3,300 ha. The annual harvest of Teak timber is estimated to be about several thousand m<sup>3</sup>, consumed by small sawmills for furniture and floorboard production destined for the domestic market.
2. Teak timber supply in Vietnam comes from imports and plantations.
3. Over the last five years about 40,000 m<sup>3</sup> were imported from South America and Africa; while the value-added teak products (e.g., furniture and floorboard) were exported to Europe and China.
4. Demand of wood processing industry in Vietnam is high. Development of teak plantations has potential, but the long rotation is a limiting factor for the expansion of teak areas.





## Session 2: In-situ and Ex-situ Conservation of Teak Resources in Mekong

### Summary of the presentations

Prof. Yongyut Trisurat, Kasetsart University, presented Teak as one of the most valuable hardwood species specifying that, in its natural state, it occupies worldwide a total area of 29 million ha and teak plantations cover an area of 4.4 million ha in 38 countries, yet the 83% is in Asia, specifically in Myanmar, Thailand and India. Natural teak forests are, according to Prof. Yongyut Trisurat, in danger because of overexploitation and nonsustainable management, moreover, the fragmentation of forests forms barriers to genetic flows (Graudal et al., 1999).



Distribution of natural teak forest  
(Kaosa\_ard, 1981)

Importantly, two studies carried out by Prof. Yongyut (Trisurat et al., 2011, Trisurat et al., 2019) predicted the long term effect of climate change on Teak geographical distribution and, as confirmed by other authors (e.g. Gopalakrishnan et al., 2011) indicated that 30% of Teak in India is likely to be vulnerable leading to variation in its phenology.

The speaker pointed out that Southeast Asia is considered one of the climate change hotspot, where temperature is likely to raise of approximately 2 C by 2100 (IPCC, 2014) and, consequently, both plants and wildlife could either tolerate the change (adapt to those changes) or migrate colonizing different areas, or at worse they might be extinct. Given that, the suitable range of teak is predicted to decrease about 20-30% from the current



distribution. Successively he also introduced some basic requirements of teak, arguing that it is a light demanding species which prefers hot and moist climate with deep, well drained and limestone rich soils with a pH values around the neutrality. Prof. Yongyut Trisurat concluded his speech claiming once again that climate change is threatening the geographical distribution of teak and more research is needed to provide precise recommendation for this species. The compilation of georeferenced species occurrences across the Mekong region and the understanding of which are the important variables in spatial distribution models, are both strongly recommended in future studies. The results will be presented at the upcoming 4th World Teak Congress to be held in Ghana in 2020.

Dr. Anto Rimbawanto, Centre for Forest Biotechnology and Tree Improvement, Indonesia, introduced the two main teak resources in Indonesia: commercial and private plantations. Opposite to other cases, in Indonesia intercropping (with maize, peanuts, cassava) is a common practice, particularly in the first two years after planting, otherwise plantations can be observed alongside the perimeter of lands or in small parcels.

The speaker drew a short history of teak plantations, which began in 1897 in Java, under Dutch colonial authority and successively was transferred to the Department of Forestry in 1927, and in 1930 to a state-owned forestry company (Djatibedrijf). In 1940, management of teak forests returned to Department of Forestry until Indonesia's independence in 1945. After that, in 1961, the State forestry company Perhutani was established to manage teak plantation in Java Island. In more recent years community and private plantations have also been established. In 2016, production from Teak plantations in Indonesia was 500,000 m<sup>3</sup> mostly for furniture industry against a 2.5 million m<sup>3</sup> demand. Dr. Anto moved forward informing the audience about the three teak research centres in Indonesia, namely 1) Perhutani Teak Centre in Cepu Central Java, established in 1997, focussing on genetic improvement, seed production, tissue culture/clonal propagation; 2) the Faculty of Forestry, University of Gadjah Mada and 3) Centre for Forest Biotechnology and Tree Improvement Research and Development in Yogyakarta, focussing on genetic improvement, DNA markers (genotyping).

The speaker moved on presenting the genetic improvement of teak, in this matter he mentioned that the first provenance trial was established in 1935 with provenances from India, Indochina and Indonesia. A comprehensive genetic improvement program was launched in 1981 establishing a clone bank and a clonal seed orchard, subsequently, several progeny trials have been established since 1987. In 1999 and 2000 clonal trials have also been established. The presenter showed some data on seed production, explaining that the production is around 40 ton/year from clonal seed orchards and the mean annual increment is 14 m<sup>3</sup>/ha/year. Dr. Anto informed the audiences that teak can benefit from biotechnology through propagation methods and molecular markers (i.e. describing geographic patterns of genetic variation, inferring taxonomic and phylogenetic relationships among species, constructing genetic linkage maps and marker assisted breeding). The speaker highlighted the importance of genetic diversity explaining how it is a key to survival and the adaptation of species and potential for its utilization and argued that it is based on simple sequence repeat (SSR) markers. One different marker, so called Single Nucleotide Polymorphism (SNP) is utilised for population study; these genetic resources will prove useful material for future studies into the population genetics and phylo-geographic field.

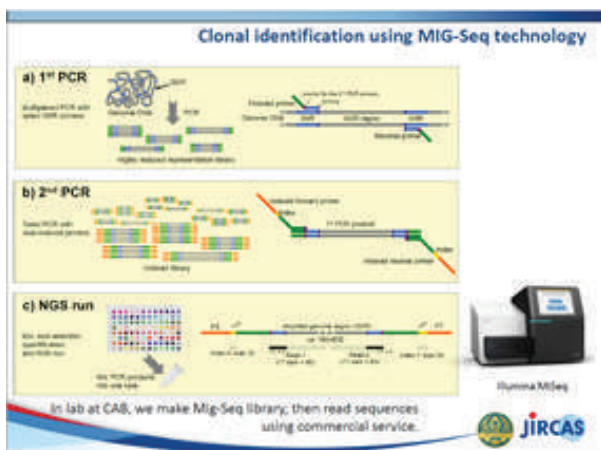






Genetic Improvement of teak

Dr. Tani Naoki, JIRACS, Japan, opened his speech specifying that the most important traits in forestry are quantitative (e.g. growth, shape, wood properties). Dr. Tani conducted a detailed study on plant genetic spacing from traditional quantitative trait loci mapping to genome wide association studies. The former is limited to detect quantitative trait loci because of low allelic diversity and it has scarce precision caused by limited recombination. The latter requires high density genome scanning and the tested population have less environmental heterogeneity. The presenter reported a study case on Thongphaphum district, Kanchanaburi Province in Thailand, which showed good survival and growth. It required clonal fingerprint using Multiplexed



identification and genetic

ISSR genotyping by sequencing (MIG-Seq) technology. This consisting in four steps: polymerase chain reaction (PCR), next-generation sequencing (NGS) run, MIG-Seq run and ata analysis. The results were reported as follows: 147 clones were identified

from 538 trees and genetic differences do exist in Thailand and Lao PDR comparing to East coast of India and Myanmar, and West coast of India. Successively, Dr. Tani talked about a genomewide association study in which no pedigrees were required, association of observedSpacing has a strong effect on quality of timber as well.

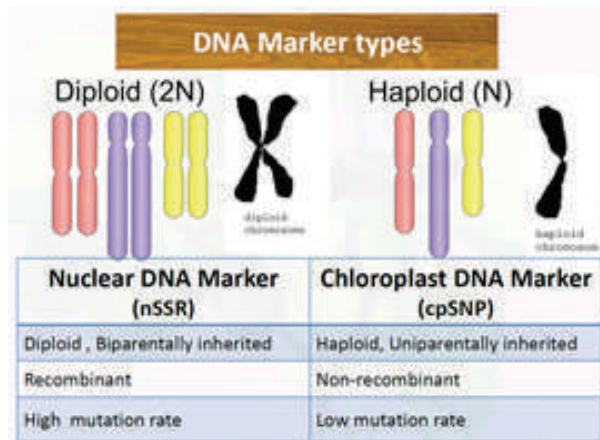


phenotypes were assessed by linear models and within the basic requirement they required experimental forest and large amount of SNP loci. The study led to the conclusion that SNP loci might be used as genetic markers for selection and in the case of not strong associated loci, one might optimistic for modelling.



Teak Plantations in Thailand

Dr. Thwe Thwe Win, Assoc. Prof. from the University of Forestry and Environmental Sciences, Myanmar presented some generic characteristics



of teak which perfectly agree with the aforementioned information. Myanmar hosts the largest area of native Teak forests (ca 50% of global extent). The large variation in climatic-edaphic conditions results in high genetic diversity in Myanmar teak, which represent the 40% of the global market. The speaker argued that teak plantations are now established in 70 countries worldwide (TWC, 2019), in fact from 1995 and 2010 the total areas increased from 1.3 to 5.5 million ha (Kollert and Cherubini, 2012). She continued claiming that Myanmar is trying to find a middle ground between conservation and utilization of teak, aiming to understand geographic genetic structure in the whole country and to detect teak forests in the need of conservation and breeding, seed and selecting new suitable areas order to increase the production. Dr. Thwe Thwe Win cited various applications of DNA markers, within population genetics, evolutionary and genetic relationship, gene flow and phylogenies, DNA barcoding and finger printing, species improvement and breeding. She presented two DNA markers: Nuclear (nSSR) and Chloroplast (cpSSR) simple sequence



used in this study case that resulted in a high genetic diversity in Yangon region and a low one in Belin region (hence different generic components in different areas). The study led to the conclusion that there are four genetic clusters of Myanmar teak and there is a significant correlation between geographic distribution and genetic distance in nuclear markers (but not in chloroplast). Moreover, strong human influence has been noticed in phylogenetic pattern of teak. Dr. Thwe Thwe Win recommended the need for a seed transfer guideline and a buffer zone between natural teak forests and plantations to facilitate gene flow. She also expressed the will for a genetic centre of teak and for a balance between conservation and economic production.





## Key messages and recommendations

1. Land use and climate change caused negative impact on teak distribution, especially to its genetic adaptation.
2. Teak geographical distribution mapping helped to determine conservation priorities, especially for vulnerable provenances.
3. The application of molecular techniques (resulted from biotech related studies) has been discussed. In Indonesia, various DNA techniques have been used for teak improvement program. Especially in clonal identification and log tracking that is useful for teak improvement and legal timber trade.
4. Various studies on genetic diversity and DNA barcoding of teak in Mekong were presented. There is a possibility to incorporate genotype and phenotype in the linear models to predict future teak phenotypes.
5. The Myanmar case indicated that there is a significant correlation of geographic distribution and genetic diversity of teak. As the result of habitat fragmentation, there is a need for seed transfer guidelines and a buffer zone management to facilitate gene flow from natural teak forests to teak plantations.





## Session 3: Sustainable Management of Teak Forests – R&D in silviculture and best practices

### Summary of the presentation

Dr. Thaug Naing Oo and Dr. U Aung Zaw Moe, Forest Research Institute, Myanmar, started the presentation talking about teak ecology, providing information already mentioned above. He said that its occurrence under multiple soils and climates has had environmental opportunities for development of numerous provenances with pronounced differences of form, vigour, and phenological characters. The differences in growth performance within the natural range of teak indicate the probability of genetic differences between provenances. Furthermore the superior genotypes at one location may be inferior due to the interaction between genotype and environment, so called *G\*E- interaction* (Matheson and Raymond, 1984).



Teak Hedge Gardens in Myanmar

Successively Dr. U Aung Zaw Moe argued that the strategy applied in natural forest management in Myanmar was introduced in 1856 by Dr. Dietrich Brandis. The method was formulated according to teak yield regulation. Some guidelines have been given to ensure sustainable timber extraction within certain girth limit, and annual cutting. The rotation period was set at 30 years. The speaker then claimed that forest management system should evolve that taken into account the balance between conservation and a sustainable use basis.



He also indicated that that Modified Myanmar Selection System (MMSS) integrates modifications on yield regulation, length of felling cycle, residual growing stock, cultural operation and research. Stepping forward, he described the three main varieties of teak in Myanmar (black striped, dark brown, and golden) and the main objective of species improvement program include: increasing volume production per unit area of plantation through the growth rate improvement (diameter and height), the establishment of long-term breeding populations for greater cumulative genetic gains of improved characters. This program also involves other species such as *Pterocarpus macrocarpus*, *Xylia xylocarpa*, *Gmelina arborea*. Dr. U Aung Zaw Moe concluded his presentation arguing that the conservation of forest diversity, started in 1984, and ex-situ teak conservation activities consist of enrichment plantations, the enhancement of seed production areas, and the selection and conservation of genetically good superior teak trees or plus trees.



Dr. Saroj Wattanasuksakul, Thailand's RFD, argued that the mean annual increment of teak differs from country to country. For instance in Indonesia it is 17.62 m<sup>3</sup>/ha/year, in India 12 m<sup>3</sup>/ha/year, in Myanmar 10 m<sup>3</sup>/ha/year, and in Thailand 3.13 and 5.94 m<sup>3</sup>/ha/year under and over bark, respectively. In Thailand teak genetic resources can be used both for seed production area and for the selection of superior phenotypes (plus trees) which follow a vegetative propagation leading to clone banks. The cloned trees derived from the best tree genotypes are successively implemented in plantations and



Pollen collection



in breeding program and in seed orchards. Dr. Saroj continued with attention on teak flowering. The flowering period occurs between July and September and produces 5,000 to 8,000 flowers per stand, the breeding time occurs between 11:00 am and 2:00 pm, and each flower blooms for one day while each inflorescence has a blooming period lasting 40 to 90 days. The speaker emphasised the difference between the natural breed and the controlled breed. The percentage of the former range from 0.4 and 5.1% (1.3% on average), the latter from 5 and 10% (7.7% on average).

Mrs. Chumnun Piananurak, Production of good-quality planting material Consultant, Thailand, opened the presentation showing the natural distribution of teak. The genetic resources of teak in Thailand are collected in three main sources: natural stands, old plantations and provenance trials. The best plants would hand down the good traits to the progenies. She introduced selection criteria to select “mother tress or plus trees” and the results can be classified into five classes ranging from one (bad conditions) to three - four or five (excellent conditions).



Rejuvenating new shoots by trimming the primary shoots

Those criteria are growth, tree form (clear bole, straightness, axis, branch size and angle, buttress), wood texture and health. Plus tree selection from natural stands is time consuming and labour intensive due to difficult accessibility in remote



areas. She continued discussing about the teak improvement programs in Thailand, where genetic resources might be used for seed production or plus tree selection (see above), and the production of seedlings. In the latter case seed orchards are formed through various vegetative propagation techniques leading to a new tree generation with better quality comparing to the parental one. The speaker explained some of the most common problems faced during the process, for instance rooted cutting is a quite delicate process since in early stages seedlings are particularly vulnerable, while rejuvenating new shoots are common in budded trees leading to poor wood quality. Seeds are generally sterilised before planting in order to avoid parasite and/or fungal attack; the same process is done to young shoots.





Mr. Tosporn Vacharangkura, Field training in silvicultural practices Consultant, Thailand, started his presentation giving some background information on the effect of thinning, arguing that thinning has been the major tool in regulating tree growth and improving timber quality. Low thinning is commonly applied to commercial teak plantations in Thailand, especially on the first intervention, while heavy thinning (>50% removal) has shown to reduce the overall productivity of the stands and it may result in the stability of stands will beat at risk. The aim of the case study at a private plantation in



Pruning Teak Plantation

Uttaradit Province, Thailand was to evaluate the effects of thinning intensity on growth development, yield and stem form of a teak stand. The diameter



at breast height, total height, crown height and stem volume were measured four times: before thinning, just after the treatment and one and four years after thinning. Results showed that moderate thinned plots (50% removal) left an increase in the mean basal area and mean stem volume compared to non-thinned and low thinned plots (30% removal). Annual stand volume increment in the low thinned plots showed to be the highest among treatments and statistically different from the non-thinned plots. Thinning had a positive effect on stem form. The absolute stem form factor from low thinned plots was significantly different after three years compared to the non-thinned plots and the moderate thinned plots.

Dr. Sylvio Coutinho, Private Teak Plantation, Brazil, introduced his country as one of the biggest in the world, with a surface area of 8.5 million km<sup>2</sup>, a population of 208 million, and a GDP of two trillion US\$. Teak was introduced in Brazil in 1920 but the first commercial plantation was established in 1980. Nowadays planted teak covers 80,000 ha with an average productivity of 10 m<sup>3</sup>/ha. Dr. Sylvio runs the largest private FSC certified plantation with an over 40,000 ha area and with a total production (volume harvested) of 190,000 m<sup>3</sup>/year distributed in 33 individual farms in Pará and Mato Grosso states. Plantation areas are located in degraded pasture lands which were deforested in the late '90s. Based on a careful mapping of environmental factors, detailed survey, and laboratory work, it is found that the areas have suitable climate and fertile soils for teak plantations. In addition, teak plantations are accepted by local communities. Seedling are produced using clonal silviculture technology (avoiding diseases and selecting trees best adapted to environmental adversities through vegetative propagation and biotechnology),



Site preparation for large scale teak plantations in Brazil



hence attention is given to the selection and multiplication of superior genetic materials in order to obtain healthy and vigorous seedlings with high root growth potential and a production capacity of 600,000 clonal seedlings/year. Sites are weeded and shrubs are removed, plus a focus is given to the appropriate spacing for future mechanisation. Planting is done early in the rainy season, leading to a seedlings survival rate of 90% of the total planted seedlings. In 2002 the company started a clonal program. Plantations are pruned up to six m and thinned, and other silvicultural practices such as fire prevention and maintenance are frequently made. The speaker also mentioned that measurement on diameter, height and stem quality is done annually. Overall their main goal is to maximise the value of the forest through tree selection, and thinning decisions are based on diameter growth rates, basal area and volume increment. The company also applies linear models to determine the optimum rotation period, which generate the highest return. The appropriate rotation period ranges from 18 to 20 years.

## Key messages and recommendations

### *Teak resource conservation in Myanmar*

1. Teak has high genetic diversity in Southern Myanmar.
2. In-situ and ex-situ conservation practices are encouraged.
3. The establishment of seed production areas and teak hedge gardens should be encouraged to support good quality seeds and seedlings.

### *Controlled pollination for full-sib progeny test of Teak and tissue culture of young seeds*

1. Progeny test is the most important tool for tree genetic improvement.
2. It is necessary to choose a most efficient progeny testing method(s) but some problems and obstacles emerge (e.g. heavy rain, strong wind and lack of labour force).

### *Teak plus tree selection and its propagation techniques used in Thailand*

1. Propagation techniques have not been put into practice by smallholders due to lack of knowledge and experience.
2. Plus tree selection criteria include growth, tree form, wood texture, branch size, branch angle, buttress, pest and disease.

### *Effects of first thinning on growth and stem form of Teak plantation in Thailand*

1. Thinning is the most important silvicultural practice.
2. Different thinning intensities had a clear effects on stand form. Moderate thinning (30% removal) resulted in better growth, yield, tree size and stand shape compared to non-thinned and low thinned plots (30% removal).

### *Silviculture aspects of Teak plantation in Brazil*

1. A business model in teak plantation adopted in Brazil consists of land selection; seedling production; site preparation; planting; forest maintenance; growth, yield and harvest scheduling; harvesting; log marketing; lumber production.
2. Intensive silvicultural practice can shorten the rotation and time of final felling to approximately 18 – 20 years.

### *Silviculture aspects of Teak plantation in Brazil*

1. The aim of intensive silvicultural methods (e.g., irrigation and applying liquid fertilizer) is to shorten rotation period (final cut after 8 – 10 years)
2. Similar intensive and innovation approaches as presented for Brazil include choosing proper plant material, producing high quality teak seedling, irrigation and fertilization, intensive management and the adoption of a environmental friendly approach.





## Session 4: Promoting of Small Holders and Communities in Natural Teak Forest Management and Establishment of Planted Teak

### Summary of the presentation

Mr. Yong-Tae Choi, ITTO, started his presentation explaining that tropical forests cover approximately 5% of the world's total land but host about 80% of all living organisms on Earth. He pointed out that we are losing a forest cover of over 13 million ha annually resulting in biodiversity loss, altered climate condition and desertification. Mr. Yong-Tae Choi defined forest degradation as the reduction of the capacity of a forest to provide goods and services, therefore actions such as forest restoration (defined as the process of regaining ecological functionality and enhancing human well-being across deforested or degraded forest landscapes) plays a pivotal role to stop the on-going



trend. The Convention on Biological Diversity (CBD) Aichi target 15, concerning forest landscape restoration, was set as follows: “By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced through conservation and



restoration, including restoration of at least 15% of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification”. Together with eight partners (IUCN, IUFRO, CIFOR, UNEP, FAO, WRI, AFoCO, WeForest) they agreed to focus on landscape scale, engaging stakeholders and supporting participatory governance; restoring multiple functions for numerous benefits; maintaining and enhancing natural ecosystems within landscapes; tailoring to the local context using different approaches and adaptively managing forests for long-term resilience. According to the speaker, a joint venture between policy makers, restoration practitioners, private sector organizations, civil society organizations, research and educational institutions is needed. Guidelines make recommendations on design, implementation and financing FLR programmes and projects.



Mr. U. Sein Moe, Assistant Director, Extension Division, Forest Department, Myanmar, introduced the scope of the Community Forestry National Working Group for advising decision makers in a comprehensive and revised community forest instructions. Its specific responsibilities are to share knowledge, experience, policy and activities, to enhance the research, to get community forest certifications and to receive sufficient funding and information from both local and international organisations. Successively the speaker expressed the needs for cooperation in the field, namely in training, community forest conservation, legality of forest user groups, facilitations and funding. U Sein Moe continued his speech listing the community forest strategic plan from 2018 to 2020, which include raising awareness, promoting small-scale forest enterprises, strengthening working groups and community forest units, and enhancing research,



Smallholders in community forestry

development and policies. He then recalled the history of community forests in Myanmar. In 1995 the policy was based on participation of people, public awareness, regaining environmental stability, addressing basic needs of local communities and supporting economic activities. In 2001, the forest



master plan had set 920,000 ha as target to be reached by 2030 for forest plantations, yet in 2019 only the 27% has been planted (250,867 ha). U Sein Moe presented the new goals set by community forest instruction, the most important are: sustaining forests, satisfying the needs of communities; reducing poverty through the increase of environmental services and creating job opportunities; developing community forest enterprises and enhancing gender balance. He also mentioned the most relevant voices of community forest in Myanmar, which aim to help smallholders through leasing the land possession for 30 years, providing seeds, seedling and technical support, no restriction on selling, and the possibility of inheriting tenures. For plantations at large scale, a landscape approach is applied, and site location is listed as of high priority in order to accommodate the needs of smallholders and ecological integrity. The designated areas combine smallholder land tenure and remnant natural forests. The presenter concluded his presentation listing the main challenges varying from political ecology to stakeholders, from sustainability to capacity building and included social problems such as livelihood of local people.



Dr. Nopparat Kaakkurivaara, Minimize Harvesting Loss, Efficient Transport and Processing of Teak Round-wood Consultant, Thailand, defined sustainable forest management (SFM) as “the process of managing forest to achieve one or more clearly specified objectives of management with regards to the production of a continuous flow of desired forest products and services without undue reduction of its inherent values and future productivity and without undue undesirable effects on the physical and social environment”. She successively mentioned some advantages of certified forests including credibility, transparency, access to markets, environmental protection and community engagement. According to FSC database in 2017, only 0.38% of the remaining forest in Thailand spread over 17 locations are certified. She presented some obstacles to achieve forest certification, including inappropriate work safety gears, lack of traceability and appropriate guidance. To achieve SFM and sustainable forest operation (SFO), the management strategies have to



Log unique ID

consider three sustainable indicators: economic aspect (e.g. productivity and its harvesting costs; environmental aspect (e.g., logging impacts on soil compaction and soil erosion) and the energy use; and societal aspect (e.g., accidents, workload and working posture). The speaker then showed the most relevant FSC criteria and principles that the organization, through engagement with local communities, should take action to 1) identify, avoid and mitigate significant negative social,



environmental and economic impacts of its management activities on affected communities; 2) identify and implement effective actions to prevent negative impacts of management activities on the environment, mitigate impacts and repair those that are likely to occur; 3) monitor and evaluate the environmental and social impacts of the activities carried out in the Management Unit, and changes in its environmental condition; and 4) manage activities associated with harvesting and extraction of timber and non-timber forest products to enhance environmental services and to reduce merchantable waste to avoid damage to other products. Dr. Nopparat presented a case study carried out in four logging sites in Phrae Province (Thailand). The objectives of the study was to determine a suitable logging system on the basis of SFM and to promote suitable tools for sustainable forest operations. She concluded that the combination of chainsaw, elephant and either tractor or skidders are suitable for felling trees in forest plantations and for the skidding process, while trucks are recommended for log transportation. These two options may vary according to topography and site condition. It is important that, logging operation systems use cost-effective tools and relatively simple for smallholders of forest plantations.

Mr. Suriyan Vichitlekarn, GIZ Thailand, gave some background information arguing that the global demand of palm oil had quadrupled over the past 20 years, being widely consumed for bioenergy worldwide, but there is a lack of management capacities, resulting in negative impacts on deforestation and contributing to GHGs emissions. The presented project, “Sustainable and Climatefriendly Palm Oil Production and Procurement” (commissioned by the German Federal Ministry of the Environment, Nature Conservation and Nuclear Safety and



Thailand Oil Palm Smallholder Academic (TOPSA) Curriculum

financed by the International Climate Initiative), aims to promote the reduction of GHGs emissions from palm oil production in Thailand and Indonesia;



to improve economic, environmental and social sustainability of smallholders; to achieve jurisdictional certifications and stimulate the demand of sustainable palm oil products in Germany. The on-going project uses a partnership approach and works closely with responsible agencies (Department of Agriculture and Department of Agriculture Extension), and smallholders, as well as engaging private companies. The speaker concluded his speech highlighting the need of trust among stakeholders, upgrading the capacity of governmental officers and sharing knowledge and lessons learnt among farmers and smallholders at larger scale. Besides, it is essential to create alliances among stakeholders (governments, farmers and private companies) via self-sustaining strategies. The latter can be applied for teak smallholder enterprises.

Dr. Oka Hiroyasu and Takao Gen, JIRCAS, started introducing his institution: Japan International Research Centre for Agricultural Sciences (JIRCAS). JIRCAS and the RFD (Royal Forest Department) have jointly implemented research and development projects in forestry since 2001 particularly for teak. An on-going project entitled “Higher Value Forestry (2016-2020)” aims to achieve higher-value (forest) plantation products through developing technologies about stand treatments, soil analyses and efficient monitoring, which all might help to obtain higher value plantation products. Several working reports have been published, including teak plantation management (e.g., Improved soil suitability map for teak plantations in northeast Thailand, second clonal test of teak in northeast Thailand, improved yield prediction model for teak plantations and estimation of biomass and carbon stock in young teak plantations), seven reports related to the socio-economic aspects of teak industry (e.g., Trends of forestry and wood processing industry in Thailand, Current functions and expected roles of Private Forest Plantation Cooperatives) and two reports on inter-cropping with indigenous tree species. In addition, JIRCAS is also working in collaboration with NAFRI since 2016 to implement the project entitled “Development of Forestry



Technologies of Indigenous Tree Plantations on Slopes in Laos (2016-2020). This project aims to determine the factors controlling soil erosion, and to prepare soil suitability maps for teak plantations in steep slopes. The project site is located in Luang Prabang Province (Lao PDR) because of a large amount of teak plantation areas. Key findings include soil suitability maps for teak plantations in some provinces located in northeast Thailand, and the estimation of above- and below-ground biomass of teak. A soil suitability map for teak plantations in Luang Prabang, based on tree measurement, physico-chemical analysis of soils and geographical information, is in preparation.



Measurement of below ground biomass and standing trees



Mr. Martin Greijmans, RECOFTC, presented his organization which was founded in 1987 in collaboration with FAO, Swiss government and Kasetsart University (Thailand). The RECOFTC engages local people, governments, international organizations, NGOs, research/educational institutes, civil society, and private sector in forest sector. The target areas include in the Asia and the Pacific region, in particular five countries in the GMS (Cambodia, Lao PDR, Myanmar Thailand and Vietnam). Mr. Greijmans elaborates that these five countries have set a very ambitious forest target of 60, 70, 45, 40 and 45% of the total country area, respectively in Cambodia, Lao PDR, Myanmar Thailand and Vietnam. The strategic plan (2018 – 2023), entitled “Resilient Forest Landscapes”, was jointly developed by RECOFTC and collaborative partners. The speaker then talked about Flourish, a community based conservation program which is willing to attract investors in reforestation and production using a forest landscape restoration



Trading smaller diameter trees for local livelihoods

approach under REDD+ in collaboration with private sector and community. He explained that with no rights to resources, equitable benefits and livelihood development, the foundation of FLR will be difficult



to carry out. He also pointed out that the private sector plays a vital role in Flourish program even though communication problems emerged due to different languages and cultures between the involved communities. Moreover he emphasised how the risk of conflicts is likely to increase when rights are not set down clearly. The project sites of Flourish are located in Lao PDR, Thailand and Vietnam aiming to develop a communityprivate sector business to participate in forest restoration and to enhance productivity and improving local livelihoods. The presenter also mentioned the main challenges that have emerged: the high risk and costs of engaging partnerships; a lack of experience and time to deal with communities; different mindsets and objectives of companies and communities; tension within communities; and the priorities of local government which are not always aligned. Mr. Greijmans also mentioned the four main voices in the matter of facilitation, which are: the collaboration in forest based partnership; ensuring an inclusive partnership process; the negotiation towards partnership and the maintenance of those partnerships. He concluded talking about the four stages of development of Community Forest Enterprises: subsistence, early, developing and mature stage.



## Key messages and recommendations

### *ITTO Legal and Sustainable Supply Chain Initiative (Dr Ma)*

1. Illegal logging still remains, but timber legality measures are in place.
2. Demand/supply measures towards legal wood products are increasing, especially in China PR both by private sector and government.

### *Legality of Teak in Myanmar (Mr. U Min Min Oo)*

1. Mechanisms and reforms are in place for Myanmar timber industries to enter the global market. This include MFCC, members of PEFC, third party verification system MTLAS, Myanmar Timber Chain of Custody according to the FLEGT VPA process. This will be done with Open Foris application to modernize CoC efforts using available QR-barcoding.
2. Forest plantations have increased steadily in the last three decades both on public and private owned lands and teak is the dominant species.

### *Sustainable wood industry and certification in Thailand (Dr. Nikhom Laemsak)*

1. The total demand of round wood is predicted to increase in all sectors and particularly in the energy and the wood composites sectors.
2. The value of export of (value-added) forest products has increased rapidly. Rubber wood is dominant, while teak wood from thinning and/or final cutting are limited due to lack of certification.
3. The forest certification guidelines (codes of practice) should be modified to match national and local circumstances and be appropriate and affordable for smallholders.

### *Forest policy in the Mekong (Dr. Promode Kant)*

1. Most countries in Mekong are committed to increase forest cover to enhance ecosystem services.
2. All governments in the Mekong should formulate policies to attract green' investors in teak plantations either in degraded public land or private owned lands requires supportive environment (e.g., less bureaucracy, lower procedural costs, long-term land tenure, soft loans) to reduce risk and increase incentives to boost smallholders or commercial companies to enter/remain in the teak sector.





## Session 6: Value Chains and Demand and Supply in Teak

### Summary of the presentation

Dr. Tetra Yanuariadi, ITTO, talked about the situation and trends of trade and market access of tropical timber and related products. He started the presentation warning the audiences about the dramatic deforestation trend that have occurred in the last decades, due to the fact that the global wood demand is increasing, particularly in the sector of fuel wood and charcoal. He mentioned that commodities produced in low income countries are often associated with deforestation, forest degradation and illegalities. These factors subsequently reduce capacity to supply



Wood-based industries  
(Myanmar, 16-19 August 2010)

forest products to local, national and global markets. Dr. Tetra then mentioned three important factors concernin market development of tropical timber



and related products: 1) economic trends (GDP is an important measure of a country's economic outputs), 2) building indicators (global housing and construction trends are important indicators of tropical wood products demand with the most demanding countries: USA, China, Japan, and EU, and 3) policy trends and market access (certifications, procurement policies , and CITES species protection). Lastly he appeared to be proud in presenting India as one of the countries which is taking tangible actions in matters of reforestation citing an example: "India planted 66 million trees in 12 hours", but he also was concerned about the huge population in India with 1.3 billion people making it the second most populated country in the world after China.



## Key messages and recommendations

### *ITTO Guidelines (Choi)*

1. Deforestation areas cover more than 13 million ha annually, thus forest landscape restoration (FLR) is essential. This approach has been mentioned in the Bonn, SDG 15, and CBD.
2. ITTO published Voluntary Guidelines for SFM 2015 and developed a new guideline for FLR in 2019. A Regional Workshop on capacity building to implement this guideline is planned in 2020.
3. Within the ITTO FLR guideline, six principle guidelines and 32 guiding elements have been formulated to assist stakeholders for a successful FLR at multiple scales.

### *Forest plantation and community forest in Myanmar (Mr. U Sein Moe)*

1. Myanmar started community forests in 1995, but tangible outputs and actions on the ground started first in 2012 with technical support from RECOFTC. Target areas cover: 5% of the forest land. In addition, strategic and action plans (2018 – 2020) were formulated to satisfy the communities' needs (people centred approach) and to reduce rural poverty through the increase of provisions and rge support of environmental services.
2. Teak seedling production and plantations by smallholders account for about 51% of the total production (6.8 million out of 13 million).
3. Key recommendations to strengthen forest plantations and community forests include: mobilizing the resources or soft loan; centralizing support with localized delivery systems; field oriented forestry extension; promoting forest plantations in the cultivated land through agroforestry systems.

### *Sustainable logging system (Dr. Nopprarat)*

1. Advantages of certified forests include: credibility, transparency, access to market. Currently, only 0.38% of the total forest area is managed through FSC.
2. A pilot project on sustainable forest operation was conducted in teak plantations in northern Thailand based on three criteria: economic, environmental and societal aspects.
3. Key recommendations include: the usage of simple and affordable tools for smallholders seeking for suitable harvesting systems based on SFM.

### *Oil palm (Mr. Suriyan)*

1. Palm oil plantations stimulate deforestation, and GHGs emission. About 40% of total palm oil plantations in Thailand are established by smallholders.
2. The GTZ Project aims at enhancing capacity building, promote sustainable production (co-benefits) and mitigate climate change impact through a partnership approach.
3. Key success factors include: trust among stakeholders (smallholders, government and private sector); capacity building; networking; sharing knowledge.

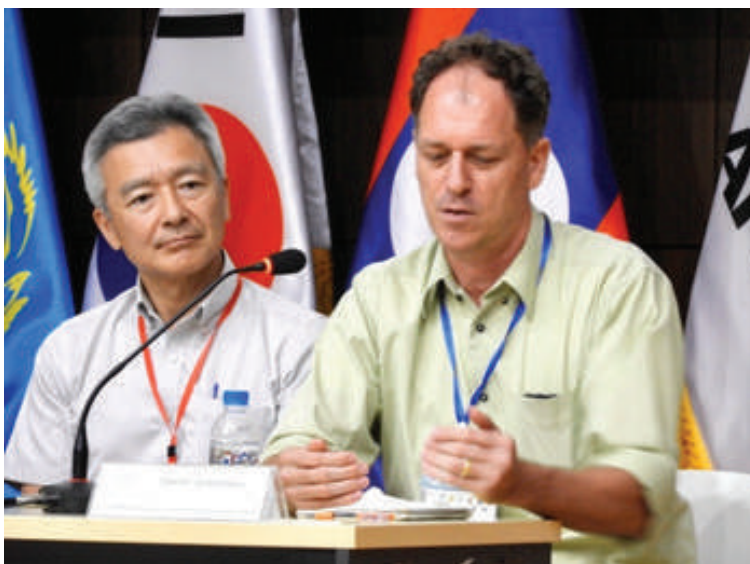
### *Joint teak R&D (Dr. OKA)*

1. JIRCAS has worked with the RFD particularly in teak since 2001. On-going project (2016-2020) aims to achieve higher-value (forest) plantation products through technology development, while the project in Luan Prabang, Lao PDR (2016-2020) aims to determine the factor controlling soil erosion, and to prepare soil suitability maps for teak plantations in steep slope areas.
2. In Thailand, the working reports on management of teak plantations, socio-economic aspects and intercropping with indigenous species were documented. Soil suitability maps for teak plantations and biomass estimations were also documented.
3. In Laos, soil suitability map for teak plantation are in preparation.



*Private partnership in FLR program (Martin)*

1. RECOFT and collaborative partners are jointly developing a strategic plan 2018 – 2023 on Resilient Forest Landscapes to support a very ambitious forest target of many countries in the Mekong region.
2. The FLOURISH project, a part of the above strategy, aims at reducing forest fires; restoring forest productivity; providing commercial options for local communities. It is largely implemented in Lao PDR with some activities in Thailand and Vietnam.
3. The lesson learned indicated that collaboration in the forest based fair partnership process is an important factor, but the stage of development of Community Forest Enterprises depends on variation of economic, ecological and social circumstances among the sites.



## Session 5: Legality and Sustainability in Teak supply chains in Mekong

### Summary of the presentation

Dr. Ma Hwan-ok, ITTO, opened the presentation with the issues in forest law enforcement and governance. He pointed out the obstacles caused by excessive regulations, the high costs of legal operations and the internal contradictions in national legal frameworks (the lack of power in preventing outsiders from entering forest lands and extracting timber and minerals). He also argued that the institutional weaknesses and deficiencies lead to insufficient enforcement capacities; corruption in government institutions and private sectors and that insufficient information on forest resource conditions



Chinese Private Sector Initiative (GGSC) -Beijing, June 2018

increased the difficulties in understanding what is happening in those landscapes. Dr. Ma successively mentioned that illegal logging remains the main environmental crime, yet many countries are taking actions to solve this issue and to promote legal and sustainable forest products and their trade.



He also expressed the need for private sector to increase the discipline and for governmental institutions to enhance capacity building in the matter of legality compliance, especially for small and medium companies. The EU countries prohibit to import illegal timber products and encourage the traders to use traceable system for timber products. He concluded his presentation explaining the main points of the Global Green Supply Chain Platform (GGSC) held in China in October 2019. It now includes 14 progressive Chinese wood importing and processing enterprises counting on three expert groups (ITTO, TAG and Centre for International Forest Products Trade) with the support of Ministry of Commerce of China PR, GIZ Forest Policy Facility, The Nature Conservancy (TNC) and Department of International Development (DID, UK).

Mr. U Min Min Oo, Staff Officer, Natural Forest and Plantations Division, Forest Department, Myanmar, presented the goals of the sustainable development plan for Myanmar (2018 – 2030). The Ministry of Natural Resources and Environmental Conservation (MONREC) aims to conserve and protect natural resources, to extract and utilize the natural resources in a sustainable manner so that they can be inherited and transferred from one generation to another and to create harmony of environmental conservation and implementation of development projects in a balanced manner. Detailed information on legal policy framework has been provided such as Forest Law, Conservation of Biodiversity and Protected Areas Law, Forest Rules, Community Forestry Instructions, and Standard Operation Procedures for Forest Operations. Several laws were recently gazetted or are currently reviewed. The speaker continued explaining how the Myanmar Selection System (MSS) has been practiced for the sustainable management of forest resources of Myanmar (selection-cum-cultural system). From 1856 to the present plantations have increased and the annual planting rate reached the peak during 1980-1984 (30,000-47,000 ha per year) and is now



Teak plantation in Myanmar



over 6,000 ha with an annual support of 17 million seedlings to the public. The accumulated plantation areas cover over 900,000 ha. U Min Min Oo also explained that the government is actively encouraging private sector investments for forest plantations. Planted areas during 2006-2019 are 768,000 ha and teak contributes about 23%. He explained that the Timber Certification Committee of Myanmar (TCCM) was established in 1998, re-named Myanmar Forest Certification Committee (MFCC) in 2013, and MFCC has become a Programme for the Endorsement of Forest Certification (PEFC) members since 2019. There are six criteria established for legal timber operations in Myanmar: right to harvest; forest operations; statutory charges; other user's rights; mill operations; trade and customs. The speaker thereafter presented the Chain of Custody (CoC) in Myanmar, where the main involved actors are the Forest Department, Myanmar Timber Enterprise, Trade Department, Custom Department, and buyers (private sector). Lastly he explained how many reforms that have been made at regional, national and international scales in the forest sector. Notably all the sectors have been reformed and a commission of anti-corruption has been formed in collaboration with international organizations.





Dr. Nikhom Laemsak, New Management System for Natural Teak Forests Consultant, KU, Thailand, presented the future trends in raw wood demands, sawn wood production, global paper and paperboard production (with high rates in Asia and the Pacific), and global production of round wood. All materials have been in steady increased from 2000 to 2030 (FAO). In addition, the adopted bio-economy policies at national and global levels stimulate wood consumption and provide an opportunity for the reforestation business sector. He moved forward presenting the Thai wood industry in eight sectors, which forecasts that the total demand



Certified teak timber from Thungkwian teak plantation station

of round wood will increase from ca. 60 million tonnes in 2016 to ca. 108 million tonnes by 2026 and to ca. 158 million tonnes by 2036. A rapid increase in energy and wood composite sector is expected. The thinned wood particles from plantations are used for various products such as the preserved and dried



wood, charcoal, wood vinegar, tar and sawn wood. In addition, the value of the export of (value-added) forest products has increased rapidly, especially from 1996 to 2017 (last data available). He pointed out that only 86,684 ha of forest cover and rubber plantations or less than 0.2% of the total remaining forest cover is managed under FSC standards largely due to various obstacles (see Dr. Nopparat and Dr. Ma's presentation). Dr. Nikhom has also been involved in the previous ITTO project (Criteria and Indicators and CoC for sustainable management of planted and community forests). He concluded his presentation advising that the National Forest Policy and Forestry sectors need to follow a clear direction in order to achieve sustainable development goals. It is also important that the forest certification guidelines (codes of practice) should be modified to match the national and local circumstances that are appropriate and affordable for smallholders.

Dr. P.K. Thulasidas, Information management and networking, outreach Conference Consultant, Institute of Green Economy, Noida NCR, India, briefly presented a policy perspective in the Mekong Sub region on behalf of Dr. Promde Kant (Forest Policy Consultant). Primarily governments in all Mekong countries should encourage teak planting in public lands. Yet with limited availability of public lands for raising teak plantations, the trend is to encourage teak plantations in private lands by individuals, communities and companies through



subsidies. Unfortunately, as Dr. Thulasidas added, many policies and laws discourage private sector investment in teak especially the restrictions on felling and transport of teak. Although, the new



forest act in Thailand allows cutting planted teak in legally owned or permitted lands there are still obstacles in log processing. Overall, there is a need to review the regulations related to harvesting, transportation, import and export, fiscal and land policies that are negatively affecting investments in large and small scales teak plantations. This review should be able to identify specific financial incentives at global, national and local levels, and the legal and institutional environment in which these incentives are placed, that are most efficient and cost-effective in leading to the desired changes.



Ms. Dang Hai Ha, VAFS, began her speech explaining that the total export value of wood based products in Vietnam (2018) was about eight million US\$ and the target was set at nine billion US\$ by 2020. The supply of domestic timber is insufficient and the wood quality is low; while the demand for high quality timber imported from overseas is increasing annually. She argued that 30,000,000 m<sup>3</sup>/year (mainly *Acacia* spp. and rubber) are harvested and around 2,200,000 m<sup>3</sup> of other wood species are imported mostly from America, Africa and Europe. Ms. Dang presented a case study from Son La Province (Vietnam) where teak was planted in the 90s with the help of some projects supporting households for livelihood improvement and reforestation. The existing plantations are estimated to cover about 1,650 ha. She also specified that the price of timber at the sawmill gate is about 400 US\$/m<sup>3</sup> for diameter <30 cm and 600 US\$/m<sup>3</sup> for diameter ≥30 cm. The speaker claimed that the largest import markets of Vietnam timber products are US, Japan, China, EU, Korea, Australia and Canada (readers might take into account that Vietnam exports timber and wood-based products to more



than 150 countries in the world). Ms. Dang mentioned that the main value of timber based products in Vietnam come from furniture, followed by woodchips and wooden planks. The presenter concluded the presentation encouraging the Vietnam Government and wood-based companies to import legal and certified wood. Vietnam shows a strong potential demand for teak timber and supplies imported teak products to global markets as the domestic production is in shortage of round wood.



Teak furniture factory in Vietnam for export and domestic consumption





U Kyaw Naing, Assistant General Manager, Myanmar Timber Enterprise (MTE), started his speech saying that MTE is a state institution responsible for both harvesting and distributing round wood and timber related products. The MTE aims to fulfil the target to earn and supply raw timber material. In addition, he informed that extraction of timber throughout the whole country has been banned in 2016/2017. Due to the log export ban (LEB) from 2014, teak buyers started to offer higher bidding prices in monthly open tenders. Consequently, teak harvesting has been substantially reduced since 2014. Moreover



Open tender sale (Teak logs lot)

timber companies do not have reliable export markets for teak products and the scarcity of raw material and the properties of teak logs under long time storage persuade companies to make competitive bidding in monthly open tenders. Furthermore,



three years after LEB the prices of teak log declined due to low wood quality, while the rest of species maintained good prices. U Kyaw Naing moved on to the market share situation, claiming that Myanmar natural teak holds a global niche market, but the situation is changing due to international trade policies (barriers) and environmental factors. He specified that the main two imported markets before and after the LEB are India and Thailand. U Kyaw Naing concluded that the total export volume from the state and the private sector is dominated by teak sawn timber. Nowadays, raw teak wood has become scarce and more expensive. All woodbased industry companies face a serious situation (see under the MRT visit). Thus, Myanmar is strengthening teak value chains through the manufacture of value-added teak products.

Mr. Vongvilay Vongkhamsao, Deputy Director, NAFRI, who presented this paper on behalf of Dr. Tek Maraseni, Value Chain Consultant, University of Southern Queensland, began his presentation



Natural teak in Laos



mentioning that Value Chain Framework (VCF) can identify opportunities to improve the chain performance in identifying the knowledge network, mapping the chains, developing semi-structured questionnaires and triangulating data collected. He successively gave to the audience some recommendations in matters of government interventions. The most important factors he mentioned are: improving the quality of Teak seedlings and supplying them to growers; training farmers and encouraging them to thin at age five/six years to produce bigger trees more quickly; supporting log sales by quality and grade; fostering the role of traders as providers of vital services; simplifying (as much as possible) current registration, harvesting, transportation rules, regulations and costs; and creating a supportive investment environment for traders and timber processors.

## Key messages and recommendations

### *Situation and trends of trade and market access of tropical timber and timber products (Dr. Tetra Yanuariadi)*

1. Three important factors for timber trading: economic trends, building and construction indicators policy trends and market access.
2. Tropical wood products are exported mainly to China.

### *Demand and supply of Teak in Vietnam (Dr. Dang Hai Ha)*

1. Vietnam exports timber and wood-based products to more than 150 countries, especially US, Japan, China, EU, Korea, and Australia.
2. Vietnam shows both strong potential in teak timber demand and supply. However, domestic teak productions from plantations are not sufficient for domestic and international markets.

### *Current situation of Teak marketing in Myanmar (U Kyaw Naing)*

1. MTE is a state institution responsible for harvesting and distributing timber and related products (similar to FIO in Thailand).
2. Teak sale volumes, especially round wood has decreased significantly after the log export ban (LEB) in 2014 and this policy is causing serious problems to the wood-based industry in Myanmar.
3. Myanmar is strengthening teak value chain in the manufacture of value-added Teak products for export.

### *Teak Timber Value Chain Analysis (VCA) in Lao PDR (Mr. Vongvilay Vongkhamsao)*

1. VCA can identify opportunities to improve chain performances.
2. Actors in teak timber value chain are: growers; traders; sawmilling/wood products manufacturing companies.
3. Sharing market information and developing relationships among the chain actors would be mutually beneficial.





## Key Messages

### Regional Workshop on Sustaining Teak Forests in Mekong Basin

24-27 September 2019, Yangon, Myanmar

*Enhancing the in-situ and ex-situ conservation* of Teak genetic resources through establishment of seed production areas and seed orchards as well as long-term Teak tree improvement research and development programs to supply high quality seed for Teak plantations and encouraging joint research on conservation of Teak genetic resources linked with breeding and biotechnology, including transferring seed for plantations, in the Mekong Sub-region to improve the genetic component of the population without its genetic erosion.

*Improving silviculture practices* of Teak plantations from selection of suitable sites to thinning and harvesting techniques to ensure good productivity, taking into account the fact that Teak is demanding for deep and good fertile soils, and sharing knowledge and experience for the development of sustainable management of Teak forest plantations in the Mekong region.

*Promoting the engagement of smallholders and communities, including young people and women*, in natural Teak forests management and establishment of planted Teak to improve livelihood, income generation and job creation, through support of quality Teak seedlings and extension services to farmers and capacity building, networking and partnerships for smallholders groups.

*Promoting value chains of Teak timber and timber products through value-added product development*, appropriate incentives mechanisms for smallholders plantations, improved marketing, improved financial resource access and long-term investment and conducting a global study of Teak supply and demand and sustainable Teak industry development to ensure enhanced policies, law enforcement and promotion of intraregional Teak trade.

*Strengthening sustainable supply and consumption of Teak timber and timber products through establishment of incentive mechanisms to promote the legality and sustainability of Teak supply chains* and strengthening regional cooperation for increased investments in downstream supply chains, marketing and trade of Teak timber and products by ensuring the legality and sustainability of domestic and international trade.

*Encouraging the formulation of sustainable global Teak strategies and recommended actions at the 4th World Teak Conference* (Accra, Ghana, August 2020) and scaling up international cooperation, partnerships and networking to promote the contributions of sustaining Teak forests and Teak products in addressing climate change mitigation and adaption, and the Sustainable Development Goals, especially Goal 15 “Life on land”, Goal 12 “Sustainable supply and consumption” and Goal 8 “Decent work and economic growth”.



## Field visit (26 September 2019)

### *Locations and themes*

#### *AFoCO RECT – Hedge Garden and Forest nursery*

Next to the AFoCO RECT research centre, there is a hedge garden and a forest nursery belonging to the Forestry Research Institute of the Forest Department. The area is located in Hmawbi Township, 50 km NW from Yangon and it is used as experimental plot by scholars, who are interested in forest dynamics and seedling production in Myanmar. The nursery we visited housed numerous species, and important are teak (*Tectona grandis* L.f.), Burmese Iron wood (*Xylia xylocarpa* Roxb. Taub.) and Burmese Padauk (*Pterocarpus macrocarpus* Kurz.). Right next to the nursery pops up a teak hedge garden planted in 2008 using good quality material, which can produce 600 shoots/tree/year, which are used to prepare new seedlings. Moving forward we had the opportunity to visit other two plots: an experimental forest, which was established back in 1969 and an old teak plantation planted in 1964. The latter did not show optimal condition, likely due to the presence of a hardpan layer since the soil originated from a coarse-grained granite rock.







## Field visit (26 September 2019)

### *Teak plantations – Taik Kyi township*

At the edge of Taik-Kyi township, located 70 km from Yangon (NW direction), Myanmar's Forest Department planted teak in 2002 using 3 m x 3 m spacing. The visited site covers about one ha. Teak is a light demanding species and individual trees barely tolerates competition with other species, especially in early stages). The plot was managed using thinning to boost the growth and the health of the stands. This silvicultural practice can reduce overcrowding and relieve tree stress helping to maintain a vigorous and healthy forest. The first thinning (50% removal of the total stands) was done in 2009, while the second treatment will be planned for 2025, hence respectively at the 7th and 23rd year. Despite the good soil conditions, stands grow slowly compared to private plantations in Thailand. Notably, trees are of uneven growth. The mean DBH is 19 cm or 60 cm girth (ranging from 40-80 cm girth), and the trunk straightness was not optimal, scoring a low grade (citing the presentation of Mrs. Chumnun Pianurak, see Session 3). The apparent poor condition of the stands might also indicate inadequate management practices and/or different seedling sources.







### *Acacia mangium* plantation – Taik Kyi township

This plot, not far from the teak plantation, hosts *Acacia mangium*, a species native to Northern Australia, Papua New Guinea and parts of Indonesia. This private plantation was established in 2015. Thanks to a good management, one/two years old stands looked taller than the ones found in natural forests. *Acacia* is becoming the preferred choice for commercial plantations, including reforestation projects.

Its wood is mainly used for the production of paper and charcoal, but it is also suitable for in-door furniture (e.g. doors and window frames). It is a fast growing species and capable to fix atmospheric nitrogen to soil. Translated into an economic point of view, it means that it generates a short-term income return. Like most fast growing species, *Acacia* requires high amount of light and, even though thinning is not a required practice, some stands tend to die due to self-thinning as a result of (light) competition with neighbouring trees. This plantation is clear cut every five/six years.

After 2006 Myanmar Forestry Department has set up plans to reforest around 258,000 ha of denuded forest land by 2028. The department hopes that the private sector will boost the increase in forest cover establishing around 113,300 ha plantations because of the raising demand for *Acacia mangium* wood. It can be planted at a density of 485 trees/ha and plantations are generally (clear) cut at five/eight years of age. The harvested trees generate approximately 200 US\$/ha.





*Bamboo plantation – Taikkyi township*

Nearby the previous two plantations, we visited a bamboo pilot farm which was established in 2015 by Myanmar Rattan, Bamboo Entrepreneurs Association and Green Move Co. Ltd (GMG). It is the only private bamboo plantation in Myanmar. The company obtained permissions from the Forest Department to use 1,214 ha forest plots located in Taikky and Minhla townships. The company started propagating the first batch of bamboo in 2015 using rhizomes, but the 90% of planted rhizomes died due to wrong practices and not suitable species. In 2016, the company got bamboo seeds (*Dendrocalamus asper*) from Daiwai region and (*D. brendisii*) from Pinlong region. In 2017, they collected seeds of two more species (namely *D. tulda* and *D. pragraicile*) and started an irrigated nursery plot.





A second plantation was established in 2016 starting from seedlings. The first check was done after three year and resulted in a survival rate > 90%. The company is now able to earn extra incomes exporting fresh leaves and young shoots to Japan and South Korea. The manager lamented how the materials they are currently able to produce are not sufficient to satisfy the market. Given that they have planned to expand their estate by 2,000 ha in Bago Yama region. Importantly the company aim to establish a bamboo furniture factory and a wood processing industry for international export. The Myanmar Bamboo Association appeared to be worried about the shortages of the versatile raw material.



According to U Khin Hla Aung, an executive member of the MBS, the bamboo supply is not enough for the local market. He specified that bamboo is used in Myanmar as a raw material for construction flooring, other products such as furniture, textiles, vinegar and alcoholic beverage production. Yes, the former purpose is still difficult to achieve (referring to his bamboo plantation near Okkan, in Taik Kyi Township). There has been high demand from overseas buyers for raw bamboo and value-added products such as furniture for many years. Unfortunately both a lack of technology and the shortage of raw material are limiting the growth of bamboo industry. MBS has been promoting the establishment of bamboo plantations on degraded forest land since its foundation in 2015.

#### *MRT Wood Factory Co LTD – Yangon*

MRT Myanmar Wood Based Industry is one of the four remaining wood sawmills in Myanmar. It is located 30 km in NW direction from Yangon city centre and it started its business with rice (rice mill) (*Orzya sativa*). It successively turned into a wood-based industry in 2004. Its main customers are India, China, and Japan, while the export to EU countries is limited due to wood certification requirement by European companies.

Wood-based industry in Myanmar started facing difficulties after the log export ban 2014 aiming at reducing illegal logging and generating greater benefits to all actors involved in the value chain. In addition, the Myanmar government significantly reduced wood productions derived from logging concessions (from 100,000 m<sup>3</sup>/year to 10,000 m<sup>3</sup>/year). Furthermore, private-owned teak plantations are now aged 14-15 year, hence DBH is too small to be processed for construction purposes. Furthermore, wood export is only allowed for logs reaching bigger size.





MRT Manager emphasized that the current regulation is going to reduce the value of large teak logs. He lamented that nowadays there is a shortage of raw material (round-wood) to feed wood factories because of the high competition in bidding among international and domestic companies. Participants and Company Manager also shared their experience in the matter of sustainable forest management, legality, wood certification and a need for a balance between conservation and sustainable use. Based on participants observations, MRT Company will not be able to keep up with the times and to turn itself into a valued-added business sector, unless its wood business would become viable in the medium term.



## Appendices

### Conference program

Date	Topics
<b>Tue, 24 September</b>	
<b>9:00-10.20</b>	<p><b>Opening Ceremony</b></p> <ul style="list-style-type: none"> <li>• Dr. Ma Hwan-ok, Senior Projects Manager, ITTO</li> <li>• Mr. Sung Ho Choi, Program Officer, Asian Forest Cooperation Organization (AFoCO)</li> <li>• Dr. Nikhom Laemsak, Dean, Faculty of Forestry, Kasetsart University, Thailand</li> <li>• Dr. Chanh Samone <u>Phongoudome</u>, Deputy Director-General, National Agriculture and Forestry Research Institute, Lao PDR</li> <li>• Dr. Ye Myint Swe Deputy Minister of Natural Resources and Environmental Conservation Myanmar</li> </ul> <p>Group photo and refreshment</p> <p>Rapporteurs: Dr. Thulasida and Mr. Choi</p>
<b>10.20-10.35</b>	<p><b>Presentation of the Workshop Program and Announcement</b></p> <ul style="list-style-type: none"> <li>• Objectives and Programs of the Workshop (Dr. MaHwan-ok, ITTO &amp; Prof. Yongyut Trisurat, Kasetsart University)</li> <li>• Announcement of the 4th World Teak Conference (24-27 August 2020, Accra, Ghana) (Dr. P.K. Thulasidas, TEAKNET)</li> </ul>
<b>10.35-11.15</b>	<p><b>Keynote presentation</b></p> <p>Chairman: Prof. Yongyut Trisurat, Kasetsart University, Thailand</p> <ul style="list-style-type: none"> <li>• Sustainable forest management in Myanmar (Dr. Thaug Naing Oo, Director of FRI, Myanmar)</li> <li>• Conservation of Teak genetic resources in Thailand (Dr. Suwan Tangmitcharoen, Thailand's RFD)</li> </ul> <p>Rapporteurs: Dr. Ma Hwan-ok and Ms. Zar Chi Hlaing</p>
<b>11.15-13.00</b>	<p><b>Session 1: National Report on Natural Teak Forest and Teak Plantation</b></p> <p>Chairman: Dr. Thaug Naing Oo, Director of FRI, Myanmar</p> <ul style="list-style-type: none"> <li>• Cambodia: Cambodia's Forestry Administration (FA)</li> <li>• Lao PDR: National Agriculture and Forestry Research Institute (NAFRI)</li> <li>• Thailand: Royal Forest Department (RFD)</li> </ul>

	<ul style="list-style-type: none"> <li>• Vietnam: Vietnamese Academy of Forest Sciences (VAFS)</li> </ul> <p>Q&amp;A and three key messages  Rapporteurs: Dr. Tetra Yanuariadi and Dr. Nikhom Laemsak</p>
<b>13.00-14.00</b>	<b>Lunch Break</b>
<b>14.00-15.30</b>	<p><b>Session 2: In-situ and Ex-situ Conservation of Teak Resources in Mekong</b></p> <p>Chairman: Mr. Sapol Boonsermsuk, RFD, Thailand</p> <ul style="list-style-type: none"> <li>• Teak distributions under land use and climate change and conservation implication in the Mekong: Prof. Yongyut Trisurat, Kasetsart University</li> <li>• Using various DNA techniques for various Teak research - clonal identification, and log tracking: Dr. Anto Rimbawanto, Centre for Forest Biotechnology and Tree Improvement, Indonesia</li> <li>• Genetic diversity and DNA barcoding of Teak in the Mekong: Dr. Tani Naoki, JIRACS, Japan</li> <li>• Myanmar: Teak genetic resources in Myanmar: Dr. Thwe Thwe Win, Assoc. Prof. from the University of Forestry and Environmental Sciences</li> </ul> <p>Q&amp;A and three key messages  Rapporteurs: Dr Anto Rimbawanto and Dr. Win Thwe Thwe</p>
<b>15.30-15.45</b>	<b>Tea/Coffee Break</b>
<b>15.45-17:30</b>	<p><b>Session 3: Sustainable Management of Teak Forests - R&amp;D in silviculture and best practices</b></p> <p>Chairman: Dr. Dong Lam Tran, VAFS</p> <ul style="list-style-type: none"> <li>• Teak resource conservation in Myanmar (Dr. Thaung Naing Oo and U Aung Zaw Moe, Forest Research Institute)</li> <li>• New breeds of Teak from full-sib progeny and their vegetative propagation: (Dr. Saroj Wattanasuksakul, Thailand's RFD)</li> <li>• Teak plus tree selection and its propagation techniques used in Thailand: (Mrs. Chumnun Piananurak, Consultant #2)</li> <li>• Effects of first thinning on growth and stem form of Teak plantation in Thailand (Mr. Tosporn Vacharangkura, Consultant #5)</li> <li>• Silviculture aspects of Teak plantations in Brazil (Dr. Sylvio Coutinho, Private Teak Plantation, Brazil)</li> <li>• New Intensive method for growing Teak (Dr. Nir Atzmon, CEO Greenforest Consulting Ltd).</li> </ul> <p>Q&amp;A and three key messages  Rapporteurs: Dr. Nopparat and Ms. Woraphan Himmaphan</p>
<b>18.30-20.00</b>	<b>Welcome Dinner</b>





<b>Wed, 25 September</b>	
<b>9:00-11.10</b>	<p><b>Session 4: Promoting of Small Holders and Communities in Natural Teak Forests Management and Establishment of Planted Teak</b></p> <p>Chairman: Dr. Chanh Samone <u>Phongoudome</u>, DDG of NAFRI, Lao PDR</p> <ul style="list-style-type: none"> <li>• ITTO Guidelines on FLR in the Tropics (Mr Yong-tae Choi, ITTO)</li> <li>• Myanmar: Forest plantations and community forestry in Myanmar. (USein Moe, Assistant Director, Extension Division, Forest Department)</li> <li>• The selection of sustainable logging systems, case study Teak plantations in Thailand (Dr. Nopparat Kaakkurivaara, Consultant #6)</li> <li>• Community-based oil palm/rubber wood supply chain (Mr. Suriyan Vichitlekarn, GIZ Thailand)</li> <li>• Teak farm in Cambodia: Mr. Guy Yogeve, Director of Teak Farm Innovative Agroforestry, Cambodia</li> <li>• Designing a production driven FLR program: forest communities - private sector partnerships (Martin Greijmans, RECOFTC)</li> </ul> <p>Q&amp;A and three key messages</p> <p>Rapporteurs: Dr. Tani Naoki and Prof. Yongyut Trisurat</p>
<b>11.10-11.30</b>	<b>Tea/Coffee Break</b>
<b>11.30-12.30</b>	<p><b>Panel Discussion: Opportunities and Challenges of Smallholders Teak in Mekong Basin</b></p> <p>Moderator: Mr Ma Hwan-ok, ITTO</p> <p>Panel members:</p> <p>Dr Thaug Naing Oo (Myanmar), Dr Dong Lam Tran (Vietnam), Mr Guy Yogeve (Teak Farm Innovative Agroforestry, Cambodia), Dr Martin Greijmans (RECOFTC), Mrs Chumnun Piananurak (Consultant), Mrs. Sopheap Lim (Cambodia), Mr. Vongvilay Vongkhamsoo (Lao PDR)</p> <p>Questions:</p> <ol style="list-style-type: none"> <li>1. Will smallholders be a key player of Teak plantations and management in the Mekong Basin?</li> <li>2. What are key opportunities for smallholders for Teak?</li> <li>3. What are key challenges for promotion of smallholder Teak development and what is the priority?</li> </ol> <p>Rapporteurs: U Sein Moe and Dr. Thulasida</p>
<b>12:30-13.30</b>	<b>Lunch Break</b>
<b>13.30-15.00</b>	<p><b>Session 5: Legality and Sustainability in Teak supply chains in Mekong</b></p> <p>Chairman: Dr. Sylvio Coutinho (Private Teak Plantation, Brazil)</p>

	<ul style="list-style-type: none"> <li>• ITTO Legal and Sustainable Supply Chain Initiative (Dr Ma, ITTO);</li> <li>• Legality of Teak in Myanmar (U Min Min Oo, Staff Officer, Natural Forest and Plantations Division, Forest Department)</li> <li>• Sustainable wood industry and certification in Thailand (Dr. Nikhom Laemsak, Kasetsart University)</li> <li>• Forest policy in the Mekong: Dr. Promode Kant, India (presented by Dr. P.K. Thulasidas).</li> </ul> <p>Q&amp;A and three key messages</p> <p>Rapporteurs: Dr. Martin Greijmans and Mr. Kim Sobon</p>
<b>15.00-15.30</b>	<b>Tea/Coffee Break</b>
<b>15.30-17.00</b>	<p><b>Session 6: Value Chains and Demand and Supply in Teak</b></p> <p>Chairman: Dr. Nikhom Laemsak, Kasetsart University</p> <ul style="list-style-type: none"> <li>• Situation and trends in world tropical timber production, trade and market (Dr. Tetra, ITTO)</li> <li>• Demand and supply of Teak in Vietnam: Dr. Dong Lam Tran, VAFS</li> <li>• Myanmar: Demand and supply of Teak in Myanmar. (U Kyaw Naing. Assistant General Manager. Myanmar Timber Enterprise)</li> <li>• Lao PDR: Teak Timber Value Chain Analysis (VCA) by Prof. Tek Maraseni, Univ of Southern Queensland, Australia (presented by Mr. Vongvilay VONGKHAMSAO, Deputy Director, NAFRI)</li> </ul> <p>Q&amp;A and three key messages</p> <p>Rapporteurs: Ms. Woraphan Himmaman and Mr. Oka Hiroyasu</p>
<b>17.00-17.20</b>	<p>Draft outcomes/ key messages of the Workshop</p> <p>Chairman: Dr Thaung Naing Oo</p> <p>Presenters: Prof Yongyut, Dr. P.K. Thulasidas, Dr Tetra</p> <p>Closing remarks: Dr Ma (ITTO) and Dr Thaung Naing Oo (Myanmar)</p>
	<p><b>Session 7: Field visits to a natural Teak forest and a Teak product company near Yangon</b></p> <p>Suggested rapporteurs: Ms Hlaing Zar Chi, Mrs Sopheap Lim, Dr. Woraphan Himmaman</p>
<b>7.30</b>	Departure from RETC-AFoCO
7.30-12.30	RETC-AFoCO to Taikkyi Township



13.30-19.00	Visit to Wood-based Industry factory of Myanmar Timber Enterprise, Insein Township Visit to Shwedagon Pagoda in Yangon
19.00-20.00	Dinner Loi Sam Sip Restaurant, Yangon City
20.00	Back to RETC-AFoCO or Hotel / Start of departure of participants
<b>Fri, 27 September</b>	
8:00-11:00	<b>2<sup>nd</sup> Project Technical Committee Meeting</b> <b>(members and partners only)</b> Co-Chairs: Dr. Suwan Tangmitcharoen and Dr. Ma Hwan-ok Provisional agenda: <ul style="list-style-type: none"> <li>• Progress of the implementation of the ITTO Teak Project Review of the implementation of the ITTO Teak including review the implementation of the recommendations of the first Project Steering Committee held in April in Bangkok</li> <li>• Review of the work plans for the second half of the first year and second year</li> <li>• Next PSC and PTC meetings</li> </ul>
11:30-12:30	<b>Lunch Break</b>
12:30	Departure of participants



## Appendix 2 List of participants

No.	Name	Affiliation	Role	E-mail
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17.	U Sein Moe	FRI, Myanmar		



No.	Name	Affiliation	Role	E-mail
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## Appendix III: Introduction to the Greater Mekong Sub-region and Teak

### Ecology (contributed by Mr. Paolo Sartorelli)

The Greater Mekong Sub-region (GMS) is a transnational area of the Mekong River, which includes the Yunnan and Guansi Provinces of China, Myanmar, Thailand, Lao PDR, Cambodia and Vietnam (the Korea Times, 2014). The high rate of population growth (estimated around 70 million in 2008 (Pech and Sunada, 2008, CDRI, 2008), among which 71.03% rural (retrieved from Greater Mekong Subregion Statistical Database, 2017)) is negatively affecting the management of the Mekong basin, with direct consequence on its vegetation, land use and on its natural resources. The majority of people is poor, with an estimated average GDP of 1,488 US\$ (Hook et al., 2003), therefore the development of the area plays a vital role as it has been emphasized by national governments and international organizations (Campbell, 2009). Moreover, the lack of studies decreases the possibilities to highlight the main needs (Kraay, 2005).



Figure. The Mekong basin. Retrieved from Laohachaiboon and Takeda (2007)

To start a good management plan of the Mekong River and its surrounding vegetation there are some basic needs. Among them defining clear objectives (see e.g. Le Moigne et al., 1994, Barrow, 1998); more scientific research by competent scholars and high quality technicians; enhancing the cooperation between stakeholders and decision makers that will help local people in their capacity of conserving the environment (Campbell, 2007, Campbell, 2009).

### *Mixed deciduous forests in the GMS*

Vegetation structure and composition is largely influenced by climato-geographic factors (Rundel, 1999, Rundel, 2009). Precipitation and temperature largely vary along the area (rainfalls range from 600 mm to 5000 mm) influencing species variety (Rundel, 2009). Moreover, the high rate of population growth led to high level of deforestation, resulting in large areas covered by secondary forests (Rundel, 2009).

Table 1: the lower Mekong basin, endemic area of teak.

	Forest formation	Other names	Location	Characteristics	Common species
Lower basin	Mixed deciduous forest	Monsoon forest	Ganges basin, Myanmar, Northern Thailand, Lao.	Strong seasonality (5 – 6 months of dry season). Frequent fires. Closed upper canopy > 30 m. Understorey open canopy.	Shrubs, bamboos, Fabaceae ( <i>Xylia kerrii</i> , <i>Azalia xylocarpa</i> , <i>Pterocarpus macrocarpus</i> , and <i>Dalbergia</i> spp.), Lythraceae, Rubiaceae, <i>Terminalia</i> spp., <i>Lagerstroemia</i> .  <i>Tectona grandis</i> was the dominant spp before human impact.

(Campbell et al., 2009)

Mixed deciduous forests, also called Monsoon forests, cover great part of the Mekong basin (Campbell, 2009). These ecosystems are characterised by high rainfall seasonality and have a dry season lasting around six months (Campbell, 2009) leading to fire occurrence, especially at the end of the dry season that is February/ March (Huke, 1982, Campbell, 2009).

Monsoon forests are defined by multi-layer canopy structure (see e.g. Bassow and Bazzaz, 1997, Herbst, 2008, Campbell, 2009) with the upper one reaching 30 m with several species belonging to the Fabaceae, Combretaceae, Rubiaceae and Lythraceae family (Elliott et al., 1989, Campbell, 2009). The understorey layer is mostly occupied by shrubs and Poaceae (Bambusoideae) that replaced teak natural regeneration after land use change consequently to human establishment.

Likewise in other regions, boundaries between ecosystems are not well defined (see e.g. Gosz, 1991, Yarrow and Marin, 2007, Hansen and Di Castri, 2012), especially in the southern part of the Subregion, like Campbell, 2009 emphasized. These transition zones have been exploited for long time by intensive logging and agriculture which led to substantial change in species composition (Campbell, 2009). Authors like Vidal highlighted this fact describing monsoon forests as degraded communities derived from previous semi evergreen forests (Vidal 1956, Vidal, 1960).



*Tectona grandis* L.f. is vulnerable to interspecific competition at early stages (Briscoe, 1995, Sima Gonzáles, 2010). But as Orwa et al. (2009) described in the agroforestry database, it revealed to be quite adaptable to different environments. Nowadays teak plantations are worldwide spread along the tropics, thriving under different climato – edaphic condition, e.g. Caribbean Islands (from 1880, (Deval et al., 2003)), Central and South America, West Africa, and other Southeast Asian countries such as Vietnam and Philippines (Orwa et al., 2009).

The same authors, together with other studies (see e.g. CATIE, 2016, Torres Medina, 2018) argued that teak is able to develop under a wide range of rainfall: from (500) 600 mm to 4000 (5000) mm, even though its optimal requirements range from 1,200 to 2,500 mm/year (Mascarenhas et al, 1987, Kaosa-ard, 1998, Orwa et al, 2009). The same studies also reported the resistance of teak under seasonal climatic conditions, with a dry season ranging from three to five months. It can also resist under a great range of temperature (2 – 48 °C) although it is not resistant to frost (Mascarenhas, 1987, Kaosa-ard, 1998); the optimal temperature range from (23) 25 °C to 33 (35) °C (Kanchanaburangura, 1976, Mascarenhas, 1987).

Teak is a pioneer species (Mascarenhas, 1987, Orwa, 2009, Torres Molina 2018) hence it does not tolerate shade at any stage of its life (panamateakforestry.com, 2019). It shows better performances on deep, nutrient rich, well drained, sandy-loamy to clay-loamy soils (Kaosa-ard, 1998) although it is also found on nutrient poor acidic soils (Kaosa-ard, 1998). The optimal pH range around the neutrality: (5.5) 6.5 – 7.5 (Torres Medina, 2018). Teak thrive on soil riches in limestone, granite, schist, gneiss (Kaosa-ard, 1998, panamateakforestry.com, 2019). It requires K, Ca, N, P, Mg as nutrients (Kaosa-ard, 1991, Kaosa-ard, 1998, Torres Medina, 2018). Calcium has been found to be pivotal for its dominance above other species with which is commonly associated (Bunyavejchewin, 1983, Kaosa-ard, 1998).

In its natural habitat teak is commonly associated with *Xylia* spp., *Azelia* spp, *Terminalia* spp., *Lagerstroemia* spp. (Orwa et al., 2009, Campbell, 2009), *Lythraceae*, and *Rubiaceae* (Campbell, 2009) (see also table above). In the case of teak plantations, the associations with other species are quite different. For instance, being an invasive spp in Central and South America and in the Caribbean is replacing native species such as Puerto Ricans mahoe (*Hibiscus elatus* Sw.) (Devall et al., 2003) with possible consequence on natural vegetation.

Teak site (particularly in plantations) has a significant effect in its development, therefore in the quality of the timber products (Kaosa-ard, 1998). Teak wood colour is strongly influenced by the amount of water it receives (Nobuchi et al., 2005), importantly heartwood shown to be darker when the species receives higher amount of water (Kaosa-ard, 1998, Nobuchi et al., 2005). Moreover, Nobuchi et al. (2005) argued that growth rings were more blurred when the stands received more water.

With the increasing trend in atmospheric CO<sub>2</sub> concentration, it is expected an increase in net primary productivity (Gopalakrishnan et al., 2011) yet other scholars (see e.g. Varadharajan et al., 2010) found opposite results, indicating the need for further research.



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