

Gene Conservation and Research & Development of teak (*Tectona grandis* L.f.)

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Key note speeches for workshop for ITTO Project: Enhancing Conservation and Sustainable Management of Teak Forests and Legal & Sustainable Wood Supply Chains in the Greater Mekong Sub-region” (PP-A/54-331) @ Bangkok, Thailand

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Dr.Suwan Tangmitcharoen RFD



www.forest.go.th

Teak is the most common priority species

(forest industries and planted forest)



THE STATE
OF THE WORLD'S
FOREST GENETIC RESOURCES

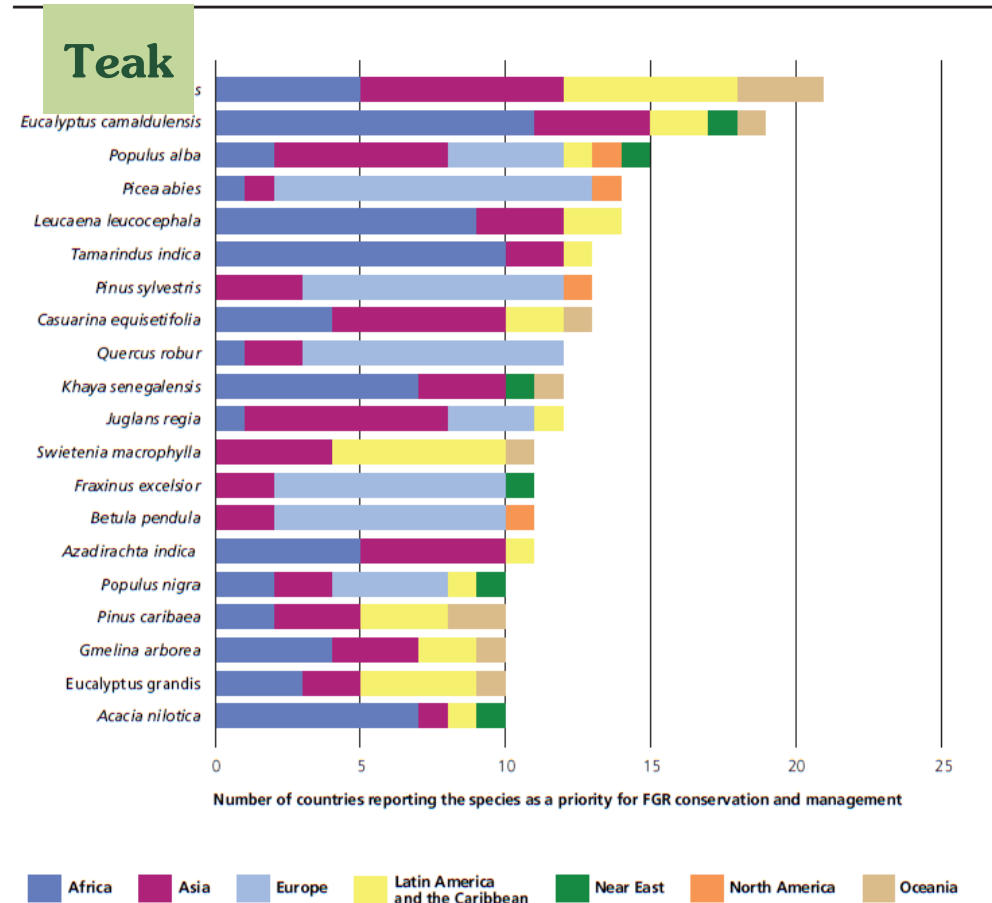
2014

COMMISSION ON
GENETIC RESOURCES
FOR FOOD AND
AGRICULTURE

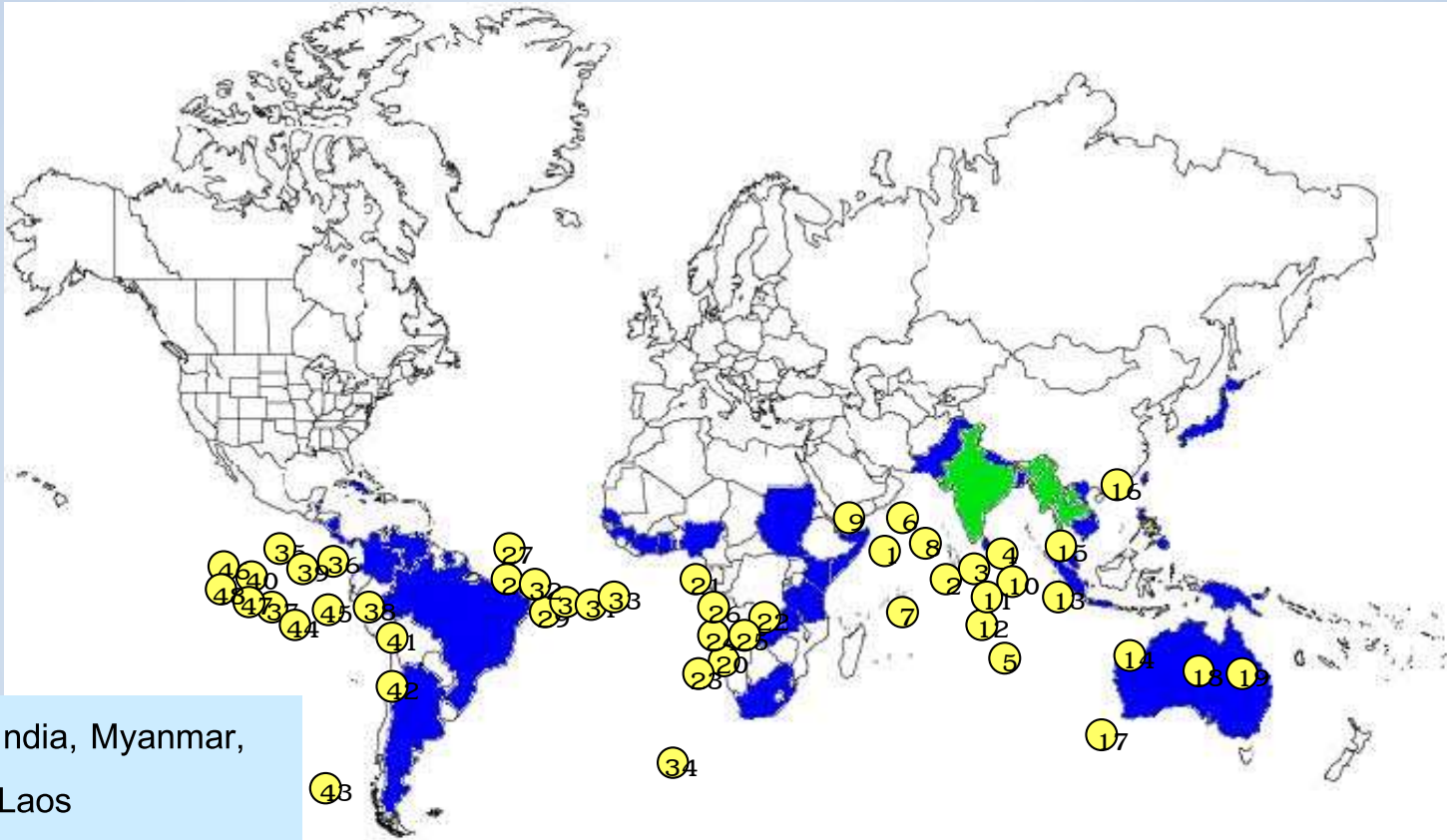


FIGURE 10.2

Most common priority species, by region



Distribution of teak in the world (Natural & Plantation)



Native to India, Myanmar,
Thailand, Laos

ADAPTED FROM Tewari (1992)

1. India 2. Myanmar 3. Thailand 4. Laos 5. Indonesia 6. Nepal 7. Srilanka 8. Bangladesh 9. Pakistan 10. Vietnam
11. Cambodia 12. Malasia 13. Philippines 14. Papua New Ginea 15. Taiwan 16. Japan 17. Australia 18. Solomon Isl
19. Figi Isl 20. Tanzania 21. Sudan 22. Somalia 23. Zimbabwe 24. Uganda 25. Kenya 26. Malawi 27. Senegal
28. Guinea 29. Ivory Coast 30. Ghana 31. Togo 32. Dahomey 33. Nigeria 34. South Africa 35. Cuba 36. Puerto Rico
37. Panama & Illonduras 38. Trinidad/Tobago 39. Jamaica 40. Nicaragua 41. Suriname 42. Brazil 43. Argentina
44. Columbia 45. Venezuela 46. Belize 47. Costa Rica 48. El Salvador



WORLD TEAK CONFERENCE 2013



Suggestions from World Teak Conference 2013

For future activities to meet the actual need and practical application, the meeting suggests that:

- **Genetic conservation program should be developed as an integral part of tree improvement and plantation management.**
- **Strategy of genetics improvement of teak should be formulated with more consideration to the genetic conservation of existing gene pool.**
- **The delineation of provenance zones and the controlled harvest in seed production areas established in these zones is suggested as priority.**
- **A re-evaluation of clone archives and existing clonal seed orchards is recommended and the origin of land races needs to be investigated and their diversity should be assessed.**
- **Genetic materials and genetic exchange should be promoted to maximize plantation production and teak improvement program.**
- **Seed production of clonal seed orchard required more urgent researches to overcome the existing problems.**

Suggestions from World Teak Conference 2013 (cont.)

- **Biotechnology tools in conjunction with intensive breeding program need to be developed.**
- **Prioritize capacity building are necessary to address the needs on information sharing, training, workshop, technical conference, field visit and scholarship funding.**
- **Mutual cooperation among international, regional and national agencies with cooperation of TEAKNET and IUFRO need to be strengthened.**
- **Experts on teak should be listed and exchanged to serve the needs of developing countries.**
- **Risk assessment should be taken into consideration in conjunction with insurance package.**
- **Young planted teak need to find new and innovative ways to market**

OUTLINE

- ✓ *In situ & Ex situ* Gene Conservation of Teak
- ✓ Germplasm Collection & Tree Improvement
- ✓ R&D of Teak Management and Breeding
- ✓ Challenging Future Work



Genetic Conservation

First Era: การศึกษาไม้ป่าเบื้องต้น, ทดสอบชนิดไม้, สวนพฤกษศาสตร์
(tree introduction, species trail, botanical garden)

Second Era: การผสมพันธุ์ไม้ป่า - งานทดลองภาคสนามรูปแบบต่าง ๆ
tree breeding (provenance trails, progeny test)

Third Era: การเชื่อมโยงการผสมพันธุ์กับเทคโนโลยีทางชีวภาพ
(Linked with breeding & biotechnology – DNA Molecular)

(Soekotjo 2001)

In situ gene conservation of teak



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**Teak plus tree selection from high land
(1200 MASL) teak forest, Mae Hong Son**



Ex situ gene conservation of teak

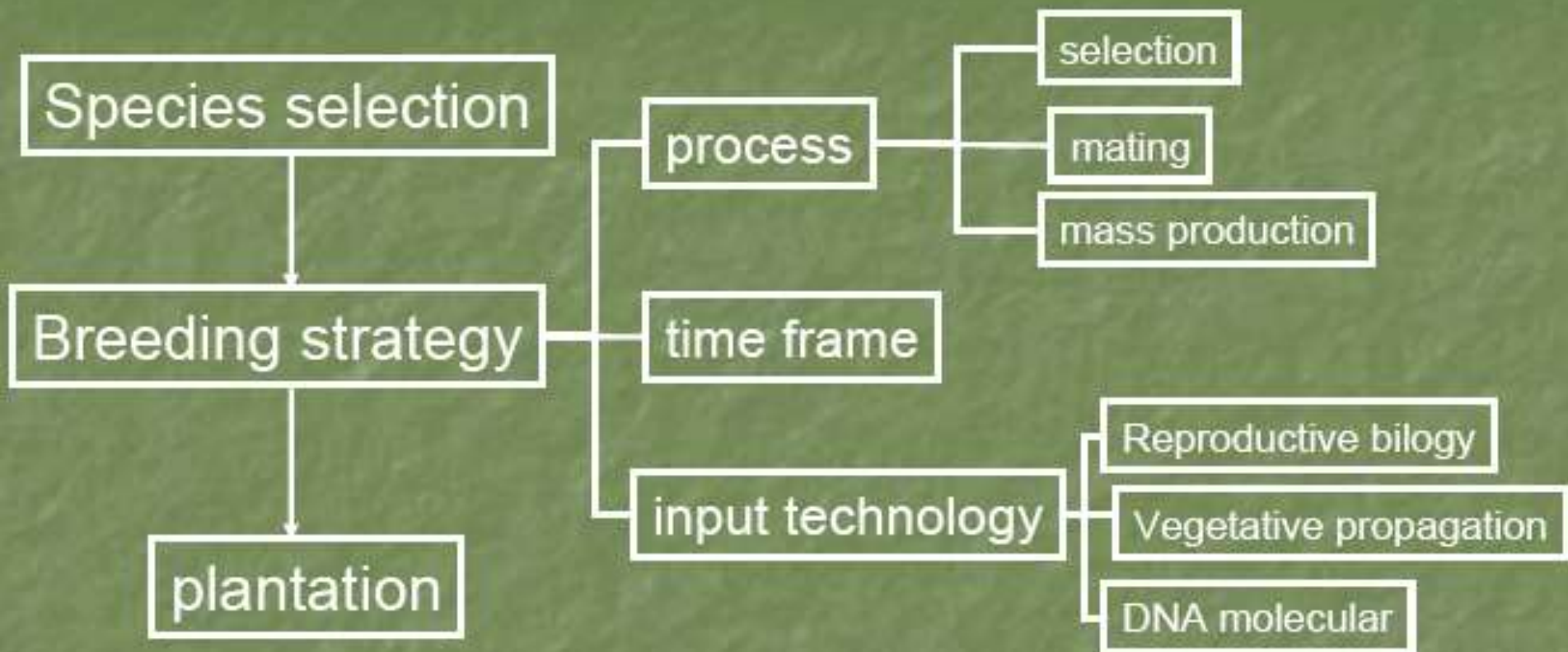
✓ *Plantation Forest*

✓ *Tree Improvement Plot*

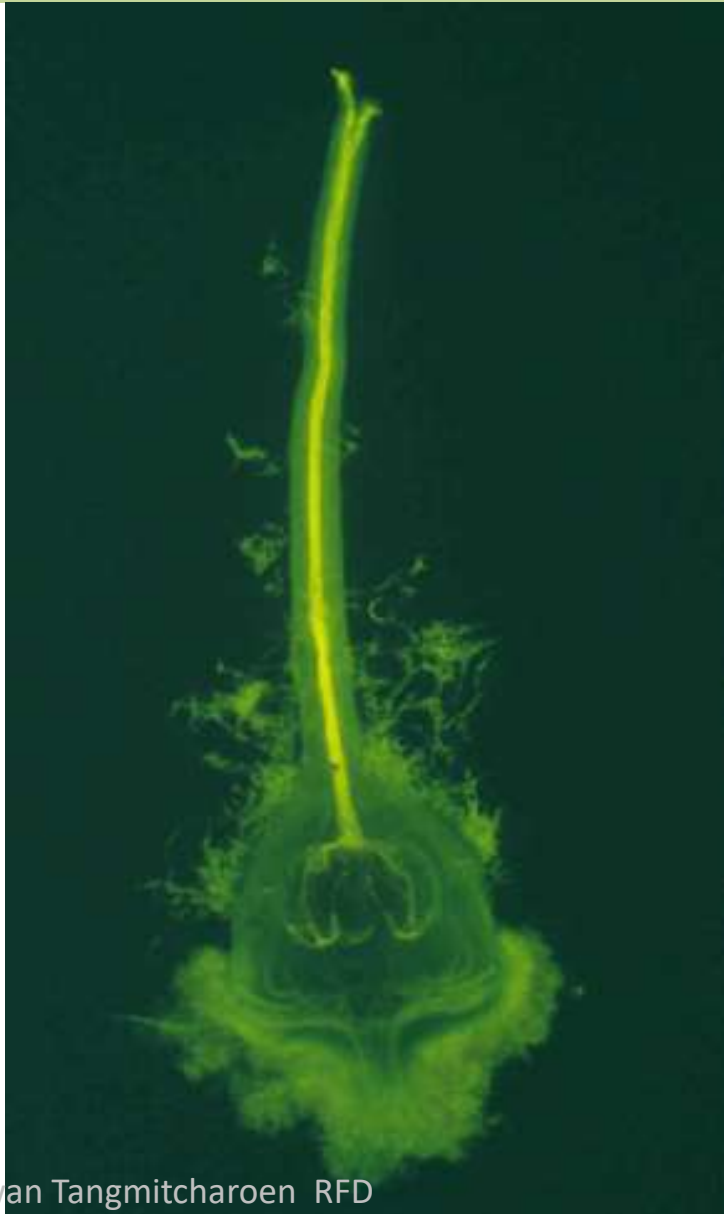
- Gene bank / Clone bank
- Seed Orchard
- Seed Production area
- Provenance trials
- Progeny test
- Clonal Test



Tree Improvement Process



Reproductive Biology Study



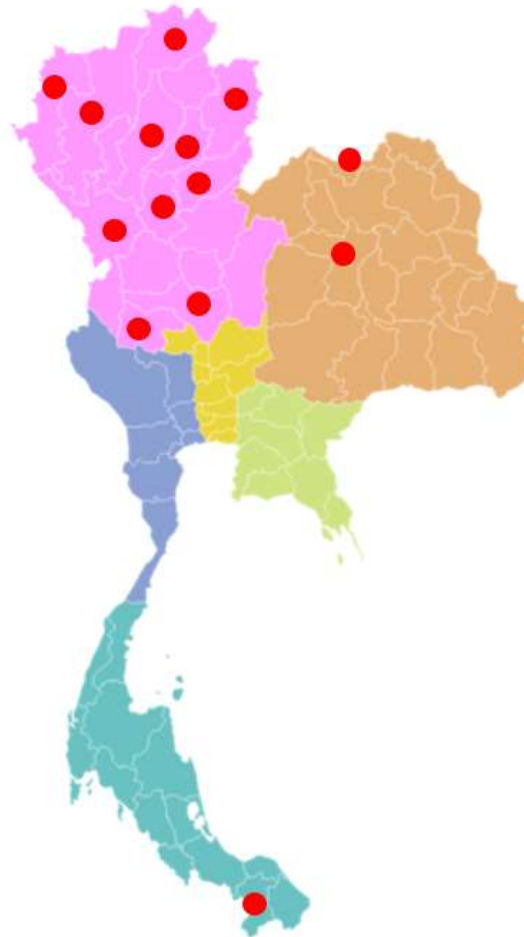
Cycle of Tree Improvement

Testing, Selection and mating are repeated by generation

[Plus tree selection or provenance introduction]



568 Plus Trees from selected from natural and plantation



Lampang	151
Chiang Rai	25
Chiang Mai	59
Phrae	105
Mae Hong Son	118
Tak	42
Sukhothai	17
Uthai Thani	3
Khon Kaen	20
Uttaradit	8
Nong Khai	3
Nakhon Sawan	6
Nan	10
Yala	1

Ngao Silvicultural Research Station, Lampang

(Teak Improvement Center- TIC)



Clonal Test



Progeny Test





Teak Improved Seed Sources in THAILAND

Seed Orchard (784 ha) & Seed Production Area (225 ha)

Chiengrai



Phayao



Chantaburi



Khonkan



Lampang





- Group 1 Salween and MaeMoei watershed
- Group 2 Middle western (KlongWangJao, MaeWong)
- Group 3 Lower western (Maenam Kwae Yai, Kwae Noi, Maeklong)
- Group 4 Upper Ping, Wang and Yom watershed
- Group 5 Mae Klong watershed (Maenam Kok, Ing, Mekhong)
- Group 6 Maenam Nan watershed
- Group 7 Central lower northern (Lower Ping, Wang, Yom and Nan rivers)

Source: Saichat and Hugo Volkaert, in preparation (2015)

Geographical grouping of teak populations in Thailand based on the results of the DNA structure analysis identified 6 regions and 1 admixture zone

Saichat Pongkrawee & Hugo Volkeart,
In preparation



Produced New Breeds by Hand-Controlled Pollination



New Breed from Teak Improvement Program (RFD 1-10)

RFD 1-1



RFD 1-2



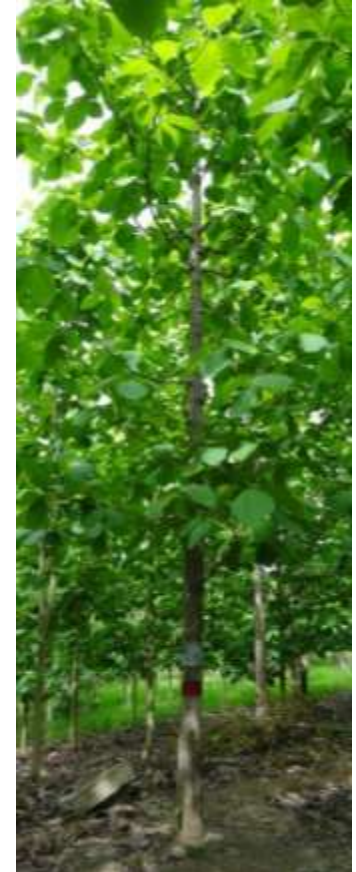
RFD 1-3



RFD 1-4



RFD 1-5



Donglan Silvicultural Research Station, Khonkaen



Private plantation in Lampang planted by improved genetic materials from RFD- 3 year old

On going activities under the present joint research project



Unthinned



50% thinned

**Effects of Thinning in
Teak Plantation**



Dr.Suwan Tangmitcharoen RFD



The growth of coppiced teak



**Effects of Pruning in Teak
Plantation**



**Estimation teak stand volume
by UAV**



**Teak Clonal test for Northeast
of Thailand**

Photo by Woraphun Himmaphan



Transfer Knowledges from the joint research project to the teak owners and extension officers



On going Research on Molecular Genetic for Teak Breeding



- **Genotyping of all clones**
- **Focus on important traits for teak timber production**
- **Genetic markers are used for further selection**
- **develop model to estimate future traits of the seedling**
- **This model can help to accelerate teak breeding program**



**Kasetsart
University**



Outputs of the Joint Research Project between RFD and Japan International Research Center for Agricultural Sciences (JIRCAS)



Soil suitability map for teak plantation in Udon Thani and Nong Bua Lam Phu Provinces



Yield table for Teak Plantation in the Northeast of Thailand

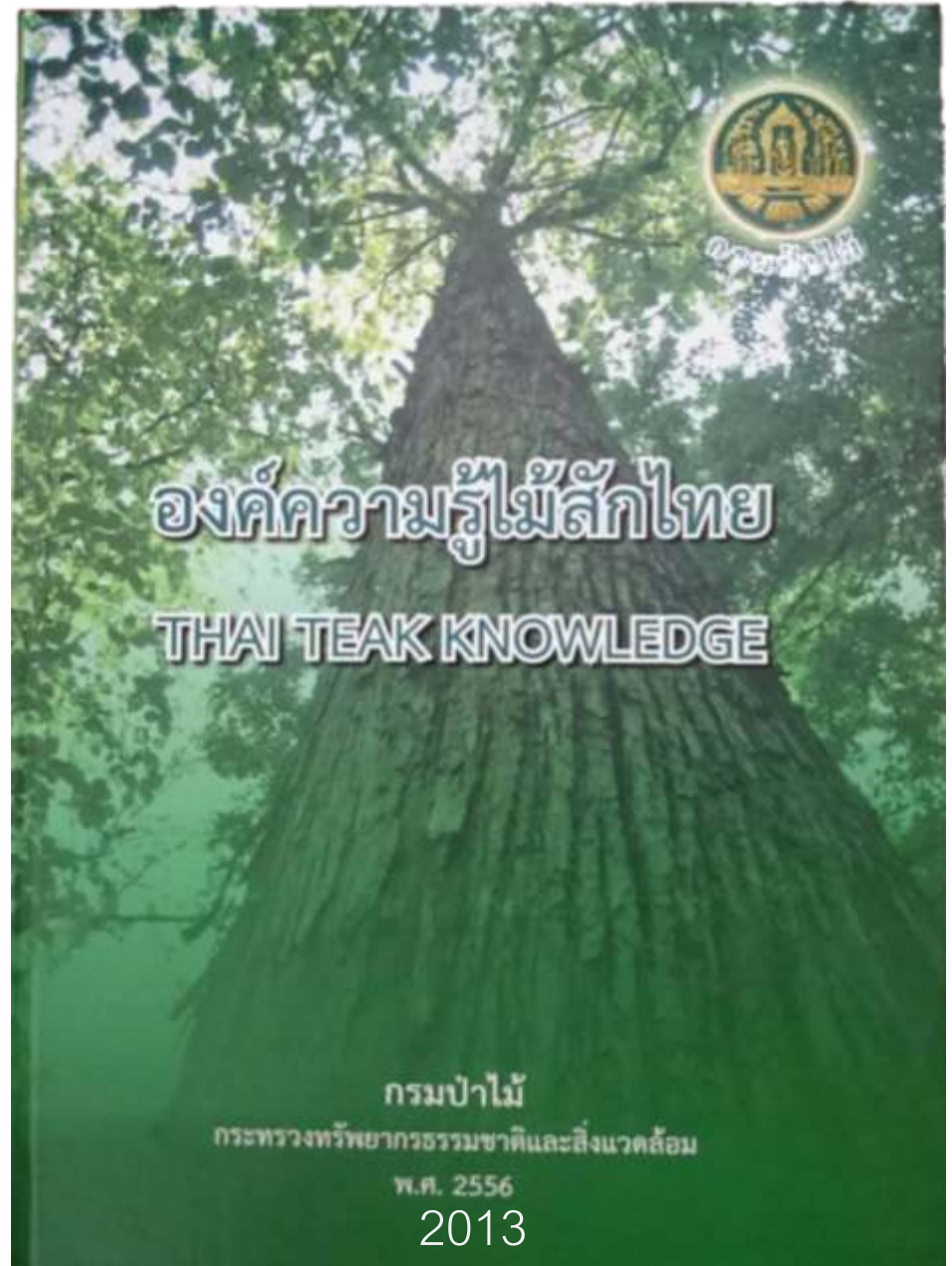


Table of Dry weight, Carbon stock and CO₂ absorption in Teak Plantation of Thailand



Content

- 1 Thai Teak History
- 2 Law and Regulation
- 3 Tree Improvement
- 4 Teak Seed and Sowing
- 5 Teak Propagation
- 6 Teak and its Environment
- 7 Teak Planting and Management
- 8 Growth and Yield
- 9 Teak Biomass
- 10 Pest and Disease of Teak
- 11 Wood Property and Use of Teak Wood
- 12 Major Factors of Private teak
Plantation



Challenges in R&D of teak breeding & management

- **Updating long-term breeding strategy**
- **Linked with breeding & biotechnology – DNA Molecular**
- **Continuing finding proper techniques of teak plantation management**
- **Extensively support better germplasm to tree farmers**
- **Knowledge transfers to tree farmer & extension officers**



Partnership & Network on Teak R &D & Conservation



Federal Ministry
of Food
and Agriculture



Department of National Park,
Wildlife and Plant Conservation
(DNP)



International Tropical Timber
Organization (ITTO)



Faculty of Forestry Kasetsart
University (KUFF)



Japan International Research Center
For Agricultural Sciences (JIRCAS)



Plant Genetic Conservation
Project Office (ปพ.สอ)



Forest and Forest Products Research
Institute (FFPRI)



Center for Agricultural Biotechnology
(CAB KU Kamphangseang)