Planting Report Conserve Natural Forests For CHANINTR

Introduction

Conserve Natural Forests (CNF) is a non-profit NGO operating primarily in Mae Hong Son and Chiang Mai Provinces of Northern Thailand. Our mission is to restore natural forest landscapes throughout Thailand to optimal structure, functionality, and resiliency in ways that protect and enhance biodiversity, self-regulate landscape ecological functions, and improve the livelihoods of local communities in the long term.

Our main project sites, including our tree nursery and first restoration sites, are situated in an intermontane valley bisected by the Pai River, a major tributary to the Salween River in Myanmar, which provides alluvial deposits rich in clay. Limestone parent material of the Ultisol found in the area provides slightly acidic or even neutral soil pH. Elevation ranges between 460m and 480m and the average annual precipitation is 1,200mm. The area is dominated by a complex mix of dry dipterocarp, mixed deciduous, and semi-evergreen forests depending on soil characteristics and elevation. Major disturbances and drivers of

degradation include fire, logging, shifting agricultural systems, and convective wind storms. Until 2014, the land was primarily cultivated for garlic, rice, and soybean.

Ecosystem Type

Geology, Topography, Soils

The highlands of Northern Thailand are characterized by complex hilly and mountainous terrain ranging from ~200m to 2560m a.s.l., including intermontane basins, alluvial gorges, rolling hills, precipitous mountains, and floodplains near the borders to the east. Situated between the north-south strikes of the Western and Doi Inthanon Thongchai Ranges, much of the bedrock includes metamorphic gneissose granodiorites and marble with overlying sedimentary limestone, dolomite, and sandstone layers resulting from millions of years of marine deposition during the Paleozoic Era (Baum et al 1970). The limestone karst topography – spectacular caves, shafts, and sinkholes – is a prominent feature and major tourist attraction in the area. More research is needed to accurately map soil profiles in these highlands (Figure 1), but the current agreement describes a complex mix composed primarily of Cambisols, Acrisols, and Ferralsols (or Oxisols and Ultisols according to the USDA Soil Classification System) (Heidhues et al 2007). Combined with the underlying limestone, these soils are deep, highly weathered, well-drained, and neutral or alkaline. Soils formed over granitic parent material are more poorly drained, sandy, and acidic. Clay-rich alluvial deposits of Fluvisols or Inceptisols are common in riparian environments.

Climate

Thailand's climate is dominated by the monsoon winds. The southwest monsoon carries a mass of warm moist air from the Indian Ocean to Thailand between mid-May and mid-October, while the northeast monsoon from mainland China brings cold and dry air particularly to the high-latitude and high-altitude northern regions of Thailand. Rainfall decreases with latitude: While the northern region receives approximately 1,200mm – 1,600mm annually, some leeward mountain slopes in the southern peninsula receive in excess of 4,500mm annually. The convergence of the monsoon winds with the Inter-Tropical Convergence Zone (ITCZ) air currents divide the annual climate regime into three seasons:

- **Rainy/Southwest Monsoon Season**: Mid-May to Mid-October. In Northern Thailand the ICTZ often delays the onset of the rainy season to the beginning of June. Mean daily temperature averages 27^{O}C with a mean maximum of 32^{O}C and mean minimum of 24^{O}C (Figure 2). Warm moist air from the southwest creates abundant rainfall - approximately 950mm in Northern Thailand - with the highest concentrations in August and September (Figure 3).
- **Winter/Northeast Monsoon Season**: Mid-October to mid-February. Cold and dry air from the northeast drops temperatures at night in Northern Thailand to near freezing. Mean daily temperature is 23 ^{O}C with a mean maximum of 31^{O}C and a mean minimum of 17.5^{O}C, with some areas at higher elevations reaching <0^{O}C (Figure 2). Less than 100mm of rain can be expected to precipitate over the entire four months, or approximately 25mm/month (Figure 3).
- **Summer/Pre-monsoon Season:** Hot, dry period as the currents transition between the northeast and southwest monsoon winds. Mean daily temperature is 28 ^{O}C with a mean maximum of 36^{O}C and a mean minimum of 22^{O}C (Figure 2). Almost no rain will fall until the middle of May or

beginning of June, with approximately 190mm of rainfall concentrated at the end of the season (Figure 3).

Due to the complex terrain, orographic effects on rainfall, and variations in exposure and aspect along the north-south orientation of the mountains, a myriad of microclimates can deviate substantially from the average climatic regime in the highlands of Northern Thailand. Each restoration site should be carefully assessed to determine its soil type, climate, aspect, and native species composition.

Vegetation Type and Forest Succession

The western spine of Thailand contains the largest remaining tracts of continuous natural forest in the entire country. 54% of the total land cover in the Northern region is forested with a further 26.4% under agricultural cover and the remaining 19.6% unclassified (FAO 2009). According to the relationship between seasonal precipitation and latitude expressed above, the forest type transitions dramatically from everwet and evergreen forests in the southern peninsula to semi-evergreen, mixed deciduous and dry dipterocarp forests in the north (Figure 4).

- **Dry deciduous dipterocarp** forests are dominated primarily by five xerophytic dipterocarp species – *Dipterocarpus intricatus, D. obtusifolius, D. tuberculatus, Shorea obtusa*, and *S. siamensis* – which dominate up to 45% of forest area, more than half of all trees, and up to two-thirds of the total basal area (Ghazoul 2016). These forests are normally found between 200m and 1300m a.s.l. in areas with poor, sandy soil and annual precipitation between 1,000mm and 1,500mm, although they can succeed with precipitation as low as 650mm/yr (Simitimand 1970; Ghazoul 2016; Marod et al 2019). Other species include leguminous *Dalbergia, Azfalia, Pterocarpus, and Xylia* (Ghazoul 2016).
- At higher elevations, **semi-evergreen forests** are composed primarily of Fagaceae oaks (*Quercus spp.*) and chestnuts with the undergrowth comprising mainly of bamboo and rattan (FAO 2009; Marod et al 2019). Moss and lichens are characteristic of this forest type. Increasing latitude lowers the elevational transition zone between dipterocarp- and oak-dominated forests (Ghazoul 2016).
- **Mixed deciduous forests** are the most commercially valuable (and most threatened) forest type in Thailand, historically dominated by teak (*Tectona grandis*) and Siamese or Burmese rosewood (*Dalbergia spp*.) (Marod et al 1999). Undergrowth is dominated by bamboo and rattan. They can be found in intermontane valleys, along riparian corridors and on gentle slopes up to 800m a.s.l (FAO 2009, Marod et al 1999). Many of these tree species lose their leaves during the dry winter season (normally in January) (Bunyavejchewin 1983).

These forest types and the ecotones that mark their transitions are determined mainly by elevation and soil type. Lower elevations and poor, sandy soils are dominated by large dipterocarps (up to 45m in height). Mixed deciduous forests are smaller (25 – 30m) with open canopies and dense undergrowth, while semi-evergreen oak forests at high elevations are often closed canopy with lighter undergrowth.

Disturbance Regimes

Much more research is needed to understand the natural disturbance regime in Northern Thai forests. A study by Baker et al found evidence that prolonged drought and widespread fires have contributed to significant die-back in the past while convective wind storms and herbivory drive gap dynamics today (Baker et al 2005). Most chronic disturbances are attributed to anthropogenic causes, including induced fires with shifting and stationary slash-and-burn agriculture (Baker et al 2005; Heidhues et al 2007; Hermhuk 2019).

Conservation Value

While not as charismatic or as biodiverse as the tropical everwet forests to the south, the dry forests of Northern Thailand provide unique refugia to a myriad of threatened flora and fauna. Megafauna like the Asian elephant (*Elephas maximus*) and the Asiatic tiger (*Panthera tigris*) depend on the open savannah-like structure of the dry forests to migrate and forage (Sukumar 2006; DNP 2010). Elephants are a keystone species in dry forest ecosystems and contribute to forest health through nutrient cycling, seed dispersal, and gap dynamics (Sukumar 2006; Fernando et al 2011; McConckey et al 2018). Due to habitat loss and fragmentation, the wild elephant population in Thailand has been reduced by over 95% in the last 120 years from more than 100,000 to less than 5,000 individuals (Sukumar 2006).

One study in nearby Doi Inthanon National Park found over 165 tree species of 118 genera and 59 families spread over a 3 ha permanent plot (Marod et al 2019). In Mae Hong Son Province, *Ficus* species found in riparian areas stabilize streambanks, minimize erosion, purify the water, and mitigate flooding during the wet season (Pothasin et al 2014). Complex rooting systems in natural tropical forests have been found to minimize the risk of destructive landslides during the monsoon season. Teak, rosewood, bamboo, and rattan are a small sample of tree species that provide an array of timber and NTFPs – medicines, food, construction material, fuelwood, etc – that benefit local communities and contribute to the local economy (FAO 2009). Additionally, the Northern Highland forests of Thailand are the ancestral homeland of an estimated 1 million households living within and benefitting from these forests (RECOFTC 2014).

Clearly, natural forest restoration must be planned to restore degraded landscapes to their full potential, restore a broad swath of ecosystem services, and to meet the needs of both the animal species that regulate these ecosystems as well as the diverse communities of people who are embedded in the landscape.

Degradation

Intensive state-directed logging during the 20th century exceeded 1.4% forest cover annually and reduced Thailand's forests by over 50% between 1961 and 1994 (FAO 2009). From a historical high over >80% forest cover, by the late 1990s Thailand's remaining forest was fragmented over <20% of the total land cover (Ibid). In the Northern region, teak and rosewood, once the dominant canopy trees in mixed-deciduous forests, were highly valued and heavily reduced during this time (Marod et al 1999). Other than historical logging, the other main drivers of deforestation and land degradation in the

northern provinces include population growth, the relocation of settlements, land conversation to agriculture, and the decrease of fallow periods related to increased production (Fukushima 2008; Hermhuk 2019). In 1989, after a series of highly destructive landslides in southern Thailand that were attributed to deforestation and shallow-rooted rubber plantations, the government implemented an extensive protected area system and became one of the first nations in the world to ban logging entirely (FAO 2009). However, while species richness has improved in many protected areas, species composition and late-successional forest structure may take hundreds of years to recover without assistance (Derroriere 2016).

Another driver of deforestation and forest degradation highlighted by the Thai government is swidden agriculture, common to several indigenous peoples inhabiting the northern provinces. Recent literature suggests that like other agricultural styles, the level of degradation depends on management practices (Schmidt-Vogt 1998; Fukushima 2008). Fukushima distinguishes between "established" and "pioneer" swidden agriculture based on whether or not root stocks and seed banks are preserved, how much forest is cleared, how long the land is cultivated, and soil conditions before/after use. In summary:

- **Established swidden** normally leaves the tree stumps, root stocks, and seed bank intact, clears small areas (~1 ha), and cultivates for 1-3 years before moving on to a new area. The soil is relatively intact afterward and multiple regeneration pathways - resprouting, seed banks, advance regeneration, animal dispersal, etc - enable swift restoration within 10 or 20 years.
- **Pioneer swidden**, mainly employed for cultivating poppy, clears much larger areas of land (5-15 ha), strips the soil, the stumps, and the root stocks, cultivates until the soil is exhausted, and move on. The only reliable regenerative pathway left is seed rain from surrounding forest, so regeneration takes much longer (if it occurs at all).

Rather than swidden agriculture practiced by the Karen, Lawa, Lisu, and other indigenous hill tribes, most recent literature points to land development and agricultural subsidies spearheaded by the Thai government as the primary drivers of land degradation today. The strict governance of protected areas combined with increasing population density and government-sponsored crop subsidies have transitioned land-use from shifting to stationary and shortened fallow periods, increased the use of pesticides, encouraged massive seasonal fires to reduce labor inputs, and promoted maize, soybean, garlic, and rice rotations year-round. (Heidhues et al 2007; FAO 2009; Fukushima 2008; Hermhuk 2019). Also, the longstanding practice of prescribed ground fires to encourage germination and re-sprouting of certain edible mushrooms, bamboo, and rattan have the potential to arrest regeneration and suppress understory growth and diversification (Fukushima 2008).

Regeneration Potential

The regeneration potential of our restoration sites depends heavily on the project site history. Some secondary forests merely require enrichment planting and selective thinning to encourage native species composition and structure, while sites acquired from abandoned agricultural land – usually soybean and garlic – often involve intensive site rehabilitation. This includes assisted natural regeneration techniques like weeding and mulching, fertilizer inputs, irrigation, the careful selection of hardy, drought-resistant, and nitrogen-fixing pioneer species.

CNF uses the Framework Species Method approach to forest restoration. This involves planting a mix of 25 – 30 native species with a variety of life history traits and growth strategies, including pioneers, late-

successional species, and fruiting trees to attract seed dispersers from surrounding native forest. Ideally, after a few years the pioneers will shade out the weeds and encourage the growth of planted shade-tolerants, and the fruiting and flowering trees will attract pollinators and seed dispersers to enrich the biodiversity of our artificially regenerated forests. After 2 – 5 years of maintenance, depending on the site degradation level, the forest should begin to self-regulate (See Figure 5 for a list of successional framework species).

After 10 – 30 years of intensive cultivation and prescribed burning, some of our sites are completely exhausted. Regeneration potential has been arrested and requires significant intervention to resume track. We strategically select our sites near existing secondary forest to provide seed rain and seed dispersers in areas where root stocks and the seed bank have been destroyed by intensive agriculture. In other areas where we are encouraging teak and rosewood to succeed in degraded forests, we might use selective thinning techniques to open the canopy and encourage advanced regeneration release. Areas with recently cut stumps or moderately disturbed soils are left to regenerate naturally from the root stocks and seed banks. In all areas, it may be necessary to test the trade-offs of prescribed fires between seed germination, seedling suppression, and the dangerous overgrowth of understory fuel to develop best management practices.

Figures

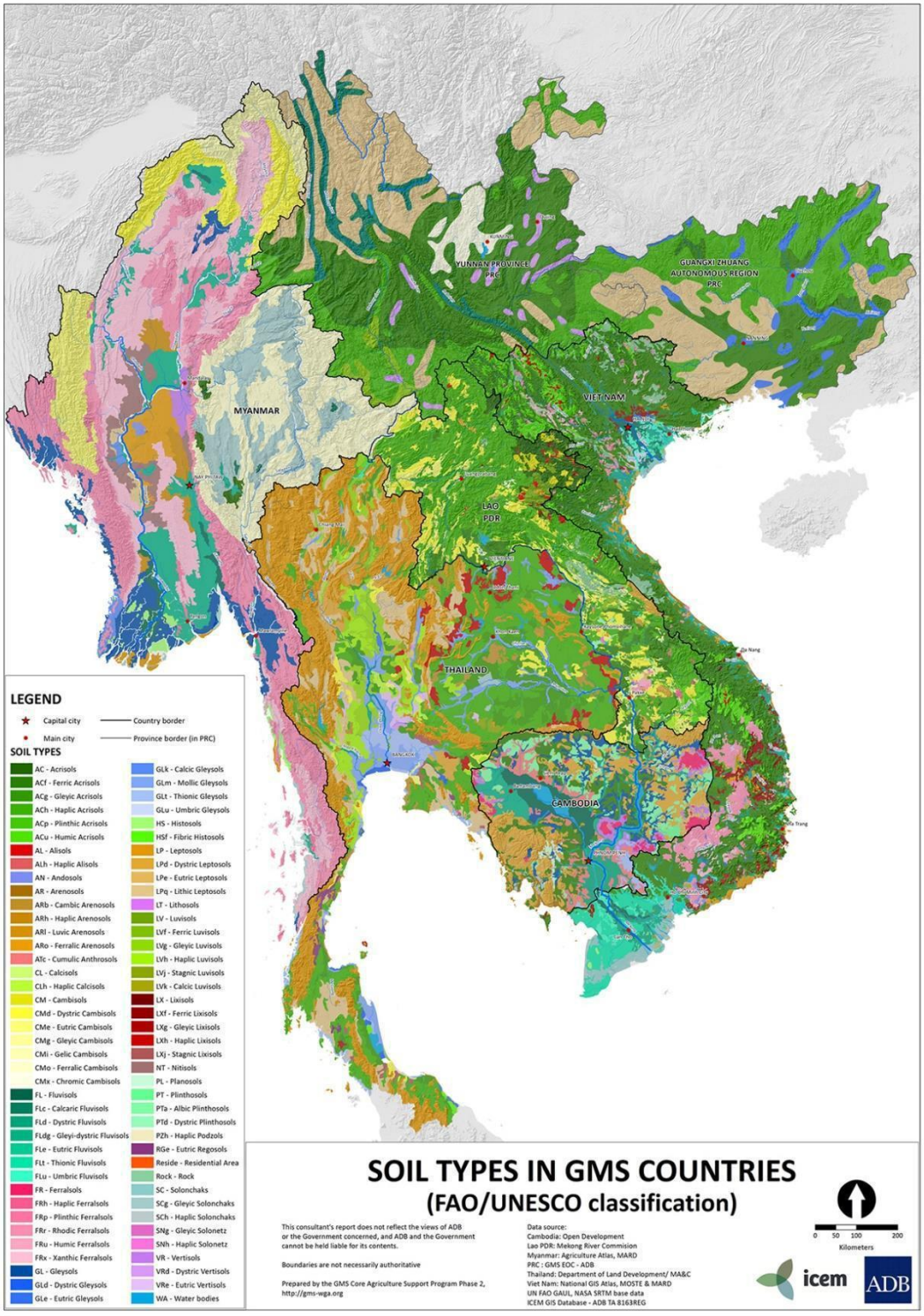

Figure 1 Soil Map of Thailand (ICEM 2015)

Seasonal temperatures (°C) in various parts of Thailand

Temperature	Region	Winter	Summer	Rainy
Mean	North	23.4	28.1	27.3
	Northeast	24.2	28.6	27.6
	Central	26.2	29.7	28.2
	East	26.7	29.1	28.3
	South			
	- East Coast	26.3	28.2	27.8
	- West Coast	27.0	28.4	27.5
Mean maximum	North	31.1	36.1	32.4
	Northeast	30.6	35.2	32.6
	Central	32.3	36.2	33.4
	East	32.0	34.1	32.3
	South			
	- East Coast	30.4	33.0	32.7
	- West Coast	32.0	34.1	31.6
Mean Minimum	North	17.5	21.8	23.8
	Northeast	18.7	23.2	24.4
	Central	21.2	24.6	24.8
	East	22.3	25.2	25.2
	South			
	- East Coast	22.8	24.1	24.4
	- West Coast	23.2	24.0	24.3

Based on 1981-2010 period

Figure 2. Average Temperature Thailand (Thai Meteorological Department 2011)

Seasonal rainfall (mm) in various parts of Thailand

Region	Winter	Summer	Rainy	Annual rainy days
North	100.4	187.3	943.2	122
Northeast	76.3	224.4	1,103.8	116
Central	127.3	205.4	942.5	116
East	178.4	277.3	1,433.2	130
South				
- East Coast	827.9	229.0	680.0	145
- West Coast	464.6	411.3	1,841.3	178

Based on 1981-2010 period

Figure 3. Seasonal Rainfall (Thai Meteorological Department 2011)

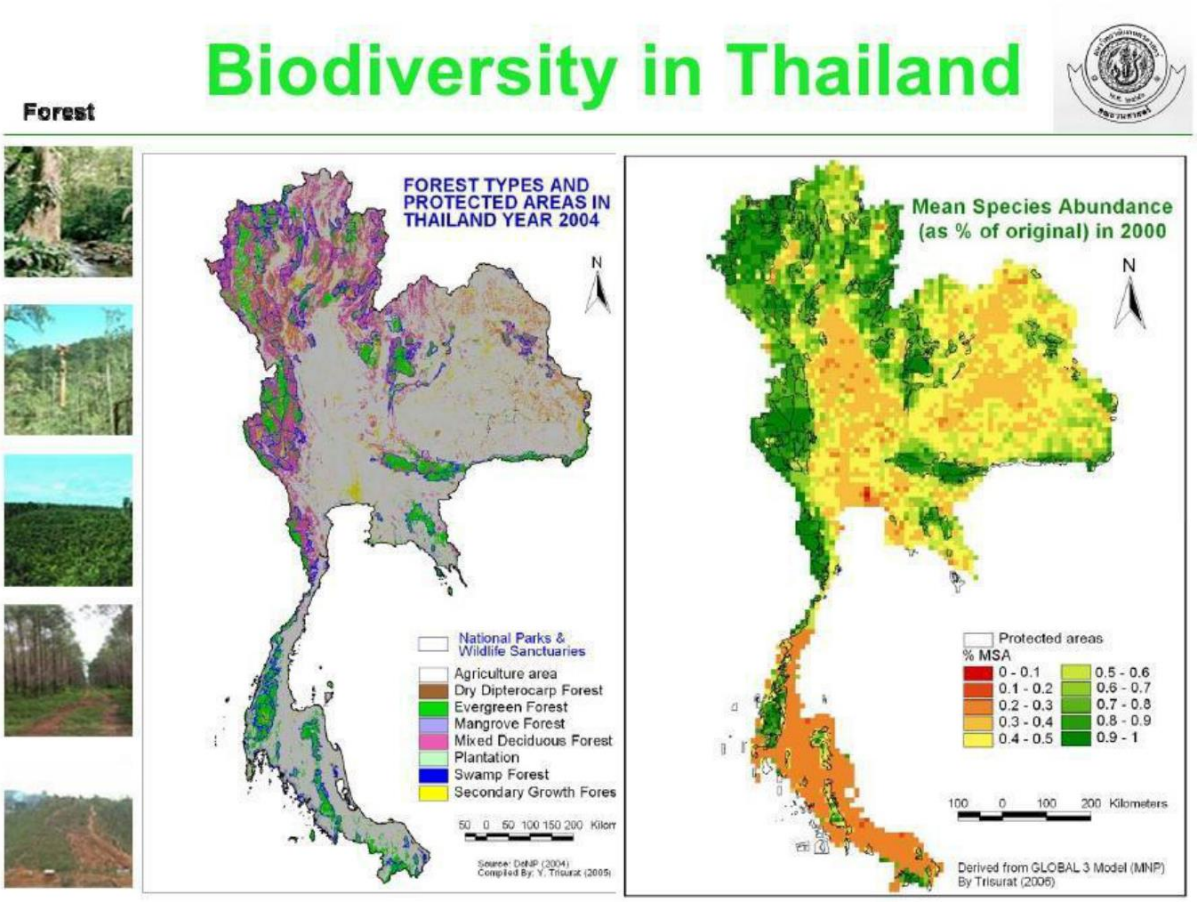

Figure 4. Forest Type and Biodiversity of Thailand (Trisurat 2005)

Table 6
Summary of framework species classification based on field performance (E, excellent; A, acceptable; M, marginal; U, unacceptable and R, rejected)

Tree species	Survival[a]	Growth[b]	Crown width[c]	Weed suppression[d]	Fire resilience[a]	Overall classification
A. fraxinifolius Wight ex Arn.	U	E	E	E	E	A
A. lawii (Wight) Sald. and Rama.	A	U	U	U	–	R
B. javanica Bl.	E	U	U	M	E	M
B. baccata (Roxb.) Ess.	M	E	E	E	U	A
C. arborea Roxb. var. *arborea*	U	U	U	A	–	R
C. acuminatissima (Bl.) A. DC.	A	M	M	E	A	A
C. caudatum Nees	U	U	M	E	A	R
D. glandulosa Lace	U	M	U	U	–	R
E. subumbrans (Hassk.) Merr.	E	E	E	E	U	E
F. altissima Bl.	E	U	U	A	E	A
F. benjamina L. var. *benjamina*	E	U	U	A	M	A
F. glaberrima Bl. var. *glaberrima*	E	U	M	E	A	A
F. heteropleura Bl. var. *heteropleura*	A	U	U	E	M	M
F. hispida L. f. var. *hispida*	E	A	M	E	E	E
F. racemosa L. var. *racemosa*	E	M	M	E	E	A
F. subulata Bl. var. *subulata*	E	U	M	E	–	A
G. kerrii Craib	M	U	U	E	E	A
G. arborea Roxb.	E	A	A	E	E	E
H. nilagirica Bedd.	E	U	U	M	–	R
H. trijuga Roxb. ex Sims	E	U	U	E	A	A
H. thorelii Lec.	U	U	U	E	U	R
H. dulcis Thunb.	E	E	M	E	E	E
L. fenestratus (Roxb.) Rehd.	U	U	U	E	A	R
M. denticulata (Bl.) M.-A.	U	E	E	E	A	A
M. bombycina King ex Hk.f.	A	A	M	A	E	A
M. garrettii Craib	M	M	M	A	–	M
M. toosendan Sieb. and Zucc.	E	E	E	E	E	E
M. baillonii Pierre	A	E	A	E	E	E
N. javanica (Bl.) Wang.	A	E	A	A	M	A
P. cathia (D. Don) Kosterm.	U	U	U	E	A	R
P. cerasoides D. Don	E	E	E	E	A	E
P. macrocarpus Kurz	M	U	U	E	U	R
Q. semiserrata Roxb.	E	U	U	E	U	M
R. rhetsoides Craib	E	E	M	E	E	E
S. rarak DC.	E	M	U	E	E	A
S. arboreum Bth.	E	U	M	A	E	A
S. axillaris Roxb.	E	E	E	A	E	E

Figure 5. Framework Species Performance (Elliott et al 2003)

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Information gaps

More research is required to understand the microsite conditions that promote different successional trajectories in the dry forests of Thailand. Most detailed life history traits are limited to economically valuable species like teak or rosewood – a more thorough understanding of ecosystem functioning and the supporting role of biodiversity is necessary for sustainable and safe intervention. An honest accounting of both natural degradation regimes and the role of indigenous people, other local communities, and the government is required to mitigate the primary drivers of deforestation and forest degradation.

Restoration Sites:

Community forest Baan Teen tart

GPS: GPS: 19.31126° N, 98.43312° E
Size: 60,000 square meter, 6 hectare
Planting days: 4-9 June 2021
11-13 June 2021
Total number of planted trees: 50,010 trees

1. Tectona grandis / Teak: 10,000
2. Bauhinia purpurea / Orchid tree: 5,800
3. Syzygium cumini / Black Plum: 4,800
4. Delonix regia / Flamboyant: 4,700
5. Albizia saman / Samanea saman / Rain Tree: 3,900
6. Albizia lebbeck / siris tree:3,800
7. Terminalia Catappa / Beach Almond: 2,600
8. Tamarindus indica / Tamarind: 2,300
9. Yellow India / Golden Trumpet Tree: 2,200
10. Dipterocarpus alatus Roxb.: 2,000
11. Dalbergia cochinchinensis / Siamese Rosewood / Thai Rosewood: 1,900

12. Afzelia xyloarpa / Makha: 1,600
13. Millingtonia hortensis / Indian Cork Tree : 1,000
14. Sesbania grandiflora / Vegetable Hummingbird: 900
15. Cassia fistula / Golden Shower: 500
16. Murraya siamensis Craib. / Andaman satinwood： 500
17. Pachira aquatica / Malabar Chestnut : 400
18. Xylia xylocarpa/ Ironwood:400
19. Dalbergia oliveri / Burmese Rosewood : 200
20. Canarium pimela / Chinese Black Olive :200
21. Tecoma stans / Yellow Elder / Trumpet Flower : 100
22. Morus nigra / Black Mulberry: 100
23. Artocarpus heterophyllus / Jackfruit: 100
24. Terminalia ivorensis A.Chev / Black afara : 10


Tiger


adidas
Tiger

Albizia lebbeck

Common name: Siris Tree
Pruek
พฤกษ์

Siris Tree is growing to a height of 18 - 30 m tall. In the West Indies and certain parts of South America this tree is known as a 'Shak Shak Tree' because of the sound the seeds make in the pod. In Tamil Nadu, the tree is known as 'vaagai' as the ancient kings of the Sangam Age had worn the garland made by this flower whenever they win battles. Similarly, 'vaagai' means 'victory' in Tamil. Its uses include environmental management, forage, medicine and wood.

Tamarindus indica

Common name: Tamarind

Ma-kham

มะขาม

Family:	Fabaceae
Framework Class:	Climax
Origin:	Exotic; from tropical Africa; cultivated in the Indian subcontinent
Seasonality:	Evergreen; but deciduous in drier regions
USDA Hardiness Scale:	10 - 12
Sun exposure:	Full
Height:	12 - 30 m
Growth:	Slow
Soil condition:	Well-drained deep alluvial soils
Soil type:	Sand, Loam, Clay
Soil pH:	Neutral; pH 5.5 - 6.5; tolerates very acidic to alkaline
Altitude:	0 - 1500 m
Mean annual rainfall:	350 - 2700 mm; tolerates 300 - 4500 mm
Mean annual temperature:	20 - 33 °C
Drought tolerance:	Yes
Cold tolerance:	No
Advantages:	Nitrogen-fixer, Extensive root system, tolerant to wind
Use:	Medicinal use: fruit applied to forehead to reduce fever Wood: durable in decay resistance and resistant to insects; furniture, carvings, eg. mortar and pestles, chopping blocks Fruit pulp used to polish brass shrine statues and other copper
Additional info:	Trees commence bearing fruit at 7 – 10 years of age Can continue yielding for 200 years
Cultivation techniques:	Soak the seed for 24 h in warm water before sowing 90 % germination achieved in 40 - 50 days Germination best when seeds covered by 1,5 cm loose sandy Loam

Name:	**Vegetable Hummingbird** *Sesbania grandiflora* ต้นแค Ton Keeh
Family:	Fabaceae
Framework Class:	Pioneer
Origin:	Exotic; from Malaysia, Brunei, Philippines
Seasonality:	Deciduous
USDA Hardiness Scale:	9 - 12
Sun exposure:	Full
Height:	8 - 15 m
Growth:	Fast
Soil condition:	Moist, well-drained
Soil type:	Sand, Loam, Clay
Soil pH:	Neutral; pH 5.5 - 8.5; tolerates acidic pH 4.5
Altitude:	0 - 1000 m
Mean annual rainfall:	2000 - 4000 mm; tolerates 800 mm
Mean annual temperature:	22 - 30 °C
Drought tolerance:	Yes
Cold tolerance:	No
Advantages:	Attracts birds Ideal for rehabilitating eroded hills Nitrogen-fixer: but may be suppressed by nematodes or high acidity of the soil Soil improver: fruits, falling leaflets and flowers make excellent green mulch and improves soil fertility
Use:	Medicinal use: crushed leaves are applied to sprains and bruises; root as medicine for malaria Edible leaves, flowers, seeds; raw flowers as a salad Wood: from 5 – 8 year-old trees can be used in house construction; trunk used for poles but may not last long due to insect infestation Ornamental use
Additional info:	Life span 20 years
Cultivation techniques:	Hard seedcoat: pour a small amount of nearly boiling water on the seeds and soak them in warm water for 12 - 24 h



Name:	***Tectona grandis***
	Teak
	ต้นสัก (ต้นสักทอง)
	Ton Sak Ton Sak Thong
Family:	Lamiaceae
Framework Class:	Pioneer
Origin:	Native
Seasonality:	Deciduous
USDA Hardiness Scale:	10 - 12
Sun exposure:	Full
Height:	< 40 m
Growth:	Fast
Soil condition:	Deep, well-drained, alluvial soils derived from limestone, schist, gneiss, shale
Soil type:	Sand, Loam, Clay
Soil pH:	Acidic, Neutral, Alkaline; pH 6 - 7.5; tolerates pH 4.5 - 8.5
Altitude:	0 - 1200 m
Mean annual rainfall:	1200 - 2500 mm; tolerates 600 - 4000 mm
Mean annual temperature:	12 - 36 °C
Drought tolerance:	Yes
Cold tolerance:	No
Advantages:	Attracts bees (Pollinators mainly small carpenter bees (Ceratina))
Use:	Wood: valued for its durability and water resistance, termite and fungus Resistant Used for boat building, exterior construction, furniture
Additional info:	Flowering Jun – Aug
Cultivation techniques:	Seeds germinate best if stored for 12 months Scarification of fresh seeds by alternately wetting and drying the seeds for 12 h intervals over a period of 10 - 14 days; Soak seeds in warm water 12 - 24 h before sowing; Char bottom of seeds by placing on grass and lighting on fire Germination after 2 - 4 weeks; Germination rate: 30 - 50 %; up to 80%; Flowering starts at the age of 8 - 10 years (in Thailand)




Name:	***Syzygium cumini*** *Black Plum / Java Plum / Jambolan* ต้นหว้า Ton Wah
Family:	Myrtaceae
Framework Class:	Pioneer / Fruiting
Origin:	Native
Seasonality:	Evergreen
USDA Hardiness Scale:	8 - 12
Sun exposure:	Full; young plants partial shade
Height:	10 - 30 m
Growth:	Fast
Soil condition:	Well-drained soil; salinity, waterlogged conditions
Soil type:	Sand, Loam, Clay
Soil pH:	Acidic, Neutral, Alkaline; can grow in very acidic soil
Altitude:	0 - 1800 m; no fruiting over 600 m
Mean annual rainfall:	900 - 1200 mm
Mean annual temperature:	25 - 27 °C; tolerates -2 - 48 °C
Drought tolerance:	Yes
Cold tolerance:	Yes
Advantages:	Attracts birds, bats, bees Fire resistant Tolerant to strong winds
Use:	Ornamental use Wood: water resistant, used in railway sleepers and to install motors in wells Fruits: used to make wine and vinegar Medicinal use: seeds to treat diabetes
Additional info:	Lives more than 100 years Flowering March - April Fruiting May - June
Cultivation techniques:	Moist soil more important than sunlight for seedlings; can't compete with weedy areas if there is frost



Name:	***Artocarpus heterophyllus*** *Jackfruit* ต้นขนุน Kanoon
Family:	Moraceae
Framework Class:	Pioneer / Fruiting
Origin:	Native
Seasonality:	Evergreen
USDA Hardiness Scale:	10 - 12
Sun exposure:	Full; seedlings best grown in 30 - 50% sunlight
Height:	8 - 25 m; 1,5m/y for the first few years; after that 30 – 60 cm/y
Growth:	Fast
Soil condition:	Moist, well-drained soil
Soil type:	Sandy, Loam, Clay
Soil pH:	Acidic, Neutral, Alkaline; can grow in very alkaline soil
Altitude:	450 - 1200 m; best below 1000 m
Mean annual rainfall:	900 - 4000 mm; prefers short dry season
Mean annual temperature:	24 - 28 °C
Drought tolerance:	No
Cold tolerance:	No
Advantages:	Highly wind tolerant, therefore used for windbreak or border planting
Use:	Edible fruit and seeds Medicinal use: ashes of leaves, roots, fruit and seeds Wide-ranging root system: to control floods and soil erosion Used as shade trees Wood: resistant to termite attack and fungal / bacterial decay; for furniture, construction, musical instruments Roots: for carvings
Additional info:	Largest tree-borne fruit up to 55 kg Mature jackfruit tree can produce about 100 - 200 fruits in a year
Cultivation techniques:	Seeds lose viability quickly and should be sown as soon as possible; germination begins within 10 days; best between 24 - 27 °C; seedlings form taproot and should be moved to permanent site quickly

Name:	**Flamboyant** *Delonix regia* ต้นหางนกยูง Haang Nok Yung
Family:	Fabaceae
Framework Class:	Pioneer / Flowering
Origin:	Exotic; from Madagascar and Zambia
Seasonality:	Usually evergreen; deciduous with long dry season
USDA Hardiness Scale:	10 - 12
Sun exposure:	Full
Height:	10 - 18 m
Growth:	Fast
Soil condition:	Draining soil
Soil type:	Sand, Loam
Soil pH:	Acidic, Neutral, Alkaline
Altitude:	0 - 2000 m
Mean annual rainfall:	700 - 1200 mm
Mean annual temperature:	14 - 26 °C
Drought tolerance:	Yes
Cold tolerance:	No
Advantages:	Nitrogen-fixer (for soil rehabilitation, improvement) Erosion control Attracts birds, bees, butterflies Tolerates salty conditions Provides shade
Use:	Ornamental use Medicinal use: to treat inflammation, diabetes, malaria Wood: soft, heavy, weak wood; resistant to moisture and insects but prone to attacks by dry-wood termites
Additional info:	Flowering season: April – May No serious insect or disease problems Flowering starts in its 4th or 5th year Shallow-rooted, competes with other seedlings
Cultivation techniques:	Hard seedcoat: scarify with near-boiling water, soak in warm water for 12 - 24 h; germinates in 5 - 10 days, up to 90% success; nursery for 3 - 5 months; plant during rainy season



Name:	**Rain Tree** *Albizia saman / Samanea saman* ต้นจามจุรี ก้ามปู Chamchurri Kam Poh
Family:	Fabaceae
Framework Class:	Pioneer
Origin:	Exotic; from Central America, Northern South America
Seasonality:	Deciduous
USDA Hardiness Scale:	10 - 12
Sun exposure:	Full
Height:	25 - 30 m
Growth:	Fast
Soil condition:	Dry moist or wet soil
Soil type:	Sand, Loam, Clay
Soil pH:	Neutral, moderately acidic
Altitude:	0 - 1300 m
Mean annual rainfall:	600 - 3000 mm
Mean annual temperature:	20 - 35 °C
Drought tolerance:	Yes
Cold tolerance:	No
Advantages:	Nitrogen-fixer Produces a lot of seeds, therefore natural regeneration is quite dependable
Use:	Wood: furniture and carvings Medicinal use Ornamental use Used as shade
Additional info:	Leaflets close together on cloudy days, allowing rain to fall through the canopy to the ground, therefore the grass is greener around a rain tree than the surrounding grass Flowering season: Feb-May and Sep-Nov (in Thailand)
Cultivation techniques:	Trees are planted at a spacing of 1.5 - 2 m Fresh seeds that are still moist usually germinate freely without pre-treatment Once the seedcoat has dried and hardened it needs a nick in the seedcoat or needs to be soaked in hot water for 3 minutes In either case, the seed is then soaked for 12 - 24 h in warm water before sowing Treated seeds usually germinate in 6 - 8 days under optimal conditions



Name:	**Siamese Rosewood / Thai Rosewood** *Dalbergia cochinchinensis* ต้นพะยูง Pha Yoong
Family:	Fabaceae (Leguminosae)
Framework Class:	Climax
Origin:	Native
Seasonality:	Evergreen
USDA Hardiness Scale:	10 - 12
Sun exposure:	Full; young plants partial shade
Height:	20 - 30 m
Growth:	Slow
Soil condition:	No special demands; deep, calcareous, well-drained soil
Soil type:	Sand, Loam, Clay
Soil pH:	Acidic, Neutral, Alkaline
Altitude:	400 - 500 m
Mean annual rainfall:	1200 - 1650 mm
Mean annual temperature:	20 - 32 °C
Drought tolerance:	Yes
Cold tolerance:	No
Advantages:	Nitrogen-fixer Flower attracts mainly insects
Use:	Wood: durable, resistant to insects; furniture, wood carvings, musical Instruments, boat building Ornamental use: cut wood releases a rose-like fragrance
Additional info:	Vulnerable species due to overexploitation, illegal logging It was once more expensive than gold in the Chinese black market
Cultivation techniques:	Hard seedcoat: pour a small amount of nearly boiling water on the seeds and soak them in warm water for 12 - 24 h; if not swollen by this time, make a nick in the seedcoat and soak for another 12 h before sowing

Name:	***Afzelia xyloarpa*** *Makha* ต้นมะค่า Ma Kah
Family:	Fabaceae
Framework Class:	Climax
Origin:	Native
Seasonality:	Deciduous
USDA Hardiness Scale:	10 - 12
Sun exposure:	Full; young plants prefer shade but become intolerant of shade as they grow
Height:	15 - 30 m
Growth:	Medium
Soil condition:	Moist soil
Soil type:	Sand, Loam, Clay
Soil pH:	Neutral
Altitude:	100 - 650 m
Mean annual rainfall:	1000 - 1500 mm; dry season 5 - 6 months
Mean annual temperature:	20 - 32 °C
Drought tolerance:	Yes
Cold tolerance:	No
Advantages:	Nitrogen-fixer
Use:	Medicinal use: seeds Seed pulp: used to make cigarettes Wood: ornamental woodturning, pens, knives, carvings, musical instruments
Additional info:	Status: endangered (IUCN Red List of Threatened Plants Status)
Cultivation techniques:	Hard seedcoat: scarification by boiling may not work; aril around seed must be removed to promote germination; soak 12 h before sowing

Name:	***Morus nigra*** *Black Mulberry* ลูกหม่อน Luug Mon
Family:	Moraceae
Framework Class:	Fruiting
Origin:	Exotic; native to W. Asia
Seasonality:	Deciduous
USDA Hardiness Scale:	5 - 9
Sun exposure:	Full; partial shade
Height:	10 - 20 m
Growth:	Slow
Soil condition:	Deep, alluvial soil
Soil type:	Sand, Loam, Clay
Soil pH:	Acidic, Neutral, Alkaline; pH 6.0 - 7.5
Altitude:	0 - 3300 m
Mean annual rainfall:	1500 - 2500 mm
Mean annual temperature:	No data
Drought tolerance:	Yes
Cold tolerance:	Yes
Advantages:	No data
Use:	Leaves: feedstock for silkworms, food for livestock and tea Edible fruit (dried or made into wine) Medicinal use Ornamental use Fibrous bark; used for clothing and
Additional info:	Short lived (comparable with human lifespan but some specimens up to 250 years old) Berries are poisonous when unripe Notable for the rapid release of its pollen – movement is approximately 560 km/h = fastest known movement in the plant kingdom
Cultivation techniques:	2 - 3 months cold stratification; plant in late spring

Name:	**Yellow India / Golden Trumpet Tree** *Tabebuia chrysantha* ต้นเหลืองอินเดีย Luang India
Family:	Bignoniaceae
Framework Class:	Climax
Origin:	Exotic; from Central America and northern South America
Seasonality:	Deciduous
USDA Hardiness Scale:	10 - 13
Sun exposure:	Full
Height:	6 - 15 m
Growth:	Slow
Soil condition:	No data
Soil type:	Sand; tolerates Loam, Clay
Soil pH:	Acidic, Neutral; pH 5.5 - 8
Altitude:	No data
Mean annual rainfall:	No data
Mean annual temperature:	No data
Drought tolerance:	No
Cold tolerance:	No
Advantages:	No data
Use:	Ornamental use
Additional info:	No data
Cultivation techniques:	Seeds will readily germinate if planted as soon as the pods crack open Semi-ripe stem cutting can be rooted Best results obtained with bottom heat

Beach Almond

Terminalia Catappa

Sa-mho-phi-phek

สมอพิเภก

The tree grows to 35 m tall, with an upright, symmetrical crown and horizontal branches. Terminalia catappa has corky, light fruit that are dispersed by water. The seed within the fruit is edible when fully ripe, tasting almost like almond. They are dry-season deciduous. Due to this chemical richness, the leaves (and the bark) are used in different herbal medicines for various purposes.

Name:	**Yellow Elder / Trumpet Flower** *Tecoma stans* ต้นทองอุไร Tong U Rai
Family:	Bignoniaceae
Framework Class:	Pioneer
Origin:	Exotic; from Southern USA, Mexico, Caribbean, Peru, Ecuador
Seasonality:	Evergreen
USDA Hardiness Scale:	8 - 15
Sun exposure:	Full
Height:	5 - 8 m
Growth:	Fast
Soil condition:	Well-drained soil
Soil type:	Loam; tolerates most types of fertile soils
Soil pH:	Alkaline; pH 6 - 8.5; tolerates pH 5.5 - 9
Altitude:	0 - 2000 m
Mean annual rainfall:	600 - 1100 mm
Mean annual temperature:	20 - 32 °C
Drought tolerance:	Yes
Cold tolerance:	No
Advantages:	Attracts bees, butterflies, hummingbirds
Use:	Ornamental use Medicinal use: to treat diabetes, stomach pain and intestinal worms Wood: very durable, used in cabinet making, turnery, tools, construction of buildings
Cultivation techniques:	Seedlings require 3 - 4 months in nursery Regeneration by cuttings is possible

Name:	**Burmese Rosewood** *Dalbergia oliveri* ต้นประดู่ Ton Padu
Family:	Fabaceae (Leguminosae)
Framework Class:	Climax
Origin:	Native
Seasonality:	Deciduous
USDA Hardiness Scale:	10 - 12
Sun exposure:	Full; young plants partial shade
Height:	15 - 30 m
Growth:	Slow
Soil condition:	Moist, well-drained soil
Soil type:	Sand, Loam, Clay
Soil pH:	Acidic, Neutral, Alkaline
Altitude:	0 - 1200 m
Mean annual rainfall:	No data
Mean annual temperature:	No data
Drought tolerance:	No data
Cold tolerance:	Moderate
Advantages:	Flowers attract insects
Use:	Ornamental use Wood: hard, heavy and resistant to the attacks of termites; furniture
Additional info:	Small white-purple flowers Endangered due to overexploitation
Cultivation techniques:	Hard seedcoat: pour a small amount of nearly boiling water on the seeds and soak them in warm water for 12 - 24 h If not swollen by this time, make a nick in the seedcoat and soak for another 12 h before sowing

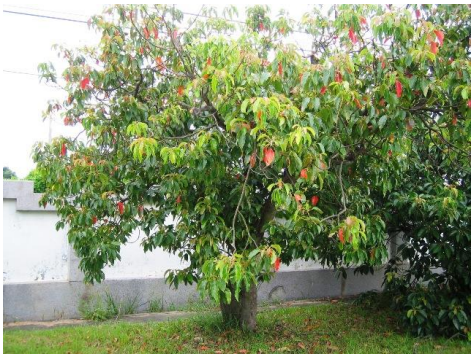
Name:	**Indian Cork Tree** *Millingtonia hortensis* ต้นปีป กาสะลอง Ton Pip Gah Sa Long
Family:	Bignoniaceae
Framework Class:	Pioneer / Flowering
Origin:	Exotic; from Burma, India
Seasonality:	Deciduous
USDA Hardiness Scale:	11 - 13
Sun exposure:	Full
Height:	18 - 25 m
Growth:	Fast
Soil condition:	No data
Soil type:	Loam
Soil pH:	Alkaline
Altitude:	500 - 1200 m
Mean annual rainfall:	No data
Mean annual temperature:	No data
Drought tolerance:	Yes
Cold tolerance:	No
Advantages:	No data
Use:	Medicinal use: antifungal, antioxidant, antibacterial, larvicidal, antimutagenic, antiproliferative; leaves and roots as antiasthmatic and antimicrobial Wood: as timber Bark: inferior substitute for cork Ornamental use
Additional info:	Lives to up to 50 years White flowers, flowers at night and sheds flowers early in the morning
Cultivation techniques:	No data



Canarium pimela

Common name : Chinese Black Olive

หนำเลียบ



Chinese Black Olive trees are planted in Vietnam, Japan, Malaysia, etc besides China. The native habitat is in 22°N-26°N. An annual average temperature of 20-22° C is needed, with a rainfall of 1200-1400 mm. It is cold sensitive and does not withstand sub-zero temperature.

Description

Tree, 10-18 m high, trunk and branch with aromatic resin, odd-pinnate compound leaf, alternate; leaflet with petiolule, opposite, entire, papyraceous to coriaceous; slightly concave reticulate veins giving a special smell while twisted; floret unisexual or polygamous; staminate inflorescence thyrsoid, pistillate inflorescence racemose, inflorescences terminal or axillary, corolla white to yellowish white.

Chinese Olives are native to Subtropical Asia and Africa. They are cultivated throughout greater China, Vietnam, Japan and Malaysia. They require warm summers, consistent rainfall, the trees are very cold sensitive and do not withstand sub-zero temperature. It provides high yields of fruit and can withstand a variety of growing conditions ranging from poor soil to drought. It has been naturalized outside of Asia in Eastern and Northern United States, where it was brought to revitalize forested areas and attract wildlife, especially birds.

Maintenance Plan For trees planted:

Multiple site assessments will be carried out for each restoration site per year to monitor success rates, annual biomass increment, biodiversity, and carbon sequestration. We will weed once a month for the first year and once per season in subsequent years until canopy closure is complete and stem exclusion begins. Other ANR techniques include mulching, fertilizer application, and irrigation in degraded areas that require intensive rehabilitation.

Site assessments will indicate which species should be included in enrichment plantings on a case-by-case basis. The end results should be a healthy mix of 25-30 species that emulate nearby native forest composition, including long-lived pioneers and shade-tolerant late-successional species with an emphasis on fruiting trees to attract seed dispersers. After 2-3 years, the restoration sites should be capable of autonomous self-regulation. Site assessments will continue regardless.

Scientific name: **Murraya siamensis Craib.**

Common name: Andaman satinwood

โปร่งฟ้า

Botanical characteristics

tiny tree height up to ten m , evergreen leaves square measure authorized leaf surface is dark and it's each the flower bouquet out tufts of white hair is incredibly scented, fresh , round , or oval. the check to a small degree. it had been evident that enclosures with nodes 5-8 millimetre long, 0.8-1 cm wide, the sunshine inexperienced Ripe orange . Bean eggs I even have had short hair, spherical seeds 4-6 millimetre long, 6-9 millimetre wide, white with 1-2 seeds per fruit.

Part used: root .

Indications: The drug driving amount.

Terminalia ivorensis A.Chev

Black afara

หูกระจง / แผ่บารมี

Family: Combretaceae
Vernacular names: Black afara, black barked terminalia, black bark

Origin and geographic distribution

Terminalia ivorensis occurs from Guinea-Bissau east to western Cameroon. It has been planted in many tropical countries as a promising timber plantation species, e.g. in Senegal, Uganda, Tanzania, India, Malaysia, the Solomon Islands, Fiji, Costa Rica, Panama and Brazil.

Ecology

Terminalia ivorensis occurs in evergreen forest and moist semi-deciduous forest, where larger trees are most common in lower-lying localities. It is most abundant in the transition zone between humid semi-deciduous forest and evergreen forest. In Ghana it seems most common along roadsides. It is found in regions with an annual rainfall of 1250–3000 mm and a dry season up to 3 months, and mean annual temperatures of 23–27°C. Terminalia ivorensis occurs on a wide range of soil types, from sandy to clayey-loamy and lateritic. It does not tolerate prolonged waterlogging, and is vulnerable to fire.

Prospects

The fair wood quality, including durability, high growth rate, straight bole and self-pruning ability make Terminalia ivorensis suitable for planting in timber plantations. However, the severe die-back in many plantations stopped the establishment of larger-scale plantations in the 1970s. Studies indicate that in Ghana the problems were caused by severe drought in combination with unfavourable sites, and the negligence of thinning and other appropriate silvicultural practices. Recommendations for successful new plantations include planting on oxysol-ochrosol intergrade soils, planting in mixtures with other timber species, especially line planting, and appropriate spacing and thinning. Trials demonstrated that under suitable growing conditions and proper management Terminalia ivorensis plantations are capable to produce trees with 60 cm bole diameter in 30 years.

Uses

The wood, usually traded as ‘framiré’ or ‘idigbo’, is valued for light construction, door and window frames, joinery, furniture, cabinet work, veneer and plywood. It is suitable for flooring, interior trim, vehicle bodies, sporting goods, boxes, crates, matches, turnery, hardboard, particle board and pulpwood. It is used locally for house construction, planks, roof shingles, fencing posts, dug-out canoes, drums and mortars. Mixed with other woods, it is suitable for paper making. The wood is also used as firewood and for charcoal production; offcuts are highly valued in Ghana for making charcoal. The tree is used in agroforestry systems as a shade tree in cocoa, banana and coffee plantations, and it is also planted as roadside tree. A yellow dye is present in the bark and wood; it is used traditionally to dye clothes and fibres for basketry. Bark decoctions or powdered bark are used in traditional medicine to treat wounds, sores, ulcers and haemorrhoids, against malaria and yellow fever, and as an anodyne in cases of rheumatism and muscular pain. Leaf sap is applied to cuts and against colds, and is also taken, together with bark decoctions, as an enema to treat gonorrhoea and kidney complaints, and as an aphrodisiac.



Xylia xylocarpa

Common name: Ironwood

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Xylia xylocarpa is a deciduous tree with a dense crown usually growing 20 - 40 metres tall, though on dry and poor sites the tree may be smaller and the bole crooked. The bole is usually straight and cylindrical, sometimes with small buttresses

It can be unbranched for 12 meters or more and around 40 - 60cm in diameter. The plant is mainly harvested from the wild It is cultivated as shade tree in S India and as fodder plant for lac insects

It is also sometimes grown in plantations in Asia and Africa. Formerly a major component of forests in its native range, it is less common today because of selective logging for its excellent dark-brown wood

Range: E. Asia - India, Myanmar, Thailand, Cambodia, Laos, Vietnam.

Habitat: Dry evergreen forest and mixed deciduous forest, but growth is poor in dry deciduous dipterocarp forest, in higher altitude forests and in moist bamboo forests**.** Often found on areas of abandoned cultivation and on low hilly country**.**

Propagation:

Seed - it can be stored at ambient temperatures for more than three years if kept dry. Fresh seeds do not need pre-treatment. seeds should be pre-soaked prior to sowing - immerse the seed in almost boiling water for a few minutes (being careful not to cook the seed!) and then soak it in warm water for 12 - 24 hours, by which time it should have imbibed water and swollen up

Seed viability is high and germination occurs readily when sown under shade and with adequate watering.

A germination rate of 70% - 90% can be expected, with the seeds sprouting within 3 - 4 days.

Direct seeding is recommended, as seedlings do not stand the shock of transplanting well, probably because the tap root develops rapidly and attains 30cm length in 1 - 2 months.

Agroforestry Uses:

- Leaves are used as green manure in Areca cultures.

Other Uses:

- The bark and wood are a source of tannins.
- A red resin is obtained from the trunk.
- An oil is obtained from the seeds.

Dipterocarpus alatus Roxb.

Dipterocarpus alatus Roxb. ex G.Don is a medicinal plant in Asia. In Thailand, this plant was used for skin, rheumatism and liver diseases. This study was determined to assess the anticancer and antifungal activities of the extracts from leaves, bark and twig of D. alatus as well as to identify the phenolic compounds in these extracts using HPLC analysis. The results suggest that all of extracts exhibited the highest cytotoxicity against Jurkat cancer cell line followed by HeLa and HepG2 cancer cell lines but do not show cytotoxicity against the non-cancerous cells (Vero cell line). Regarding its antifungal activity, extracts of the leaves and bark inhibited only T. mentagrophytes but have no capacity against other tested fungal stains. The HPLC analysis revealed the presence of, gallic acid in all extracts. Protocatechuic acid was found only in bark, while, p-coumaric acid and ferulic acid were found in twig. The result obtained suggested that D. alatus might be further explored for its contribution in cancer therapy. The obtained information could be useful for promoting the exploitation of the Thai medicinal plant.

Name: ***Bauhinia purpurea***
Orchid
ต้นชงโค
Ton Chong Koh

Family: Fabaceae
Framework Class: Pioneer / Flowering
Origin: Native
Seasonality: Evergreen
USDA Hardiness Scale: 9 - 12
Sun exposure: Full; young plants partial shade
Height: 6 - 10 m
Growth: Fast

Soil condition: Well-drained soil
Soil type: Sand, Loam, Clay
Soil pH: Acidic, Neutral, Alkaline; can grow in very acidic and saline soils

Altitude: 500 - 2000 m
Mean annual rainfall: 1000 - 5000 mm
Mean annual temperature: 12 - 21 °C

Drought tolerance: Yes
Cold tolerance: Yes

Advantages: Deep root system good for erosion control and slope stabilization

Use: Medicinal use: reduces swelling and bruises; bark as poison antidote;
leaves as cough medicine
Edible young leaves and flowers
Bark used to make rope
Ornamental use

Additional info: Purple, pink flowers: Sep – Nov
Flowering starts at early age: 2 – 3 years

Cultivation techniques: Germinates rapidly; up to 100% success up to 14 months storage
Seedlings appear within 4 - 10 days
Up to 1 metre tall within 2 months of germination
Transport to permanent position while seedlings are small

Name:	***Cassia fistula***
	Golden Shower
	ราชพฤกษ์ คูน
	Ratchaphruek Khun
Family:	Fabaceae
Framework Class:	Climax / Flowering / Fruiting
Origin:	Native
Seasonality:	Deciduous
USDA Hardiness Scale:	9 - 11
Sun exposure:	Full
Height:	10 - 20 m
Growth:	Slow
Soil condition:	Well-drained soil
Soil type:	Sand, Loam
Soil pH:	Acidic, Neutral, Alkaline; pH 5.5 - 8.7
Altitude:	0 - 800 m
Mean annual rainfall:	480 - 2720 mm
Mean annual temperature:	18 - 29 °C
Drought tolerance:	Yes (mild drought)
Cold tolerance:	No
Advantages:	Soil-improver
	Attracts birds and insects
Use:	Ornamental use
	Medicinal use
Additional info:	Thailand's national tree and national flower
	Small yellow flowers bloom at the end of the cool season: March – July
	Pollinators: bees and butterflies

Cultivation techniques: Hard seedcoat: mechanical scarification; or concentrated sulfuric acid for 45 min; or soak in warm water for 12 - 24 h; sown in full light; germinates in a few days

Name:	***Pachira aquatica***
	Malabar Chestnut
	ต้นนุ่นน้ำ ต้นศุภโชค
	Ton Nun Naam Su-pa-chok
Family:	Malvaceae
Framework Class:	Pioneer
Origin:	Exotic; from Central and South America
Seasonality:	Evergreen
USDA Hardiness Scale:	10 - 12
Sun exposure:	Full
Height:	6 - 18 m
Growth:	Fast
Soil condition:	Well-drained soil
Soil type:	Sand, Clay, Loam
Soil pH:	No data
Altitude:	No data
Mean annual rainfall:	No data
Mean annual temperature:	No data
Drought tolerance:	Yes
Cold tolerance:	No data
Advantages:	No data
Use:	Edible nuts, also leaves and flowers Medicinal use -> bark to treat stomach complaints and headache; skin of immature fruits used in treatment of hepatitis Bark: yellow / dark red dye Seeds: oil has industrial potential for manufacturing soap
Additional info:	Known as the “money tree”, associated with good fortune
Cultivation techniques:	Seeds can float in water for several months without loss of viability, not germination until they are washed up on the land Sprout within 5 - 10 days; high success rate; seedlings grow fast; plant within 3 - 4 months; flowering starts at 4-5 years of age



Maintenance Plan For trees planted:

Multiple site assessments will be carried out for each restoration site per year to monitor success rates, annual biomass increment, biodiversity, and carbon sequestration. We will weed once a month for the first year and once per season in subsequent years until canopy closure is complete and stem exclusion begins. Other ANR techniques include mulching, fertilizer application, and irrigation in degraded areas that require intensive rehabilitation.

Site assessments will indicate which species should be included in enrichment plantings on a case-by-case basis. The end results should be a healthy mix of 25-30 species that emulate nearby native forest composition, including long-lived pioneers and shade-tolerant late-successional species with an emphasis on fruiting trees to attract seed dispersers. After 2-3 years, the restoration sites should be capable of autonomous self-regulation. Site assessments will continue regardless.

Planting Report Conserve Natural Forests

For CHANINTR

Introduction

Conserve Natural Forests Foundation (Conserve Natural Forests) Foundation registered at No.1/2015, its head office is located at 97 Moo 4, Thung Yao Sub-district, Pai District, Mae Hong Son Province. It is a non-profit organization. (Non-Governmental Organizations: NGOs) with the objective of establishing the Foundation. To breed seedlings from seedling nurseries for use in planting forests in every rainy season which will plant as many forests as Breeding endangered wildlife Opened a learning center focusing on organic agriculture and sufficiency economy for local and international students. By focusing on learning from direct experience to raise awareness and awareness of environmental conservation. It also accepts foreign volunteers with English and computer skills to help teach and educate children and youth in the area. The Foundation strongly believes that reforestation to restore degraded forests, along with raising awareness of natural resources, is essential to restore lost environments.

Ecosystem Type

Geology, Topography, Soils

The south of Thailand sits on a long, narrow peninsula, a piece of land flanked by the sea on both sides connecting two larger areas. Mountains form the core of the peninsula and coastal plains slope down to the sea on both sides. Limestone peaks are scattered across Krabi Province, on the land as well as on the water. These peaks are created over an extended period of time by rainfall as limestone is an exceptionally soft rock and easily eroded. Many different caves were created by these kinds of weathering properties and nowadays a huge tourist attraction and income for local communities. These caves provide shelter for various kinds of species such as numerous bats and birds.
The general altitude of Krabi province is ranging from 0 – 500 meters a.s.l. belonging to the lowest altitude of whole thailand. The altitude of Ko Klang, Changwat ranges from 11 meters to 269 meters a.s.l., and is characterized by sandy beaches. A more rolling and mountainous terrain and the absence of bigger rivers are some features of south Thailand.
The general soils that can be found in the Krabi province are dystric nitosols, ferric acrisols, eutric gleysols and orthic acrisols. At Ko Klang, Changwat orthic acrisols are mostly found, which is a clay-rich subsoil. The age of this type of soil and its extensive leaching capability has led to low fertility and aluminum compounds, limitations arise when using the land for agriculture. Acrisols occur on undulating landscapes and humid tropical climates. Normally palm, rubber and coconut plantations do very well on these types of soil.

Climate

The climate of Thailand is influenced by monsoon winds, which has a more seasonal character. These monsoons can be classified as southwest monsoon and northeast monsoon. Southwest monsoon winds brought by the Indian Ocean last from May until October and are warmer, moist are that is causing abundant rain all over the country. The northeast monsoon winds bring a colder, and dry air from China. This results in mild weather and abundant rainfall on the eastern coast of Thailand.
The south of Thailand has a more tropical monsoon climate. Abundant rainfall occurs in the south of both northeast and southwest monsoons with a peak in September for the western coast and in November-January for the eastern coast. The convergence of the monsoon winds with the Inter-Tropical Convergence Zone (ITCZ) air currents divide the annual climate regime into three seasons:

- **Rainy/Southwest Monsoon Season**: Mid-May to Mid-October. In Southern Thailand, the ICTZ often delays the onset of the rainy season to the beginning of June. The mean daily temperature of the eastern coast of the south averages 27.8°C with a mean maximum of 32,3°C and mean minimum of 24.4°C (Figure 2). When looking at the mean daily

temperature of the west coast of the south Thailand, it is 27.4°C with a mean maximum of 31.6°C and mean minimum of 24.3°C. Warm moist air from the southwest creates abundant rainfall - approximately 1,841.3 mm in the west coast of southern Thailand and 680 mm at the east coast (Figure 3).

- **Winter/Northeast Monsoon Season**: Mid-October to mid-February. Cold and dry air from the northeast. At the east coast of south Thailand, the mean daily temperature is 26.3°C with a mean maximum of 30.4°C and a mean minimum of 22.8°C. At the west coast of south Thailand, mean daily temperature is 27.0°C with a mean maximum of 32.0°C and a mean minimum of 23.2°C. approximately 830 mm of rainfall on the west coast of south Thailand and 464.6 mm on the east coast.

- **Summer/Pre-monsoon Season:** Hot, dry period as the currents transition between the northeast and southwest monsoon winds. Mean daily temperature is 28.2°C for the east coast and 28.4°C for the west coast with a mean maximum of 33.0°C for the east coast and 34.1°C for the west coast and a mean minimum of 24.1°C for the east coast and 24.0°C for the west coast (Figure 2). Less than 411.3 mm of rain is expected to fall during this period on the west coast and 229 mm of rain on the east coast (Figure 3).

Vegetation Type and Forest Succession

1. Many different vegetation types can be found in South Thailand because of many distinct factors such as altitude, slopes, and coastal areas. The following ecosystems can be found:

2. Tropical rain forest: forests that have a rainfall not less than 2,500 mm per year. When this vegetation type gets destroyed, it will get replaced quickly with pioneer species. The species that can be found in this vegetation are Takhian, Saya, Cat's Eye, Krabak, Jackfruit etc.

3. Dry evergreen forest: can be found along the plains and valleys with an altitude of 100 – 500 meters a.s.l., with rainfall between 1,000 – 2,000 mm per year. This type of forest can be transformed from a destroyed evergreen forest or intact mixed forest. Once destroyed, it is more likely that the forest will become a mixed forest. There are many main types of wood such as Krabak, Yang Na, Red Yang, Takhian Hin, Teng Tani, Payom, Sattaban, Sompong, Makha, Nong Nong etc.

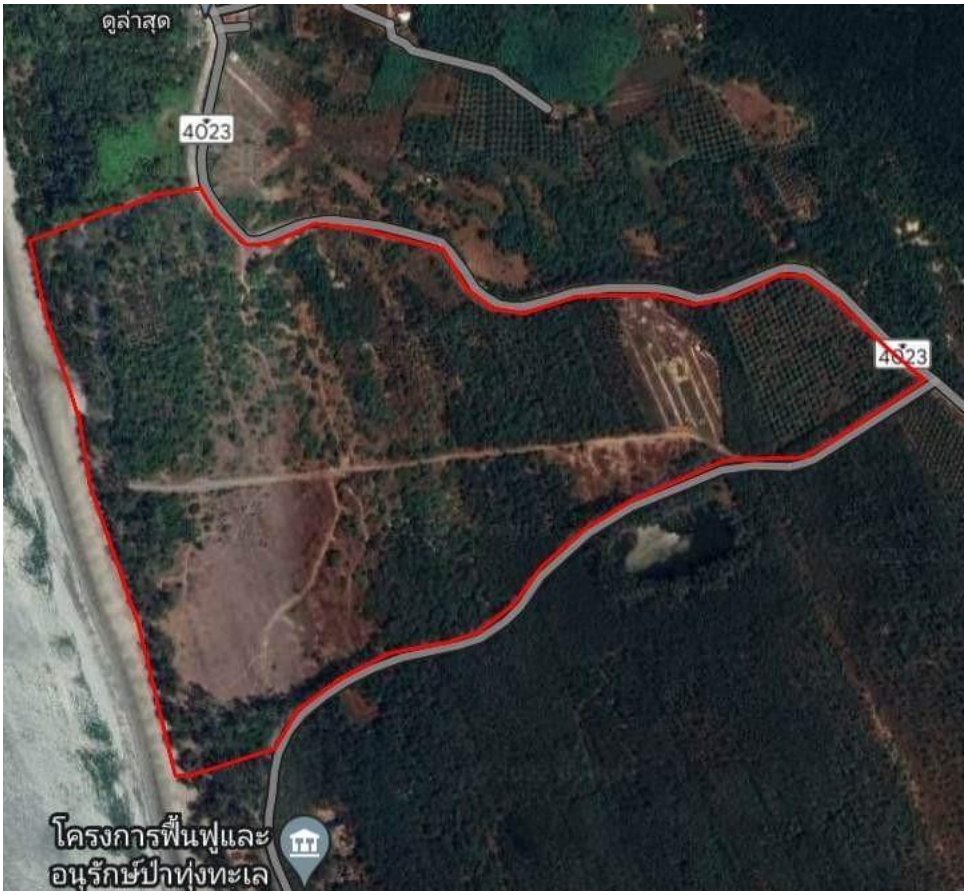
4. Hill evergreen forest: a forest type that occurs at 1,000 meters a.s.l. with a rainfall between 1,500 – 2,000 mm per year. This type is prone to changes, and likely to get replaced with pines and grasses. Succession of this type of forest goes slow, it needs time for other species to return. The main plant species are quite limited, such as producing diverse types of fish Queen Sua Krong see young elephants, 3,000-year-old pines, tamarind, dong, phayamai, tamarind, pine, wild rose, etc.

5. Peat swamp forest: type of vegetation that always has water and is strongly influenced by it, which needs 2,300 – 2,600 mm of rain a year. This is a type of forest that has rich biodiversity. When it is degraded for the first time, it is relatively easy to restore it. But when it is repeatedly destroyed, it will turn into a freshwater swamp forest and extremely difficult to be a peat swamp forest again. The main plant species are Mahang, Satiao, Yakatara, Ai Bao, Wa Nam, Wa Hin, Chang Hai, Tang Nan, and red trotters.
6. Freshwater swap forest: a forest type that is flooded at certain times all year round. They have a rainfall of around 1500 – 2000 mm a year. Because the soil is very fertile it is used for agriculture. When destroyed, evergreen plants replace this vegetation type. The main plant species is white samedo, which is sometimes almost the only type of plant; Sanon, Chum Saeng, some types of ficus, sod water, Khoi, etc.
7. Mangrove forest or salt marsh forest is a type of forest with sea influences. It has an annual rainfall between 1,500 – 4,000 mm. The main plant species are small-leaved mangroves and large-leaved mangroves. This type of vegetation is particularly important for wildlife. If this type of forest is destroyed, it will turn into terrestrial forests. Restoration is exceedingly difficult.
8. Beach forest: located along the coast with gravel soil and rocks. The rainfall is like mangrove forests. If it is a sandy soil area, there will be a group of sea pines, rarely mixed with other plants. Lower plants such as people, morning glory, and other creeping plants, etc. When destroyed, it will become grassland.
9. Cliff forest: type of vegetation that can be found along rocks from seashore to the top of the mountain. The plants growing in this type are drought-tolerant and wind-resistant. When destroyed, it will become grassland for the most part. There are not less than 60 species, such as wild opera, Lime Phi, Thorn Phrom, Sandalwood, Laem Bai Laem, small plantain, Chang Nao, Machata, Sae Macha, Sedge, etc.

Conservation Value

It is important to bring back original species back to their natural habitat. When forests are restored, many varied species will follow such as mammals, bird species and many different insects. Seed dispersal birds and insects will return, and the forests will be sustainable again. This will not only result in more biodiversity, but also provide income for different communities living within these areas. It will minimize erosion which also reduces landslides and soil degradation. This way future generations can enjoy the forests and the species that lives within them.

Restoration Sites: Ko Klang



GPS: 7.752036° N, 99.026862° E

Size: 60 Rai

Planting days: **23-30 December 2022**

Total number of planted trees: 40,000 trees

1) Gurjan 5,600
2) Moulmein cedar 3,400
3) Resak 5,000
4) Monkey fruit 5,800
5) Malabar iron wood 5,000
6) Agar wood 4,600
7) Brazillian mahogani 5,600
8) Trumpetflower 1,000
9) Makha 2,000
10) Rain tree 1,000
11) Flamboyant 500
12) Iron wood 500

Maintenance Plan For trees planted:

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Figures

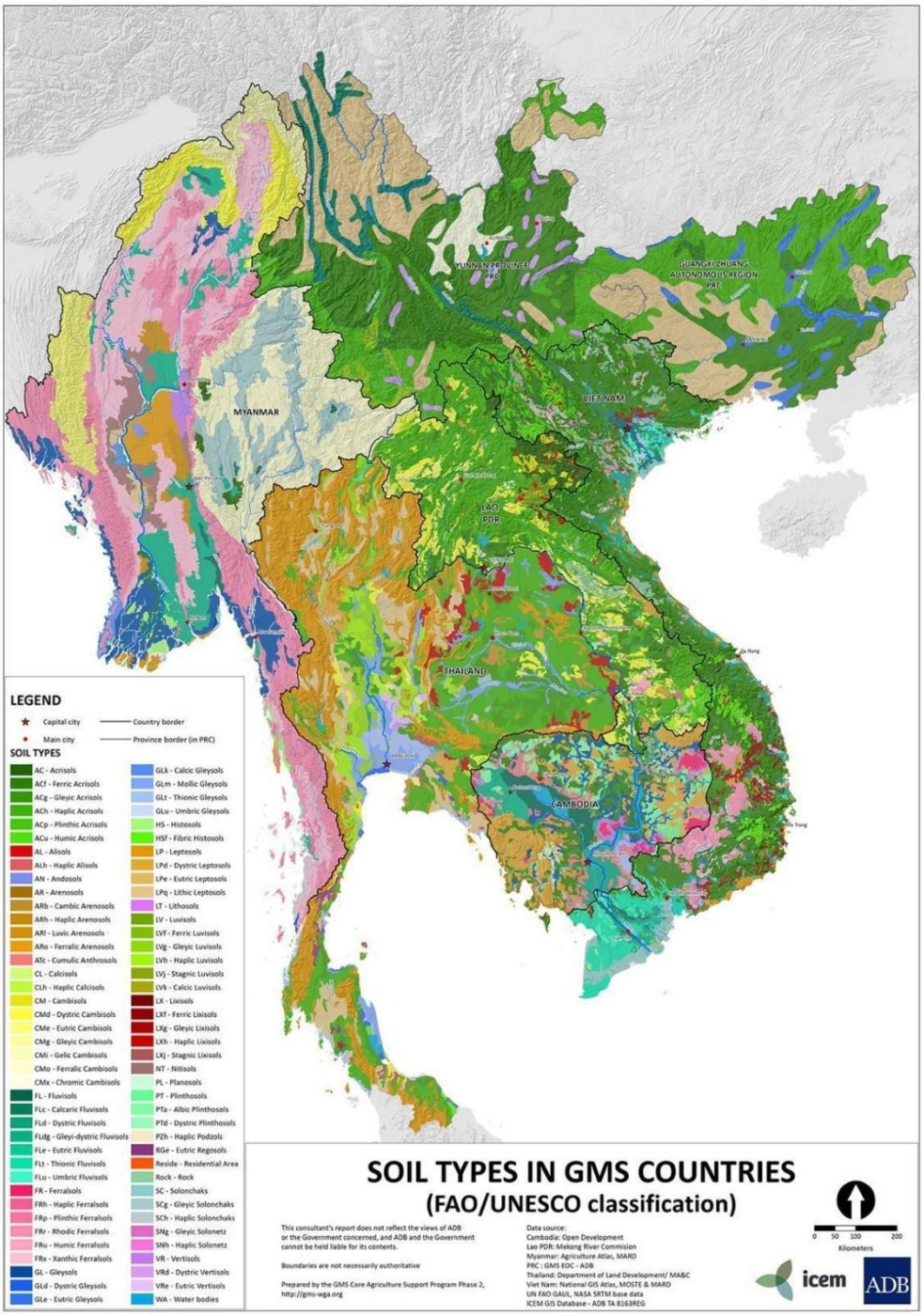


Figure 1: soil map of Thailand (ICEM 2015)

Seasonal temperatures (°C) in various parts of Thailand

Temperature	Region	Winter	Summer	Rainy
Mean	North	23.4	28.1	27.3
	Northeast	24.2	28.6	27.6
	Central	26.2	29.7	28.2
	East	26.7	29.1	28.3
	South			
	- East Coast	26.3	28.2	27.8
	- West Coast	27.0	28.4	27.5
Mean maximum	North	31.1	36.1	32.4
	Northeast	30.6	35.2	32.6
	Central	32.3	36.2	33.4
	East	32.0	34.1	32.3
	South			
	- East Coast	30.4	33.0	32.7
	- West Coast	32.0	34.1	31.6
Mean Minimum	North	17.5	21.8	23.8
	Northeast	18.7	23.2	24.4
	Central	21.2	24.6	24.8
	East	22.3	25.2	25.2
	South			
	- East Coast	22.8	24.1	24.4
	- West Coast	23.2	24.0	24.3

Based on 1981-2010 period

Figure 2: Average temperature

Seasonal rainfall (mm) in various parts of Thailand

Region	Winter	Summer	Rainy	Annual rainy days
North	100.4	187.3	943.2	122
Northeast	76.3	224.4	1,103.8	116
Central	127.3	205.4	942.5	116
East	178.4	277.3	1,433.2	130
South				
- East Coast	827.9	229.0	680.0	145
- West Coast	464.6	411.3	1,841.3	178

Based on 1981-2010 period

Figure 3: Seasonal rainfall (mm) in Thailand

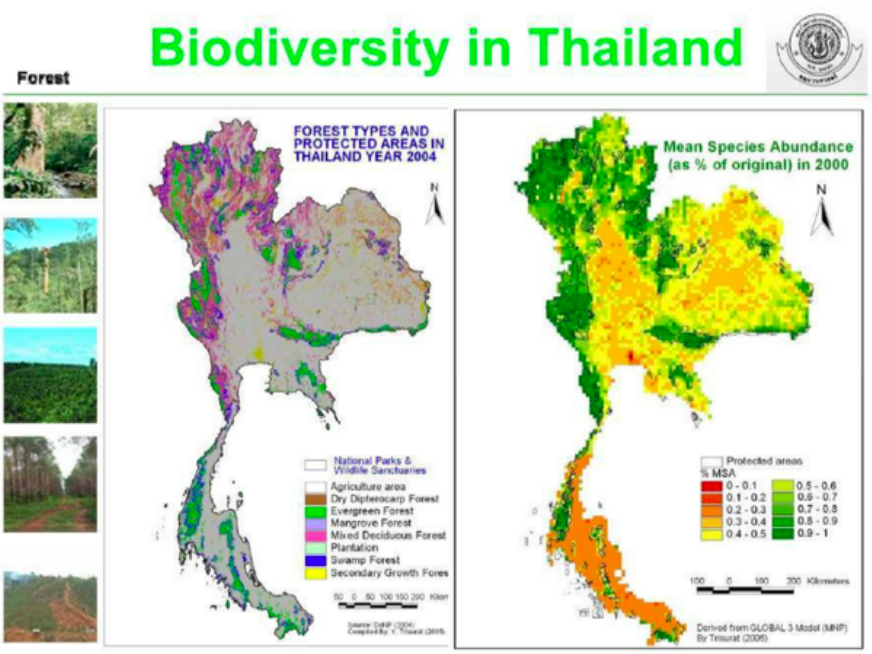


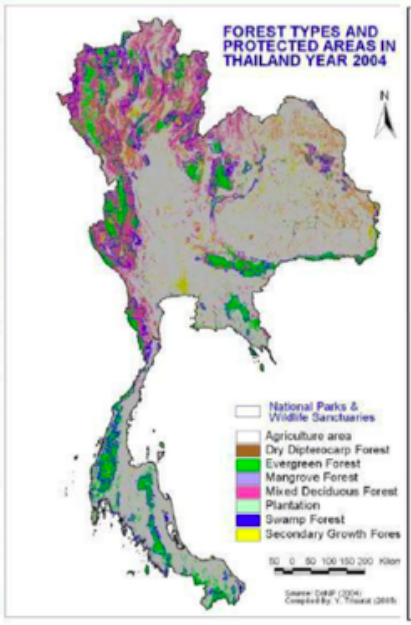
Figure 4: Forest Type and Biodiversity of Thailand (Trisurat 2005)

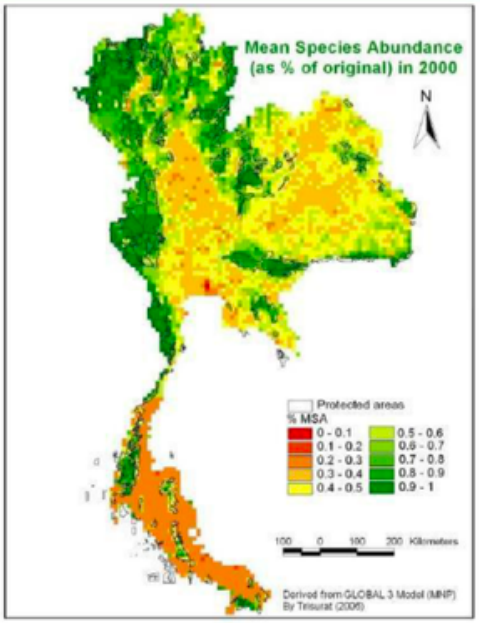
Biodiversity in Thailand

Forest









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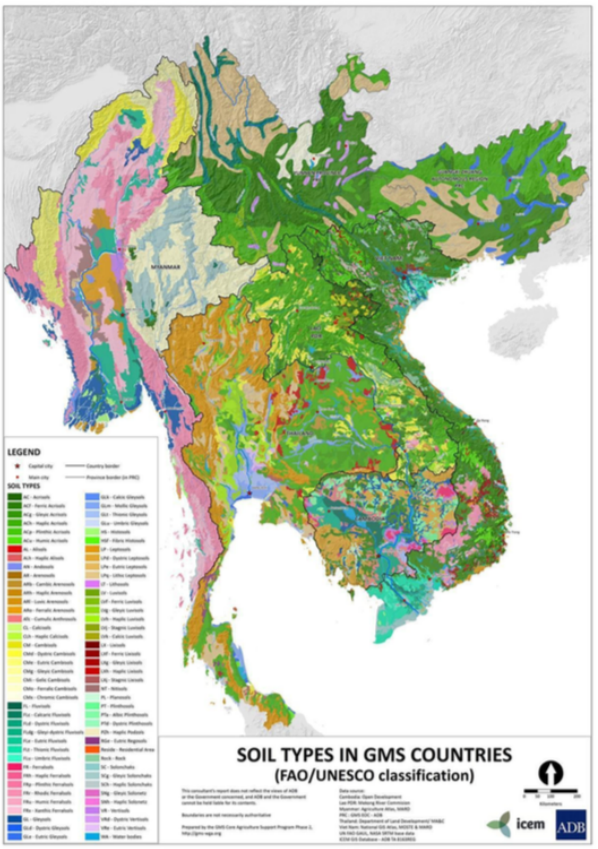

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Based on 1981-2010 period