Work Plan for the Restoration Component under the AFoCo Landmark Program:

Establishment of Forest Genetics Research Center for Restoration of Major Timber Species in Cambodia

AFoCO
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ASEAN-Korea Forest Cooperation

ACRONYMS AND ABBREVIATIONS

AFoCo	ASEAN-Korea Forest Cooperation
AKECOP	ASEAN-Korea Environmental Cooperation Project
AMS	ASEAN Member States
CLMV	Cambodia, Lao PDR, Myanmar, Vietnam
DANIDA	Danish International Development Agency
FA	Forestry Administration
GMS	Greater Mekong Sub-region
IRD	Institute of Forest and Wildlife Research and Development
KFRI	Korea Forest Research Institute
KNA	Korea National Arboretum
KRCC	Korea Rural Community Corporation
RGC	Royal Government of Cambodia
ROK	Republic of Korea
RUA	Royal University of Agriculture

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Establishment of Forest Genetics Center for Restoration of Major Timber Species in Cambodia

1. Background

The Greater Mekong Subregion (GMS), which covers Cambodia, Lao PDR, Myanmar, Viet Nam, Thailand and Southern China, had lost 30 % of its forest cover over the past 30 years (1973-2009). The major factors attributed to this loss include economic development, population growth, dam and road construction and the increased consumption patterns and thus, frequent illegal timber trade in addition to legal logging (WWF, 2012).

Cambodia, in accordance with the trend in the GMS, had lost 22 % of its forest cover from 73.1% (13.2 million ha) in 1973 to 57% (10.3 million ha) in 2010. The main causes of the loss in forest cover include increased forest fire, population increase, shifting cultivation, fuel wood/charcoal, land conversion, encroachment and expansion of infrastructure for economic development of the country. This has resulted in the threat in terms of both number and quality of *Dalbergia Cochinchinens*, one of the valuable and native species in Cambodia. This species is currently included in the IUCN Red List of threatened and endangered species in Cambodia (FAO, 2010; IUCN, 2015; WWF, 2012).

Cambodia has promoted the National Forest Program (NFP) for sustainable forest management., The NFP for 2010-2029, which has the mission of "…sustainable management and development of (our) forests for…poverty alleviation, enhanced livelihood, economic growth and environmental protection, including conservation of biodiversity and (our) cultural heritage." Under the list of eight (8) objectives, the objective 7, which seeks to 'Ensure environmental protection and conservation of forest resources,' is supported by several sub-programs. Among those, sub-program 2.6 deals with 'Tree Planting and Development of Forest Plantation aiming to promote the national-scale restoration throughout

Cambodia.

As one of the restoration projects in Cambodia, the ASEAN-Korea Environmental Cooperation Project (AKECOP) has been supporting the research on the "Regeneration of *Dalbergia cochinchinensis* in degraded forest area in Siem Reap" since 2011 by establishing an experimental plot for improvement of conservation and restoration management. In addition, the Korea Rural Community Corporation (KRCC) has been supporting the restoration project entitled "Forest Restoration and Establishment of Forest Research Facilities in Phnom Penh and Siem Reap" since 2012 through the establishment of a research building, a nursery, experimental plots for the application of restoration techniques and a *Dalbergia cochinchinensis* plantation. Furthermore, the Asia-Pacific Network for Sustainable Forest Management (APFNet) supported the restoration project entitled "Multi-Functional Forest Restoration and Management of Degraded Forest Areas in Cambodia" from 2011 to 2014, through the establishment of a community nursery, demonstration plots of community-based restoration, and agroforestry model plots of pineapples intercropped with *Dalbergia* and *Pinus* species. Last but not least, the AFoCo has been supporting the restoration project entitled "Promotion of Forest Rehabilitation in Cambodia and Viet Nam through Demonstration Models and Improvement of Seed Supply System" since 2015, through the establishment of seed supply system model between seed suppliers and buyers in local areas.

Despite the implementation of a series of restoration projects in Cambodia, the fundamental issue regarding the source of seeds is still being questioned. Most of the time, seeds have been collected or purchased at different places without clear genetic information across the country as well as neighboring countries. Especially for the major timber species such as *Dalbergia cohinchinensis*, the quality of seeds in terms of its genetic superiority (e.g. phenotype and productivity) cannot be guaranteed. With limited financial resources, for more effective and efficient restoration of the major timber species in Cambodia, it is necessary to

produce the genetically improved seeds within Cambodia through a long-term tree breeding plan. However, there is limited experience and knowledge on tree breeding in Cambodia.

2. Objectives

The major objectives of Restoration Component of Landmark Program in Cambodia are to: 1) implement a long-term tree breeding plan; and, 2) strengthen the restoration and tree breeding capabilities of the Forestry Administration in Cambodia. The specific targets for each objective are as follows:

2.1. To implement the long-term tree breeding plan

a. Plus tree selection of 3 targeted major timber species (*Dalbergia cochinchinensis, Pterocarpus macrocarpus* and *Dipterocarpus intricatus*)[1]
b. Establishment of progeny test plantation (24 ha)
c. Establishment of seed orchard (6 ha)
d. Establishment of demonstration forest (18 ha)
e. Silvicultural management in genetic resources conservation forest and forest restoration area (200 ha)

2.2. To strengthen the restoration and tree breeding capabilities of Forestry Administration in Cambodia

a. Training on tree breeding for the Forestry Administration technical staffs in the ROK and Cambodia
b. Education programs on the restoration techniques and tree breeding
c. Local training on forest protection for villagers
d. Publication of textbook on tree breeding in Cambodia (English/Khmer)

[1] The 3 targeted tree species were selected by FA, and the major information on those 3 species are described in the Annex of this work plan (p. 48-55).

3. Project sites

The project sites are located in two (2) different locations (to be confirmed by December 2015), and the total size of the project sites is **248 ha**. The project activities to be implemented are as follows:

a. Establishment of progeny test plantation (total 24 ha)

= Khun Ream in Siem Reap (12 ha) + another place in a separate area (12 ha)

b. Establishment of seed orchard (total 6 ha)

= Khun Ream in Siem Reap (3 ha) + another place in a separate area (3 ha)

c. Establishment of demonstration forest (total 18 ha)

= Khun Ream in Siem Reap (18 ha)

d. **Silvicultural management at forest genetic resources conservation and forest restoration area (total 200 ha)** = Khun Ream in Siem Reap (200 ha)

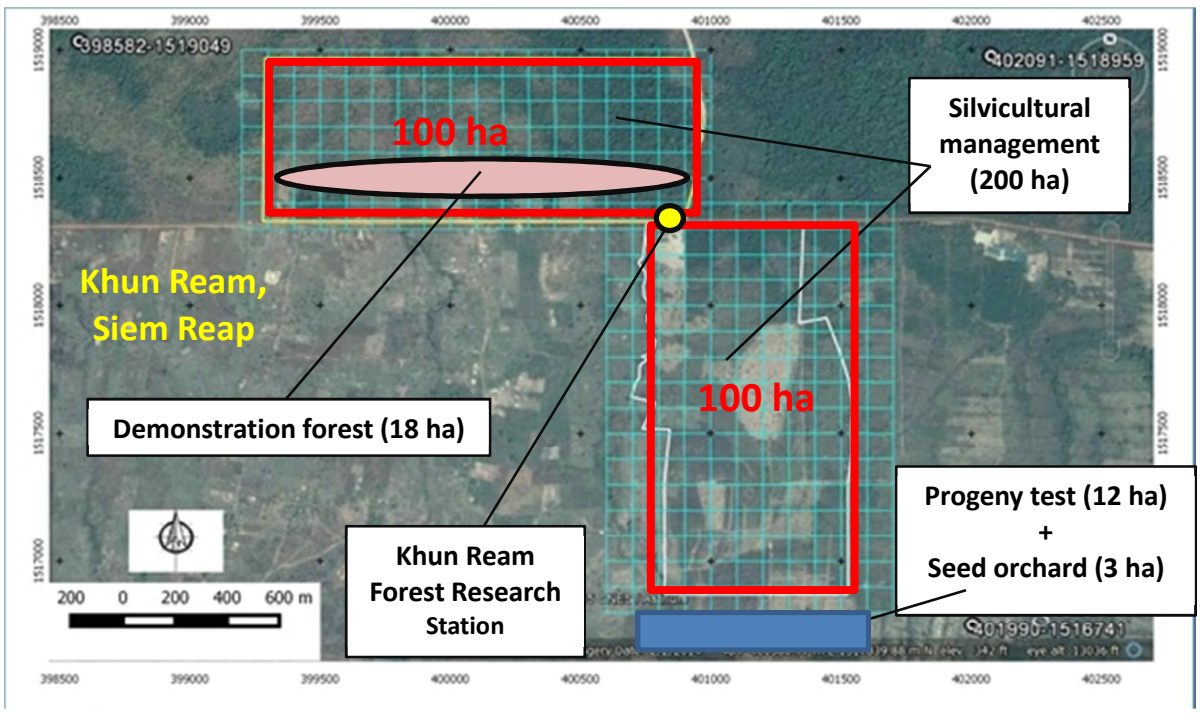


Figure 1. Project sites in Khun Ream, Siem Reap

3.1. Sites for progeny test plantation and seed orchard

Two (2) sites for progeny test plantation and seed orchard will be located outside of the 200ha of silvicultural management area. As for the confirmation of this sites for progeny test plantation and seed orchards, it is necessary to go through the official process to seek the approval from the FA. The locations of the sites will be confirmed by December 2015.

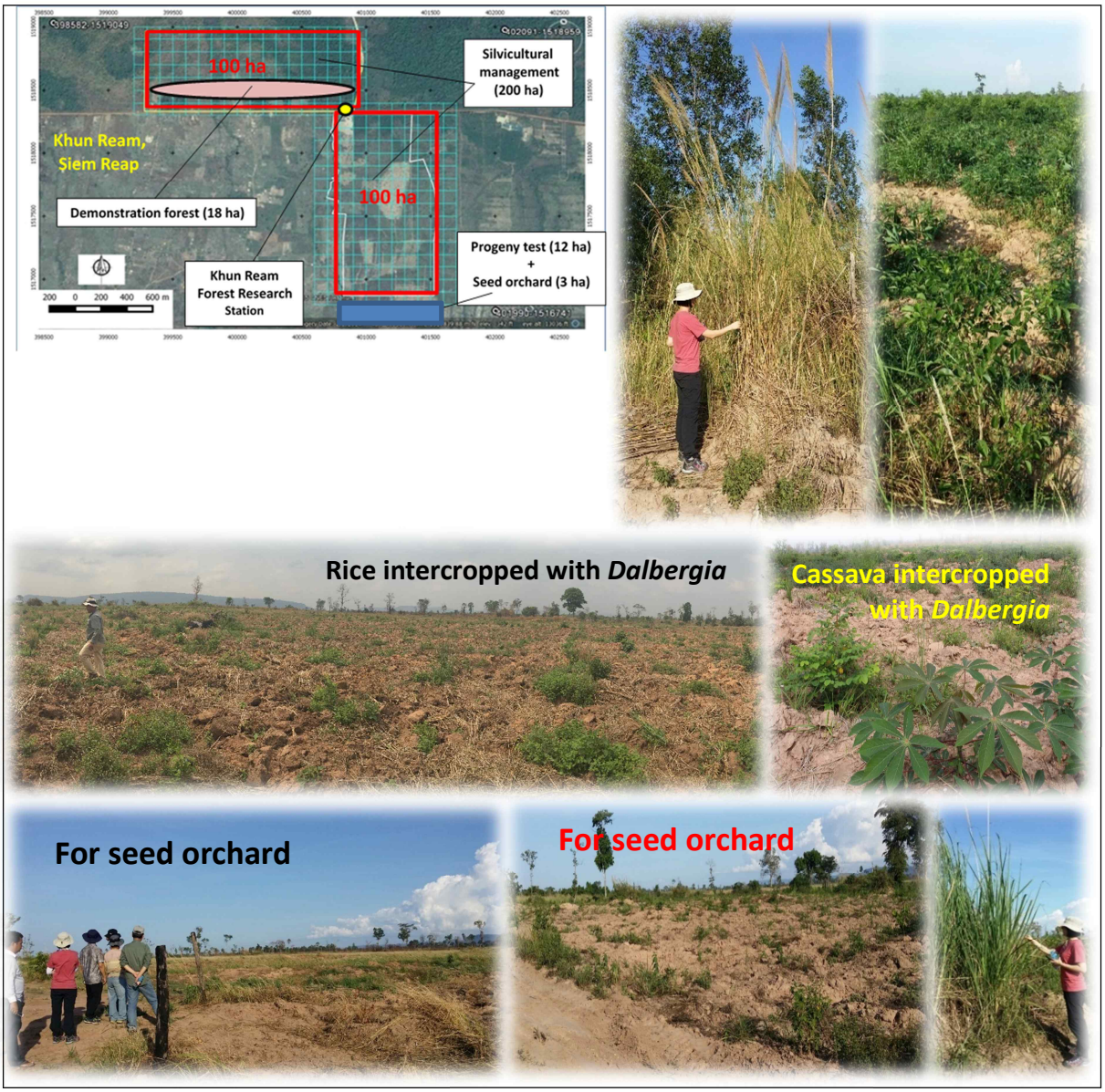


Figure 2. Potential sites for progeny test plantation and seed orchard

3.2. Khun Ream Forest Research Station

The IRD has a forest research station in Khun Ream, comprising of a research building and nursery facilities. Currently, there are few staff and limited office supplies inside the recently established research building. The nursery has a production capacity of about 50,000-60,000 seedlings per year. The list of species and the number of seedlings that Khun Ream Forest Research Station currently holds are as follows:

Table 1. The seedlings in the nursery of Khun Ream Forest Research Station in 2015*

Species	The number of seedlings
Dalbergia cochinchinensis	47,546
Hopea odorata	1,191
Ptepcarpus pedatus	2,081
Shorea siamensis	2,610
Dipterocarpus alatus	1,740
Afzelia xylocarpa	830
Shorea volgaris	728
Acacia sp.	724
Mitrella mesnyi	299
Albizia lebbek	87
Total	57,836
(*Note: Number of seedlings produced is different annually.)	

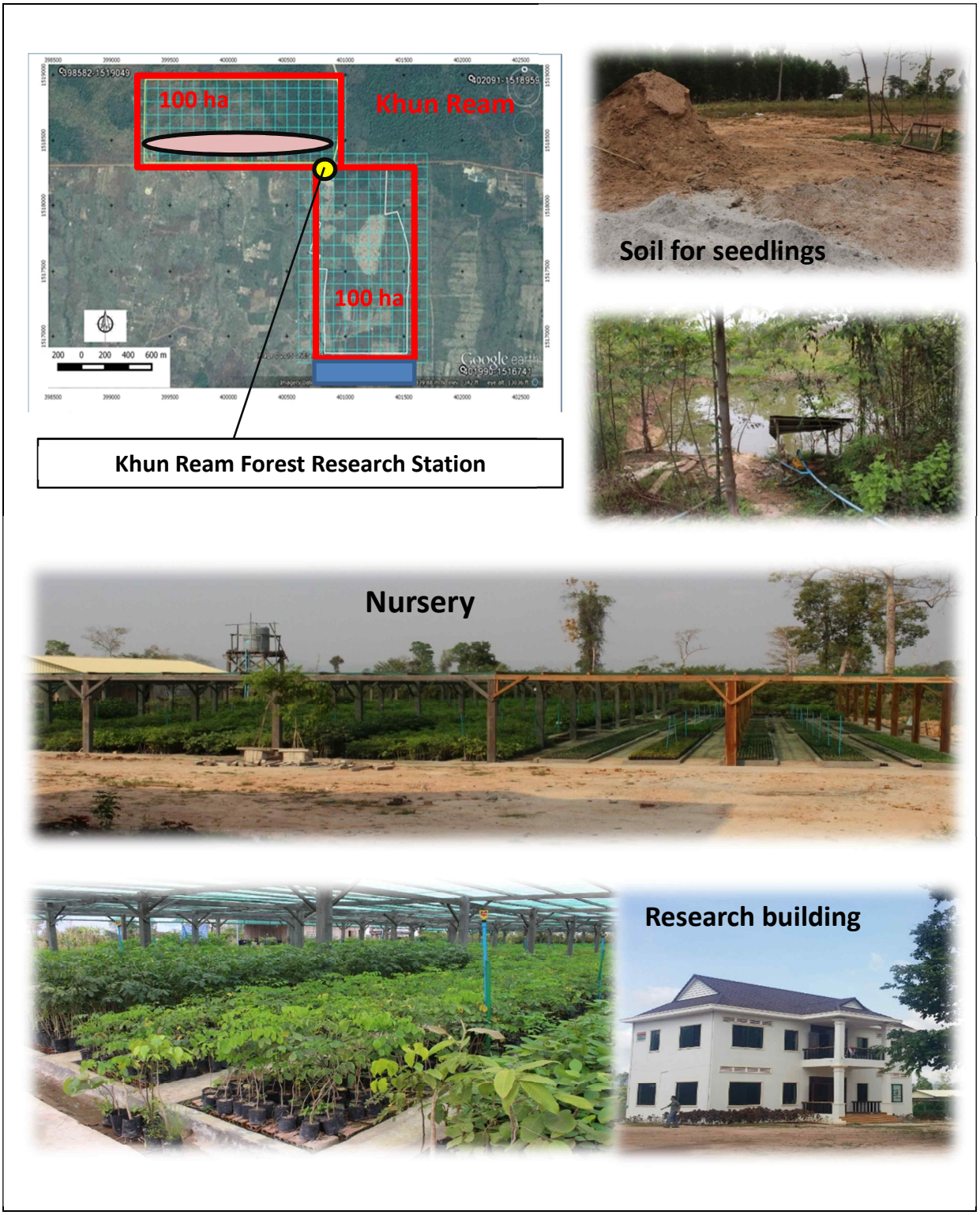


Figure 3. Khun Ream Forest Research Station

3.3. Sites for demonstration forest

Currently, at the potential site for the demonstration forest, there are research plots in which the various restoration techniques are being tested. The methods being applied in these testing plots include Assisted Natural Regeneration, Enrichment Planting, Screening species, and Direct Seeding.

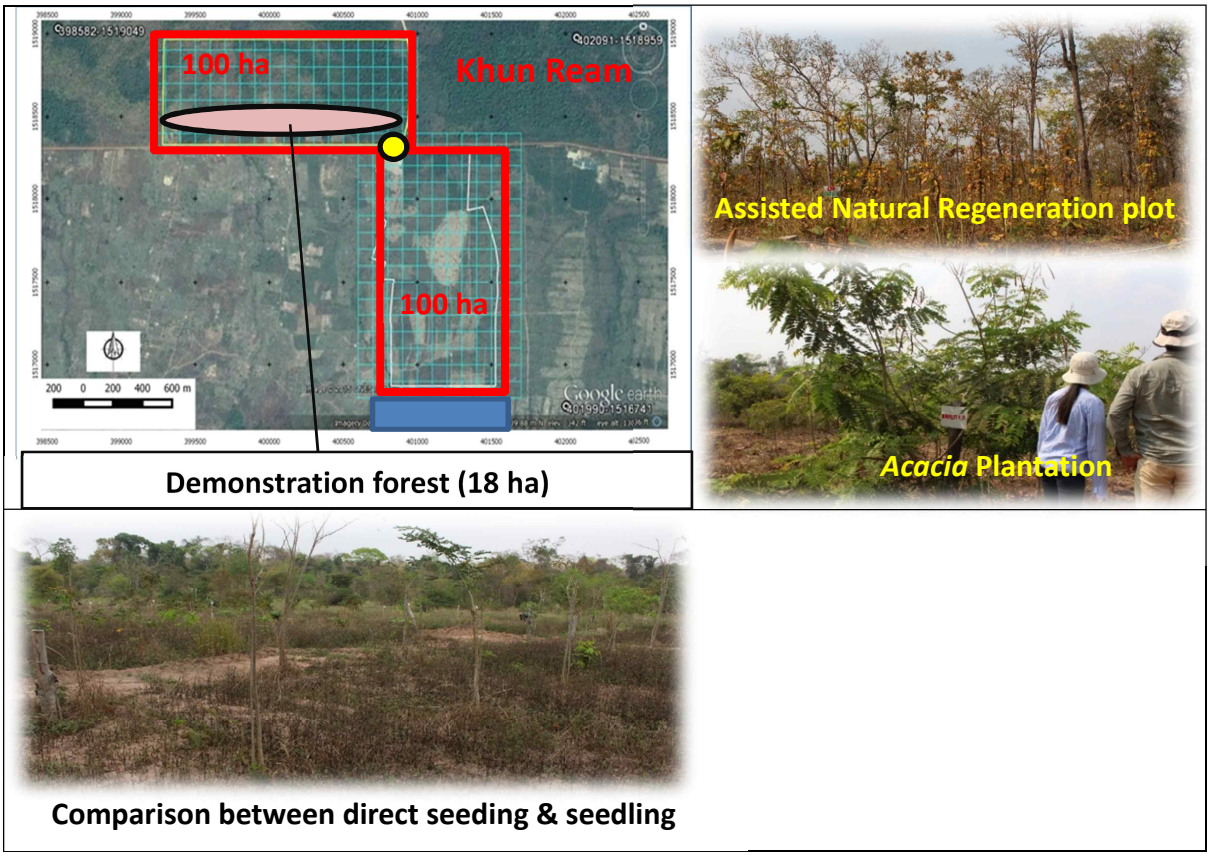


Figure 4. Potential sites for demonstration forest

4. Detailed activities

4.1. Implementation of a long-term tree breeding plan

The long-term tree breeding plan is as follows:

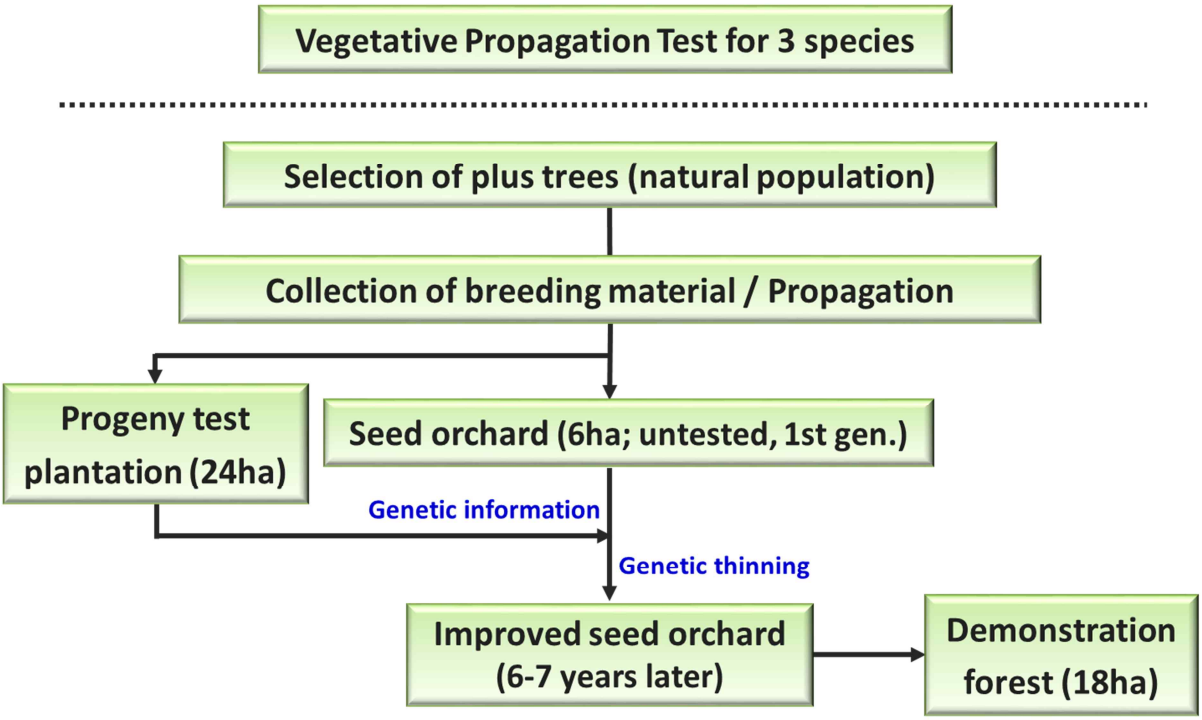


Figure 5. Long-term tree breeding plan in Cambodia

4.1.1. Vegetative propagation test for the three (3) targeted major timber species (*Dalbergia cochinchinensis, Pterocarpus macrocarpus* and *Dipterocarpus intricatus*)

There are two (2) major propagation types: sexual propagation through seeds, and asexual or vegetative propagation through cutting, grafting or tissue culture. The progeny test plantation will be established with seedlings that have been produced via sexual propagation (through seeds). The seed orchard will be established with seedlings that have been produced via vegetative propagation (through cutting or grafting).

In order to test whether the vegetative propagation is effective for the 3 targeted species, preliminary experiments are necessary. If it is proven to be effective, the seeds will

be collected for progeny test plantation, and the scions (i.e. stem, leaf bud, root) will be collected for establishing seed orchard. If it is proven to be ineffective, only the seeds will be collected for the establishment of both progeny test plantation and seed orchard. The experts from the ROK will visit Cambodia in 2015 to demonstrate how to carry out cutting and grafting as well as conduct the preliminary experiments on the vegetative propagation test for the 3 targeted species.

4.1.2. Plus tree selection for the 3 targeted species in the natural population

The 100 plus trees per species, which are in natural populations at a wide geographic distribution, will be selected, referring to the Danish International Development Agency (DANIDA) project report on the natural distribution of the 3 targeted species. As for the standard to be used in the selection e.g. phenotype, the Cambodian criteria will be adopted. The joint field survey to select the plus trees will be conducted in cooperation with the Department of Forest Genetic Resources of KFRI in December 2015.

4.1.3. Collection of breeding material

With regards to the breeding material, seeds will be collected for progeny test plantation, and scions (i.e. stem, leaf bud, root) will be collected for grafting to establish seed orchard. The time schedule for collecting seeds of the 3 targeted species is illustrated below:

No.	Species	Month											
		1	2	3	4	5	6	7	8	9	10	11	12
1	*Dalbergia cochinchinensis*												
2	*Pterocarpus macrocarpus*												
3	*Dipterocarpus intricatus*												

4.1.4. Propagation (seedling production)

The basic standard of seedlings to be used for Restoration Component of Landmark Program in Cambodia is at least 6-month of age and a height of at least 40cm. The number of seedlings to be produced is as follows.[2]

(i) Progeny test plantation (3m x 3m interval, 24 ha)

10 seedlings/plus tree x 100 plus trees/species x 3 species x 4 duplications = 12,000 seedlings → 12 ha; site duplication = 12 ha + 12 ha = 24 ha → **24,000 seedlings (→ 30,000 seedlings)**

(ii) Seed orchard (5m x 5m interval, 6 ha)

400 seedlings/ha x 3 ha = 1,200 seedlings; site duplication = 3 ha + 3 ha = 6 ha → **2,400 seedlings (→ 3,000 seedlings)**

(iii) Demonstration forest (3m x 3m interval, 18 ha)

1,000 seedlings/ha x 18 ha = **18,000 seedlings (→ 22,500 seedlings)**

4.1.5. Establishment of progeny test plantation (24 ha)

- Objectives:

(i) To confirm the superiority of selected plus trees upon their progenies

(ii) To provide the genetic information for genetic thinning at the untested (1st gen.) seed orchard

- Plantation design:

✓ 3m x 3m planting, 1 ha (1 species, 10 seedlings x 100 plus trees) x 3 species x 4 duplications = 12 ha, site duplication in a separate location = 12 ha + 12 ha = 24 ha

[2] The number of seedlings to be produced is 125% of the actual necessary number.

- ✓ Labeling, signboard, edge and fencing will be established.
- ✓ More specific planting design will be made when the sites are confirmed by December 2015.

4.1.6. Establishment of seed orchard[3] (6 ha)

- Objective: To collect genetically superior seeds in the future
- Plantation design
  - ✓ 5m x 5m planting, 1 ha/species x 3 species = 3 ha, site duplication = 3ha+3ha = 6 ha
  - ✓ Labeling, signboard, edge and fencing will be established.
  - ✓ More specific planting design will be made when the sites are confirmed by December 2015.

4.1.7. Establishment of demonstration forest (18 ha)

- Objectives:

(i) To maintain the genetic resources via ex-situ conservation

(ii) To do exhibition of successfully improved plus trees

(iii) To conduct long-term monitoring for comparison studies between bred and conventional seedlings

- Plantation design:
  - ✓ 3m x3m planting, 6 ha/species x 3 species = 18 ha

[3] Firstly, the 6 ha of untested (1st gen.) seed orchard will be established. Then, based on the genetic information provided from progeny test plantation, relatively inferior trees will be removed at the untested seed orchard through so called 'genetic thinning'. This repeated genetic thinning will make the untested seed orchard get improved in terms of its genetic superiority. After 6-7 years later, when the trees start to produce seeds at the improved orchard, the seedlings will be produced from those seeds to be planted at demonstration forest.

✓ It will start to establish from 2019, after seed collection from the selected trees through the first genetic thinning, and more specific planting design will be made when the sites are confirmed by 2024.

4.1.8. Silvicultural management in genetic resources conservation forest (200 ha)

- Weeding: 4 times/year x 3 years
- Pruning: 2 times/10 years
- Measuring and monitoring
- Protection from forest fires by constructing firebreak lines

4.2. Capacity building

In addition to the joint propagation test and joint field survey to select plus trees, KFRI will cooperate with IRD for the training as well during the initial stage of a long-term tree breeding plan, in particular, the training for the IRD technical staffs in the ROK and Cambodia. The trainings to be implemented by KFRI will cover the introduction to tree breeding, progeny test plantation and seed orchard etc. The training courses for the IRD technical staffs on tree breeding are illustrated as follows:

4.2.1. Training for the IRD technical staffs on tree breeding

A. Training in the ROK: 4 trainees x 5 days x 2 times

No.	Theme	Schedule	Funded by
1	- Introduction to tree breeding - Practical guide on field survey for plus tree selection	Sep-Nov	KFRI
2	- Progeny test plantation and seed orchard	Feb. 2016	KFRI
3	**- Monitoring and data collection/management**	**Q3, 2016**	**AFoCo**
4	**- Maintenance and protection of the sites**	**Q1, 2017**	**AFoCo**

B. Training in Cambodia: 4 Korean experts x 5 days x 1 times

No.	Theme	Schedule	Funded by
1	- Joint experiments on vegetative propagation	Dec. 2015	KFRI
2	- Joint field survey for plus tree selection	Dec. 2015	KFRI
3	**- Propagation (seedlings production)**	**Q1, 2016**	**AFoCo**
4	**- Planting design/planting/labeling/signboard/edge**	**Q3, 2016**	**AFoCo**

4.2.2. Education program on the restoration techniques and tree breeding

No.	Theme
1	- Tree breeding system
2	- Restoration techniques (measuring/monitoring/data analysis)
3	- Forest fire protection

4.2.3. Public awareness on forest protection

No.	Theme
1	- Protection on the established progeny test plantation and seed orchard (e.g. patrolling system set-up)
2	- Forest fire protection

4.2.4. Publication of textbook on tree breeding in Cambodia (English/Khmer)

In 2020, the IRD will publish the textbook on tree breeding in Cambodia in both English and Khmer language, based on the experiences and knowledge obtained over the duration of implementation.

5. Project office

The two (2) project offices including a meeting room will be located in the IRD, Phnom Penh and Khun Ream Forest Research Station, Siem Reap Province. In addition, the research materials and publications will be displayed.

6. Equipment

In implementation of Restoration Component of AFoCo Landmark Program in Cambodia, it is necessary to secure some office supplies, such as computer, copying machine and printing machine etc. In addition, as for the field survey for plus tree selection, the relevant field equipment is necessary. The details of equipment to be purchased are listed below:

Table 2. List of equipment to be purchased

No.	Item	Model/Standard	Qty.
1	Desktop computer	Samsung DM500T4A-A53 (4th Generation Intel, i5 Processor, windows 8.1, 8GB memory, 1TB hard drive) + 23' Monitor	2
2	Laptop computer	Samsung NT930X2K-KY4 (Intel CORE M, windows 8.1, 4GB memory, SSD 256GB, 15' display)	2
3	Copying machine (A4 + cartridge)	Samsung CLX-9201 (415x500x980mm, multi tray, 4800dpi)	1 set
4	Printing machine (A4 + cartridge)	Cannon LBP7664Cdn (415x500x350mm, multi tray, 9600dpi)	1 set
5	Scanner	Cannon CS-9000F (270x480x111mm, 9600dpi, scan: 7sec.)	1
6	AVR	SM 5000 Live	2 set
7	GPS	Garmin Oregon (3' display, 3.2 megapixel, 7,000 points, memory 850MB)	4
8	Tent	Kovea (4 persons, one touch)	4
9	Telescope	PF-65ED (caliber 65mm, magnifying 19.5, waterproof)	2

10	Height-measuring rod	Max. height: 8m (folded: 1.42m), weight: 1.95kg	4
11	Haglof laser vertex hypsometer	CSP Forestry (93x63x72mm, 243g, height: 0-999m, laser: 46cm-700m)	1
12	Vernier calipers	Mitutoyo 530-101	4
13	Other field survey equipment	e.g. chain saw, measurement etc.	
14	Camera	Nikon D (2,400 megapixel, shutter speed 1/8,000 sec.)	2
15	Pruning saw/cutter	BOSCH KEO (saw length 150mm, max cut diameter 80mm)	5 set
16	Grass cutter	Gardena/Wolfgarten products	10
17	Car	KIA Mohabi (2,959 cc, diesel, 260 hp, 10.3km/L) or Ford	1
18	Motorbike	Honda (125 cc)	1
19	Nursery management equipment	e.g. fertilizer, irrigation equipment, shade net etc.	

7. Organizational structure

Over the course of implementation of Restoration Component of AFoCo Landmark Program in Cambodia, the public officials (i.e. IRD/FA staffs) will not be paid from its project budget. Instead, the external staffs will be paid: one (1) administration/finance staff, one (1) consultant, one (1) field project coordinator, two (2) nursery staffs and four (4) patrolling staffs. The organizational structure in implementation is as follows:

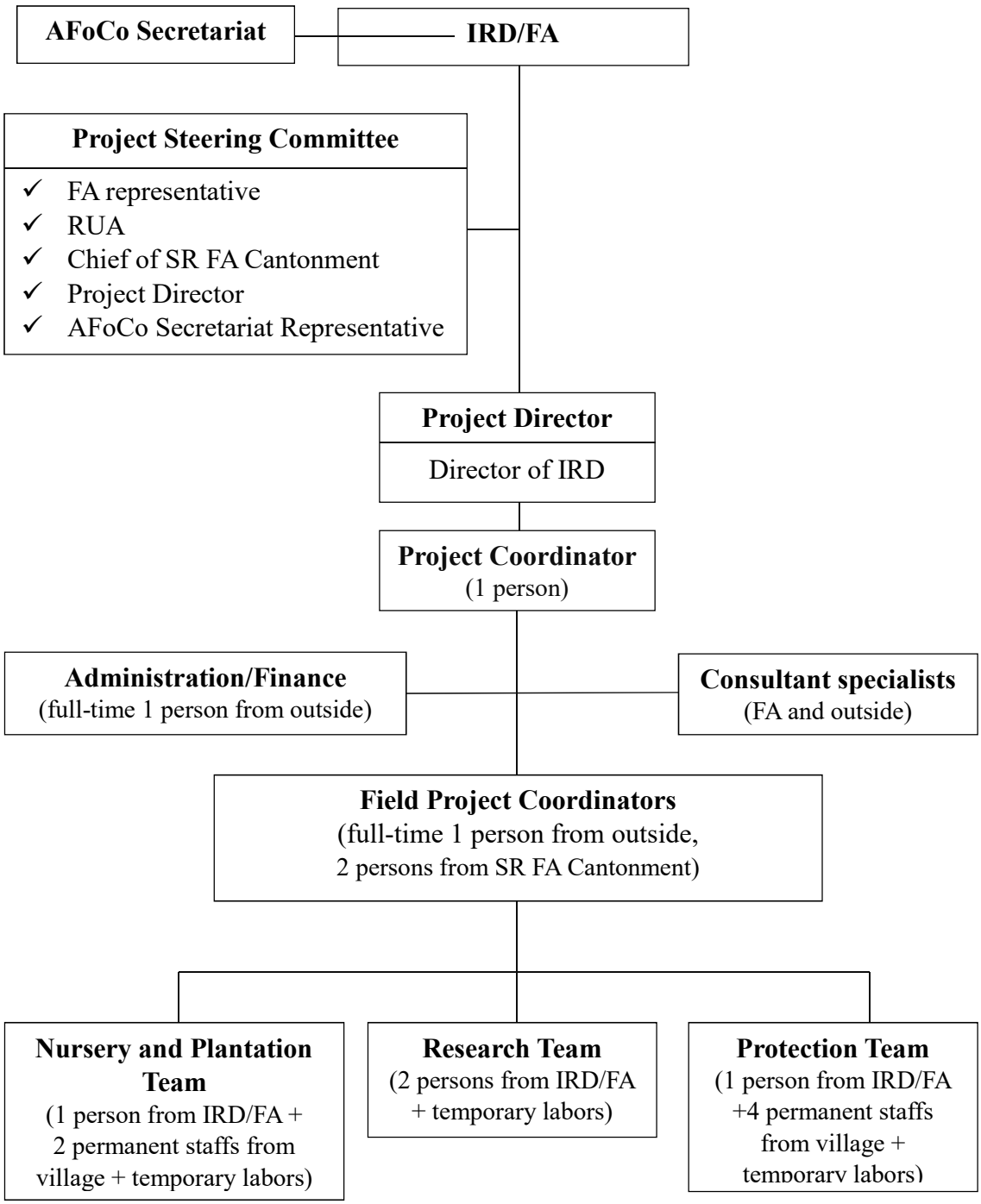


Figure 6. Organization structure in implementation in Cambodia

8. Time schedule

8.1. Annual time schedule

Activities	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
01. Inception workshop[4]										
02. Establishment of progeny test plantation (24 ha)										
03. Establishment of seed orchard (6 ha)										
04. Establishment of demonstration forest (18 ha)										
05. Silvicultural management (200 ha)										
06. Education and training										
07. Publication of textbook										
08. Equipment supply										
09. Report										
10. Dissemination workshop										

[4] IRD hoped to start the project this year for the administrative process to secure the land for the project site, as well as for acquisition of necessary equipment for the field survey for plus tree selection.

8.2. Time schedule by detailed activities

8.2.1. KFRI (USD 50,000 for June 2015~June 2016)[5]

Activities	2015						2016	
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
1. Preliminary experiments on vegetative propagation for 3 species								
1-1. Korean expert's visit to Cambodia (for technical advice)								
2. Educational training in the ROK (1)								
2-1. Introduction to tree breeding/plus tree selection								
3. Plus tree selection								
3-1. Korean experts' visit to Cambodia (joint field survey)								
4. Collecting seeds/scions[6]								
4-1. *Dalbergia cochinchinensis*								
4-2. *Pterocarpus macrocarpus*								
5. Educational training in the ROK (2)								
5-1. Progeny test plantation/seed orchard								

[5] It is necessary to be agreed between the AFoCo Secretariat and KFRI for this plan.

[6] The seeds/scions of the other species among 3 species, that is *Dipterocarpus intricatus*, will be collected in April~May 2016 with the AFoCo budget, in accordance with the flowering/seed collection calendar (FA, 2008).

8.2.2. AFoCo

Activities	2016				'17	'18	'19	'20	'21	'22	'23	'24	'25
	Q1	Q2	Q3	Q4									
1. Start of the project													
1-1. Inception workshop													
2. Progeny test plantation (24 ha)													
2-1. Collecting seeds													
2-2. Seedling production													
2-3. Land preparation													
2-4. Planting													
2-5. Labeling/Signboard/Fencing													
2-6. Weeding													
3. Seed orchard (6 ha)													
3-1. Collecting seeds/scions													
3-2. Seedling production													
3-3. Land preparation													
3-4. Planting													
3-5. Labeling/signboard/fencing													
3-6. Weeding													

3-7. Fertilizer													
3-8. Pruning													
4. Demonstration forest (18 ha)													
4-1. Collecting seeds													
4-2. Seedling production													
4-3. Land preparation													
4-4. Planting													
4-5. Labeling/signboard/fencing													
5. Silvicultural management in genetic resources conservation forest (200 ha)													
5-1. Weeding													
5-2. Pruning													
5-3. Measuring and monitoring													
5-4. Protection from forest fire (fire break lines)													
6. Education & Training													
6-1. Training in Cambodia (technical staffs)													
6-2. Training in Korea (technical staffs)													
6-3. Local training for villagers													
6-4. Education for undergraduate students													
7. Publication of text book													
7-1. Writing/editing													

7-2. Design/publication													
8. Report													
8-1. Interim report													
8-2. Final report													
9. Closure of the project													
9-1. Dissemination workshop													

9. Budget plan

9.1. Annual budget plan

(Unit: USD 1,000)

Activities	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total
01. Inception workshop	30	-	-	-	-	-	-	-	-	-	**30**
02. Progeny test plantation	86.64	7.68	7.68	7.68	-	-	-	-	-	-	**109.68**
03. Seed orchard	23.04	1.92	1.92	2.52	-	-	-	-	0.6	-	**30**
04. Demonstration forest	-	-	-	-	-	-	-	-	11.25	119.75	**131**
05. Silvicultural management	37	37	37	15	5	5	5	5	15	5	**166**
06. Education & Training	32.28	16.72	4	4	4	4	4	2	2	2	**75**
07. Publication of textbook	-	-	-	-	10	-	-	-	-	-	**10**
08. Facility operating cost	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	**144**
09. Equipment	85.52	-	-	-	-	-	-	-	-	-	**85.52**
10. Dissemination workshop	-	-	-	-	-	-	-	-	-	40	**40**
11. Report	-	-	-	-	10	-	-	-	-	20	**30**
12. Personnel expenses	31.68	31.68	31.68	31.68	31.68	31.68	31.68	31.68	31.68	31.68	**316.8**
13. Project management	31	31	31	29	29	29	29	16	16	16	**257**
14. Contingency	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	**75**
Total	**379.06**	**147.9**	**135.18**	**111.78**	**111.58**	**91.58**	**91.58**	**76.58**	**98.43**	**256.33**	**1,500**

9.2. Budget plan by detailed activities

9.2.1. Inception workshop (Cambodian 40 persons + Korean 6 persons, 1 day in Phnom Penh + 2 days in Siem Reap)

(Unit: USD)

Activities	Qty.	Calculation	**Total**
01. Inviting people	46	[Cambodia] Category B: 1 person x [USD 160 (DSA/3 days) + USD 100 (flight from PP to SR)] = USD 260 Category C: 10 persons x [USD 130 (DSA/3 days) + USD 100 (flight from PP to SR)] = USD 2,300 Category D: 14 persons x [USD 100 (DSA/3 days) + USD 100 (flight from PP to SR)] = USD 2,800 Category D: 15 persons x USD 25 (DSA/1 day) = USD 375 Category D: 15 persons x USD 90 (DSA/2 days) = USD 1,350 [Korea] Category B: 6 persons x [USD 300 (DSA/3 days) + USD 100 (flight: int'l + domestic)] = USD 7,200	**14,285**
02. Honorarium	20	20 persons x USD 200 = USD 4,000	**4,000**
03. Dinners	10	46 persons x USD 30 x 2 times = USD 2,760	**2,760**
04. Workshop preparation		USD 8,955	**8,955**
Total			**30,000**

9.2.2. Progeny test plantation (24 ha)

(Unit: USD)

Activities	Qty.	Calculation	**Total**
01. Seedling production (at least 12,000)	15,000	USD 0.5/seedlings x 15,000 seedlings = USD 7,500	**7,500**
02. Land preparation (Feb~June 2016)		USD 2000 x 12ha = USD 24,000	**24,000**
03. Planting (3x3, July to September))		USD 25 x 12 days x 12 ha = USD 3,600	**3,600**
04. Labeling	1,200	USD 0.6 (1m wooden pole + name tag) X 300 trees X 4 = USD 720	**720**
05. Signboard	4	[1 big board with photo zone, roof etc. x USD 1000] + [3 small board x USD 100] = USD 1,900	**1,900**
06. Weeding	12	USD 80 x 12 ha x 4 times x 3 years = USD 11,520	**11,520**
07. Fencing			
* pole	1,200	USD 1.5/pole x 1200 = USD 1,800	**1,800**
* wire		2400m x USD 25/100m x 3 lines = USD 1,800	**1,800**
* labor		USD 2,000/12ha	**2,000**
08. Duplication of progeny test forest (01~07)		Sum (01~07)	**54,840**
Total			**109,680**

9.2.3. Seed orchard (6 ha)

(Unit: USD)

Activities	Qty.	Calculation	**Total**
01. Seedling production (at least 1,200)	1,500	USD 0.5/seedlings x 500 seedlings x 3 species = USD 750	**750**
02. Land preparation		USD 2000 x 3ha = USD 6,000	**6,000**
03. Planting (5x5)	3	USD 25 x 8 days x 3 ha = USD 600	**600**
04. Labeling	300	USD 0.6 (1m wooden pole + name tag) X 300 trees = USD 180	**180**
05. Signboard	4	[1 big board with photo zone, roof etc. x USD 1000] + [3 small board x USD 90] = USD 1,270	**1,270**
06. Weeding	12	USD 80 x 3 ha x 4 times x 3 years = USD 2,880	**2,880**
07. Fertilizer	1	150kg/ha x 3 ha x USD 0.5/kg = USD 225 (→ USD 220)	**220**
08. Pruning	2	USD 100/ha x 3 ha x 2 times/10 years = USD 600	**600**
09. Fencing			
* pole	600	USD 1.5/pole x 600 = USD 900	**900**
* wire		1200m x USD 25/100m x 3 lines = USD 900	**900**
* labor		USD 700/3ha	**700**
10. Duplication of progeny test forest (01~09)		Sum (01~09)	**15,000**
Total			**30,000**

9.2.4. Demonstration forest (18 ha)

(Unit: USD)

Activities	Qty.	Calculation	**Total**
01. Seedling production (at least 18,000)	22,500	USD 0.5/seedlings x 22,500 seedlings = USD 11,250	**11,250**
02. Land preparation (Feb~June 2016)		USD 4200 x 18ha = USD 75,600	**75,600**
03. Planting (3x3 July to September)		USD 50 x 12 days x 18 ha = USD 10,800	**10,800**
04. Signboard	9	[3 big board setting. x USD 3000] + [6 medium board x USD 200] = USD 10,200	**10,200**
05. Fencing			
* pole	2,500	USD 1.5/pole x 2500 = USD 3,750	**3,750**
* wire		2200m x USD 25/100m x 3 lines = USD 1,650	**1,650**
* labor		USD 2500/6ha x 18 ha = USD 7,500	**7,500**
06. Establishment of park items (road, bench etc.)		USD 10,250	**10,250**
Total			**131,000**

9.2.5. Silvicultural management (200ha)

(Unit: USD)

Activities	Qty.	Calculation	**Total**
01. Weeding	12	Diesel (USD 80 x 100 ha = USD 8,000) x 4 times x 3 years = USD 96,000	**96,000**
02. Pruning	2	USD 100/ha x 100 ha x 2 times/10 years = USD 20,000	**20,000**
03. Measurement and monitoring		USD 1,500 x 2 times/year x 10 years = USD 30,000	**30,000**
04. Protection from forest fire (constructing firebreak lines)		USD 2,000/year x 10 years = USD 20,000	**20,000**
Total			**166,000**

9.2.6. Education and training

(Unit: USD)

Activities	Qty.	Calculation	**Total**
01.Training in Cambodia	2	Korean experts (2) x 5 days	**15,560**
02. Training in Korea	2	4 trainees x 5 days, Korean experts (5)	**25,440**
03. Public awareness for villagers	10	USD 2,000 x 1 time/year x 7 years = USD 14,000	**14,000**
04. Education program for students		USD 2,000 x 10 students = USD 20,000	**20,000**
Total			**75,000**

9.2.7. Facility operating cost

(Unit: USD)

Activities	Qty.	Calculation	**Total**
01.Movable (car, tractor, pumping, generator)		USD 600/month x 12 months x 10 years = USD 72,000	**72,000**
02.Office equipment (printing/copying machine, computer)		USD 300/month x 12 months x 10 years = USD 36,000	**36,000**
03. Tissue culture lab		USD 300/month x 12 months x 10 years = USD 36,000	**36,000**
Total			**144,000**

9.2.8. Equipment

(Unit: USD)

Activities	Qty.	Calculation	**Total**
01. Desktop computer	2	USD 1,500 x 2 = USD 3,000	**3,000**
02. Laptop computer	2	USD 1,000 x 2 = USD 2,000	**2,000**
03.Copying machine (A4 box + cartridge)	1	USD 3,000	**3,000**
04. Printing machine (A4 box + cartridge)	1	USD 1,500	**1,500**
05. Scanner	1	USD 300	**300**
06. AVR	2	USD 2,000 x 2 = USD 4,000	**4,000**
07. GPS	4	USD 500 x 4 = USD 2,000	**2,000**
08. Tent	4	USD 200 x 4 = USD 800	**800**
09. Telescope	2	USD 1,000 x 2 = USD 2,000	**2,000**
10. Height-measure rod	4	USD 400 x 4 = USD 1,600	**1,600**
11. Haglof laser vertex hypsometer	1	USD 2,500	**2,500**
12. Venier calipers	4	USD 20 x 4 = USD 80	**80**
13. Other field survey equipment	1	USD 5,000	**5,000**
14.Camera	2	USD 1,000 x 2 = USD 2,000	**2,000**
15.Pruning saw/cutter	5	USD 300 x 5 = USD 1,500	**1,500**
16. Car	1	USD 38,000	**38,000**
17. Grass cutter (including spare knife)	10	USD 100 x 10 = USD 1,000	**1,000**
18. Notorbike	1	USD 2,000	**2,000**
19. Nursery management equipment	1	USD 13,240	**13,240**
Total			**85,520**

9.2.9. Personnel expenses (only for the person who is from outside of FA)

(Unit: USD)

Activities	Qty.	Calculation	**Total**
01. Administration/finance (permanent)	1	USD 500/month x 12 months x 10 years = USD 60,000	**60,000**
02. Consultant specialist	1	USD 300/month x 12 months x 10 years = USD 36,000	**36,000**
03. Field project coordinator (permanent)	1	USD 1,200/month x 12 months x 10 years = USD 144,000	**144,000**
04. Nursery staff (permanent)	2	USD 120/month x 12 months x 10 years x 2 persons = USD 28,800	**28,800**
05. Patrolling staff (permanent)	4	USD 100/month x 12 months x 10 years x 4 persons = USD 48,000	**48,000**
Total			**316,800**

9.2.10. Project management

(Unit: USD)

Activities	Qty.	Calculation	**Total**
01. Phnom Penh ~ Siem Reap (DSA+Transportation)		USD 1,000/month x 12 months x 10 years = USD 120,000	**120,000**
02. Consultation fee for the experts		[USD 3,000 x 3 years] + [USD 1,000 x 7 years] = USD 16,000	**16,000**
03. Honorarium		[USD 300 x 10 persons x 7 years] + [USD 600 x 5 persons x 7 years] = USD 42,000	**42,000**
04. Incentive		USD 200 x 15 persons x 10 years = USD 30,000	**30,000**
05. Meeting		USD 4,000 x 7 years = USD 28,000	**28,000**
06. Public awareness		USD 3,000 x 7 years = USD 21,000	**21,000**
Total			**257,000**

9.3. Budget plan by time schedule

(Unit: USD 1,000)

Objectives	Activities		2016				2017				'18	'19	'20	'21	'22	'23	'24	'25
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4								
Opening ceremony and inception workshop (Jan)			30															
Sub Total			**30**															
Progeny Test Plantation (24 ha)	01. Seedling production		5	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02. Land preparation (Feb~June 2016)		12	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	03. Planting (3x3, July to September)		-	-	3.6		-	-	-	-	-	-	-	-	-	-	-	-
	04. Labeling		-	-	0.48	0.24	-	-	-	-	-	-	-	-	-	-	-	-
	05. Signboard		-	-	-	1.9	-	-	-	-	-	-	-	-	-	-	-	-
	06. Weeding		-	-	-	-	0.96	0.96	0.96	0.96	3.84	3.84	-	-	-	-	-	-
	07. Fencing																	
	* pole		-	-	1.2	0.6	-	-	-	-	-	-	-	-	-	-	-	-
	* wire		-	-	1.2	0.6	-	-	-	-	-	-	-	-	-	-	-	-
	* labor		-	-	1.3	0.7	-	-	-	-	-	-	-	-	-	-	-	-
	08. Duplication of progeny test forest (01~07)		17	14.5	6.58	5.24	0.96	0.96	0.96	0.96	3.84	3.84	-	-	-	-	-	-
Sub Total			**109.68**															
Seed Orchard	01. Seedling production		0.5	0.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02. Land preparation		-	-	4	2	-	-	-	-	-	-	-	-	-	-	-	-

(6 ha)	03. Planting (5x5 July to September)		-	-	0.6		-	-	-	-	-	-	-	-	-	-	-	-
	04. Labeling		-	-	0.12	0.06	-	-	-	-	-	-	-	-	-	-	-	-
	05. Signboard		-	-	-	1.27	-	-	-	-	-	-	-	-	-	-	-	-
	06. Weeding		-	-	-	-	0.24	0.24	0.24	0.24	0.96	0.96	-	-	-	-	-	-
	07. Fertilizer		-	-	0.15	0.07	-	-	-	-	-	-	-	-	-	-	-	-
	08. Pruning		-	-	-	-	-	-	-	-	-	0.3	-	-	-	-	0.3	-
	09. Fencing																	
	* pole		-	-	0.6	0.3	-	-	-	-	-	-	-	-	-	-	-	-
	* wire		-	-	0.6	0.3	-	-	-	-	-	-	-	-	-	-	-	-
	* labor		-	-	0.45	0.25	-	-	-	-	-	-	-	-	-	-	-	-
	10. Duplication of progeny test forest (01~09)		0.5	0.25	6.32	4.45	0.24	0.24	0.24	0.24	0.96	1.26	-	-	-	-	0.3	-
Sub Total			**30**															
Demonstra-tion Forest (18 ha)	01. Seedling production		-	-	-	-	-	-	-	-	-	-	-	-	-	-	11.25	-
	02. Land preparation (Feb~Jun 2016)		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	75.6
	03. Planting (3x3, July to September)		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10.8
	04. Signboard		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10.2
	05. Fencing		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	* pole		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.7

																		5
	* wire		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.65
	* labor		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.5
	06. Establishment of park items (road, bench)		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10.25
Sub Total			**131**															
Silvicultural Management (200 ha)	01. Weeding		8	8	8	8	8	8	8	8	32	-	-	-	-	-	-	-
	02. Pruning		-	-	-	-	-	-	-	-	-	10	-	-	-	-	10	-
	03. Measurement and monitoring		1.5		1.5		1.5		1.5		3	3	3	3	3	3	3	3
	04. Protection from forest fire		2	-	-	-	2	-	-	-	2	2	2	2	2	2	2	2
Sub Total			**166**															
Education & Training	01.Training in Cambodia		7.78	-	7.78	-	-	-	-	-	-	-	-	-	-	-	-	-
	02. Training in Korea		-	-	12.72	-	12.72	-	-	-	-	-	-	-	-	-	-	-
	03. Public awareness for villagers		-	-	-	2	-	-	-	2	2	2	2	2	2	-	-	-
	04. Education program for students		-	-	-	2	-	-	-	2	2	2	2	2	2	2	2	2
Sub Total			**75**															
Textbook	01. Writing/editing		-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-
	02. Design/publication		-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-
Sub Total			**10**															
Facility Maintenance	01.Movable (car, tractor, pumping, generator)		1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2
	02. Office equipment (printing/copying machine,		0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6

	computer)																	
	03. Tissue culture lab		0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Sub Total			**144**															
Equipment	01. Desktop computer		3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02. Laptop computer		2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	03.Copying machine (A4 box + cartridge)		3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04. Printing machine (A4 box + cartridge)		1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05. Scanner		0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06. AVR		4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07. GPS		2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08. Tent		0.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09. Telescope		2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10. Height-measure rod		1.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11. Haglof laser vertex hypsometer		2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12. Venier calipers		0.08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	13. Other field survey equipment		5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	14.Camera		2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	15.Pruning saw/cutter		1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	16. Car		38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	17. Grass cutter (including spare knife)		1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

	18. Motorbike		2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	19. Nursery management equipment		13.24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sub Total			**85.52**															
Closing ceremony and dissemination workshop			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	40
Sub Total			**40**															
Report			-	-	-	-	-	-	-	-	-	-	10	-	-	-	-	20
Sub Total			**30**															
Personnel Expenses	01. Administration/finance		1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	6	6	6	6	6	6	6	6
	02. International consultant		0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
	03. Field project coordinator		3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4
	04. Nursery staffs		0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	2.88	2.88	2.88	2.88	2.88	2.88	2.88	2.88
	05. Patrolling staffs		1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8
Sub Total			**316.8**															
Project Management	01. Phnom Penh ~ Siem Reap (DSA + Transportation)		3	3	3	3	3	3	3	3	12	12	12	12	12	12	12	12
	02. Consultation fee for the experts		0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	3	1	1	1	1	1	1	1
	03. Honorarium		1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	6	6	6	6	6	-	-	-
	04. Incentive		-	-	-	3	-	-	-	3	3	3	3	3	3	3	3	3
	05. Meeting		1	1	1	1	1	1	1	1	4	4	4	4	4	-	-	-
	06. Public awareness		0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	3	3	3	3	3	-	-	-
Sub Total			**257**															

Contingency (5% of total budget)		1.875	1.875	1.875	1.875	1.875	1.875	1.875	1.875	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
Sub Total		**75**															
TOTAL (1,500)		**379.06**				**147.9**				**135.18**	**111.78**	**111.58**	**91.58**	**91.58**	**76.58**	**98.43**	**256.33**

10. Future Plan (potential)

(i) Demonstration forest

- The demonstration forest (18 ha) will start to be established from 2019. It will resemble a park with roads and benches, which can be developed as the recreational forest for ecotourism purposes. The demonstration forest trail can also be included to the tourism package of Angkor Wat and nearby local village visits.

(ii) Genetic resources conservation forest in Khun Ream, Siem Reap

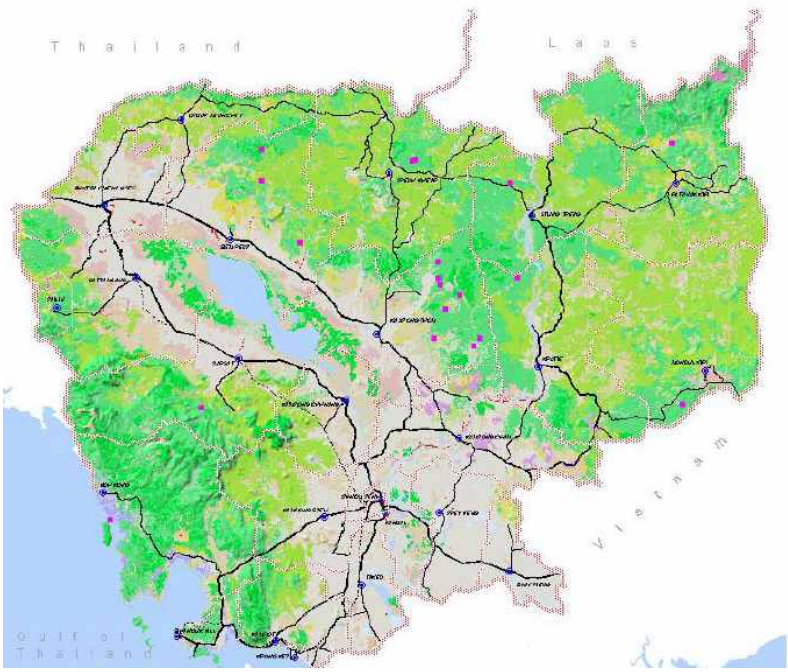
- The illustrated book for Flora of Genetic Resources Conservation Forest in Khun Ream, Siem Reap can be published in cooperation with Korea National Arboretum (KNA).
- An arboretum for major timber species can be established in cooperation with KNA.

Annex. Information on the selected 3 targeted major timber species

The 3 targeted major timber species were selected by FA for tree breeding, which are *Dalbergia cochinchinensis*, *Pterocarpus macrocarpus* and *Dipterocarpus intricatus,* and the major information is described below:

1. Dalbergia cochinchinensis

- **Family**: Fabaceae
- **Wood classification in Cambodia**: 1st Class (Luxury)
- **Distribution and habitat**: Native to Indochina, this tree species is shade-tolerant when young. It usually occurs sparsely in open and semi-deciduous forests from 400-500 m, and prefers deep sand, clays or calcareous soils (Khorn, 2002). This rosewood prefers uniform rainfall that ranges from 1,200-1,650 mm per year. This species requires high amounts of light to thrive, and is drought tolerant and able to grow on most soils (DFSC, 2000). Within Cambodia, this species is found in Kampong Thom, Preah Vihear, Ratanakiri, Pursat, Siem Reap, Kratie, Koh Kong, Stung Treng and Modulkiri (Khorn, 2002; see the map below).



Source: Cambodia Tree Seed Project (CTSP), 2002

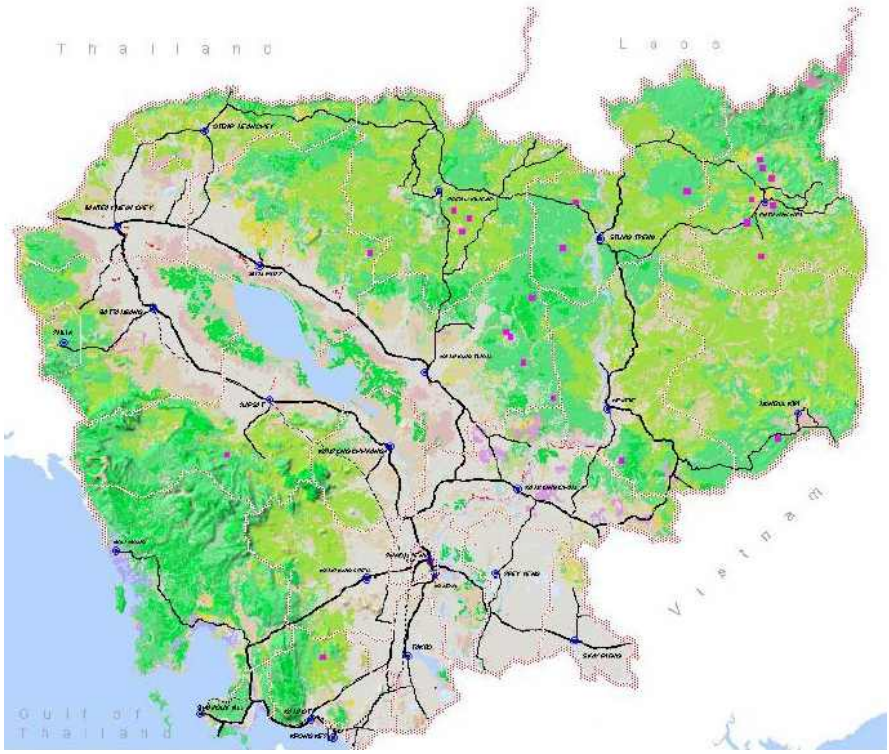
- **Botanical description**: *Dalbergia cochinchinensis* is a large evergreen tree species,

reaching from 25-30 m in stature and producing boles to 60 cm dbh. This species is easily recognized by its light yellow bark and ramified canopies. Its wood is hard, durable and red-colored with prominent and beautiful veins. The plant is identified by its pinnate leaves, which generally have 7-9 leaflets, the upper-most of which is the largest (CTSP, 2001).

- **Flowering and fruiting habit**: Flowering occurs in May and June while fruits ripen in November and December (DFSC, 2000).
- **Fruit and seed description**: The fruit is long and tapering and generally contains 1 or 2 seeds. The weight of 100 seeds is 18.5 g, and 100 g of seed can provide up to 54,000 propagules (CTSP, 2001).
- **Seed collection**: The seed is mature when the pod dark brown in color. The pods are often collected as soon as the color turns from green to yellow, so as to minimize insect predation. The branches are cut or shaken, and the seed collected from tarpaulin spread on the ground (DFSC, 2000).
- **Seed handling**: After collection, the pods are dried in the sun for about three days. The dry pods remain closed and must be cut into one-seeded pieces. A seed thresher could probably extract the seeds effectively, but care should be taken not to damage the seeds (DFSC, 2000).
- **Sowing and germination**: The plant can also be propagated by air layering, cutting, and grafting. Stands can be established through natural regeneration or using planting stock (DFSC, 2000).
- **Uses**: Wood can be exported at a high price, and is used for making high quality furniture, art handicrafts and musical instruments. The root base and root can also be used for high quality art handicrafts (CTSP, 2001).
- **Current status**: *Dalbergia cochinchinensis* has been found in concessions (commercial forest), protected areas and various regions in the Northern Highlands of Cambodia. Illegal cutting in many areas has resulted in few and sparse populations of this species. This presents difficulties in finding germplasm sources within and outside protected forests and national parks. In 2002, Cambodia Tree Seed Project (CTSP) funded by DANIDA in cooperation with FA had a meeting on the Forest Gene Conservation Strategy and defined *Dalbergia cochinchinensis* as a priority species in need of immediate conservation intervention and appropriate protection. This species is protected by Cambodian Forestry Law No. 35.
- **IUCN Classification**: VU Alcd (threatened)

2. *Pterocarpus macrocarpus*

- **Family**: Fabaceae
- **Wood classification in Cambodia**: 1st Class (Luxury)
- **Distribution and habitat**: This species is a common constituent of tropical deciduous forests in Cambodia, Lao PDR and Viet Nam (FIPI, 1996). In Cambodia this species usually occurs in dense deciduous or cleared forests up to 700 m (Dy Phon, 2000). The species is rarely found in primary forests. The tree is often mixed with many other species, but often occurs as a dominant plant. It is a light-demanding, drought tolerant tree that is suitable for well drained, light textured soils with shallow depths and little humus (Khorn, 2002). It is found in Kampong Thom, Stung Treng, Preah Vihear, Rattanakiri, Kratie, Siem Reap, Kampot, Pursat and Mondulkiri (Khorn, 2002; see the map below).



Source: Cambodia Tree Seed Project (CTSP), 2002

- **Botanical description**: As a medium to large tree, it reaches from 25-30 m high and produces boles from 70-90 cm in dbh (CTSP, 2001). The wood is durable and medium-textured, and the color is a rich red-purple. The trunk is straight, and the bark is dark brown. Leaves are compound, alternate, bi-pinnate with densely hairy on the petiole. The leaflets are glossy-green above and dull below. About 20 densely reticulate pairs of nerves from 7-9 mm long are evident on both surfaces of the leaf. Leaves are shed during the dry season (FIPI, 1996).

- **Flowering and fruiting habit**: Small, yellow, aromatic flowers are concentrated on axillary flowering stalks from 10-15 cm long. These are bell-shaped and covered with dense brown hairs. Flowering and fruiting times of this species varies according to regions and climates. In Cambodia, flowers generally appear in March-April, and fruit ripens from September-October (FA, 2000).
- **Fruit and seed description**: The fruit is surrounded by thin wing which is flat and round, and around 8 cm in diameter. It has 1-2 chambers and bears 1-2 seeds in each (FIPI, 1996).
- **Seed collection**: Seeds are usually collected from the tree or from the ground after shaking the branches. In the seed-source areas, the ground is usually cleared and sometimes burnt to prepare for seed collection. To ease collection, a cover can be spread out on the ground. The optimal time of collection is reached when the majority of fruit has turned brown and dry. Maturity can be confirmed by a cutting test (DFSC, 2000).
- **Seed handling**: To reduce bulk, the wings needs to be removed in the field. The fruit is then dried in the sun. Seed extraction is very labor-intensive (DFSC, 2000).
- **Sowing and germination**: Seeds start to germinate after 5 days and final germination is usually 80% successful. After 11 days, only 74% of the seeds of wingless fruits germinate. Natural regeneration is best in dry, open forest and in disturbed areas. Vegetative propagation by cutting is possible (DFSC, 2000).
- **Use**: This species is used in making luxury furniture, cabinetwork, art handicrafts, musical instruments and flooring (FIPI, 1996).
- **Current status**: In Cambodia, *Pterocarpus macrocarpus* occurs mostly in the North. Most timber is harvested from natural forests and the species is suffering from over-exploitation and agricultural expansions (CTSP, 2001). Its natural habitats are being destroyed, and the species is facing the possibility of extinction if protection measures are not taken. In 2002, CTSP funded by DANIDA in cooperation with FA had a meeting on the Forest Gene Conservation Strategy and defined *Dalbergia cochinchinensis* as a priority species in need of immediate conservation intervention and appropriate protection. This species is protected by Cambodian Forestry Law No. 35.
- **IUCN Classification**: VU Ald (threatened)

3. *Dipterocarpus intricatus*

- **Family**: Dipterocarpaceae
- **Wood classification in Cambodia**: 2nd Class
- **Distribution and habitat:** Native to Indochina, this species is commonly found in open dry deciduous forests in Cambodia, Lao PDR, Viet Nam, Thailand and Malaysia that is periodically flooded plain forests. It is also found in the transition zone between dry evergreen and deciduous forests. In Cambodia it occurs in open forests with other dipterocarps, in dense forests or secondary forests where *Pinus merkusii* is more or less abundant. It is also found in degraded open forest (shrub savanna) and closed moist evergreen forests where it grows with *Shorea cochinchinensis*. This species is mostly found in plains but also found in hilly areas up to 500 m, and generally it grows on sandy soils.

- **Botanical description**: This species is a large deciduous tree which reaches 20-30 m in height and 60-80 cm in dbh. Twigs and buds are covered with many star-shaped grey yellow to brown hairs. The bark surface is grey brown or dark brown and longitudinally splitted into pieces. The leaves are simple; old leaves fall in the end of December, and young leaves appear in the beginning of January.
- **Flowering**: Flowering starts in December to January.
- **Fruiting**: Fruiting occurs from March to April.
- **Seed collection**: The seeds can be collected from late March to May.
- **Silviculture and management:** In case of natural regeneration, the seedlings of this species can persist in the forest for years under heavy shade. In the first 2 years, major openings in the canopy are not tolerated, but after the seedlings are well established, the canopy can be opened up and to speed up to growth. In case of plantation, when the seedlings are planted in open areas, shade trees are used, such as *Acacia auriculiformis* and *Paraserianthes falcataria*.
- **Use**: As for wood, this species is appreciated for the construction of carts and houses. As for non-wood, the grey brown resin is collected from the tree and used for the preparation of torches.
- **IUCN Classification**: LR Ic (least concern)

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