

**REPORT ON
IDENTIFICATION OF SEED SOURCES OF PRIORITY SPECIES IN
NATURAL FORESTS RESULTED IN THE LIST OF SEED SOURCES,
TREE SPECIES AND SEED SUPPLIERS**



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ABRIVIATION

CSO	: Clonal Seed Orchard
CTSP	: Cambodian Tree Seed Project
FA	: Forestry Administration
MoE	: Ministry of Environment
NTFP	: Non-Timber Forest Product
RGC	: Royal Government of Cambodia
SSO	: Seedling Seed Orchard

1. INTRODUCTION

Hundreds of millions of poor people live within or adjacent to forest areas. There is evidence that forest products are harvested in significant quantities by a large number of households across virtually all forest types in developing countries (Scoones *et al.* 1992; Pérez & Arnold 1996; Neumann & Hirsch 2000; Cunningham 2001). Like many other countries in the world, Cambodian forests play a very important role in providing forest goods such as non-timber forest products (NTFPs), construction material, traditional medicine, and services such as reduction of soil erosion, regulating hydrological cycle, and atmospheric regulation. Depending on different forest types and location, the contribution of local livelihood ranging from 21 to 34 percent.

The forests of Cambodia has been classified into different forest types, including evergreen, semi-evergreen, deciduous, and other forest (regrowth, stunted forests, mangrove forests, inundated forests, forest plantations bamboo, rubber and Palm oil plantation). However, the same with many other developing countries, forest in Cambodia has been decreased from 11.1 million hectares or 61 percent in 2002 to 10.1 million hectares or 57 percent in 2010 (FA, 2011). This remaining forest consisted of 25 percent deciduous forest, 19 percent evergreen forest, 7 percent semi-evergreen forest, and 6 percent other forests. Deforestation in Cambodia involves with different drivers including migrant encroachment, conversion of forest land to crop land or other plantations, conversion to settlement, forest fire, and illegal logging. Furthermore, it is observed that many remaining forest areas have been degraded in which capacity in providing good quality of goods and services have been decreased. Boung and Phoeun (2005) reported that up to 6 million ha of the forests are considered as degraded in 2003 and need rehabilitation.

The Royal Government of Cambodia (RGC) has stated in the national forest programme to maintain forest cover up to 60 percent of the total land area (RGC, 2010). To meet this target objective, different mechanisms have been put in place, including forest restoration and tree planting programme. Up to date forest restoration activities have been carried out within a small area using different methods such as assisted natural regeneration and enrichment planting while tree planting activities have been active during the last few years in which, from 2009 to 2013, more than 86,668 ha was planted by all stakeholder using different tree species while more than 40,000,000 seedling was produced and distributed to local people for tree planting programme (Sam Ol, 2015).

Even trees have been planted, most of seedlings used in tree planting programme came from unclassified seed source, thus, growth performance is relatively low with poor stem form which is low in economic value while survival rate is also low. To address these challenges, Forestry Administration (FA) has allocated many forest areas as seed production area for seedling production and tree improvement purposes.

Up to 2003, Forestry Administration (FA) through Cambodia Tree Seed Project (CTSP) established 11 seed production areas/seed sources in natural forests with 17 indigenous tree species. These species were classified as rare and endangered and need to be conserved either in-situ or ex-situ (Boung & Phoeun, 2005). Seed source has at least three characteristics, i) seed source produces plants with better genetic qualities than seed from unselected seed source in terms of adaptability, vigor, stem and crown characteristics and pest resistance, ii) geographic location of parent trees are known, and information is available to the grower about the soil and climate of the parent stand and iii) selected seed provides a reliable source of well-adapted plants at modest cost (John et al., 2007). Furthermore, seed production area would provide direct benefit in term of monetary term to the forest owner such as local community as incentive for their forest protection and management.

The project on “Promotion of forest rehabilitation in Cambodia and Vietnam through demonstration models and improvement of seed supply system” aims at promoting reforestation programme and rehabilitation of degraded forests in Cambodia through demonstration of good practice of forest restoration and improvement of tree seed supply system was launched in December 2014. In order to achieve this goal, a series of interventions were identified which include identification of seed sources of priority species in natural forest resulted in the list of seed source, tree species and seed suppliers. The identification of seed sources and seed suppliers aims at establishing the seed supplied chain which resulted in the ease of access to tree seeds, and wider participation of stakeholders in reforestation programmes.

2. OBJECTIVE

The objective of this consultancy is to prepare technical procedure for identification of seed sources in natural forest and potential seed collectors/suppliers. This assignment also includes updating the “Seed Source Information Sheet, where possible, developed by CTSP to fit with the current development and compiling/reviewing a list of priority tree species suitable for planting.

3. CRITERIA FOR SEED SOURCE IDENTIFICATION

Establishment of seed source areas can be made in natural forests (identified seed source) which constitutes *in-situ* establishment. It can also be established in plantations of open pollinated progenies of selected trees species which represents *ex-situ* establishment (Sheikh, 2007). There are two main criteria, species and area identification, of considerations when selecting a seed source in natural forests or plantations.

3.1 Identification of species

There are thousands of tree species in Cambodia. However, only a very small number of species

has been used in tree planting. Identification of priority species for promotion in reforestation is a pre-requisite for the tree seed program. It layouts the boundaries within which the tree seed program has to concentrate on. Selection of priority species for planting and gene conservation was made in the early 2000s by the Cambodia Tree Seed Project (CTSP and DFW, 2000; CTSP and FA, 2003). It has been 15 years since the first list of priority species of Cambodia was identified, and the list has never been updated even though the forestry sector, particularly the reforestation program, has undergone through significant development. The current report reviews the published and unpublished reports on tree species used in reforestation programme in Cambodia with considerations of the following criteria:

- Species of high-value timber (construction and industry): This group of species is mainly planted for economic benefits. Species have been selected to fulfill the demands of local and international markets for timbers. Trees with good stem form and high wood quality are selected for planting. This group of species is selected from the families Dipterocarpaceae and Leguminosae. For pulp industry, desirable wood cellulose quality is preferred and some exotic species are widely planted.
- Species produce NTFP: In this group, timber is not the main purpose of tree planting, but other products and services, such as fire wood, edible fruits, vegetables, resin, fodders, shading and beautification, animal shelters, soil improvement and watershed protection. Local communities usually prefer this group of species. Some fast growing species, such as *Acacia*, *Eucalyptus*, *Cassia siamea*, and *Leucaena leucocephala*, are planted by local communities for production of fuel wood and poles. Some species with good looking forms or bears colorful flowers, such as *Cassia fistula* and *Cassia javanica*, are planted for street/road ornamentations. Local communities also plant many species of bamboos and rattans for vegetable, poles for light constructions and implements, handicrafts, and prevention of soil erosion.
- Species of conservation value: A list of 31 tree species was proposed for genetic conservation through planting (CTSP and FA, 2003). These are the group of species that are rare in natural habitats and those that have been over logged, particularly of the high-value timber species. Planting of these species is contributing toward conservation of their genetic resources.
- Seeds/wildings of high potential value for reforestation/rehabilitation: In some areas where high- value tree species could not survive, tree species of high potential for reforestation programme would be an advantage for forest restoration purposes.
- Wide distribution in natural habitats: This would provide high survival rate for tree planting in most of geographical areas in the whole country.
- History of producing fruits: This is important not only for seed collection but also for the healthy mother tree.

Although different tree species serves different planting purposes, many trees provide multiple products. For example, *Dipterocarpus alatus* is mainly planted for timber (commercial purpose),

but during its life span it also produces resin which is a valuable NTFP. The priority tree species suggested for tree planting are shown in Annex 1.

3.2 Identification of areas

- Seed sources should be located in the best natural forest areas with good stocking and good health. In view of this requirement, priority should be given to the following considerations: i) Virgin forests; ii) Accessible at present and future; iii) Typical for the species selected; iv) Of sufficient stocking in order to reasonably provide for cross pollination among neighbors over time and space.

With the current conditions of the forested areas in Cambodia, it may not be possible to find a virgin forest. For examples, it is not possible to find virgin forest. However, many of these criteria.

- Where virgin forest areas are more difficult to reach, establishment of seed sources can also be considered in degraded forest areas where adequate and matured stands of the target species are available.
- Where seed sources are to be established from planting of seedlings of selected mother trees of good phenotypes, the areas need to be in the permanent forest estate suitable for the particular species or species mixture. Wherever possible establishment of such areas should be in very accessible locations in which the time taken to reach them will be very minimal (Sheikh, 2006).
- Seed sources should be secured not only for the present but also in the future uses. This refers to the areas that are allocated and used as permanent forest estate and not be converted to other land use. Management of seed sources would involve with cost and time consuming if the stand is still young. Thus, protected forests and community forests that already approved by MAFF, and protected areas would be ideal for locating seed sources.

3.3 Seed trees/mother trees

It is well known in the tree seed sector that each seed source should have a minimum of 25 unrelated mother trees (or which are located at least 50 m apart) of a particular species. With the current conditions of natural forests, this criterion has proved difficult to meet for many tree species in the suggested list of priority species, particularly those of high-value timber species, such as *Azizia xylocarpa*, *Dalbergia cochinchinensis*, *D. oliveri*, *Hopea odorata*, *Dipterocarpus alatus* and *Pterocarpus macrocarpus*. A field survey to Kampong Thom and Preah Vihear provinces during this consultancy proved this. This is simply because the forests are degraded. In order to overcome this difficulty, it is suggested that seeds from a seed source should be mixed with those from other seed sources within the same or similar ecological zones. This will reduce the risk of using seeds from related trees.

Selection of mother trees is of important consideration for high-value timber species. Mother trees are selected based on the phenotypic traits of trees. Trees with straight boles, lack of low branching, and well spread crowns are of desirable characteristics. Good characteristics of

mother trees are discussed in detail in a manual published by the Cambodia Tree Seed Project titled “Farmers’ Tree Planting Manual” which is available in Khmer and English at http://www.treeseedfa.org/tree_planting.htm. After selection, mother trees should be marked with identification numbers so that seed collectors will only collect seeds from the marked trees. However, it is not always recommended to mark mother trees for seed collection as this will result in the short supply of seeds during the period between mast fruiting years, which last from two to five years for the majority of tree species. Considering the scarcity of mother trees and the mast fruiting years, sometimes seeds can be collected from phenotypic inferior trees providing the trees do not have disease infections. In natural forests, a tree with inferior stem form does not necessary mean it has genetic inferiority than its neighbors. For trees that are planted for NTFP, such as fuel wood, fruits, resin and vegetables, and environmental services, such as shelter, soil improvement and soil erosion control, the phenotypic characteristic is not the main concern.

4. SEED SOURCE INFORMATION SHEET

Seed source information sheet, hereinafter referred to as “information sheet”, is a form used for recording information related to a seed source, such as site conditions, ownership and seed collection. The information sheet was developed by CTSP in 2003, but it has never been updated to meet the current development. Changes were made to every sub-titles of the former information sheet with particular attentions given to ownership and seed collection. As indicated in Section 3.2, priority areas for locating seed sources are given to protected forests and community forests as these forest areas are more secured than other types of forest estates. Methods of seed collection, particularly the requirement of supporting tools and equipment, are of main concern as the ease of seed collection and availability of seeds is a prerequisite in seed supplying system. The revised “Seed source information sheet” is shown in Annex 2.

6. CONCLUSION AND RECOMMENDATION

To meet the need of tree plantation programme, seed source identification is a must. This report provides updated criteria for seed source identification. Seed source information sheet is also updated and priority tree species for tree planting programmes were identified. The list of priority species is of useful when identifying seed sources in natural forests and plantations. Stakeholders, private sector, community, and government, can select tree species from the list for planting to meet the need of their end uses.

Considering the growing competition of land uses from other sectors, it is recommended to locate “seed sources in natural forests” in the forested areas with some forms of protection, such as, community forests, community protected areas, protected forests and protected areas, even though those forests are relatively degraded.

Natural forests may not be reliable seed sources for many high-value timber species any more. It is recommended that urgent measures have to be taken to establish “seed production areas” (outside of natural forests) to make sure the availability of seeds for future reforestation programs.

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Annex 1: Summary of tree species prioritized for tree planting programme in Cambodia

No	Scientific name	Local name	Family	Purposes			
				Construction or industry	Community uses	Non-timber products	Conservation
1	<i>Acacia auriculiformis</i>	Acacia sleuk tauch	Mimosaceae	√	√		
2	<i>Acacia intsii</i>	Thmear	Mimosaceae		√	√	
3	<i>Aegle marmelos</i>	Phnao	Rutaceae			√	
4	<i>Afzelia bijuga</i>	Pkaypreuk (Kokoh Prek)	Caesalpiniaceae	√	√		
5	<i>Afzelia xylocarpa</i>	Beng	Caesalpiniaceae	√	√		√
6	<i>Albizia lebbek</i>	Chress	Mimosaceae	√	√	√	√
7	<i>Albizia lebbekoides</i>	Chamriek	Mimosaceae	√	√		
8	<i>Alpinia officinaricum</i>	Mdeinh	Zingiberaceae			√	
9	<i>Anida cordifolia</i>	Kvav	Rubiaceae	√	√		
10	<i>Anisoptera costata</i>	Phdeak	Dipterocarpaceae	√			√
11	<i>Aquilaria crassna</i>	Chann krasna	Thymeleaceae		√	√	√
12	<i>Artocarpus altilis</i>	Knol prey	Moraceae		√		√
13	<i>Azadirachta indica</i>	Sdav	Meliaceae		√	√	
14	<i>Arundinaria falcate</i>	Reussey Ping Pong	Bambusa	√	√	√	
15	<i>Arundinaria pusilla</i>	Reussey Prich	Bambusa			√	
16	<i>Bambusa multiplex</i>	Reussey Srok Chen	Bambusa	√	√	√	
17	<i>Bambusa blumeana</i>	Reussey Roliek	Bambusa		√	√	
18	<i>Bambusa vulgaris</i>	Reussey Keo	Bambusa		√	√	
19	<i>Bambusa bambos</i>	Reussey Kley	Bambusa		√	√	
20	<i>Bambusa procera</i>	Reussey Tgnor	Bambusa		√	√	
21	<i>Dendrocalamus giganteus</i>	Reussey Prey	Bambusa		√	√	
22	<i>Dendrocalamus membranaceus</i>	Reussey Srok	Bambusa	√	√	√	
23	<i>Gigantochloa albociliata</i>	Reussey Kley Srok	Bambusa		√	√	
24	<i>Bouea oppositifolia</i>	Mak prang	Anacardiaceae		√	√	
25	<i>Calamus bousigonii</i> Becc.	Phdao Arech	Palmae		√	√	
26	<i>Calamus erinaceus</i>	Phdao Teuk Pray	Palmae		√	√	
27	<i>Calamus godefroyi</i>	Phdao Toeuk	Palmae		√	√	
28	<i>Calamus guruba</i>	Phdao Achmoarn	Palmae		√	√	
29	<i>Calamus lateralis</i>	Phdao	Palmae		√	√	
30	<i>Calamus rudentum</i>	Phdao Dambang	Palmae		√	√	
31	<i>Calamus palustris</i>	Phdao Chheang	Palmae		√	√	
32	<i>Calamus siamensis</i>	Phdao Toeuk	Palmae		√	√	
33	<i>Calamus sp.</i>	Phdao Teuk Kmom	Palmae		√	√	
34	<i>Calamus salicifolius</i>	Lpeak	Palmae		√	√	
35	<i>Calamus tetradactylus</i>	Phdao Changret	Palmae		√	√	
36	<i>Calamus viminalis</i>	Phdao Krek	Palmae		√	√	
37	<i>Daemonorops jenkinsiana</i>	Phdao Em	Palmae		√	√	
38	<i>Korthalsia laciniosa</i>	Phdao Kraham	Palmae		√	√	
39	<i>Myrialepis paradoxa</i>	Phdao Reussey	Palmae		√	√	
40	<i>Plectocomia elongata</i>	Phdao Reussey Yeak	Palmae		√	√	
41	<i>Plectocomia pierreana</i>	Phdao Reussey Msao	Palmae		√	√	
42	<i>Plectocomiopsis geminiflora</i>	Phdao Teang Oa	Palmae		√	√	
43	<i>Callophyllum sp.</i>	Pha' Ong	Guttiferae	√	√		
44	<i>Canaugaz latifolia</i>	Chker Sraing	Annonaceae			√	√
45	<i>Cassia fistula</i>	Loeung Reach	Caesalpiniaceae			√	

46	<i>Cassia garretiana</i>	Hai San	Caesalpiniaceae	√			√
47	<i>Cassia grandis</i>	Oy Moy	Caesalpiniaceae		√	√	
48	<i>Cassia javanica</i>	Bau Prek	Caesalpiniaceae	√	√		
49	<i>Cassia siamea</i>	Angkanh	Caesalpiniaceae		√	√	
50	<i>Casuarina equisetifolia</i>	Sngav	Casuarinaceae	√		√	
51	<i>Chukrasia tabularis</i>	Voiryorng	Meliaceae	√			√
52	<i>Cinnamomum cambodianum</i>	Tepirou	Lauraceae		√	√	√
53	<i>Cinnamomum cassia</i>	Chheu Eem	Lauraceae			√	
54	<i>Combretum quadrangulare</i>	Sangke	Combretaceae		√	√	
55	<i>Crypteronia paniculata</i>	Traptum	Crypteronaceae	√			
56	<i>Dalbergia bariensis</i>	Neang Nuon	Papilionaceae	√			√
57	<i>Dalbergia cochinchinensis</i>	Kranhoung	Papilionaceae	√			√
58	<i>Dalbergia cultrata</i>	Kranhoung Sva	Papilionaceae	√			
59	<i>Delonix regia</i>	Kngaok	Caesalpinaceae			√	
60	<i>Dialium cochinchinensis</i>	Kro lanh	Caesalpiniaceae		√	√	
61	<i>Dillenia ovata</i>	Phlou	Dilleniaceae			√	
62	<i>Diospyros beaudii</i>	Angkat khmao	Ebenaceae	√			√
63	<i>Diospyros nitida</i>	Chheu phleung	Ebenaceae			√	√
64	<i>Diospyros pilosantha</i>	Tra Yeung	Ebenaceae	√			√
65	<i>Dipterocarpus alatus</i>	Chheuteal teuk	Dipterocarpaceae	√		√	√
66	<i>Dipterocarpus costatus</i>	Chheuteal bangkuoy	Dipterocarpaceae	√		√	
67	<i>Dipterocarpus intricatus</i>	Trach	Dipterocarpaceae	√	√	√	
68	<i>Dipterocarpus obtusifolius</i>	Tbeng	Dipterocarpaceae	√	√	√	
69	<i>Dipterocarpus tuberculatus</i>	Khlong	Dipterocarpaceae	√	√	√	
70	<i>Dipterocarpus turbinatus</i>	Chheuteal preng	Dipterocarpaceae	√		√	
71	<i>Dracaena cambodiana</i>	Angredek	Agavaceae			√	
72	<i>Eucalyptus camaldulensis</i>	Prengkyl	Myrtaceae	√	√		
73	<i>Eugenia Jambolana</i>	Pring	Myrtaceae		√	√	
74	<i>Fagraea fragrans</i>	Tatrao	Loganiaceae	√	√		√
75	<i>Gardenia ankoriensis</i>	Daykhla	Rubiaceae			√	√
76	<i>Garcinia hanburyi</i>	Runk	Garcinia		√	√	√
77	<i>Hopea helferi</i>	Koki daik	Dipterocarpaceae				√
78	<i>Hopea ferrea</i>	Koki thmor	Dipterocarpaceae	√			√
79	<i>Hopea odorata</i>	Koki msav	Dipterocarpaceae	√	√	√	√
80	<i>Hopea pierrei</i>	Koki khsach	Dipterocarpaceae	√	√		
81	<i>Khaya senegalensis</i>	Kroabek	Meliaceae	√	√		
82	<i>Lagerstroemia calyculata</i>	Sralao	Lythraceae	√	√		
83	<i>Lagerstroemia floribunda</i>	Trabek prey	Lythraceae			√	
84	<i>Lagerstroemia ovalifolia</i>	Sra loa chou	Lythraceae	√	√		
85	<i>Leucoena lecocephala</i>	Kanthumthet	Mimosaceae		√	√	
86	<i>Litchi sinensis</i>	Kou len	Sapindaceae		√	√	
87	<i>Mangifera indica</i>	Svay prey	Anacardiaceae	√	√	√	
88	<i>Melaleuca cajuputi</i>	Smach	Myrtaceae		√	√	
89	<i>Melanorhea laccifera</i>	Kreul	Anacardiaceae			√	√
90	<i>Moringa oleifera</i>	Morum	Moringaceae		√	√	
91	<i>Nephelium xerospermum</i>	Se mornn	Sapindaceae			√	
92	<i>Ochna harmandii</i>	Angkea sil	Ochnaceae			√	
93	<i>Peltophorum ferrugineum</i>	Trosek prey	Caesalpiniaceae	√	√		
94	<i>Peltophorum dasyrachis</i>	Trosek	Caesalpiniaceae	√	√		
95	<i>Pinus merkusii</i>	Sral sleuk pi	Pinaceae	√		√	√
96	<i>Psychotria revesii</i>	Anntung sar	Rubiaceae			√	
97	<i>Pterocarpus macrocarpus</i>	Thnorng	Papilionaceae	√			√
98	<i>Rhizophora spp.</i>	Korngkang	Rhizophoraceae		√		

99	<i>Samanea saman</i>	Channkiri	Mimosaceae		√		
100	<i>Sandoricum indicum</i>	Kampingreach	Meliaceae			√	
101	<i>Sesbania grandisflora</i>	Angkeardey	Papilionaceae		√	√	
102	<i>Shorea cochinchinensis</i>	Popel	Dipterocarpaceae	√	√	√	√
103	<i>Shorea hypochrea</i>	Lumbor	Dipterocarpaceae	√			√
104	<i>Shorea obtusa</i>	Phchoek	Dipterocarpaceae	√			
105	<i>Shorea guiso</i>	Chorchong	Dipterocarpaceae	√	√	√	√
106	<i>Sindora cochinchinensis</i>	Kokoh	Caesalpiniaceae	√	√		√
107	<i>Sterculia lychnophora</i>	Samrorng	Sterculiaceae		√	√	√
108	<i>Tamarindus indica</i>	Ampil	Caesalpiniaceae		√	√	
109	<i>Tectona grandis</i>	Maysac	Verbenaceae	√			
110	<i>Terminalia chebula</i>	Sramar	Combretaceae			√	
111	<i>Terminalia corticosa</i>	Pram Damleung	Combretaceae	√			
112	<i>Terminalia negrovenulosa</i>	Prea phnao	Combretaceae			√	
113	<i>Terminalia tomentosa</i>	Chhlik	Combretaceae	√			
114	<i>Terrietia javanica Blume</i>	Daunchem	Sterculiaceae	√			√
115	<i>Toona sureni</i> (Blume) Merr.	Chhamchha	Meliaceae	√			
116	<i>Vatica astrotricha</i>	Chramas	Dipterocarpaceae		√		
117	<i>Vatica philastreana</i>	Tralath	Dipterocarpaceae	√			
118	<i>Xylocarpus xylocarpa</i>	Sokram	Mimosaceae	√	√	√	√

Priority tree species for conservation purposes

No.	Scientific name	Khmer reading	Family name	Conservation	
				National	Regional
1	<i>Afzelia xylocarpa</i> (Kurz) Craib.	Beng	Caesalpiniaceae	5	EN
2	<i>Albizia lebek</i> (L.) Benth	Chress	Mimosaceae	4	-
3	<i>Anisoptera costata</i> Korth	Phdeak	Dipterocarpaceae	2	EN
4	<i>Aquilaria crassna</i> Pierre	Chann krasna	Thymeleaceae	5	CR
5	<i>Artocarpus altilus</i>	Knol prey	Moraceae	1	-
6	<i>Canaugaz latifolia</i> (hook.f.& Thomson) Finet & Gagnep	Chker sraing	Annonaceae	4	-
7	<i>Cassia garretiana</i> Craib	Hai San	Caesalpiniaceae	2	-
8	<i>Chukrasia tabularis</i>	Voir yorng	Meliaceae	5	-
9	<i>Cinnamomum cambodianum</i> H.	Tepirou	Lauraceae	4	-
10	<i>Dalbergia bariensis</i> Pierre	Neang Nuon	Papilionaceae	5	EN
11	<i>Dalbergia cochinchinensis</i> Pierre	Kra Nhoung	Papilionaceae	5	VU
12	<i>Diospyros bejaudi</i> Lecomte	Angkat khmao	Ebenaceae	4	-
13	<i>Diospyros nitida</i> Merr.	Chheu phleung	Ebenaceae	3	-
14	<i>Diospyros pilosantha</i> Blanco	Tra Yeung	Ebenaceae	3	-
15	<i>Dipterocarpus alatus</i> Pierre	Chheuteal teuk	Dipterocarpaceae	2	EN
16	<i>Fagraea fragrans</i> Pit.	Ta trav	Loganiaceae	5	-
17	<i>Gardenia ankoriensis</i> Pit.	Day khla	Rubiaceae	5	-
18	<i>Garcinia hanburyi</i> (Hook. F.	Runk	Garcinia	4	-
19	<i>Hopea helferi</i> (Dyer) Brandis	Koki daik	Dipterocarpaceae	4	CR
20	<i>Hopea ferrea</i>	Koki thmor	Dipterocarpaceae	3	EN
21	<i>Hopea odorata</i> Roxb.	Koki msav	Dipterocarpaceae	4	LR
22	<i>Melanorhea laccifera</i> Pierre	Kreul	Anacardiaceae	2	-
23	<i>Pinus merkusii</i> Jungh. et de Vries	Sral sleuk pi	Pinaceae	4	VU
24	<i>Pterocarpus macrocarpus</i> Kurz	Thnorng	Papilionaceae	5	VU
25	<i>Shorea cochinchinensis</i> Pierre	Popel	Dipterocarpaceae	4	EN
26	<i>Shorea hypochrea</i> Hance	Lum bor	Dipterocarpaceae	3	CR
27	<i>Shorea guiso</i>	Chor chong	Dipterocarpaceae	3	-

28	<i>Sindora cochinchinensis</i> H.Baill	Ko koh	Caesalpiniaceae	3	-
29	<i>Sterculia lychnophora</i> Hance	Samrorng	Sterculiaceae	4	-
30	<i>Terrietia javanica</i> Blume	Daun chem	Sterculiaceae	3	-
31	<i>Xylia dolabriformis</i> Benth	So kram	Mimosaceae	3	-

Note: For national ranking, 5 is high priority, 1 is less priority (Source: Priority Tree Species of Cambodia, CTSP 2003)
For regional, EN is endanger, VU is vulnerable, LR, low risk (Source: Threatened Plant of Southeast Asia, Threatened Plant Species across AMS, www.aseanbiodiversity.org).

Annex 2: Seed source information sheet

Revised from (Sloth and Thea, 2002)

1. Seed source information sheet

A. Species information

Seed source reference no. (one letter and three digits): _____
Species (botanical) name: _____ Common name: _____
Species code: _____

B. Location description

Province: _____ District: _____ Commune: _____ Village: _____
Name of map and sheet no: _____
UTM: _____
Datum: _____

C. Seed source classification

<input type="checkbox"/> Unclassified, <input type="checkbox"/> Identified stand, <input type="checkbox"/> Selected stand, <input type="checkbox"/> Seed production area, <input type="checkbox"/> Seed orchard.
--

D. Type and ownership

<input type="checkbox"/> Protected forest/areas, <input type="checkbox"/> special management area, <input type="checkbox"/> Community forest, <input type="checkbox"/> Community protected area, <input type="checkbox"/> Protected area.
Seed source owner: <input type="checkbox"/> Government, <input type="checkbox"/> Private, <input type="checkbox"/> Community, <input type="checkbox"/> Other _____
Name and address of the owner/administrator:
1. _____
2. _____
Collection permit: <input type="checkbox"/> not required, <input type="checkbox"/> Required, indicate authority: _____
Collection contact: 1) _____
Collection contact: 2) _____

E. Site conditions

Terrain:
Flat: <input type="checkbox"/>
Slope: <input type="checkbox"/> Flat or gentle (<5%), <input type="checkbox"/> Intermediate (5-10%), <input type="checkbox"/> Steep (11-45%), <input type="checkbox"/> Very steep.
Aspect: <input type="checkbox"/> North, <input type="checkbox"/> East, <input type="checkbox"/> South, <input type="checkbox"/> West, <input type="checkbox"/> Variable.
Soil type: _____
Texture: <input type="checkbox"/> Sand, <input type="checkbox"/> Loamy sand, <input type="checkbox"/> Sandy loam, <input type="checkbox"/> Loam, <input type="checkbox"/> Silty clay, <input type="checkbox"/> Clay.
Other information: _____

F. Climatic records or estimates (optional)

Nearest weather station: _____ Latitude: _____ N Longitude : _____ E
 Altitude: _____ masl Distance from site (km) _____ number of years recorded: _____
 Rainfall regime: Raining season (months): _____

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall												
Temperature (°C)												

Mean annual rainfall (mm): _____ mean annual temperature (°C): _____
 Length of dry season (<60mm) (indicate months): _____
 Absolute min temperature (°C) and month: _____
 Absolute max temperature (°C) and month: _____

G. Stand description

Total area: _____ ha,
 Of target species only:
 No. of tree per ha: _____ No. of tree in stand (estimated) : _____
 Height range (m): _____, DBH range (cm): _____
 Type of stand: Natural undisturbed, Logged/secondary forest, Plantation (year) _____
 Unknown
 Maturity of stand: Young stand, Mature stand, Over mature stand.
 Species composition: Single species Associated species, please indicate: _____

 Inventory data attached Yes/No: _____

H. Assessment of seed trees in the stand

Stem form: _____, Branching: _____, Growth: _____, Health: _____ Other, please indicate: _____

 Score codes: 1. Very poor, 2. Poor, 3. Fair, 4. Good, 5. Very good

I. Seed production

Flowering period: Start _____ Peak _____
 Fruit ripening period: Start _____ Peak _____
 Harvestable fruit production (estimated): _____ kg
 Estimated price of seed on site: _____ US\$/kg

J. Seed collection:

Seed collection methods: _____

Climbing, Collecting from the ground, Shacking branches, Cutting seed cluster,
 Other, please specify: _____

Seed collection tools and equipment needed: _____

Name of nearest village: _____

Distance from seed source to nearest village: _____

Available seed collectors: _____

Labour cost per person per day (range): _____ (US\$)

K. Accessibility

Name and distance nearest to provincial office: _____

Accessibility:
 2WD, 4WD: _____ (km), Motorcycle: _____ (km), Walking distance: _____ (km)

Other information: _____

L. Other information (management, recommendation, observation, etc.)

2. Map of seed sources (typographical or sketch map)

3. Guidance for seed source information sheet

a) Species information

Seed source reference number: This number consists of a letter (A, B, C etc) referring to the ecological region and a 3-digit identification number (e.g. 001) referring to a particular seed source.

Species. For established seed sources there will usually be only one species for a particular seed source. However, natural forest may, within a limited area, be seed sources for several species. In that case a form should be filled for each species, but the seed source reference number may be the same.

Common name normally refers to Cambodian name unless other is specifically stated.

Species code is an 8 digit code consisting of the first 4 letters of the genus name and the first 4 letters of the species name, all written in capital letters e.g. ACACMANG for *Acacia mangium*.

b) Location description

Position must be read from global position system (GPS) based on satellite position. Only one measurement is usually necessary for each seed source. It should preferably indicate the center of the seed source. Datum is also needed to be mention in the data sheet.

c) Seed Source Classification

The seven main categories are:

1. Unclassified. If there is doubt of which region a seed source belongs, it should be ticked in this box
2. Identified stand. A stand of trees of a defined provenance, which has been identified for seed collection, but there has been no comparison with other stands to assess relative quality of phenotypes.
3. Selected stand. A stand of trees selected due to its high frequency of superior trees, which are above average for the region.
4. Seed production area: A stand of trees from a plantation or a natural forest which have been upgraded by removal of inferior phenotypes and managed for early and abundant seed production e.g. by pruning and thinning.
5. Seed orchard: A seed source established from selected clones or families, isolated and managed for high quality seed production.
6. Seedling Seed Orchards (SSO). Seed orchard raised from seeds from selected plus trees, which have been tested / are under testing in progeny trials and inferior genotypes removed / to be removed before seed collection. Family identity is maintained and the orchard is designed so as to minimize inbreeding.
7. Clonal Seed Orchards (CSO). Seed orchards raised from clonal material such as grafting, budding or air-layering. Clonal identity is maintained and the orchard is designed so as to minimize selfing. CSO is normally combined with a separate progeny trial.

There should be only one tick-out-box of seed source class except from the subgroups of seed orchards, where one of the 3 classes is ticked together with the Seed Orchard.

d) Type and Ownership

The main types of forest classification in Cambodia are:

- Forest Concessions are forest tracts that are under or have been under concessionary management.
- Protected forests/forest reserve is forests with restricted use, e.g. allocated for watershed, or general environmental protection.
- Special mgt areas are forests set aside for conserving nature and the natural forest ecosystem, the forest fauna and/or genetic resources.
- Private forests are all forest owned by individuals or private companies, or who have long-term lease on land tenure.
- Community forests/Community protected area are forests under the formal management of local communities .
- Protected areas are natural forests with strongly restricted use, established for e.g. protection of wildlife and biodiversity of plants. The parks are owned by central government and administered by MoE.

Owner of seed source refers to the tenure right; name of person or authority is indicated

Collection contact: Refer to contact number or person to be contacted for seed supply

e) Climatic records

The provincial weather station best representing the climate at the site of seed source is selected; that is usually the closest station, but in case of hilly or mountainous terrain a distant mountain station may better reflect the climate at the site than a closer lowland station.

All stations in Cambodia have a distinct rainy and dry season, with rainy season during the summer months.

f) Site description

Terrain: The form is self-explanatory.

Slope: Indicated in percentage, i.e. number of meters raises or falls in elevation per 100 meters horizontal. Aspect: means the main direction of slopes in hilly or mountainous terrain

Soil type: The main soil type is indicated in common terms, e.g. limestone, alluvial soil etc; texture is classified in categories according to the size of particles, the most coarse grained is sand and the most fine-grained is clay. pH is measured on representative soil samples and is indicated as a range e.g. 4.3-5.0. Soil samples are collected in the field and analyzed in the laboratory. (pH kit if possible)

g) Stand description

Total area of the seed source is indicated in hectares. Number of trees per hectare is calculated based on main spacing. Total number of trees in the stand is calculated by multiplying the two figures.

Height range of mature trees is indicated for less than 10 trees. Diameter range is indicated for the same trees.

Type of stand

- Natural undisturbed stands are all stands considered not established by humans, i.e. always indigenous species, and natural regeneration is the main dynamic of regeneration. These stands have not been logged.
- Logged/secondary stands , as above but have been logged.
- Plantations are all types of stands planted, both production forests and established seed sources. Plantations also include e.g. road, riverside and other types on non-block plantings

Maturity of the stand are categorized in three types.

- Young stands are stands largely under mature size and with small seed production.
- Mature stands have reached almost full production capacity in terms of seed.
- Over-mature stands are stands with small production due to senescence.

h) Assessment of trees in seed source. The average phenotypic appearance of the trees in the stand is assessed for 4 main characters viz. stem form, branching, growth and health. Where other characters are relevant, they should be added under 'others' (e.g. percentage of crown). The characters should be scored on a scale from 1 to 5. For grafted clonal seed orchards, assessment of phenotype is not applicable (n.a.), or it may be based on secondary information from a progeny trial, which should then be indicated.

i) Seed production

The months of flowering and fruiting is indicated.

Records on earlier fruit collection or crop assessment data forms the basic for crop production estimates. Any figure is converted into production per hectare.

j) Seed collection: This referred to collection methods, the equipment needed for seed collection, and seed collector information.

k) Accessibility

Of primary concern is the accessibility during seed collection. If this is during the rainy season, access may be impeded by flooding, which should be noted on the form. Under 'other information' should be a short description of how to reach the seed source.

l) Labor availability

Indicate name and distance to places where casual workers for collection and preprocessing are available. Note specifically if some workers have been trained or have experience in collection

m) Other information (recommendations, observations etc.)

Observations could be degree of general or selective logging, threat from local communities, recent burning, attack by insect's etc. Recommendation could be on e.g. protection and management (e.g. thinning necessary, weeding necessary or fertilization Write also any other relevant information pertaining to seed sources which has not been indicated on previous forms.

Form 2. Provincial / regional map of seed sources.

The location of each seed source is indicated on a provincial or regional map. Seed source reference number is indicated directly on the map.

