

**Part 1**  
**Country Reports**

# THE STATE OF FOREST MANAGEMENT AND CONSERVATION IN CAMBODIA

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## Introduction

Cambodia lies in the southern part of the Indochinese peninsula, between latitudes 10° and 15° N and longitudes 102° and 108° E. The country covers an area of 181,035km<sup>2</sup>, and is divided into two topographically distinct parts. The first is the central lowlands, which consist of Tonle Sap Lake, the flood plains of the Mekong River and the coastal lowlands. The second consists of the mountain ranges surrounding the central lowlands.

Cambodia has a monsoon climate with distinct wet and dry seasons. The dry season lasts from November to April, and the wet season from May to November. No rain falls during the dry season except in the highland and coastal regions. Cambodia's hydrological regime supports some of the main branches of the national economy, including agriculture, fisheries and transport. However, the potential of the Mekong and Tonle Sap Rivers, among others, for irrigation and hydroelectric power has yet to be fully explored.

Cambodia's population has grown rapidly in the past three decades, from 6.59 million people in 1973 to 9.17 million in 1992. In 1998, the population was 11.43 million people, only 15.7% of whom lived in urban areas. In the same year, the population growth rate was 2.49% and the population density about 64 people/km<sup>2</sup>.

Forests are of great importance to economic development and environmental protection in Cambodia. Before 1970, the country's forest cover was about 13.2 million hectares, or more than 73% of the national territory (Pan Leang Cheav 1972). Between 1970 and 1997 the area of forest fell to 10.8 million hectares, or 58% of the national territory (Table 1). Deforestation and forest degradation have been caused by illegal logging and rising demands for fuel wood and agricultural land, fed partly by population growth and an increasing number of development programmes.

## Institutional arrangements

The Department of Forestry and Wildlife (DFW), under the Ministry of Agriculture, Forestry and Fisheries (MAFF), is responsible for coordinating, implementing, monitoring and evaluating forest-related projects and programmes, promoting sound management practices and undertaking research to promote technical excellence in forestry practice. DFW is managed by a board of directors and organized into six offices, a forest wildlife research institute and four enterprises.

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**Table 1.** Forest area by type in 1970, 1973, 1985, 1993 and 1997 (in hectares).  
Source: GTZ/MRC forest cover monitoring project, based on Landsat satellite images (1996–97).

Forest Type	1970	1973	1985	1993	1997
<i>Dry land forest</i>	12,449,900	11,678,600	10,960,300	10,568,600	10,501,612
Evergreen	3,995,300	6,876,600	4,852,700	4,763,300	3,986,719
Mixed	2,504,000	–	1,113,000	97,300	1,505,326
Deciduous	5,296,700	4,792,900	4,367,900	4,301,200	4,056,539
Coniferous	17,800	9,300	8,200	9,800	–
Secondary	–	–	618,500	517,000	374,197
Bamboo	387,400	–	–	–	33,730
Dwarf evergreen	288,700	–	–	–	545,101
<i>Edaphic</i>	777,200	1,032,500	892,100	715,600	313,560
Flooded	681,400	937,900	795,400	370,700	219,906
Flooded secondary	–	–	28,200	259,800	20,819
Mangrove	38,300	94,600	68,500	85,100	85,100
Rear Mangrove	57,500	–	–	–	–
<b>Total</b>	<b>13,227,100</b>	<b>12,711,100</b>	<b>11,852,400</b>	<b>11,284,200</b>	<b>10,815,172</b>

DFW's mission is to establish sustainable forestry programmes to support a dynamic forest sector for Cambodia's economic growth and long-term well-being. Development activities focus on increasing forest and forest-related activities while emphasizing the multiple uses of forests. Cambodia's rural population has an acknowledged role in the development of the forest sector. Forest sector strategies articulate the need to involve rural communities in forest-based economic activity, either through small-scale forest enterprises or through protecting and enhancing biodiversity.

## Legal issues

### *Recent developments and government actions*

The Cambodian government has taken a number of steps in recent years to address problems in the forest sector. These include the preparation of a policy and legal framework for long-term sustainable management of forests. In January 1999, the government issued a declaration giving DFW sole responsibility for the forest estate. The declaration also announced a crackdown on illegal logging, ordered the police and armed forces to assist DFW in law enforcement, and banned forest clearing. Some of the results of recent initiatives include the cancellation of 12 concessions early in 1999, a reduction in illegal logging, seizures of equipment and illegally harvested logs and wildlife, and the closure of hundreds of illegal sawmills. Towards the end of 1999, the government established forest crime monitoring units with international assistance and began a review of the concession system.

### *National forest policy*

Cambodia's National Forest Policy Statement and Guidelines were formulated in consultation with all stakeholders. The policy has been updated several times to reflect the needs and interests of different groups. The policy states clearly the government's commitment to sustainable forest management, the assessment and optimal allocation of land resources, and the participation of local communities in protecting and managing forest resources. It also specifies the government's role in promoting community forestry programmes. The policy is based on the following elements (RGC/ARD1998):

- Dedicating appropriate forest areas as permanent forest estates.

- Promoting sustainable management with particular reference to conserving biodiversity and soil and water resources.
- Assuring the traditional forest use rights and privileges of communities.
- Sustaining and increasing the supply of forest products for social and economic growth.
- Enhancing the contribution of forestry to human welfare.
- Strengthening the national economy, with special reference to equitable economic development.
- Increasing the participation of local communities and the private sector in forest protection, management and improvement.
- Supporting community forestry programmes.

### ***Forest law***

MAFF, with support from the Asian Development Bank (ADB), has drafted a comprehensive forest law based on earlier drafts prepared by FAO. This law has been subject to public consultation before submission to the Council of Ministers and, subsequently, approval by both houses of Parliament. The draft law provides a comprehensive legal foundation for:

- Establishing the role and power of government agencies in forestry administration and enforcement.
- Classifying forest lands, including establishing a permanent forest estate.
- The rights and obligations of all parties involved in forest exploitation.
- Forest revenue collection.
- Private and community forestry.
- Conserving and protecting forests and wildlife.
- Forest crimes and their penalties.

### ***Forest concession management sub-decree***

A sub-decree on forest concession management was prepared after extensive consultations with non-governmental organizations, concessionaires and experts from the World Bank, ADB and FAO/UNDP. The sub-decree, which was approved in 2000, ensures the rights and privileges of local communities and related government institutions, and allows the private sector to participate in the allocation of new forest concessions, development of forest concession management plans and monitoring of logging operations. Moreover, the sub-decree requires a permanent consultative communal committee to facilitate discussions on all issues involving concessions and local communities living in or near concession areas. This measure is thought necessary to protect the subsistence and religious rights of local communities. The sub-decree also lays the foundations for improved industry performance by establishing a competitive bidding process for future concession management and planning.

### ***Code of practice for forest harvesting***

The Cambodian code of practice for forest harvesting, which was prepared under a loan from the World Bank, passed into law on 26 July 1999. The code is designed to ensure sustainable forest management in forest concession areas. It prescribes harvesting practices that protect the environment in line with the principles of sustainable development. These practices aim to protect sites of cultural significance, maintain the capacity of the forest to regenerate, improve the economic and social contributions of forestry, and ensure the health and safety of forest workers. Guidelines for implementing these practices exist in the following areas:

- Management planning systems.
- Inventories in the forest management cycle.
- Biodiversity conservation in protected forests.
- Social forestry in concession areas.
- Management of timber theft.
- Forest engineering.
- Environmental impact assessment.
- Special management areas.
- The selection of silvicultural systems and the management of wildlife habitats, water catchments and forest inventories.

### *Forest concession management*

Forest concession management is complicated by the existence of several different permit systems. The ‘collection permit’ and ‘old log permit’ systems allow private opportunists and the armed forces to carry out forestry operations with impunity outside of the formal forest concession system. Collection permits are issued with little or no technical input from DFW. In comparison with normal forest concession procedures, obtaining such permits is relatively straightforward. As a result, log production is now conducted primarily under the permit system with virtually no monitoring or enforcement of laws and regulations. In fact, a large part of log production is derived illegally from forest concession areas or from protected areas and national parks. The key issues of forest concession management are as follows:

- Concessionaires depend heavily on contractors and sub-contractors for road construction, harvesting and transport operations, but have little or no control over their working standards.
- The government lacks the institutional capacity to set up, manage, monitor and enforce forest concessions.
- A secondary forest resource allocation or ‘collection permit’ system has developed outside of the primary forest concession system.
- More than 90% of log production and trade comes from the secondary system.
- Collection permits have no technical input or quality control from DFW; nor do they cover assigned forest areas or include forest management monitoring.
- The administrative procedures of the ‘collection permit’ system are simpler and less bureaucratic than those of forest concessions.
- Collection permits can be granted to any private or public organization, or concessionaire.
- Collection permits link international firms to local industries, civilian authorities and army units at commune, district, provincial and national levels.

### *Socio-economic issues*

Cambodia has a rural economy, and about 85% of its population are farmers. Many rural inhabitants are also involved in supplementary economic activities in forests, for example tree cutting, collecting fuelwood and harvesting non-wood products such as rattan, bamboo, lianas, resins, honey, medical plants and bushmeat. These products, obtained for use or sale under traditional rights, are vital to rural livelihoods, particularly in times of drought or flooding. About 95% of rural inhabitants (and 85% of residents in Phnom Penh) depend on wood and charcoal for cooking. An estimated six million m<sup>3</sup> of wood is used every year for this purpose.

In 1999, Cambodia's gross domestic product (GDP) grew by about 6%. Average per capita incomes are about US\$300 a year. Cambodia exports rice, rubber and precious stones, but the value of imports, mainly in the form of fuel, machinery and spare parts, far exceeds that of exports.

In the natural resources sector, forestry remains one of the most important economic activities. Revenues derived from forest use in the form of royalties, export service charges (1% of f.o.b. prices), reforestation fees and other charges contribute a large share of government income. Cambodia's forests, particularly those in the Siem Reap region, also attract international tourists.

## Technical issues

### *Land use planning*

The allocation of land to private companies and groups began early in 1990. Commercial development was emphasized by leasing large areas of land to investors. By 1998, 6.5 million hectares, or 60% of Cambodia's forests, had been allocated to forest concessions. The government also granted other types of land concessions, including agricultural concessions for private rubber, cashew and oil palm plantations.

Unregulated and uncontrolled exploitation of forest concessions led to widespread misuse and illegal activities. Forest degradation became rampant, forcing the government to take drastic measures to enforce the rule of law. Since 1999, the government has cancelled nine forest concession agreements covering 12 concessions and a total area of two million hectares. These forests have been set aside as forest reserves. At present, forest concession areas cover only 4.7 million hectares, or 44% of Cambodia's forests.

Protected areas cover about 3.3 million hectares, or 18% of Cambodia's land area. There are seven national parks, ten wildlife sanctuaries, three protected landscapes and three multiple use areas (Table 2).

**Table 2.** *Protected areas in Cambodia*

Category	Number	Total Area (ha)
1. National Park	7	871,250
2. Wildlife Sanctuary	10	1,955,000
3. Protected Landscape (Cultural)	3	97,000
4. Multiple Use Areas	3	403,950
<b>Total</b>	<b>23</b>	<b>3,327,200</b>

### *Reforestation*

Reforestation has been carried out mainly on poor sites. An area of 300–400ha was planted each year between 1915 and 1972. The species used for reforestation include *Hopea odorata*, *Dipterocarpus* spp., *Tectona grandis*, *Pinus merkusii* and fast-growing fuelwood species such as *Peltophorum ferrugineum* and *Combretum quadrangulare* (Table 3).

**Table 3.** *Plantation area established between 1915 and 1972 (in hectares).*  
*Source: Chea Sam Ang (1998).*

<b>Species</b>	<b>Area</b>
Pine	225
Eucalyptus	24
Teak	2,136
Deciduous	3,085
<b>Total</b>	<b>5,470</b>

Between 1985 and 2000, DFW planted an additional area of about 10,000ha, but much of this has been damaged by fire. The main species planted are *Acacia auriculiformis*, *Eucalyptus camaldulensis*, *T. grandis* and *P. merkusii*. DFW has also encouraged local people to plant trees around their villages, mainly during National Arbour Day, but also during religious ceremonies. DFW is also actively promoting tree planting activities and awareness raising in collaboration with non-governmental organizations.

At present, DFW is working with the Japan International Cooperation Agency (JICA) to establish a reforestation training centre and an experimental forest. The purpose of this project is to provide training in forest inventory and establishment of plantation trials, and to set up a tree nursery for training and to raise seedlings for reforestation. DFW is also participating in the Indochina Tree Seed Programme (ITSP), which operates in Cambodia, Lao PDR and Vietnam. Several forestry officials have been trained in seed collection and breeding techniques, and a national seed centre is to be established in Phnom Penh.

### **Community forestry**

The Cambodian government recognizes the importance of community forestry for forest management and rural development. In addition to some donor-supported pilot projects, the government has recently formulated policies to promote community forestry, and has produced guidelines for community forestry with assistance from ADB. These guidelines are intended to provide practical strategies and operational guidance to develop community forestry in Cambodia.

The Cambodian government has received support from several donors to promote participatory forest management. However, to formulate and implement a national community forestry programme would require an investment that is beyond the means of the present government. For some time to come, therefore, further development of community forestry will depend on donor assistance.

### **Forest conservation**

A growing human population increases the demand for forest products. Deforestation and forest fragmentation are threatening many valuable plant species. Poor logging practices have caused flooding, soil erosion, reduced water quality and siltation. The main objectives of forest conservation, therefore, are to prevent soil erosion and siltation, and to conserve watershed areas.

Selective logging focuses on a few commercially desirable trees. Logging of trees with good phenotypes can result in genetic erosion and, at higher logging intensities, can endanger whole species or populations. Some of the tree species exposed to intensive logging in Cambodia include *Azelia xylocarpa*, *Pterocarpus macrocarpus*, *Dalbergia bariensis*, *Aquilaria crassna*, *Fagraea fragrans*, *Heritiera javanica* and *Hopea odorata*. Many forests in Cambodia have

recently been opened to commercial logging, but large tracts of relatively untouched forest still remain. Forest roads built by concessionaires, however, have opened forests to agricultural clearance and other human disturbances. The dangers of Cambodia's infamous mine fields apparently do little to discourage forest encroachment and clearing.

### *Flora in Cambodia*

Botanical investigations in Cambodia and other parts of French Indochina began in the latter half of the 19th century. A systematic inventory of Cambodian flora, however, has yet to be undertaken. The high mountain flora in particular is poorly known. Despite this lack of information, Dy Phon (1981, 1982) indicated that Cambodia possesses 2308 of the 8000 species described in the *Flore Générale de L'Indochine*. These belong to 852 genera in 164 families, distributed as follows:

- Gymnosperms: 7 genera, 14 species
- Monocotyledons: 219 genera, 488 species
- Dicotyledons: 626 genera, 1806 species

A taxonomic revision carried out in the past few years suggests that many more species remain to be found, and the completed list for Cambodia is expected to exceed 3000 species (Dy Phon pers. comm.). This means that at least 700 new species are waiting to be found in Cambodia, about 70 of which are assumed will be endemic.

### *Vegetation*

Forest vegetation in Cambodia is dominated by the families Dipterocarpaceae, Leguminosae, Lythraceae, Fagaceae and, in some places, Pinaceae or Podocarpaceae. Bamboos are also common in some areas. The flora of lower altitudes is typical of the Indochinese floristic provinces, whereas that of higher altitudes resembles the flora of the Indo-Malayan region (Dy Phon 1982).

Our current understanding of Cambodian flora and vegetation is based on the work of a few dedicated botanists and foresters, who concentrated on only a limited number of vegetation types and sites. Dy Phon (1970, 1971) provides the only systematic vegetation survey to cover all vascular flora. A range of forest inventories and surveys of medicinal and other useful plants have also been completed (for example see Ashton 1970; Eav Bov Bang 1970; FAO 1970; Rollét 1962, 1972a, 1972b, 1972c), but these do not include full assessments of plant resources. No studies have been made of vegetation above an elevation of 1100m (Martin pers. comm.), although Rollét (1972c) provided a cursory listing of some common genera found also at higher altitudes. Legris and Blasco (1971, 1972) and Dy Phon (1981) synthesized much of this information into a national overview of Cambodian vegetation types and their principal species.

Legris and Blasco (1972) proposed a more general classification of flora in their vegetation map of Cambodia. This is based on the classification of UNESCO (1973):

Lowland zones with a short dry season:

- Dense moist evergreen dipterocarp forest up to 700m (present classification).
- Tropical ombrophilous lowland forest.
- Dense evergreen lowland forest (Legris & Blasco 1972).

Moist zones with a pronounced dry season at low elevation (<800m):

- Dense semi-deciduous forest.
- Tropical and subtropical semi-deciduous forest.
- Dense semi-deciduous forest (Legris & Blasco 1972).

Dry zones with a pronounced dry season at low elevation (<800m):

- Deciduous dipterocarp woodland.
- Dry deciduous woodland.
- Dry deciduous forest (Legris & Blasco 1972).

### ***Forest industry***

In its declaration on ‘Measures for Management of Forest and the Elimination of Illegal Forest Activities’ of 25 January 1999, the government cancelled several permits for sawmills in order to eliminate the use of illegal wood supplies. The government allows only sawmills belonging to forest concessionaires or their subsidiaries to supply sawn timber to domestic markets.

In addition to sawmills, the government has authorized concessionaires to establish veneer and furniture industries. Concessionaires have the right to export the production from these industries. The total volume of logs supplied to these industries is less than 500,000m<sup>3</sup> per year.

As already indicated, wood is the principal source of energy for Cambodia’s population (Table 4). Total timber consumption is estimated to be 174,000m<sup>3</sup> per year for house and boat building, animal stocks and carts, for example.

**Table 4.** *Fuel wood extraction from 1961 to the present (in millions of cubic metres)*

<b>Year</b>	<b>Total</b>	<b>Extraction From Forests</b>
1961–1970	18	9
1971–1980	10	5
1981–1990	24	12
1990–Present	6 (per year)	3 (per year)

### ***Forest product exports***

The main timber species exported include *Dipterocarpus* spp. and *Pterocarpus* spp. Forest products such as logs, sawn timber, veneer and plywood are exported mainly to Singapore, Taiwan, Hong Kong, Thailand, Japan, Lao PDR, USA, China, India, Korea, Philippines, Vietnam, Malaysia and Russia.

**Table 5.** *Export of forest products from Cambodia, 1993–1999 (in cubic metres). Source: Planning and Accounting Office, Department of Forestry and Wildlife.*

<b>Year</b>	<b>Logs</b>	<b>Sawn timber</b>	<b>Veneer</b>	<b>Plywood</b>
1993	80,835	150,839	–	–
1994	300,625	295,555	–	–
1995	459,085	99,449	–	–
1996	161,673	69,042	28,489	–
1997	–	71,662	188,667	–
1998	–	55,983	179,909	16,418
1999	–	9,828	68,320	14,865

### ***National forest resources assessment***

One of the main weaknesses of the forest sector is the lack of basic information on forest resources. The information available does not provide a sound basis for economic, social or environmental planning and development. For this reason, the government is seeking donor support to develop a forest resources assessment programme. The government's objective is to initiate an allocation programme which will lead eventually to the creation and demarcation of a permanent forest estate. This exercise is expected to improve the management of forest resources under pressure from an expanding rural population.

### ***Research, extension and training***

Little coordinated forest research has been carried out in Cambodia, and basic forest management information is lacking. DFW has inadequate research facilities and few staff trained in research techniques, although its provincial offices have conducted some practical field trials in nursery and silvicultural techniques.

In 1997, MAFF approved the establishment of the Forestry and Wildlife Research Institute under DFW and allocated more than 50 staff to the institute. However, the government has been unable to provide an operational budget for the institute. Also in 1997, Cambodia became one of the 43 member countries of ITTO. The Forestry Research Support Programme for Asia and the Pacific (FORSPA), and recently ITTO, have supported DFW in its efforts to build forest research capacity.

### ***The role of different stakeholders***

The major stakeholders in Cambodia's forestry sector are rural people, government agencies, concession holders, the wood processing industry, the Cambodian Timber Industry Association (CTIA), the army and a variety of non-governmental organizations and private individuals. The role of DFW should be custodial—managing natural resources and resolving conflicts. This role has yet to be properly defined and the government's support is sometimes inadequate.

New legislation regulates the rights and obligations of concession holders. Access to forests and harvesting of non-timber products come under 'traditional rights', which must be codified and modified in several respects. Some traditional uses conflict with the obligations imposed by international conventions (see below). These have implications not only for hunting but also for collecting plants and wildlife for trade and medicinal and cultural uses. For security reasons, some forest areas are still under the control of the army. Some of these have been logged without proper authorization from the government. All protected areas and parks come under the authority of the Ministry of Environment, which lacks the staff and resources to control encroachment or enforce laws. A number of non-governmental organizations are active in the forestry sector, mainly in participatory resource management, wildlife protection, protection of customary rights and promotion of community forestry. Rural people still do not have an adequate understanding of their rights and obligations, how to organize their interests, or the basic principles of natural resource management.

### ***International agreements and conventions***

Cambodia is a signatory to a number of international conventions, including the Ramsar Convention on Wetlands and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Cambodia has also signed the Convention on Biological Diversity (CBD) and the Convention to Combat Desertification (CCD).

DFW has recently signed an agreement on medicinal plant collection with the National Cancer Institute of the US Department of Health and Human Resources. This is being executed by the University of Illinois, Chicago. The agreement gives the University the right to collect plant material and information on traditional medicines for screening of anti-cancer compounds. Cambodia also receives support from the Indochina Tree Seed Programme and the GTZ/MRC Sustainable Management of Natural Resources in the Lower Mekong Basin Project.

International agencies such as UNDP, FAO, UNEP, UNESCO and ITTO support the Cambodian forest sector through technical assistance, legal support, training and other measures. Bilateral donors finance a number of projects in the forest and rural development sectors. As a member of ASEAN and one of the four member states of the Mekong River Commission, Cambodia is committed to sustainable development and improving the living conditions of its people. A deficit of trained and experienced staff is the main impediment to successful international cooperation.

### *Identification of national priority tree species*

A National Workshop on Tree Species Priorities was organized by DFW and the Cambodia Tree Seed Project (CTSP) in 2000. This had three main aims: i) to identify priority tree species according to their general use in Cambodia; ii) to classify tree seed priorities in relation to development work, establishing seed sources and seed production systems, and enhancing tree improvement and seed supply; and iii) to consider the research base for rare and endangered species. Tables 6–8 below provide information on priority species drawn from this workshop and the work by CTSP.

**Table 6.** Value and use of target species

Species	Value Code <sup>a)</sup>	Present, future or potential use <sup>b)</sup>											
		ti	po	wo	nw	pu	fo	fd	sh	ag	co	am	xx
<i>Acacia auriculiformis</i>	1	✓	✓	✓				✓	✓	✓	✓	✓	✓
<i>Afzelia xylocarpa</i>	1	✓	✓								✓	✓	✓
<i>Albizia lebbek</i>	1	✓	✓	✓			✓			✓			
<i>Anisoptera costata</i>	1	✓							✓		✓	✓	
<i>Aquilaria crassna</i>	2				✓					✓		✓	
<i>Azadirachta indica</i>	1		✓	✓	✓		✓		✓	✓	✓		
<i>Calamus</i> spp.	2				✓					✓			
<i>Cassia siamea</i>	1	✓	✓	✓				✓	✓	✓	✓	✓	
<i>Cinnamomum cambodianum</i>	2		✓	✓			✓			✓			✓
<i>Dalbergia bariensis</i>	1	✓	✓							✓			✓
<i>Dalbergia cochinchinensis</i>	1	✓	✓										
<i>Dasymachalon lamentaceum</i>	1	✓	✓							✓			
<i>Dialium cochinchinense</i>	1	✓	✓	✓			✓		✓		✓		
<i>Diospyros beaudii</i>	1	✓	✓										
<i>Dipterocarpus alatus</i>	1	✓			✓				✓	✓	✓	✓	✓
<i>Dipterocarpus costatus</i>	1	✓			✓				✓	✓	✓	✓	✓
<i>Dipterocarpus tuberculatus</i>	1	✓	✓	✓									
<i>Dipterocarpus turbinatus</i>	1	✓	✓		✓				✓	✓	✓		
<i>Dysoxylum loureiri</i>	1	✓	✓										
<i>Eucalyptus camaldulensis</i>	1	✓	✓	✓	✓	✓				✓			
<i>Eugenia jambolana</i>	1			✓	✓		✓			✓	✓		
<i>Fagraea fragrans</i>	1	✓	✓								✓		
<i>Hopea odorata</i>	1	✓			✓				✓		✓	✓	✓
<i>Khaya senegalensis</i>	1	✓	✓						✓				
<i>Lagerstroemia ovalifolia</i>	1	✓	✓								✓		
<i>Leucaena leucocephala</i>	1		✓	✓	✓		✓	✓		✓		✓	
<i>Litchi sinensis</i>	2		✓				✓			✓			✓
<i>Melaleuca leucadendron</i>	1	✓	✓	✓									
<i>Melanorrhoea laccifera</i>	1	✓	✓		✓						✓		
<i>Moringa oleifera</i>	1			✓	✓		✓			✓	✓		
<i>Nephelium xerospermoides</i>	2		✓	✓			✓			✓			
<i>Peltophorum ferrugineum</i>	1	✓	✓	✓					✓			✓	
<i>Pinus merkusii</i>	2	✓			✓	✓			✓		✓	✓	✓
<i>Pterocarpus macrocarpus</i>	1	✓									✓	✓	✓
<i>Pterocarpus pedatus</i>	1	✓									✓	✓	
<i>Rhizophora</i> sp.	1		✓	✓	✓						✓	✓	✓
<i>Samanea saman</i>	2			✓					✓				
<i>Sandoricum indicum</i>	1	✓	✓	✓			✓			✓			
<i>Sesbania grandiflora</i>	1		✓	✓			✓	✓	✓	✓	✓		
<i>Shorea cochinchinensis</i>	1	✓	✓		✓				✓	✓	✓		✓
<i>Shorea hypochrea</i>	1	✓							✓		✓		
<i>Shorea vulgaris</i>	1	✓			✓				✓		✓		
<i>Sindora cochinchinensis</i>	1	✓	✓								✓	✓	
<i>Sterculia lychnophora</i>	1		✓	✓	✓			✓					
<i>Tarrietia javanica</i>	1	✓							✓		✓		
<i>Tectona grandis</i>	1	✓							✓	✓	✓	✓	
<i>Terminalia nigrovenulosa</i>	2		✓		✓					✓	✓		✓
<i>Vatica astrotricha</i>	1	✓	✓						✓	✓			
<i>Xylia dolabriformis</i>	1	✓	✓	✓	✓								

a) 1 = Species of current socio-economic importance; 2 = Species with clear potential or future value; 3 = Species of unknown value given present knowledge and technology.

b) ti = timber production; po = posts, poles, roundwood; pu = pulp and paper; wo = fuelwood, charcoal; nw = non-wood products (gums, resins, oil, tannins, medicines, dyes); fo = food; fd = fodder; sh = shade, shelter; ag = agroforestry system; co = soil and water conservation; am = amenity, aesthetic, ethical values; xx = other.

**Table 7.** Estimated number of individuals threatened and degree of security by species

Species	Threatened by						Security <sup>a)</sup>
	Fire	logging	biotic or abiotic factors	clearing	over-grazing	infra-structure	
<i>Acacia auriculiformis</i>	>1,000	>10,000	n.a.	n.a.	n.a.	n.a.	1
<i>Afzelia xylocarpa</i>		<10,000	–	–	–	–	5
<i>Anisoptera costata</i>		>10,000	–	–	–	–	2
<i>Aquilaria crassna</i>		>10,000	–	–	–	–	5
<i>Calamus</i> spp.		>10,000	–	–	–	–	2
<i>Dalbergia bariensis</i>	>100	>500	–	–	–	–	5
<i>Dalbergia cochinchinensis</i>	>100	>500	–	–	–	–	5
<i>Dipterocarpus alatus</i>	>1,000	>10,000	–	–	–	–	2
<i>Dipterocarpus costatus</i>	>1,000	>10,000	–	–	–	–	2
<i>Dipterocarpus tuberculatus</i>	>500	>10,000	–	–	–	–	1
<i>Dipterocarpus turbinatus</i>	>1,000	>10,000	–	–	–	–	2
<i>Fagraea fragrans</i>		>100	–	–	–	–	5
<i>Hopea odorata</i>		>1,000	–	–	–	–	4
<i>Peltophorum ferrugineum</i>		>10,000	–	–	–	–	2
<i>Pinus merkusii</i>	>100	>100	–	–	–	–	2
<i>Pterocarpus macrocarpus</i>	>100	>1,000	–	–	–	–	5
<i>Pterocarpus pedatus</i>		>500	–	–	–	–	5
<i>Rhizophora</i> sp.		>10,000	–	–	–	–	4
<i>Shorea hypochra</i>		>1,000	–	–	–	–	3
<i>Tarrietia javanica</i>		>1,000	–	–	–	–	4
<i>Vatica astrotricha</i>		>1,000	–	–	–	–	3
<i>Xylia dolabriformis</i>	<100	>5,000	–	–	–	–	3

<sup>a)</sup> Level of protection or security on a scale of 1 to 5:

1: Threat mild or occasional.

2, 3, 4: Intermediate between 1 and 5.

5: Threat severe with high probability of genetic degradation or loss.

**Table 8.** List of priority species for conservation, improvement or seed procurement

Species	End Uses				Operation/Activities							
	W	NW	FW	O	Exploration Collection	Evaluation	Conservation	Germplasm Use				
	1	2	3	4	5	6	7	8	9	10	11	12
<i>Acacia auriculiformis</i>	✓		✓		✓	✓				✓		
<i>Afzelia xylocarpa</i>	✓				✓	✓						
<i>Alpinia officinarum</i>		✓	✓	✓	✓				✓			
<i>Amomum krervanh</i>	✓	✓		✓	✓							
<i>Anisoptera costata</i>	✓				✓				✓	✓		
<i>Aquilaria crassna</i>		✓		✓	✓				✓			
<i>Azadirachta indica</i>			✓	✓	✓				✓	✓		
<i>Bambusa arundinacea</i>		✓	✓	✓								
<i>Cassia siamea</i>	✓		✓		✓				✓	✓		
<i>Cinnamomum cambodianum</i>		✓		✓	✓				✓			
<i>Dalbergia bariensis</i>	✓				✓		✓		✓			
<i>Dalbergia cochinchinensis</i>	✓				✓							
<i>Diospyros bejaudii</i>	✓			✓	✓							
<i>Diospyros crumenata</i>	✓				✓							
<i>Diospyros nitida</i>		✓		✓	✓				✓			
<i>Dipterocarpus intricatus</i>	✓		✓	✓	✓							
<i>Dipterocarpus alatus</i>	✓				✓				✓	✓		
<i>Dipterocarpus costatus</i>	✓				✓				✓	✓		
<i>Eucalyptus camaldulensis</i>	✓	✓	✓	✓	✓						✓	
<i>Fagraea fragrans</i>	✓				✓							
<i>Gardenia angkorensis</i>	✓				✓							

Table 8. (continued)

Species	End Uses				Operation/Activities							
	W	NW	FW	O	Exploration Collection	Evaluation		Conservation		Germplasm Use		
	1	2	3	4	5	6	7	8	9	10	11	12
<i>Hopea odorata</i>	✓				✓				✓	✓		
<i>Leucaena leucocephala</i>			✓	✓	✓				✓	✓		
<i>Litchi sinensis</i>	✓	✓		✓	✓				✓			
<i>Melaleuca leucadendron</i>		✓	✓	✓	✓				✓			
<i>Melanorrhoea laccifera</i>	✓	✓			✓				✓			
<i>Pinus merkusii</i>	✓	✓			✓				✓			
<i>Pterocarpus</i> spp.	✓				✓				✓			
<i>Rhizophora</i> spp.			✓	✓	✓				✓			
<i>Sandoricum indicum</i>	✓	✓		✓	✓							
<i>Sesbania grandiflora</i>			✓		✓				✓	✓		
<i>Shorea hypochra</i>	✓				✓				✓			
<i>Shorea vulgaris</i>	✓				✓				✓			
<i>Sindora cochinchinensis</i>	✓		✓		✓				✓			
<i>Sterculia lychnophora</i>	✓	✓			✓							
<i>Strychnos nux-vomica</i>		✓	✓		✓				✓			
<i>Tarrietia javanica</i>	✓				✓				✓			
<i>Tectona grandis</i>	✓				✓					✓		
<i>Terminalia nigrovenulosa</i>		✓										
<i>Vatica astrotricha</i>	✓		✓									
<i>Xylia dolabriformis</i>	✓								✓			

## References

- Ashton, P. S. (1970) *Inventaire Forestier des Terres Basses du versant Occidental des Mont Cardemoms, Cambodge: L'Ecologie Sylvicole et la Botanique Forestier*. UNDP/FAO FO: SF/CAM6/Rapport Technique 5.
- Chea Sam Ang (1998) *Country Paper on Some Aspects of Forestry in Cambodia*. Department of Forestry and Wildlife, Phnom Penh.
- Dy Phon, P. (1970) La Végétation du Sub-ouest du Cambodge: Sectors Baie de Kompong et Plateau de Kirirom. *Ann. Fac. Sc. Phnom Penh* **4**: 1–77.
- Dy Phon, P. (1971) Plantes aquatiques de consommation courante au Cambodge. *Rev. Agron. Khmère* **2**: 17–38.
- Dy Phon, P. (1981) *Contribution a l'Etude de la Végétation du Cambodge* Université de Paris-Sud, Centre d'Orsay, Paris.
- Dy Phon, P. (1982) Végétation du Cambodge: endemisme et affinités de sa flore avec les régions voisines. *C. R. Séances Soc. Biogéogr.* **58 (3)**: 135–144.
- Eav Bov Bang (1970) *Contribution a l'Étude de l'Aménagement de la Reserve des Phnom Kolen et de Kohker*. Mémoire de Fin d'Études, Université des Science Agronomiques, Phnom Penh.
- FAO (1970) *Classification and Mapping of Vegetation Types in Tropical Asia*. Food and Agriculture Organization of the United Nations, Rome.

- Legris, P. & Blasco, F. (1971) Carte Internationale du tapis Végétal at des conductions Écologique au Cambodge 1/1,000,000. *Trav. Sect. Scient. Techn. Inst. Fr. Pondichéry* **11**: 1–238.
- Legris, P. & Blasco, F. (1972) *Carte internationale du tapis Végétal a 1/1,000,000, Cambodge. Notice explicative*. Inst. Fr. Pondichéry, Trav. Sect. Scient. Techn. Hors série No. 11.
- Pan Leang Cheav (1972) *Les Forêts de la Republique Khmère*. Institute de Recherches et d'enseignements Forestiers.
- RGC/ARD (1998) *Strengthening Institutions for Implementation of Forest Policy in Cambodia*. Forest Policy Reform Project Technical Paper No. 7, Department of Forestry and Wildlife, Phnom Penh.
- Rollét, B. (1962) *Inventaire Forestier de l'Est Mékong*. Rapport FAO No. 1500.
- Rollét, B. (1972a) *La Végétation du Cambodge*. Bois et Forêts des Tropiques, No. 144.
- Rollét, B. (1972b) *La Végétation du Cambodge*. Bois et Forêts des Tropiques, No. 145.
- Rollét, B. (1972c) *La Végétation du Cambodge*. Bois et Forêts des Tropiques, No. 146.