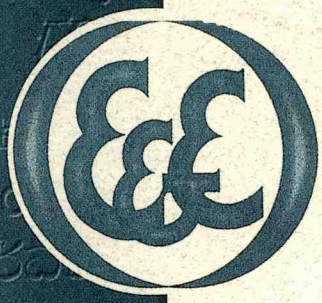

ECONOMY AND ENVIRONMENT PROGRAM FOR SOUTHEAST ASIA

An Economic Analysis of Tropical Forest Land Use Options, Ratanakiri Province, Cambodia

Camille Bann

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November 1997

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EXECUTIVE SUMMARY

Ratanakiri is a richly forested province located in remote Northeast Cambodia. Forestland in Ratanakiri represents an extremely valuable natural resource that needs to be correctly managed if its benefits are to be maximised. Despite the lack of a land use plan for the province, a number of commercial development activities are underway. Many of these options will result in the destruction of pristine forest areas. Because local communities in Ratanakiri are totally dependent on the forest and the rapid rate of deforestation is evident throughout Cambodia, sustainable forest management options *urgently* need to be identified for the area[1].

Over 85% of the population of Ratanakiri belong to ethnic minorities (Highlanders) who for centuries have made their living in and around the forest. These people clear the forest for farming and collect subsistence products such as fuelwood, medicine, food, and construction materials. Villages are based within locally recognised boundaries but local communities have no legal rights to the land.

Foreign and national commercial interest in the forest land of the province is intense. Current concession areas granted for timber and oil palm production encompass many of the traditional and currently farmed lands of the Highlanders. Despite this, consultation with local people over the development of the area has been minimal.

The effects of these outside pressures are already apparent. The increased land pressure on the uplands has resulted in shorter fallow periods between farming cycles and consequent loss of soil fertility and yields. Some farmers have been pushed deeper into the forest to open new land for cultivation, while others are seeking out new but insecure livelihoods as wage labourers. At the current rate, the local people risk losing their land. Urgent measures are needed to protect their rights to their customary land.

This 18-month research study (January 1996-June 1997), was undertaken to illuminate the social and environmental costs and benefits of different uses and management of forest land in Ratanakiri.

Forest value has been traditionally based on the commercial worth of its timber, ignoring the forest's many non-timber values (e.g., fuelwood, food, rattan, and bamboo) and ecological functions and services (e.g., watershed maintenance and biodiversity protection). The omission of these benefits in conventional economic analysis means that the forest resource is undervalued. This can result in unsustainable timber extraction or the conversion of forest land to alternative land uses, since the alternative options 'appear' more attractive. This is of particular concern for forest land in areas such as Ratanakiri where indigenous people are wholly dependent on the forest for their existence.

[1] Recent studies suggest that Cambodia's forest cover has fallen dramatically from 74% of the land area in the early 1970s to between 30-35% today (Rainforest Action Network Report 1994, The Nation 1992).
There have been no systematic studies of the causes of deforestation in Cambodia. Such a study would be useful in general but particularly useful in Ratanakiri wherein the widely held view is that swidden agriculture is the main cause of deforestation in the province. The validity of this view is questionable, and improbable in the near term given the large scale commercial pressures on forestland in Ratanakiri.

An economic assessment of the costs and benefits (including environmental values and distributional concerns) of alternative forest land use can provide information in the design of forest management plans. The analysis can also show which option is optimal in terms of maximising the economic and social returns to Cambodia over the long term.

This study compares two key land uses-the value of using the forest land for traditional purposes (such as the harvesting of NTFP) against its use for commercial timber extraction.

The study site, Tapean forest, covers 1,824 hectares and is located in Poey (Chan) Commune, O Chum District, Ratanakiri province. It is used extensively for traditional purposes by at least five villages in the area, acts as an important watershed, is a prime location for malva nuts (an important source of income for villagers), has eco-tourism potential, and houses trees of commercial value. The area is currently under concession to Macro Panin, an Indonesian logging company.

A forest inventory of half a hectare of forest land in the area revealed the area's rich diversity. The area contains close to 200 tree species and over 300 species of ground flora and saplings. One hundred types of trees and 200 species of ground flora and saplings are used by villagers for a range of traditional purposes.

A survey of 42 households was undertaken in four villages identified to depend on the Tapean forest (Kancheung, Mas, Koy, and Tanaigh village). The study sought to assess the value of the forest for traditional purposes and to value NTFP such as fuelwood, rattan and bamboo, malva nuts, house construction materials, and wildlife.

The results show that the benefits from traditional sustainable use of forest resources exceed the benefits of commercial timber extraction in the study area by at least US$200 per hectare (NPV over a 90-year period). This suggests that areas of high cultural value and environmental significance, might best be managed by local communities.

Villages themselves believe that the best way to manage the forest is for the Government to support forest protection through legislation, and for outsiders to be prohibited from cutting the trees. To this end, and faced with the current commercial pressures on their land, local people in Poey Commune have taken the initiative to set up a Forest Conservation Association to gain concession (not title) of the community's customary forest. The Association will be responsible for managing and protecting the forest and for establishing policies regarding land sales. This initiative is being supported by OXFAM/NOVIB and is likely to be adopted by other communes throughout the province.

Distributional concerns must be central to land use decisions in Ratanakiri. While commercial ventures may bring handsome short run benefits to a few, probably foreign businessmen, the whole community will be marginalised. Little development of the concession areas has been undertaken to date. However conflicts between concessionaire and Highlanders are likely in the future. Steps need to be taken now to prevent such an eventuality, which would be a serious burden on, and policy problem for, the Government.

Preservation of the unique cultural diversity of the many indigenous groups dependent on the forest in Ratanakiri, and the forest's rich non-timber values and crucial ecologically services, requires maintaining the forest resource intact.

It is hoped that the results of this study will prove useful to policy makers and other relevant parties involved in land use planning for the province. The main recommendation of this report is that all customary forest land in Ratanakiri be excluded from current and future timber concessions. As a first step, the recently formed local Forest Conservation Association in Poey Commune should be legally recognised. Further to this, the development of similar Forest Conservation Associations should be supported throughout

the province. All current commercial activities affecting forest land in Ratanakiri should be immediately frozen until a more satisfactory and economically viable land use plan can be recommended and implemented.

A parallel objective of this project was to train a team of Cambodian researchers in survey techniques, data analysis, and ultimately the economic appraisal of forest land use options. Two training workshops on the valuation of natural resources were held to complement the research study[2].

[2] A four-day workshop on the economic analysis of tropical forest and use options was held in Ban Lung, the Provincial capital (12-15 February 1996). Over 40 participants attended the first two days of the workshop from Government Ministries in Phnom Penh and departments in Ratanakiri and representatives from the districts of Ratanakiri. A major issue in Ratanakiri is that local people are poorly informed of the proposed developments for the province. The purpose of this two-day meeting was to highlight the issues to a wider audience and to introduce the project to concerned parties. A workshop on the valuation of NTFP, held on the third and fourth days, were attended by fifteen people many of whom were involved in the project as researchers.

A second workshop on the valuation of natural resources held in Phnom Penh (July 8-11 1996) was attended by 40 people including staff from Government Ministries (including researchers for this project), representatives from local NGOs, and students from Phnom Penh University.

1.0 INTRODUCTION

1.1 General Background

Ratanakiri covers an area of 11,673 km^2 and is a remote and sparsely populated province in the extreme Northeast of Cambodia. It borders Laos to the north and Vietnam to the east, and has national boundaries with Stung Treng to the west and Mondulkiri to the north. The province is divided into nine districts: Banlung, O Chum, Bokeo, Andong Meas, O Yadou, Voeun Sai, Lumphat, Ta Veng, and Kon Mum.

As a border area, Ratanakiri is of political importance. It is also of great economic potential on account of its valuable natural resources.

Ratanakiri is a unique province quite distinct from provinces of the Mekong Delta. It is characterised by high forest cover, areas of fertile volcanic soils, low population density and a unique demography.

Three distinct terrain types are evident:

(i) an undulated basalt plateau in the centre of the province with fertile red soils;

(ii) a more mountainous area north towards Laos with relatively poor lithosol soils; and

(iii) flat lands along the river and to the south of the province with clay and a large area of lithosol soils.

Natural forest cover for the province is estimated to be 70-80%. Forest cover varies from the dense impenetrable forest in the northern reaches which are still rich in wildlife, to the drier and sparser forest, composed mainly of dipterocarps, found in the Southwest.

An agricultural sector study (CARERE, December 1995) classified the province according to four 'Agro-ecological' zones (see Table 1.1).

Table 1.1 Main Agro-Ecological Zones

Agro-Ecological Zone	Central Plateau	Lowland Plains and Rivers	Hilly Region	Mountainous
Environmental features	Rolling hills and rich volcanic soil Regenerated forest and some denser forest already logged of commercial wood	Flat lowlands Degraded forest	Hills with steep slopes. Red and grey forest soil. Some rocky areas. Dense forest with some wildlife	High mountains Dense evergreen with substantial wildlife

The total population is estimated to be 79,533. Over 85% of the population belong to ethnic minorities.[3] This ethnic mix brings a wide variety of cultural traditions, beliefs and languages. The ethnic minorities, sometimes referred to as 'highlanders', are located mainly in the undulated plateau. For centuries they have made their living in and around the forest (although this situation may be gradually changing as more opportunities arise, especially near district centres and new commercial agricultural ventures). The highlanders

[3] The total ethnic breakdown of the province is estimated as follows: Tampuan 26%; Jorai 19%; Kreung 19%; Khmer 13%; Lao 10%; Brao 7%; Kachok 3%; Kavet 2%; Cham, Chinese, Lun, Phnong and Vietnamese 1% (White 1996)

are primarily farmers practising swidden agriculture[4]. Villages are based within locally recognised boundaries. Families close to forest areas where resources are easily accessed farm small agricultural plots. However, families have no legal rights to the land.

About 15% of the total population live alongside the rivers and in the lowlands and practice wetland rice cultivation and market activities. A further 15% are based in the more urbanized centers. While lowland groups such as ethnic Lao, Chinese and Khmer have migrated to Ratanakiri within the last 200 years, there are at least 12 highland minorities whose settlement predates the Angkor period by centuries and who may be thought of as 'original' inhabitants.

Unless development of the province is carefully planned and managed, irreversible damage to the natural environment could occur. This would have a damaging impact on the subsistence and self-reliance of the population as well as on the wider aim of sustainable economic development for the province. For the development process to be successful, the rights and freedoms of the ethnic minorities need to respected.

1.2 Forest Land Use in Ratanakiri

Forest land in Ratanakiri is an extremely valuable resource for the people of Ratanakiri and Cambodia. It may also be considered of increasing global importance (for example, in terms of its biodiversity and carbon storage function), as areas of tropical forests around the world become increasingly scarce.

Ratanakiri is at the early stages of development. Forest land represents an important natural resource on which development of the province may be based. If managed wisely, forest land has the capacity to provide a perpetual stream of income and subsistence products, while supporting other economic activities (such as fisheries and agriculture) through the ecological services it provides. It is therefore crucial that the opportunities for economic development based on the forest are not wasted; Government agencies, private firms and traditional users of the forest should together seek to rationalise their management of the forest.

Forest land can be used in many different ways. It can be used for commercial timber extraction and be converted for commercial agriculture (e.g., oil palm, rubber, coffee plantations). It may also be used for subsistence and commercial mining activities, or for traditional subsistence activities (e.g., traditional swidden agriculture, extraction of NTFP), or it may be afforded various levels of 'protection' through the establishment of a Protected Area, a National Park or a Wildlife Sanctuary (IIED 1995).

Forest land in Ratanakiri is used in a variety of ways[5]. It has long served as the subsistence base for the majority of people in Ratanakiri. Most of Ratanakiri's indigenous peoples have for centuries cleared forest land for agriculture, and in addition have profited by drawing from the forest a wealth of subsistence products such as food, medicine and building materials. Until quite recently, the highlanders were observed coming to markets only once a year to buy salts and metal for their knives.

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[4] Wage labour is extremely limited. The norm at the village level is labour in exchange for rice, but as villagers participate more in the market economy there appears to be increasing opportunities for wage labour at the village level. Some families who have access to cash (e.g., the head of the household who works as a soldier) will pay other villagers to carry out agricultural work at critical times in the annual cycle (White 1996).

[5] It is difficult to assess the current extent of land use in the Province. APT (Analysis and Planning Team) District assessment reports give estimates made by district staff and villagers concerning the number of hectares of forest and land under cultivation in each village and district, these are unconfirmed. An in depth mapping and analysis of land use and village areas is yet to be carried out in the province. Some recent work by international NGOs has involved the mapping of traditional village boundaries, land and forest use in some highland communities, but area measurements are still to be made (White 1996).

Ratanakiri contains one National Park and one Wildlife Sanctuary[6]. Lomphat Wildlife Sanctuary has an area of 250,000 hectares straddling Ratanakiri, Mondulkiri, and Kratie provinces. It is home to a number of wild animals such as buffalo, tiger, wild pig and bear. Virachey National Park covers 332, 500 hectares and is located in Ratanakiri and Stung Treng provinces, and is part of an international park system as its borders adjoin national parks in Laos and Vietnam.

Foreign and national commercial interest in the forest is intense. Recently, a concession of 9,000 hectares was granted for oil palm production in O'Yadao. Several hundred hectares have already been cleared and 50 hectares planted despite questions about the suitability of the soil, topography, and climate for oil palm production in the area. There is interest in developing rubber, cashew, and coffee plantations.

Local people whose land fell within the oil palm concession were reportedly paid US$36 per hectare to clear their own land and then allocated half a hectare of land along highway 19 (not large enough for swidden agriculture). An estimated 400 people are employed by the oil palm company at US$60-70/month, so up to 2,000 people may be supported by the oil palm venture (assuming an average household size of 5). However, around 4,000 people have been affected (*pers.com.* Sara Colm). Furthermore, commercial cash crop plantations are said to be exacerbating environmental problems by further diminishing land cover and the natural genetic pool of the area (Himel 1997). Areas close to Banlung, such as La'ak commune, are reportedly under a lot of speculative pressure. This pressure is being felt as far as the southern part of O'Chum district, next to Kralah village. There is interest in the development of soya bean, coffee, and cashew nut plantations. Land deals are normally facilitated through district officials assisting local businessmen with land available, which is normally fallow *chumgarr* (gardens). Families normally have 1-2 hectares of active land and 4 hectares fallow land.

In some cases, new investors are following the approach used by the oil palm plantation. Villagers are hired at low rates (US$36/hectare) to clear their own land, after which the land becomes the property of the company.

In addition, much of the province has been allocated to a commercial timber concession, Macro-Panin. Panin has already visited the area, marked trees, laid timber tracks, and set up rest areas for logs. A factory is planned near Kancheung village. The Macro-Panin concession covers over 1.4 million hectares situated in Stung Treng, Ratanakiri and Mondulkiri Provinces. The company proposes to invest US$200 million in the construction of factories to process timber and logging infrastructure. The impact on the area will therefore be immense. In addition, another logging company. Hero, is reportedly operating illegally in the area. They are said to have concession to 60,000 hectares of the best forest areas to support the manufacture of furniture.

Commercial interest in forest land in Ratanakiri has been so keen, that some areas have been allocated for more than one potential commercial investor.

Of great concern are those current concession areas that encompass many of the traditional and currently farmed lands of the Highlanders. Despite this, consultation with local people over the development of the area has been minimal. Little development of the concession areas has been undertaken to date, however, conflicts between concessionaire

[6] A National Park may be established to protect outstanding natural and scenic areas of national and international significance of scientific, educational, and recreational use. These are relatively large natural areas not materially altered by human activity where extractive resources are not allowed. A Wildlife Sanctuary may be established to assure the natural conditions necessary to protect nationally significant species, group of species, biotic communities, or physical features of the environment where these may require specific human manipulation for their perpetuation. Controlled harvesting of some resources can be permitted. (Based on IUCN (The International Union for the Conservation of Nature) guidelines).

and Highlanders seem likely, once activities are properly underway. Local people are said to be unhappy about the current 'land grab' by commercial companies. On the whole they do not want to give up their ancestral lands and do not want to work for other people.

In addition, small-scale lowland farmers are now establishing *chumgarrs* on the roadside to cultivate cash crops. Some lowlanders have moved from town to the rural area where they are farming paddy rice. It is a concern that lowland Khmers are starting to acquire the good rice from the highlanders before the highlanders realises its value. Such changes threaten indigenous small-scale agricultural production in the area (Himel 1997).

The effects of these pressures are already apparent. The increased land pressure on the uplands has resulted in shorter fallow periods between farming cycles and consequent loss of soil fertility and yields. Farmers have pushed deeper into the forest to open new land for cultivation, or seek out new insecure livelihoods as wage labourers (Himel 1997).

At the current rate, outside pressures will prove fatal to the traditional practices of indigenous communities of Ratanakiri. The risk of highland people losing and/or becoming marginalised on their own land makes it urgent that measures are taken to protect their rights to the land.

1.3 Establishment of Local Forest Associations to Manage and Protect the Forest[7]

Faced with the current threats to their land, local people in Poey (Chan) Commune have taken the initiative to set up a Forest Conservation Association to gain concession (not title) of their 'customary forest'. Customary forest are those forest areas that are used *de facto* by local communities. This initiative is being supported by the OXFAM/NOVIB, NTFP project.

The Forest Conservation Association is a community agreement. At present it has no official recognition. The objective is for the Association to be legally recognised. This would mean that customary forests would represent an exclusion zone from the current Panin concession, and from any future outside concessions. Such recognition would also legitimise 'the process', such that other villages throughout Ratanakiri could form similar Associations to gain the right to manage their community's forest.

Background Information on the Forest Conservation Association.

In January 1997, residents of Koy village, who use O' Tabearr forest, contacted three other villagers that use this forest -- Tangaich, Kres, and Klong -- to determine their interest in forming a local Forest Conservation Association. All villages expressed interest in joining the Association. Kres and Klong, however, insisted that Mas village and its own forest area, Tapean Forest, also be included. O'Tabearr forest is of secondary importance to Mas, which along with Kancheung village, relies more heavily on Tapean forest. It was therefore decided to include Tapean, Yao, and Stieng forests, which are contiguous with O'Tabearr forest. The total area of the four forests is 4,500 ha. The Forest Association therefore comprises six villages to protect four contiguous sections of forest, from O Tabearr in the east to Stieng, Tapean and Yao. Kralah and Svay villagers, who use both forests, will be observers (see Table 1.2). Local boundaries have been defined for the forest areas (see Map on Customary Forests).

At a meeting on February 1, 1997, at the Poey commune centre, representatives of all six villages established a Forest Conservation Association to protect four sections of the forest in north Poey commune. The Association will be responsible for managing and protecting the forest and for establishing policies regarding land sales. A forest

[7] This Section is based on *pers. coms.* with Gordon Paterson and Sara Colm, and Colm, 1997.

conservation committee has been set up to establish rules for the use of the forests and fines for offenders, to oversee finances, and to establish contact with higher level officials as well as villagers with regard to the Association's conservation goals.

Table 1.2 Conservation Forests, Poey Commune

Forest	Area (ha)	Village Use
O Tabearr	1, 600	Koy, Tangaich, Kres, Klong
Yao	850	Mas
Tapean	1, 800	Kancheung
Stieng	900	Mas
TOTAL	4, 250	Koy, Tangaich, Kres, Klong, Mas, Kancheung.

Source: Colm, 1997

The following forest regulations have been agreed upon:

(i) Cutting the forest for *chumgarr* or logging is completely prohibited. If a villager cuts trees he will be fined 135,000 riel (US$50) per hectare. If an outsider cuts a tree he will be taken to court. Villagers will not be fined for cutting trees that are hollowed or decayed. Fruit trees should not be cut, but the collection of fallen fruit is permitted.

(ii) Burning the forest is prohibited. Those who unintentionally set fires will be fined 2,000 riel; those who intentionally burn the forest will be fined 50,000 riel.

(iii) Hunting of rare and endangered animals is prohibited.

(iv) Gem mining is allowed only with the use of hand tools and must be regulated. Villagers who mine for gems or minerals must pay 500 riel a day. Outsiders will be charged 2,000 riel/ day.

(v) Anyone found clearing the forest for swidden land will be fined 135,000 riel (US$50) and will have to stop their activities immediately and allow the forest regenerate.

Rattan must be collected conservatively and may only be used for the manufacture of handicrafts or for use in the village. It is forbidden to cut rattan or bamboo for sale to outside companies.

Each village has a committee of four members including one woman, one elder, and the village chief. The committee is responsible for making sure that everyone remembers and understands the regulations and for resolving any conflicts that might occur. They are also responsible for issues relating to mapping and delineation of boundaries. Meetings are called by the village as and when considered necessary to resolve any issues that arise. Committee members have agreed to spend 1-2 days per months working voluntarily for the Association. If more of their time is needed then the NTFP project or the village will provide support in the form of labour (i.e., to help on the farm or to construct houses).

2.0 ECONOMIC ANALYSIS OF TROPICAL FOREST LAND USE OPTIONS

Forestland use is an economic issue, as each land use decision for a forest area will have economic costs and benefits. For example, when forests are logged, degraded or converted to other uses such as agriculture important environmental functions and resources are lost, perhaps irreversibly, such as NTFP, the watershed functions of a

tropical forest, and biodiversity. This does not mean that preservation or conservation is necessarily the best economic option. Conserving forest areas has its own costs such as the cost of establishing and managing an area and in terms of the revenue foregone from timber extraction. What is important is that account is taken of all the benefits and costs of each land use option, so that the best use of a given forest area might be determined. This requires a comprehensive social cost benefit analysis which takes into account the full range of benefits and costs, social and environmental, associated with each land use option (IIED 1994). In addition, the impact of alternative land uses on the welfare of local communities should be a central factor in investment decisions.

Management plans for Ratanakiri's forest land are yet to be developed. Furthermore, there is no clear interpretation of the law on protected areas, illegal logging is evident, and the user rights over forest and agricultural land is neither clear under Cambodian law nor enforced. An assessment of the costs and benefits (including environmental costs and distributional concerns) of alternative forest land uses can indicate to parties involved in the design of forest management plans which option will maximise the economic and social returns to Cambodia over the long term.

The framework for a comprehensive valuation of natural resources such as a tropical forest is total economic valuation (TEV) which incorporates the many values and benefits of the forest for a range of resource users. A classification of the total economic value of a tropical forest is presented in Table 2.1. Direct use values are the resources and 'services' provided directly by the forest (e.g., wood products such as timber, NTFP such as food and medicine, recreation and tourism, and human habitat).

Table 2.1 Classification of Total Economic Value of Tropical Forests

Use Values			Non Use Values
(1) Direct Value	(2) Indirect Value	(3) Option Value	
Sustainable timber Non timber forest products Recreation and tourism Medicine Plant genetics Education Human habitat	Watershed protection Nutrient cycling Air pollution reduction Micro climatic functions Carbon store Biodiversity	Future Use as per (1) and (2)	Existence Value Cultural heritage Biodiversity

Indirect use values are the environmental functions of the forest, which indirectly support economic activity and human welfare. These include air pollution reduction, watershed protection, microclimate regulation, nutrient retention, carbon storage, and biological diversity.

Option value refers to the option to use the environment in the future. Option value is like an insurance premium that individuals are prepared to pay to ensure the supply of something (i.e., the forest and its provision of multiple goods and services) the availability of which would otherwise be uncertain.

A problem in trying to measure the total economic value of a tropical forest is that many forest values have no market price (e.g., biodiversity and watershed protection services) and thus are generally ignored in conventional analysis and land use decisions.

However, many environmental goods and services provided by tropical forests are often highly significant, and methodologies do exist for estimating their monetary value. If these values are not accounted for in the assessment process, it is possible that the choice of land use will wrongly favour uses with marketed outputs (e.g., development options such as commercial timber exploitation and agriculture). This could mean too much conversion and over exploitation of forest and too little preservation, conservation or natural management of forest land (IIED 1994).

The values of tropical forests shown in Table 2.1 can be estimated using a wide variety of techniques. Direct use values can be estimated using techniques such as: market analysis; value of changes in productivity; travel cost method; contingent valuation method; hedonic prices; indirect opportunity cost approach; indirect substitute approach; and, replacement cost approach. Indirect use values are often estimated using techniques such as: damage costs avoided; preventative expenditure; value of changes in productivity; relocation costs; and replacement costs. Contingent valuation is the only technique available for estimating option and existence values. Section 6 discusses in more detail those techniques that are most relevant to the valuation of non-timber forest products.

3.0 PROJECT DESIGN AND APPROACH

In comparing the economic value of alternative forest land use options one would, ideally, measure the total economic value of the forest for each of the various land uses and/or management regimes under consideration. This would involve monetary estimation of all the different characteristics of the forest (i.e., its direct and indirect use values, and non-use values). There are few practical examples of such a comprehensive approach, which in any event is out of the question for an area like Ratanakiri where physical data on environmental functions are virtually non-existent, and where the vast majority of the population has little or no interaction with markets. Furthermore, evaluation of certain key values of the forest is often sufficient to demonstrate the benefit of supporting one land use over other possible uses of the land.

The first questions asked in designing the research project were what economic analysis could realistically be undertaken, and how the study could be structured so that it tackled some of the many issues facing the province, and thus be of use to decision makers. The first step was to hold discussions with provincial government officials and non-government organizations (NGOs) working in the province, in order to gain greater insight into these questions.

Some preliminary qualitative analysis already undertaken by OXFAM/NOVIB on the use of NTFP, showed usage of NTFP to be significant. It was therefore decided that the study would focus on quantifying NTFP. A Lao village - Itub, and a Krung village - Kancheung were selected for analysis in order that comparisons might be made[8] (February 1996).

The survey work focused on five key categories of NTFP -- fuelwood, rattan and bamboo, medicine, wildlife, and malva nuts. These products were selected following a review of existing survey work and discussions with agencies working in the villages. Given that only three days of fieldwork were possible, a rapid rural appraisal (RRA) approach was used with the objective of generating information quickly. More in-depth future research could be based on results from it. A survey questionnaire was designed by the research team prior to the fieldwork. The survey covered general socio-economic issues, as well as information necessary for valuation purposes (e.g., quantity and price information, time

[8] Research results for Itub village are presented in Bann/EEPSEA, May 1996.

spent collecting and harvesting, possible substitutes for products used and harvesting techniques).

The researchers worked in pairs, each responsible for one of the five categories of NTFP under investigation. The approach was first to meet with the village headman in order to introduce himself or herself (notification of arrival was sent to the villages in advance by radio or by foot through the Provincial Government). They had planned to start with a meeting with the key people in the village, followed by individual meetings and finally a communal meeting in evening. In reality, only a communal meeting called by the village headman was possible but every one was invited. These informal meetings proved to be very animated and fruitful. Each team of researchers interviewed a group of 6-12 villagers. At the end of the session, each of the five research teams presented the conclusions of the group's discussion to the whole gathering. This presented an opportunity for all present to contribute information on each category of NTFP and served as a check on the information. Such an approach provided a large amount of relevant information, formed relationships with the villagers, was good practical experience for the research team, and served the objective of providing the bases for the development of the longer term study.

A market survey was also undertaken in Ban Lung Market to determine the market prices of marketed forest products and of the potential substitutes for non-marketed forest products.

Following the initial field trip, Tapean forest was selected as the study site. Tapean forest is used extensively by at least five villages for the collection of NTFP (Kancheung Village, Tangaich Village, Koy Village, Mas Village, and Khlong Village). It contains timber of commercial value, is an important habitat for malva nut trees (an important source of income for villagers), acts as an important watershed, and has potential as an ecotourism site. Key productive and ecological values for the area are identified in Table 3.1.

Table 3.1 Identification of Key Productive and Ecological Values for Tapean Forest

Key Productive Uses and Ecological Services	Value			
	High	Medium	Low	Unknown
Sustainable timber	X			
Food	X			
Medicine	X			
Fuelwood	X			
Structural materials	X			
Animal products	X			
Recreation and tourism		X		
Education	X			
Human habitat	X			
Watershed protection	X			
Nutrient cycling				X
Air pollution reduction				X
Micro climatic functions				X
Carbon store		?		
Biodiversity	X			
Cultural heritage	X			
Existence value	X			

A forest inventory of half a hectare of forest land within the study site was undertaken in order to gain more accurate physical information (March 1996). Results of this inventory are presented in Section 4 and Appendix 5. Aerial photographs for the area were interpreted by the Integrated Resource Information Centre, Phnom Penh (IRIC) for accurate information on the size of forest area and land uses (January 1997).

Following the completion of the forest inventory a second field trip (July 1996) sought to acquire additional information on the importance of the forest to local communities and the value of NTFP. Meetings were held with the chief of Poey commune and the traditional healer from Kancheung Village to obtain information on the uses of forest flora identified in the inventory. In addition, eight household surveys were undertaken by the research team in Kancheung Village. The remaining survey work (39 household surveys) was undertaken in December 1996 in Koy, Mas and Tangaich villages. Survey results are presented in Sections 5 - 7.

Given data limitations, it was not be possible to value all the productive uses and ecological services of Tapean forest identified as having 'high' value. For important values which could not be valued (e.g., watershed benefits, recreation benefits, biodiversity, cultural heritage), a qualitative description of their worth is presented. Where appropriate, benefit estimates are drawn from other studies to provide 'order of magnitude' figures. Cultural heritage in particular is extremely important in the Ratanakiri context, but has not been given a monetary value (see Section 8).

Finally, an economic assessment of commercial timber extraction as a land use for Tapean forest was undertaken (Section 9), in order that the benefits from this land use could be compared to the benefits of retaining the forest area for traditional uses.

Box 1.- Summary of Research Project

Research Objective

To analyze the economic benefits of using Tapean forest for traditional uses as compared to commercial timber extraction, and to highlight the degree of dependence on the forest by local communities.

Forest Land Uses Analyzed

(i) Traditional use.

The study is focused on a valuation of NTFP.

An economic analysis of swidden agriculture management options was not possible within the framework of this study, but is an important traditional use of forestland in the study area. Available information however is presented in Section 7.

(ii) Commercial timber extraction

Research Components

(i) Forest inventory of half a hectare of forest in Tapean forest (March 1996)

(ii) Interpretation of arial photographs of the study area in order to gain more accurate information on land use and ecological functions (January 1997)

(iii) Household surveys in the four villages known to collect forest products from Tapean forest (January - December 1996) in order to determine:

- village dependence on the forest (share of total livelihood accounted for by NTFP)
- the economic value of key NTFP. NTFP valued are: malva nuts, fuelwood, traditional baskets, house construction, manufactured products and wildlife.

(iv) Descriptive analysis (with quantitative input where possible) of other important values of the forest such as watershed value, tourism, cultural heritage, biodiversity and carbon storage.

(v) Evaluation of the costs and benefits of using land for commercial timber.

(vi) Market survey

Policy Relevance

(i) Information to policy makers and other relevant parties involved in land use planning in the province

(ii) Plans are being developed for participatory community forestry projects in some target areas by local government departments and NGOs. Information on *indigenous* classification systems and values placed on different forest resources is limited. It is hoped that this research study can contribute to this information requirement.

4.0 PHYSICAL INFORMATION[9]

4.1 Forest Inventory

A forestry inventory was undertaken in March 1996 of a representative half hectare of forest in Tapean Forest. The inventory was carried out by a team of five researchers from the provincial office of the Ministry of the Environment. Two elders from Kancheung village assisted the team in the identification and uses of particular species (collaboration with local people was essential for this study since they are the only source of information on the many values and uses of the wide range of forest products). Ten transects (100 X 50 metres) were selected randomly to be surveyed.

The following information is available for each of these transects: diagrammatic interpretation of forest; a comparison of mature and immature trees for each 10 X 5 metre block for each transect; comparison of mature and immature trees for sample area as a whole; tree diversity, abundance and species richness per transect; comparison of ground flora and saplings for each 10 X 5 meter block for each transect; and, comparison of number of grounds flora and saplings in the study area as a whole.

The forest inventory identified 189 types of trees and 320 species of ground flora and saplings. The main results are summarised below and presented in more detail in Appendix 5 (selected data only).

Based on the inventory results, discussions were held with the chief of Poey commune and a traditional healer from Kancheung Village regarding the uses of listed flora by villages in the commune. Information is incomplete because it is not always clear which part of the tree is used for a particular purpose. In some cases translation from Krung to Khmer was not possible).

Of the 189 types of trees, 100 are used by the villages for a range of purposes. The main uses are: food (47); house construction (32); fuelwood (2); manufacture (10); and medicine (2). Products manufactured from tree species include weaving instruments, earrings, and coffins. Some tree species have more than one use.

Of the 320-ground flora and saplings identified, over 201 have traditional uses. The main uses are: food (81); medicine (42); house construction (18); fuelwood (16); and manufacture (12). Types of products manufactured include cooking instruments, axe handles, and toys. Other uses of ground flora and saplings include pig feed, fish poison, dye, rope, boat construction, and ceremonial purposes.

The forest inventory provided useful data on which to base additional analysis, for example on the maximum sustainable yield of certain species.

The comparison of mature and immature trees over the half hectare study area and of individual transects (block by block analysis) provides an insight into possible harvesting practices and regeneration capabilities for some species. From the survey results, certain species appear to have good regeneration capabilities. For example (traditional use in parenthesis): *aing koch* (fuelwood); *samrong* (fruit); *krong* (house construction); *kray* (house construction); *mao* (fruit); *Sa nge* (fuelwood); *Ra pe* (manufacture); and *skorr* (fuelwood).

One tree species worthy of greater analysis is *Sterculia ychnophora*, from which malva nuts (samrong) are collected. From the inventory results this species seems to be regenerating well. However, cursory interpretation of the results suggests significant cutting of trees in some areas. For example, in transect number 4, there were a lot of saplings,

[9] The research team is grateful to Dominic Taylor Hunt (IDRC) for his help in guiding the forest inventory team in Ratanakiri, and for his instructive contribution to the analysis of the inventory results.

and many big gaps suggesting that the big trees had been cut down. In transect 6, there were no malva nut trees at all, possibly because they had all been cut.

More information of the tree species needed on the harvesting practices of villages and ecological characteristics (e.g., the life cycle of samrong tree). From discussions with villagers, the forest is an open access resource and the collection of malva nuts is unmanaged and unorganised in the sense that families go off to different parts of the forest to collect these. Without proper management, the sustainability of malva nuts could be threatened in the future as market influences increase and population grows.

The SDI index (Simpson's Diversity Index) for *trees only* for each transect ranges from 1.09-40.8, with an average of 12, indicating that the area as a whole is fairly diverse (particularly so in certain areas).

4.2 Land Use Aerial photographs of the area were interpreted, to determine the total area of Tapean forest and the different land uses within the area (see Land Use Map). The land use statistics for the forest are presented in Table 4.1. The total area of Tapean forest can be seen to be close to 1,824 hectares.

Table 4.1 Land Use/ Cover in Tapean Forest

Description	Hectare (ha)
Urban / Built-up Areas	0
Agriculture	0
Swidden Lands	
Active	0
Recently fallow	0
Secondary growth	0
Subclasses	
Shrubland (0-2m)	7.068
Bushland (2-6m)	3.997
Forest cover (6-10m)	496.525
Forest Cover	
Broadleaf evergreen	1,270.752
Broadleaf deciduous	23.183
Mixed deciduous / evergreen	12.861
Bamboo forest	9.558
TOTAL	**1,823.944**

Source: Integrated Resource Information Centre, Phnom Penh (IRIC)

5.0 HOUSEHOLD SURVEY

A total of 42 household surveys were undertaken in four villages known to use Tapean Forest for the collection of NTFP in order to assess the importance of the forest for traditional uses, and to value key NTFP (see Table 5.1). The four study villages are Kancheung, Mas, Koy, and Tangaich.

Table 5.1 Summary of Household Survey

Category / Number of hh surveyed	Kancheung	Mas	Koy	Tangaich	Total
HH income and assets	3	12	15	12	42
Purchased goods	3	12	15	12	42
Farming / crops	3	12	15	12	42
Traditional baskets	3	12	15	12	42
House Construction	3	12	15	12	42
Manufactured Goods	3	12	15	12	42
Fuelwood	3	4	5	4	16
Malva nuts	3	4	5	4	16
Bamboo	3	4	5	4	16
Rattan	3	4	5	4	16
Wildlife	3	4	5	4	16
Fish	3	4	5	4	16

Comments: Information based on group discussions used to define survey questionnaire and project (February 1996), and individual household Interviews (July 1996 and December 1996)

5.1 Background on Study Villages

There are ten villages in Poey commune, O' Chum district (Kancheung, Kamenh, Tangaich, Gres, Tun, Svai, Kralah, Koy, Sarok, Mas and Klong). The population of the district is estimated to be 10,308, made of three ethnic groups: Krung (64%); Tampuan (35%); and Khmer (1%) (AP Team District Assessment Reports). Most of O' Chum district is located in the hilly region where upland rice production is practised (traditional swidden agriculture). Agricultural practices are discussed in more detail in Section 7.

Available population statistics for the four study villages are presented in Table 5.2.

Table 5.2 Population Statistics for Study Villages

Name of village	No. of families	Population			Age over 15 years		
		Total	female	male	Total	female	male
Kancheung	48	235	133	102	127	74	53
Mas	28	117	76	41			
Tangaich	27	112	56	56	69	39	30
Koy	46	n.a	n.a	n.a	n,a	n.a	n.a

Note: n.a. Not available

An overall summary of the survey results relating to forest use and basic socio-economic conditions in the villages is presented in Diagrams 1-5. These results are based on household surveys carried out in Mas, Koy and Tangaich villages only (39 household surveys in total). Information pertaining to specific villages is provided in sections 5.1.1-5.1.4.

5.1.1 Kancheung Village

Kancheung Village was established in 1971 and is approximately 2 hours by road from Ban lung. The population is estimated at 235 (48 families, average family size 5). All villagers are farmers practising swidden agriculture. Apart from the output from their farms they are dependent for their existence on products collected from the forest. Alternative employment opportunities for people living in the village are very limited and are presented in Table 5.3. Most villagers consider their farms to be more important to their livelihood than the forest because they can grow rice and vegetables for sale. However, they also recognise their dependence on the forest for food, medicine, construction materials. and importantly as a land resource for farming.

All villagers interviewed claimed that it was becoming more difficult to collect products from the forest (especially fish and wildlife). Reasons given for this are: increased forest clearance for farmland; population increase; and the over-exploitation of wildlife. The villagers cited the following as the most important products collected from the forest: bamboo, rattan, construction materials, food, malva nuts, and, pangolins.

Villagers consider the clearance of forest for farmland to be the most important environment threat to the area. They suggested ways to conserve the forest: look for flat land to plant rice; prohibit commercial forestry; and control forest clearance and promote forest regeneration.

Table 5.3 Wage Employment, Kancheung Village

Type of Employment	Wage per month (riel)	Annual wage
Commune soldier	4,500 per month (US$1.80)	54,000 (US$21.60)
Staff of commune clinic	4,500 per month (US$1.80)	54,000 (US$21.60)
Provincial policeman	4,833 per month (US$1.90)	57,996 (US$23.20)

5.1.3 Mas Village

Mas Village was established in 1994 and consists of 28 households. All villagers farm and collect NTFP. The village lacks medicine, food (including rice), and schools. The forest was considered important for: house construction; the collection of NTFP (especially malva nuts and firewood); farming; and, as a habitat for wildlife and protection from wind and rain. The most important products collected from the forest were malva nuts, rattan, bamboo, wood and wildlife. The main forest products sold were malva nuts, turtles, and monkeys. Most villagers (88%) visit the forest every 1-10 days; 12% visit the forest once a month.

Villagers feel that the best way to manage the forest is for the government to support forest protection through legislation, and for outside villages to be prohibited from cutting trees and clearing the forest for farms. According to the village chief the main threat to the forest is burning the land for farming. Local meetings were suggested so that the importance of the forest can be explained to the local people.

5.1.3 Koy Village

Koy Village was established in 1992. There were 46 households in the village. All families farmed and collected NTFP. Twenty seven percent of households had one family member in paid employment. Types of employment available to villages are listed in Table 5.4.

Table 5.4 Wage Employment, Koy Village

Type of employment	Monthly wage (riel)	Annual wage (riel)
District teacher	36,000 (US$1.44)	432,000 (US$172.80)
Village chief	11,000 (US$4.4)	132,000 (US$52.80)

The village lacked many basic goods including food, medicine, clothes, schools, and seeds for farming. Villagers considered the forest important for: house construction, NTFP (especially fruit and fuelwood), watershed protection and rainfall, wildlife, and, farming. The most important products collected from the forest in order of importance are: rattan, bamboo, wildlife (bird, mouse, snake, monkey and deer), malva nuts, wood, and, fruit. The main forest products sold were malva nuts and wildlife (snake, turtle and monkey).

An estimated 13% of villagers visited the forest every day, 74% every 5-15 days, and 13% once a month.

Villagers felt that the best way to manage the forest was to prohibit other villages from cutting the forest and to explain to the people the importance of the forest. Shifting agriculture and forest fires are considered the greatest threat to the forest.

5.1.4 Tangaich Village

Tangaich Village was established in 1994, and has a population of 112 (27 households). All families farm and collect NTFP. An estimated 33% of households have one family member in paid employment (Table 5.5).

Table 5.5 Wage Employment Tangaich Village

Type of employment	Wage per month (riel)	Wage per year (riel)
Second village chief	11,000 (US$4.40)	132,000 (US$52.80)
Provincial military	71,000 (US$28.40)	852,000 (US$340.80)
Military salary for handicapped ex-soldier	50,000 (US$20)	600,000 (US$240)

The village lacks food, medicine clothes, and, schools. It also faced difficulties farming.

The forest is considered important for: house construction, the collection of NTFP (especially firewood, wood and bamboo), farming, basket manufacture, malva nuts, and food. The most important products collected from the forest were: bamboo, rattan, wood, wildlife, firewood, malva nuts, kanma leaves, fish, fruit, house materials, and, medicine. The main forest products sold were malva nuts, bamboo and rattan. Around 18% of villagers visit the forest every day, 73% every 3 to 7 days, and 9% once a month.

Villagers considered the best way to manage the forest is to prohibit other villages from using the forest (i.e., cutting the trees and establishing farms).

5.2 Household Expenditure

Information on the monetary purchase of goods by individual households was gained from the survey work (Tables 5.6-5.9). The survey results concurred with previous research on village expenditure (e.g., APT village surveys). Limited purchases appeared to be made by most highlanders, either from travelling traders or at the market place. Regular purchases included salt, mono-sodium glutamate (MSG), tobacco, and *prahok* (fish sauce). More occasional purchases include medicine, clothes, sandals, cheese, flints for lighters, mosquito nets, blankets, and cooking utensils (pots, kettle, plates, bowls, spoons).

Table 5.6 Household Expenditure, Mas Village

Product	Average quantity Purchase / hh /year	Average Price / riel	Average expenditure/ hh /riel	Average expenditure/ hh/US$	% of HH
MSG	8 kg	5,667/kg	46,500	18.60	100%
Tobacco	14 kg	3,773/kg	46,567	18.63	100%
Salt	27.1 kg	518/kg	13,108	5.20	75%
Clothes	3.8 items	5833/item	15, 250	6.10	50%
Sandals	2 pairs	3,400/pair	6,250	2.50	33%
Cheese	0.7 kg	1,500 / kg	917	0.37	25%
Prahok	0.5	3,000/kg	1,500	0.60	8%
Medicine			5,500	2.20	25%
Flint for lighter	3.3 pieces	100/piece	333	0.13	17%
Mosquito net	0.08	10, 000/ net	833	0.33	8%
Blanket	0.16	12,500/ blanket	2,083	0.83	17%
Total			142,174	56.86	

According to White (1996), a substantial amount of highlander 'expenditure' is on non-market goods such as cattle, gongs, and rice wine jars which constitutes traditional wealth and investment and carries social prestige. However, little information on these commodities was revealed through the survey. The reason for this is not clear.

Expenditure patterns are similar in the three villages studied. They range from US$55.95 - 61.99 per household, or US$9 - 11.50 per person (Table 5.9).

Table 5.7 Household Expenditure, Koy Village

Product	Average quantity purchase / hh / year	Average Price / reil	Average expenditure/ hh / riel	Average Expenditure/ hh / US$	% of HH
MSG	6.43 kg	3,500 kg	22,900	9.16	93%
Tobacco	10.03 kg	4,458 kg	58,800	23.52	80%
Salt	28kg	528.57 kg	13,520	5.40	93%
Clothes	4.73 items	4,450 item	18,400	7.36	67%
Sandals	2.4 pairs	3,214 pair	7,433	2.97	47%
Cheese	0.53kg	2,667kg	1,033	0.41	20%
Prahok	1.16	2,900	5,120	2.05	20%
Medicine			2,333	0.93	13%
Flint for lighter			1,600	0.64	6%
Sugar	2.4kg	1,800	4,480	1.79	13%
Rice	0.6kg	900	540	0.22	6%
Oil			1,200	0.48	6%
Battery			1,920	0.77	6%
Blanket		9,000	600	0.24	6%
Total			139,879	55.95	

Table 5.8 Household Expenditure, Tangaich Village

Product	Average quantity purchase / hh /year	Average Price / riel	Average expenditure/ hh / riel	Average Expenditure/ hh /US$	% of HH
MSG	9.2 kg	5,940 kg	54,300	21.72	83%
Tobacco	8.05kg	4,500	37,500	15.00	83%
Salt	73.09	412	20,364	8.10	75%
Clothes	3.42 items	4,357 / item	15,750	6.30	58%
Sandals	1.24 pairs	3,259 / item	4,125	1.65	33%
Prahok	5.64 kg	3,900 kg	17,600	7.04	50%
Medicine			2,667	1.07	17%
Rice			2,083	0.83	8%
Total			154,389	61.75	

Table 5.9 Summary of Expenditure Patterns

	Mas	Koy	Tangaich
Average total expenditure / hh / riel	142,247	139,880	154,967
Average total expenditure / hh US$	**56.90**	**55.95**	**61.99**
Minimum	14.40	30.16	15.36
Maximum	111.20	109.20	129.60
Average hh size per survey	8 [3-16]	5.5	5.4 [3-9]
Average expenditure per person US$	**9.00**	**11.25**	**11.50**
Minimum	1.70	5.28	3.07
Maximum	37.06	21.20	21.60

5.3 Barter Exchange

Barter exchange is widely practised. All households in Mas Village barter, 54% in Koy and 77% in Tangaich. Bartering may be more common in Mas village due to the fact that the village is more isolated. The main products bartered are rice, traditional basket and chickens. Information on units of exchange and barter practices is presented in Tables 5.10 -5.12.

The information on annual household expenditure and bartering practices clearly illustrates the limited interaction highlanders still have with the cash economy and commercial markets. Hence their dependence on their farms and forest land, that is, the natural resource base.

Table 5.10 Barter Exchange, Mas Village

Product given	Product received	Unit of exchange	Average frequency of products exchanged	No. of families
Rice	Buffalo	60 baskets of rice (300, 000 riel) = 1 buffalo	1-3 times / year	2
Rice	MSG	55 cans of rice (4 cans = 1kg) = 1 kg MSG	7 times/ year	4
Rice	Tobacco	40 cans of rice = 1 kg tobacco	14 times year	4
Rice	Chicken	1 basket of rice = 1 chicken	not very often	1
Chicken	MSG	1 chicken = 0.5 kg MSG		1
Chicken	Basket	1 chicken = 1 basket	3-4 times / year	2
Sesame	Salt	1 basket of sesame = 2 baskets of salt	1 time / year	3

Table 5.11 Barter Exchange, Koy Village

Product given	Product received	Unit of exchange	Average frequency product exchanged	No. of families
Rice	Cheese	1 can = 1 bag		1
Rice	MSG	1 can =1 bag 10kg = 0.5 kg	every 20 days	4
Rice	Prahok	10 cans = 1 can	every 5 days	1
Rice	Tobacco	20 cans = 1 can	every 5 days	1
Rice	Fuel		1/ month	1
Basket	Petroleum	1 = 2 litres		1
Basket	MSG	1 = 0.5kg 1 = 1 kg		3
Basket	Chicken	1 = 1		2
Basket	Rice	1 = 1	4 / year	2
Rice container	Tobacco	1 = 0.5kg	1 / month	1
Chicken	Prahok	1 = 1 kg	1 / month	1

Table 5.12 Barter Exchange, Tangaich Village

Product given	Product received	Unit of exchange	Average frequency products are exchanged	No. of families
Rice	Prahok	10 cans = 0.5kg	1 / month	2
Rice	MSG	1 can = 50 grams	1 / 5 days	3
Rice	Candy	1 bag = 1 bag	1 / 2 days	1
Basket	Chicken	1 = 1	frequently	1
Basket	Rice	1 =1	frequently	1
Chicken	Salt	3 = 1 basket	2/ month	1
Chicken	MSG	1 = 0.5 kg	3-4 / month	1
Sesame	Salt	3 baskets = 1 baskets	1 / year	1
Sesame	Salt	1 basket = 1 basket 4 baskets = 50kg salt	1 / year	2
Pineapple	Chicken	1 = 1		1
Pineapple	Cheese	1 = 0.3 kg	10 / year	1
Pineapple	Oil	1 = 0.8 litres	50 / year	1

6.0 VALUATION OF NON TIMBER FOREST PRODUCTS (NTFP) IN TAPEAN FOREST

6.1 Definition

The term non-timber forest products may be defined as the variety of physical goods other than timber that are derived from forests. They are used either for subsistence purposes or traded or sold. Table 6.1 summarises the various categories of non-timber forest products.

Forest value has been traditionally based on the commercial worth of its timber, ignoring the forest's many non-timber values[10]. The omission of non-timber benefits in conventional economic analysis means that the forest resource is undervalued. This can result in unsustainable timber extraction or the conversion of forest land to altemative land uses, since these options 'appear' more attractive. This is of particular concem for forest land in areas such as Ratanakiri where indigenous people are wholly dependent on the forest for their existence.

Table 6.1 A Characterisation of Non-Timber Forest Products

Category	Examples
Food	bushmeat, fish, fruit, edible oils, edible plants, honey
Medicinal products	fuelwood, charcoal
Fuel	rattan, bamboo, wood poles, various fibres
Structural Materials	honey, eggs, birds nests, reptile skins, feathers and other decorative wildlife products
Animal products	
Live animals	
Ornamental plants	

6.2 TECHNIQUES FOR VALUING NON TIMBER FOREST PRODUCTS

Possible techniques for valuing NTFP are summarised below, based on IIED 1995.

6.2.1 Market prices

For NTFP that are sold, valuation can be based on market prices. The costs of harvesting, extraction, and transport should be deducted from the market price in order to derive the net price of the forest product. Total value may be derived by applying the unit price to the estimated quantities that could be harvested sustainably from the forest.

[10] Generally, greater attention is now being paid to the importance and value of NTFP. A number of economic studies of NTFP have shown the real (or potential) value of NTFP to be substantial. A study in the Amazon forest indicated that the economic value of NTFP was in fact bigger than that of the timber in the long run (Peters *et al* 1989). Other studies have shown that NTFP are important sources of fuelwood, building materials, fodder, food and income to the rural people. A number of NTFP (such as rattan, bamboo, resins and medicinal plants) have shown potential economic value for further research and development (IIED 1995). A further consideration is that higher economic values may be derived if forest management emphasizes the production of both timber and NTFP (Panayotou and Ashton 1992).

6.2.2 Valuing forest products for subsistence use

It is often not possible to apply market prices to NTFP as most of these products, as in Ratanakiri, are used purely for subsistence purposes and are not sold in the market. People acquire many goods, such as fruit, fuelwood, and medicine, not through the market but by gathering or producing them. For non-marketed products a number of alternative valuation approaches may be possible, some of which are discussed below.

6.2.3 Direct Substitute Approach

A non-marketed forest product could be valued by reference to the price of the products closest marketed substitute. For example un-marketed fuelwood may be valued by referring to other substitute fuels such as charcoal or kerosene which are sold in the market. The different fuels (products) have to be expressed in the same delivered energy terms in order for comparison to be possible, which can be difficult. The extent to which the value of the marketed good reflects the value of the un-marketed good depends largely on the degree of similarity or substitution between them. Also, this approach is likely to overvalue subsistence supplies if the users would not purchase fuel if they could not gather fuelwood (i.e., if they would adopt an alternative such as switching to other fuels).

6.2.4 Indirect Substitute Approach

If the substitutes for a forest product are also un-marketed, the value of a non-marketed forest product could be based on the value of its closest substitute when employed in an alternative use. For example, non-marketed fuelwood may be valued using information on the alternative uses of one of its substitutes – cattle dung. When wood is unavailable, cattle dung is sometimes dried and burned instead of wood. Typically, however, cattle dung is used as a fertilizer. The opportunity cost of using cattle dung as fuel rather than fertilizer could therefore be used to value fuelwood by estimating the loss in agricultural production as a result of using less fertilizer. This approach is fairly data intensive. It requires an understanding of the physical relationship between the use of fertilizer and agricultural productivity.

6.2.5 Barter Exchange Approach

Forest products may be exchanged in a non-commercial market through a process of barter. If the bartered good exchanged for the forest product is also sold in a commercial market, then it may be possible to derive the value of the non-marketed good using information about the relationship (i.e., units of exchange) between the two goods, and the market price of the commercial good. For example, if a basket of non-marketed vegetables of known weight is routinely exchanged for a chicken through a process of barter, and a chicken is known to cost US$1 in the local market, then it can be inferred that a basket of vegetables is worth US$1.

NTFP in this study have been valued using market prices and the direct substitute approach.

6.2.6 The Opportunity Cost of Labour

Value estimates for NTFP must be net of harvesting costs. This normally requires that one deduct the opportunity cost of labour from gross production values. This cost can often be taken as a wage rate in some alternative form of employment. But where markets are not well developed, some other estimate must be used for valuing labour. In the upland areas of Ratanakiri, it is common for households to use unpaid family labour that does not have other employment opportunities. The survey suggests further that there are few other productive activities that would be pursued at the time that the products are actually collected. This is due both to the seasonality of gathering and to the lack of other available activities for the family members involved in the gathering. For these reasons, the opportunity cost of labour is expected to be very low. For the purpose of this study, the opportunity cost is taken to be zero.

6.3 Fuelwood

Fuelwood is used by all families in the study villages for cooking and heating. No other form of fuel is used. While fuelwood is still readily available, 61.5% of interviewees stated that it was becoming more difficult to collect because of the increased number of farms and people collecting. Fuelwood is not bought or sold by villagers.

In Kancheung Village, fuelwood is collected from around the village. It takes an average of 30 minutes to collect one basket. In one month, one family would use, on average, 25 baskets of fuelwood (10 baskets for domestic use and 15 baskets for use on the farm). Types of fuelwood used included Kapla, Tropak, Lie, Kacey, Ongkuch, Inging, Krong, Tangelyou, Param, Kray, Montrokot. An estimated 50% of people cut trees for fuelwood and 50% collect branches that have already fallen.

Using the market price of fuelwood of 1,000 riel per basket (Banlung market), fuelwood may be valued at: 25 (no of baskets used per family per month) * 1,000 riel (market price of fuelwood per basket) * 48 (number of families in village) = 1,200,000 riel ($US444) per month, or 14,400,000 riel ($US 5,333) per year.

A similar approach is used to calculate the value of fuelwood for the other three villages surveyed. A summary of results is presented in Table 6.2 and 6.3. These values represent gross estimates since harvesting and transport costs have not been accounted for.

Table 6.2 Fuelwood: Summary of Results

Village (Number of households)	Average number of baskets collected per year[1]	Value to household / year	Value to village / year
Kancheung (48)	300	300, 000 riel (US$ 111)	14, 400, 000 riel (US$5, 640)
Mas (28)	252	252,000 riel (US$93)	7,056,000 riel (US$2,822.40)
Koy (46)	256.8	256, 800 riel (US$95)	11,812,800 riel (US$4,725.12)
Tangaich (27)	231	231, 000 riel (US$85)	7, 161, 000 riel (US$2,864.40)

Note: The average weight of a basket of fuelwood is 12.6 kg

Table 6.3 Summary of Fuelwood Harvesting Practices

Village	Area where fuelwood is collected	Average distance and travel time [min -max]	Average number of days collect / year [min-max]	Harvesting Technique
Kancheung	Around village			Cut trees and cut dead branches of trees
Mas	Around village and chumgarr	300 metres (200-500) 45 mins (30-60 mins)	177 (72-336)	Collect dead branches of trees
Koy	Around village (50-300m) Phav stream	165 meters (200-500) 42 mins (30-60mins)	103 (72-180)	Collect dead branches of trees
Tangaich	Around village and farm; Chrey mountain.	425 metres (100-600) 67 mins (60-90)	75 (36-120)	Collect dead branches of trees

6.4 Malva Nuts (Krong name: Hajong; Khmer name: Samrong)

Malva nuts are popular forest fruits used in soup or as a dessert. They are also believed to be good for energy. Malva nuts have an irregular and seasonal fruiting cycle. According to villagers there is a bumper crop every seven years for a two-month period. In other years, there are only few malva nuts (2-3kg) and collection is not considered worthwhile. They are important source of income for villagers.

All four study villages collect malva nuts from Tapean forest (Tapean mountain is possibly the richest location in the province for the collection of the nuts). The distance to Tapean mountain for the four study villages ranges from 7-15 km.

Collection starts in May and stops in June once the rains start. In May, trees are cut to collect the nuts, but by June the fruits are falling off the trees and can be collected from the ground.

Malva nuts are collected mainly for sale to Khmer traders, who come to the villages from Ban Lung. They are typically sold to Vietnam and then on to Hong Kong and China[11]. Prices vary through the season from 500 riel to 2,400 riel per kg, increasing with the increase in traders. The most commonly quoted price is 2,000 riel per kg. Money from sale of the nuts is used by villagers to buy cooking pots, clothes, medicine, tobacco, mats and livestock. According to the chief of Kancheung Village, malva nuts are the most important source of income to the village after hunting and farming. According to survey results malva nuts are the most important forest product sold (Diagram 4).

Interviews with three households in Kancheung village revealed that in a good year, one family collects between 800 - 2,100kg of fruit (this is considerably more than the quantity previously quoted of 500 kg obtained from group discussions in February 1996). One explanation for this is that villagers do not have a clear concept of weight (or area)[12]. This highlights the difficulty of deriving accurate measurements for valuation purposes. A more realistic collection quantity of 500 kg is therefore used in calculations. Only 2-3 kilograms are kept for personal consumption, the rest are sold. Sometimes malva nuts are exchanged (bartered) for prahok in equal weight.

Assuming that on average one family collects 500 kg of fruit at a market price of 2,000 riel/kg, a family can earn on average 1,000,000 riel (US$370). The potential income to the village as a whole is estimated at US$17,760. It should be noted that such returns are only possible every seven years, and are gross estimates as no account is taken of harvesting costs. Similar calculations were performed for the other study villages. Table 6.4 summarizes harvesting practices and malva nut benefits for the four study villages.

The forest is an open access resource, so anyone can collect the nuts. Villagers in Kancheung believe that the supply of malva nuts is plentiful and that the nut will always be available as the land is unsuitable for other uses. However, 50% of interviewees from Mas, Koy and Tangaich villages stated that malva nuts were becoming more difficult to collect due to the fact that more people were collecting and also because people were cutting the trees to collect the fruit. Typically, the trees are cut early in the season (before the fruit is ripe and ready to fall) in order to profit from higher price at this period of low supply. Such issues raise concern over the sustainability of current harvesting practices, supported by the forest inventory (see Section 4.1).

[11] The market price for malva nuts in Vietnam, Hong Kong and China is unknown. It is assumed that prices in these locations would be quite high, given that malva nut is considered to be a delicacy.

[12] Such difficulties have been encountered by other researchers. *per com* Dominic Taylor Hunt

Sustainable harvesting techniques for malva nuts need to be more widely introduced in the area. For example, a technique used in Lao (known by only a few villagers in the area) might be promoted. This involves tying a rattan vine tightly around the bark so that the moisture is cut off to the upper part of the tree, which then becomes dehydrated and the tree sheds it fruit.

Harvesting of the fruit by people from outside also needs to be controlled. One option is for the villages to introduce a tax on the quantity of malva nuts taken out of the forest, or to base the tax on the number of days people spend collecting. Any form of taxation will require carefully monitoring by the villagers.

Table 6.4 Summary of Malva Nut Harvesting Practices and Gross Value

Village (number of households) % collected from Phnom Tapean[1]	Average quantity collected per HH per seven year cycle	Value per family per seven year cycle[2] / riel	Value to village per seven years cycle / US$	Average number of days collect / 7 years	Collection site Distance / travel time
Kancheung 48 100%	500kg	1, 000, 000 (US$370)	US$17, 760		Tapean mountain 7km / 3 hrs
Mas (28) 10%	46.5 kg (15-340)	93,000 (US$34)	US$964	10 (2-20)	Tapean mountain 6km / 2.30 hrs Chan mountain 4km / 1.30 hrs Kean mountain 4 km / 1.30 hrs
Koy (46) 31%	36 kg (20-50)	72,000 US$27	US$1,227	3.8 (2-5)	Tapean mountain 11 km / 5 hrs Chrey mountain 10 km / 3 hrs Taber stream 3 km / 1 hr Kayat stream 7 km / 2 hrs
Tangaich (27) 86%	120 kg (50-360)	240, 000 US$89	US$2,403	11 (2-30)	Tapean mountain 7km / 3hrs Laber mountain 10km / 4 hrs Tuan mountain 2km / 30 mins

Notes: 1 Based on the number of days spent collecting from each location per survey information. 2 Based on market price of 2,000 riel / kg

6.5 Rattan (Krung - Rare, Khmer - P'deo) and Bamboo (Khmer -Russey)

All families collect bamboo and rattan from the forest. Bamboo and rattan is used for making baskets, and rice stores. They are also used in house construction. Rattan and bamboo are considered to be the most important products collected from the forest (Diagram 2). However, 100% of households interviewed stated that collection of rattan and bamboo is becoming more difficult due to the clearing and burning of the forest to establish farms, and forest products' collection by more people.

Tables 6.5-6.8 present collection practices and value estimates for bamboo and rattan for the four study villages. The value of bamboo and rattan is based on the quantity collected per survey information and available market prices for certain species. Value estimates may overestimate true value in that not all rattan and bamboo collected may be of commercial value, and also harvesting costs have not been deducted.

Table 6.5 Estimates of the Value of Bamboo

Village Number of households	Types of bamboo collected	Average quantity stems /HH / year / * average market price[1]	Value / reil (US$)	Average quantity of stems collected per village / year	Value (US$)
Kancheung 48	Phor; Prey; Pork; Srok	90 * 350 riel	31,500 riel (US$12)	4,320	US$560
Mas 28	Phor; Keo; Banlar; Pork; Prey; Thnor; Kley	288 * 475 riel	137,156.25 riel (US$51)	8,085	US$1,428
Koy 46	Kley; Phor; Pork; Thngnor; Borlao; Chartearng; Rakou; Prey	237 * 300 riel	71,100 riel (US$26)	10,902	US$1,196
Tangaich 27	Phor; Pork; Kley; Thngor; Prey	34 * 300 riel	31,050 riel (US$12)	9,118	US$324

Note: Average price used per stem based on market price for available species (Banlung market): Pork -200r (3-6m); Kley 200 r (3-5m); Bonla 1000r (5-6m); Phor - 500r (6-7m); Ping Pong - 1500r (6-7m); Skokcham - 3000r (6-7m).

Table 6.6 Bamboo: Harvesting Practices

Village	Source / Distance	Average travel time	Average number of days collect / year
Kancheung	O' Chadav (2km) O' *Kayat (5km)* O' Lemeurs O' Torteng (8km)	54 mins (20-90mins)	30
Mas	Chan mountain (0.5km) *0'Kayat (1km)* Chaa Rong Mountain (1km)	37 mins (30-45mins)	70 (6-191)
Koy	O' Chadav (0.625 km) O'Pa'ay (0.1km) O'Taber O' Kamao (1km) Run dzern mountain (1km)	27 mins (10-40)	no data
Tangaich	Chrey mountain (0.5km) Chataov mountain (3km) Dzri mountain (1.5km) O Pa'ay (1km) O' Kork (1km)	1hr 40 mins (20 mins-5 hrs)	20 (6-11)

Table 6.7 Value Estimates for Rattan

Village (Number of HH)	Types of rattan	Average quantity vines collected year / HH * average market price[1]	Value per HH / riel (US$)	Average quantity of vines collected per village /	Value riel / US$
Kancheung (48)	Kantoy kandol; Chhvang; Sum	100 * 750 riel	75, 000 riel US$28	4,800	3,600,000 riel US$1333
Mas (28)	Chaing; Kontoy kandal; Lving Dambourng Amborn; ReiTaseuy; Morng Harbak; Trosorng Anchor	132 * 750 riel	99,000 riel US$37	3,696	2,772,000 riel US$1,036
Koy (46)	Thomada ;Kantoy kandol; Domborng; Seuy; Taaseuy	56 * 750 riel	42,000 riel US$16	2,576	1.932,000 riel US$736
Tanaigch (27)	Charvaning; Habak; Thomada Kantoy kandal; Damborng.	54.3 * 750 riel	40,725 riel US$15	1,466	1,099,575 riel US$405

Notes: 1 Average price based on available market prices for rattan per vine (Banlung market) Chaing - 500r (8-11 metres; Achmonn 500 reil (8-11 metres); Domdorng - 100r (5-30 metres); Som - 1000r (5-meters).

Table 6.8 Rattan: Harvesting Practices

Village	Source	Average Travel Time	Average Collection Time
Kancheung	*O' Pin Pin* *O' Kayart* O' Hahang Balat stream	40 mins	30 days / year [2-60]
Mas	Chan mountain O'Touk stream O'Kayat stream	40mins	20 days/ year [2-56]
Koy	O'Taber	2 hrs	[2-3 months / year]
Tangaich	Tapean mountain O' Halang O'Tamau O'Dzoun	3 hrs	[2-5 months/year]

6.6 Traditional Baskets

Traditional baskets (Khmer name: kappah, Krung name: Reo) are made from woven bamboo or a cane species found near rivers. The straps are made from rattan strips. Almost all families make baskets. They take on the average 4 days to make, while the materials needed can only be collected in one day. Traditional baskets are the principal means of transporting produce from the forest or garden and for transporting products to the market. In addition, they are an important source of income to the village and are sold for 3,500 riel (small) to 5,000 riel (large). The baskets are mainly bought by tourists in Banlung market. Baskets are sometimes bartered for fish sauce (prahok) and salt.

Eight households were interviewed in Kancheung Village regarding their manufacture and use of traditional baskets. Survey results indicated that the average number of baskets made and sold per household is 11 and 7, respectively. Taking 4,250 riel as the average price (information on the size of baskets made was not obtained) the average value of traditional baskets per family is estimated at 46,750 riel (US$17.30) per year, and US$830.40 to the village as a whole. Average income per family based on the average number of baskets sold per household is 29,750 riel (US$11.9). Similar calculations were performed for the other villages and a summary of the results is presented in Table 6.9.

Table 6.9 Summary of Traditional Baskets Manufactured and Sold in Study Villages

Village No. HH	Av. No of days to make	Av. no made /hh [range]	Value per HH / av. mkt price 4250 riel	Value to village	Av. no sold /hh	Average selling price / riel	Av. Income per HH riel / US$
Kancheung 48	3	11 [2-36]	46,750	2,244,000 US$830.40	7 [0-26]	4,250	29, 750 riel US$11.90
Mas 28	6	7.6 [2-20]	32, 300	904,400 US$336	3.25 [0-16]	2,916	9,477 riel US$3.80
Koy 46	4	15 [0-35]	63, 750	2,932,500 US$1086	12 [0-20]	3,395	40,740 riel US$16.30
Tangaich 27	3.5	4.4 [0-10]	18,700	504,900 US$189	2.6 [0-10]	3,312	8,611 riel US$3.45

6.7 Manufactured Products

A range of products is manufactured by villagers, many of which are made from forest materials. Products manufactured (and materials used) include: hunting, fishing, cooking and weaving implements; wine jars; musical instruments; rice wine; hand-woven cloth; rice stores (5 bamboo stems); mortar and pestle (1.5 meter tree); and, fish/vegetable baskets (3 rattan/ 4 bamboo). Manufactured products are a potential source of income for villagers. Sufficient information was available from the survey to value two commonly manufactured products - rice shallows and mats (Table 6.10 and 6.11). Shallows are used for sifting rice and are typically made from 1 bamboo stem and 3 rattan vines, mats are used for drying rice and for sleeping. They are woven from around 40 sloek romcheck (Pandamus odoratissimus) leaves. Valuation is based on the average quantity manufactured and selling price reported by villagers.

Table 6.10 Shallow Manufacture

Village	Average quantity manufactured/ year/ hh	Selling Price riel	Value / hh riel	Value/ village riel/US$
Mas	1.5	3,000	4,500	126,000 riel (US$47)
Koy[1]	2	3,000	6,000	276,000 riel (US$102)
Tangaich	0.5	3,000	1,500	42,000 riel (US$16)

Note: 1 One family sells 10 shallows a year. Other families manufacture product for home use.

Table 6.11 Mat Manufacture

Village	Average quantity manufactured / year/ hh	Selling price riel	Value/ hh riel	Value / village riel/US$
Mas	1.5	2,500	3,750	105,000 riel (US$40)
Koy[1]	2.8	2,500	7,000	322,000 riel (US$119)
Tangaich	1.75	2,500	4,375	1,225,000 riel (US$44)

Note: 1 One family interviewed sells 17 mats per year

The value of rattan and bamboo based on the quantities of vines/stems collected is significantly higher than the value based on goods manufactured from these materials (Table 6.12). One explanation for this is that many goods made from rattan and bamboo are not included in the analysis. However, the value based on manufactured products is used in the analysis, partly to avoid double counting the benefits of the use of these materials in house construction (see Section 6.8).

Table 6.12 Rattan and Bamboo Values

	Value per quantity of rattan / bamboo collected (US$)	Value per traditional baskets and manufactured goods (US$)
Kancheung	1,893	848
Mas	2,464	423
Koy	1,932	1,307
Tangaich	729	249

6.8 House Construction

The forest is extremely valuable to local people as a source of construction materials. Houses are made from bamboo, rattan, wood, saek, and kanma leaves, all of which are collected from the forest. It takes 1-3 months to collect the necessary building materials, and 6.5-23.5 days to construct a house. Houses last for approximately 3 years, and around 4 new houses are built per village every year.

An average house is made from (range in parenthesis) 35 trees [3-100], 73 bamboo stems [9-260], 50 rattan vines [20-300], and 282 kanma leaves [150-700]. According to the commune chief, tree species used in house construction includes: la ngeang, chraing, kreang, baing, and ring.

The value of village houses has been estimated using the direct substitution approach based on the market price of a similar size and style house in Banlung (Table 6.13). The market prices of houses in Banlung are presented in Table 6.14 and were derived through a survey of house prices in Banlung. The cost to build a basic one-room village style house can be as high as US$1,300 (including the cost of a metal roof). A more conservative house price of US$220 is used in the analysis.

Table 6.13 House Construction and Value in Study Villages

Village	Estimated No of houses	Value using market price US$222	Av. life of house	Source of materials	Av. collection time	Av. construction time
Kancheung	32	7,104	4	Tapean mountain O' Chadav O' Trawchik	1 month	12.5 days
Mas	14	3,108	3.5	Chan mountain Ta verng mountain Pa rass mountain O' Kayart stream O' Touk Kom Forest Kampeang stream	2 months	23.5 days
Koy	16	3,552	2.5	Tapean mountain O' Chadav O'Taber O' Pla'ay	1.5 months	6.5 days
Tangaich	27	5,994	2.5	Tapean mountain Pa lat mountain O' Chataov O' Tamau Rove Chern mountain O' Ha lang Ralang stream Chrey mountain O' Kayart Koy stream O' Chadav O' Chartar O'Taber Ka Yeng forest Touch forest	2-3 months	12.5 days

Notes: Estimated number of houses based on survey responses. Not clear which products are collected from each specific location. Not clear what proportion of time is devoted to collection

Table 6.14 House Prices in Banlung

Size / Description of House	Price riel (US$)
7m * 6m (Wood, rattan, Bamboo)	600,000 riel (US$222)
4m * 6.5m (Wood, rattan, bamboo, leaves for roof)	600,000 riel (US$222)
4m * 8m (1 room Wood, bamboo)	720,000 riel (US$267)
5.5m * 7m (1 room Bricks, bamboo, rattan)	3,000,000 riel (US$1,111)
5m * 7m (Wood, corrugated iron roof)	3,600,000 riel (US$1,333)

6.9 Wildlife

Tapean forest is said to house a lot of wildlife including elephants, gaur and monkeys. Nearly all families collect wildlife using traps, cross bows or guns.

Survey information differs between Kancheung village (where information was derived mainly through group discussion) and the other three villages (information based on individual interviews). With the exception of Kancheung, nearly all households interviewed claimed to collect wildlife for subsistence purposes only and not for sale (perhaps to avoid any suggestion of illegal practices). Only one interviewee in Mas village stated that he sold on average 24 pangolins a year for 20,000 riel/kg. However, reported quantities collected are much lower for Kancheung village. All interviewees claimed that it was becoming more difficult to collect wildlife.

Tables 6.16 - 6.20 detail the wide range of wildlife collected by the four study villages, wildlife prices, locations where wildlife are collected, and harvesting practices. It was not possible to put a value on all species of wildlife collected due to data limitations. While price data is available in kilograms for a number of species, the average weight in kilograms of some species was not determined. Species for which valuation was possible are pangolin, wild pig, barking deer, wild chicken, wild buffalo, sambar deer, and lizard.

Market prices have been used to estimate the value of wildlife. For example, assuming that on average 35 pangolins are caught each year in Kancheung village, returns to the village are 892,500 riel (US$331) per year (35 as the average number of animals sold per year) * 3kg (average weight) * 8500 riel as price per piece). Information on the market price for pangolin varies from 11-24,000 riel /kg. Using a market price of 20,000 riel, the value of pangolins collected by the village can be estimated at 2,100,000 riel (US$778). This represents gross prices (harvesting costs are not known and have not been deducted).

Available price information on wildlife clearly shows the large difference between the farm gate price obtained by villagers and subsequent profits made by middlemen trading with villagers and sellers in Ban lung market (Table 6.17).

The value of wildlife to the four study villages is summarised in Table 6.15

Table 6.15 Summary of the Value of Wildlife (US$)

	Kancheung	Mas	Koy	Tangaich
Value for village / year	6, 683	39, 163	153, 671	27, 000
Value per HH/ year	139	1, 398	3, 201	1, 000

6.9.1 Hunting and the Sustainability of Wildlife

Wildlife is an important source of income for villages but is reportedly declining in most areas. Hunting of endangered species is evident. The increasing demand and higher prices being offered for wildlife products in neighbouring countries are said to have encouraged commercial hunting which is taking place indiscriminately and in an unsustainable fashion.

A recent survey of large mammals in Ratanakiri, concluded that hunting and the trade in wildlife is extensive and intense (42 species of mammals were recorded in the wildlife trade). It is projected that at the present rate of hunting it is unlikely that either gaur or banteng will survive through the next 5-10 years. The number of gaur, banteng, elephant and sambar deer tracks recorded by the survey team were very low, despite the availability of large areas of suitable habitat. The only species commonly found was the wild boar (Deasi and Vuthy 1996).

According to local people inside Lomphat Wildlife Sanctuary gaur, banteng, brow-antlered deer, sambar deer, muntjac and wild boar are common, and elephants may be found in

the dense virgin forest. The hunting of wildlife for subsistence and commercial purposes urgently needs to be assessed in more detail and management plans developed and enforced at the community level.

Table 6.16 Estimated Quantity of Wildlife Collected per Village per Year, and Status

Species	Kancheung	Mas	Koy	Tangaich	Availability	Status[1]
Pangolin	35	42	0	0	HIGH	II
Wild pig	25	88	607	121	HIGH	
Barking deer	25	126	129	0	V.LOW	
Wild chicken	65	6,328	19,872	2,430		
Wild buffalo (Gaur)	2	0	184	0	MED	II / V
Apple snail	0	84	0	0		
Rat		[700kg]	1,104	9,720		
Lizard	50	[30.80kg]	276	0	HIGH	
Sambar / Rusa deer	10	21	0	0	MED	
Banteng	25	28	0	0	V.LOW	V
Large deer	0	0	276	135		
Grey squirrel	0	0	2,760	0		
Squirrel	0	0	2,208	3078		
Turtle Dove	0	0	331	567		
Monkey	0	0	3,312	0		
Musk Deer	0	0	0	101		
Bird sp.	0	0	0	2,430		
Porcupine	55	0	0	0	HIGH	
White Macaque	4	0	0	0	LOW	
Gibbon	4	0	0	0	MED	I
Monitor lizard	80	0	0	0	HIGH	
Otter sp.	25	0	0	0		II / K
A Guy	0	0	0	0	HIGH	
Asian Elephant	0	0	0	0	V.LOW	I / E
Tiger	0	0	0	0	MED	I / E
Leopard	0	0	0	0	MED	I
Python	0	0	0	0	LOW	

Status: 1 CITES Appendices: Endangered species, trade normally prohibited; II: Threatened species, trade controlled. IUCN categories (WCMC, 1990): E: Endangered; V: Vulnerable; R: Rare; I: Indeterminate (but E, V, or R); K: Insufficiently known

Table 6.17 Wildlife Prices

Species	Price at location riel / kg [1]	Market Purchase Price riel/per kg or per animal [2]	Market Selling Price / riel/ per kg or per animal [2]	Quantity sold at market / year [3]	Average weight (kg)[2]
Pangolin [4]	8,500 20, 000	9,000-10,000	11,000-12,000	144	3
Wild pig	2,500	2,500-6,000	3,000-9,000	30	30-50
Barking deer	3,000	6,000-7,000 2,500	4,000-12,000	48	35
Wild buffalo (Gaur)	2,500	5,000-6,000	6,000-8,000		10-30
Wild chicken		5,000-6,000	7,000-8,000		0.6
Large Deer		2,000-2,500	4,000 -5,000	36	45
Porcupine	3,000				
A guy			5,000/animal	48	
Indian Elephant		US$200-300/ animal	US$1000		
Panther					
Lizard	2,500	5,000-6,000	7,000-8,000		
Monitor Lizard	2,700	7,000-8,000	10,000-12,000		
Rusa / Sambar Deer	3,000				30
Python			4,000		
Otter		5,000-6,000	6,000-8,000		
Squirrel				1	
Apple Snail				1	
Black Tortoise			3,500	300	3
Malayan Sun Beer[5]			US$500 per live animal		

Notes: 1 Based on survey information from Kancheung village; 2. Based on market survey; 3. Based on interview with wildlife meat seller in Banlung market. Number of wildlife sellers unknown; 4. 8,500 riel is price quoted in Kancheung, 20,000 riel - price quoted in Mas village. Other reports cite higher prices for pangolin 24,000 riel/kg/ live animal; 60,000 riel for skin (Taylor-Hunt, 1996), 10,000-20,000 riel/kg (Barid, 1996); 5. Gall bladder sold for US$450

Table 6.18 Locations where Wildlife is Collected

Location	Wildlife species collected	Village/s who collect in this area
Tapean Forest	Pangolin; Gibbon; A Guy; Barking Deer; Indian Elephant; Tiger; Leopard; Python sp.; Asian Wild Dog; Malayan Sun Beer; Squirrel; Bird; Turtle Dove; Rat; Musk Deer; Wild Pig; Large Deer; Monkey; Peacock	Kancheung Tangaich
O'Chadav	Porcupine; Wild Chicken; Squirrel; Wild pig	Kancheung Koy
Balat Forest	Pangolin	Kancheung
O' To Teung	Porcupine; Gaur; Monitor Lizard; Wild Chicken	Kancheung
O Ta Veth	White Macaque; Wild Pig	Kancheung
O Tret	Banteng	Kancheung
O Chan Preng	Lizard sp.	Kancheung
Viel Kay Forest	Rusa Deer; Barking Deer; Sambar Deer; Wild Pig; Banteng; Pangolin	Kancheung Mas
O' Lang	Otter	Kancheung
Chhay Mountain	Wild chicken; Squirrel	Koy
O Touk O Taber O Chrang	Wild Boar; Large Deer; Barking Deer; Wild Buffalo; Monkey; Squirrel; Wild Chicken; Grey Squirrel; Turtle dove; Rat; Apple Snail	Koy
O Kayat	Apple Snail; Rat	Mas
Yang Nay	Lizard	Mas
O Toll	Wild Chicken	Mas
Kort Forest	Barking Deer	Mas
Proun Forest	Wild Pig	Mas
Trachang	Mouse; Squirrel; Wild boar; Musk Deer	Tangaich

Table 6.19 Percentage of Households that Collect Different Wildlife Species

Species	% of hh who collect
Apple snail	15%
Wild chicken	69%
Rat	46%
Lizard	15%
Barking Deer	31%
Wild Pig	46%
Sambar Deer	15%
Banteng	8%
Pangolin	8%
Grey Squirrel	15%
Squirrel	61%
Turtle Dove	31%
Large Deer	15%
Wild Buffalo	8%
Monkey	8%
Musk Deer	15%

Table 6.20 Summary of Wildlife Harvesting Practices

	Kancheung	Mas	Koy	Tangaich
Average travel time / distance	2 hours / 6 km	50 mins [30 - 90 mins]	1 hr 20 mins [15mins - 3 hrs]	40 mins [30 mins - 1 hour]
Average no. of days spent hunting / hh / year	1-90 represents range of days spent collecting each species	330 days	360 days	360 days

6.10 Fish

Most families fish for subsistence purposes. Table 6.21 summarizes harvesting practices and the estimated value of fish using a market price of 4,000 riel/kg (general price used for all species). Tables 6.22 and 6.23 show the percentage of households collecting each species and locations were people fish based on survey information.

Information on fishing activities was not available for Kancheung Village. Discussions with the villagers reveal that the main types of fish caught are snakehead, mud carp, catfish and yellow mystus. Fish are caught using many different techniques including nets, traps, bamboo barriers to stop fish, water drainage, and the use of poison (using a tree root).

A high percentage of households interviewed (62%) claimed that it is becoming more difficult to catch fish because too many people are fishing, and because of poison use.

Table 6.21 Fishing Harvesting Practices and Estimates of Fish Value

Village	Percentage of hh who fish	Average number of days fish/year	Average quantity of fish collected kg/hh/year	Value per hh / year	Value to village / year
Mas	100%	83 [30-170]	350.25 [36-729]	519 [58-1166]	14,529
Koy	100%	224 [15-360]	294 [60-720]	436 [96-1152]	20,056
Tangaich	50%	No data	96 [0-360]	142 [0-576]	3,834

Table 6.22 Percentage of Households Harvesting Popular Fish Species

	Mas	Koy	Tangaich
Talipia	75%	0%	0%
Snakehead	100%	80%	25%
Catfish	75%	100%	50%
Eal	25%	0%	0%
Yelow mystus	0%	60%	25%
Mud carp	0%	20%	0%
Common silver barb	0%	20%	25%
Freshwater prawn	0%	20%	25%
Silver carp	0%	20%	0%

Table 6.23 Main Locations where Villagers Fish

Location	Villages who fish at location / travel time / distance from village
Okayat	Mas: 1km / 15 mins Koy: 3 km Tangaich: 4 km / 3 hrs
O'Touk	Mas: 2 km / 1 hour 15 mins Koy: 4 km
Ta Taboug	Mas: 1 hour 30 mins
O'Preisse	Mas: 7 km / 2 hours
O Ta Tav	Koy:
O Taber	Koy: 2km
O Chrang	Koy: 2 km
O Pa 'ay	Koy: 10 mins
O' Chadav	Koy: 1 km Tangaich: 3 km / 2 hrs
O'Pin Pin	Tangaich: 8 km / 4 hrs

6.11 Medicine

Tapean forest is a popular location for the collection for medicinal plants.

There are two traditional medicine healers in Kancheung village. One woman (Mik Chan treats close family and friends) and one man (Chung treats anyone free of charge). Chung collects medicinal products from the forest whenever necessary, sometimes travelling considerable distance to the mountains or foothills in order to obtain the right products. In

addition, 10-15 people (mostly men) collect traditional plants. They may spend 1 hour per day collecting. One person collects between 1-12 baskets per year. One basket of medicine can be sold for 1,400 riel per kg (middleman receives 1, 600 riel per kg). The number of kilograms per basket is unknown. People in the village expressed a preference for modem medicine. Lots of people buy modem medicine from Ban Lung, and sell traditional medicine to traders from Ban Lung.

Traditional healer Mr Pheung Reur Yang was interviewed in August 1996. He spends 3 days a week collecting medicine from Tapean Mountain and around the village. On the average he collects 20 kg of medicine per month, 17 kg of which is used by his family.

There are two traditional healers in Mas Village, three in Koy and one in Tangaich. The most common illnesses are headaches, diarrhoea, malaria, colds, bone ache, catarrh and measles. The main types of modem medicine used are aspirin, penicillin, tetra and cloroquine. An estimated 20% of households in Koy village buy modem medicine, 50% in Mas and 100% in Tangaich, spending on average US$2.70 (US$1.60-4.80) per year. Families who do not buy modem medicine say this is because they cannot afford it.

One approach that could be used to value traditional medicines is to use the price of the closest modem marketed substitute. Estimates of the value of traditional medicine are not presented here due to lack of data (for example, on quantities prescribed for particular illnesses).

Certain wildlife species are also of high medicinal value. For example, pangolin scales and blood are mixed with wine and drunk for energy. Pangolin scales have a market price of 70,000 riel/kg (US$26). Pangolin stomach is also used to treat pregnant women and is sold for 5,000 riel/kg in Banlung market. Bear gallbladder, said to promote good circulation, has a market price of 172,500 riel/kg (US$64).

Minimum estimates of the value of medicinal products to households have been derived based on the assumption that households not buying modem medicine use traditional medicine instead, and the average spent by other households on modem substitutes (i.e., US$2.70). See Table 6.24.

Table 6.24 Minimum Estimates of the Value of Medicinal Plants

Village	% of Households using traditional medicine	Estimated value per village, US$/year
Kancheung	50%	60
Mas	50%	35
Koy	80%	92
Tangaich	25%	19

Notes: It is assumed that 50% of households in Kancheung village use traditional medicine. It is probable that households purchasing modern medicine also use traditional medicine so estimates of households using traditional plants can be seen as conservative.

6.12 Valuation of Non-Timber Forest Products Based on Inventory Results

The value of malva nuts, rattan and bamboo is estimated below based on the quantities estimated to be available in Tapean forest based on the inventory results. These value estimates can be seen to represent the potential benefits from sustainable harvest, as opposed to the actual benefits, estimated in Sections 6.3-6.11.

6.12.1 Malva Nuts

Based on the forest inventory results, there is an estimated 62,014 mature and 4,833,452 mature and immature malva nut trees in Tapean forest[13]. In a good year one tree is estimated to yield 100kg of fruit (communication with villagers). It can therefore be estimated that the potential annual harvest of the Tapean forest area (on a seven year cycle) is 12, 402, 819, 200 riel (US$4,593,629). This value was obtaing using 62,014 as the total number of mature trees with each tree yielding 100kg fruits on the average and a price of 2,000 riel per kilogram of malva nuts.

A sustainable harvest rate for malva nuts is not known. However, using different fruit harvesting intensities (100%, 80%, and 50%), estimates of the potential present value (PV) of malva nut harvesting over a 90-year cycle can be made (Table 6.25). It should be noted that these represent gross benefits as harvesting costs have not been netted out. Also these estimates represent potential values and are dependent on a market for considerably higher volumes of malva nuts existing and the viability of marketing the product on a much bigger scale.

Malva nuts are typically exported to Vietnam and China so the potential market is very large, and the demand for a bigger quantity may exist. The channels for international distribution are also available. A potential bottleneck is currently the availability of middleman who can transport the produce from the upland areas of Ratanakiri to the border, but presumably this would not be a problem as the market develops. A further issue affecting demand is that it is unclear if there are other areas in Southeast Asia producing the fruit at different times[14].

Value estimates for malva nuts are much higher than the estimates derived from the household survey (see Table 6.4). However, it is known that two years ago, when there was a bumper crop, only a fraction of the fruit was harvested. Assuming that a strong international market for malva nuts does exist, returns to villagers from sustainable harvest of this resource could be substantial.

Table 6.25 Potential Returns from the Harvesting of Malva Nuts (value per hectare in parenthesis)

	PV, 6% discount rate (US$)	PV, 10% discount rate (US$)
100% of fruit harvested	13,903,677 (7,623)	9,262,442 (5,078)
80% of fruit harvested	11,123,101 (6,098)	7,409,953 (4,062)
50% of fruit harvested	6,951,939 (3,811)	4,631, 220 (2,540)

Note: Assumes 7 year fruiting cycle

6.12.2 Rattan and Bamboo

Based on the forest inventory, there is a total of 623,789 species of bamboo in Tapean forest (species include Russey Phaoror, Russey Tngor (Chuy), Russey Tngor (Chhav), and, Russey Porkotal). Using an average market price for all species of 200 riel per stem, the annual value of bamboo in Prey Tapean can be estimated at 124,757,770 riel (US$46, 139).

Using a similar approach for rattan species (Habek, Svain), the value of rattan is estimated at 485,169,000 riel (US$179,692) using the market price of 500 riel per vine.

[13] Ground truthing suggests that these calculations based on inventory results may over estimate actual numbers, due to the fact that malva nut trees are believed to occur in greater density on higher levels.

[14] Malva nuts can be stored for 3-4 months, so villagers could co-ordinate and agreed to hold the fruit until prices were reasonable on the international market.

This assumes that all species are of commercial value.

Taking a harvesting cycle of 10 years (based on an assumed growth cycle of 10 years), the present value of rattan and bamboo is estimated over a 90-year period at various discount rates (Table 6.26). Again, these figures represent the potential returns from sustainable harvesting, and assume that a market exists for higher quantities of these products.

Table 6.26 Sustainable Harvesting rates and Prices for Bamboo and Rattan

	Bamboo	Rattan
Stocking density (vines per hectare)	171	266
Price	200 riel [3-7 metres]per stem	500 riel [8-11 metres] per vine
Years to maturity	10 years	10 years
Annual stock vines/year	17.1	26.6
Total Value (Annual value)	2,310	8,985
6% discount rate	41,364	160,880
10% discount rate	24,945	97,022
Per hectare value (Annual value)	1.3	5
6% discount rate	23	88
10% discount rate	14	53

Note: Forest inventory records number of individuals (clumps). Estimates for bamboo are therefore considered to be lower bound estimates since they are based on the number of clumps (the average number of stems per clump is not known).

6.13 Summary of Results

A summary of the benefits of NTFP is presented in Table 6.27. The most important forest resources for local people are wildlife, fish, fuelwood and materials for house construction. Benefits per village range from US$30,088-$180,564, and US$625-$3,925 per household per year. The high values for Koy Village are largely explained by the higher than average reported quantity of wildlife collected compared to the other study villages.

Annual benefits per village are discounted over a 90-year time horizon to illustrate the present value (PV) of forest benefits to local communities (Table 6.28). Two discount rates have been used (6% and 10%). At a 6% discount rate the present value of NTFP benefits ranges between US$510,167-300,917 per village, or US$65,346 - $10,628 per household.

The figures represent gross estimates and therefore over estimate true value. Harvesting costs should be netted out (e.g., the opportunity cost of labour and materials used for harvesting forest products such as bullets and arrows used for harvesting wildlife). The opportunity cost of labour has been taken at zero in this study given the extremely limited opportunities for paid employment in the area. The difference between gross and net costs is therefore considered to be low.

A further issue not addressed in the calculations presented, is that price estimates should be applied to the quantities that could be sustainably harvested from the forest area. This question is particularly important for wildlife given that current levels are believed to be unsustainable, and could become important for malva nuts, since collection of this lucrative fruit is presently unmanaged, and the cutting of trees is evident. Sustainable harvest rates for wildlife and malva nuts are at present unknown.

The results can be expected to contain a further margin of error due to the difficulties of carrying out economic valuation in the remote setting of Ratanakiri. Apart from the fact that market influences are limited in the study area (and were in fact non-existent until fairly recently), determining reliable measurements of the quantity of products collected and distance travelled

Table 6. 27 Summary of Annual value (US$) of Forest Products per Village (household values in parenthesis)

Village	Fuelwood	Malva nuts	Trad. baskets	House Cons	Man. Goods	Wildlife	Fish	Medicine	Total
Kancheung	5,333 [111]	2,537 [53]	830 [17]	1,776 [37]	123 [2.6]	6,683 [139]	12,806 [267]	60	30,088 [627]
Mas	2,613 [93]	138 [5]	336 [12]	777 [30]	87 [3.10]	39,163 [1,399]	14,529 [519]	35	57,678 [2,060]
Koy	4,375 [95]	175 [3.8]	1,086 [24]	888 [19]	221 [4.80]	153,671 [3,123]	20,056 [436]	92	180,564 [3,925]
Tangaich	2,652 [98]	343 [12.70]	189 [7]	1,498 [55]	60 [2]	27,000 [1,000]	3,834 [142]	19	35,576 [1,318]
Total	14,973	3,193	2,441	4,939	491	226,517	47,391	206	

Notes: Annual returns from malva nuts based on 7 years production cycle (no discount rate used). Annual house construction benefits based on 4 year life time for houses (no discount rate used). Kancheung - fish and manufactured products benefits based on the average benefits for other three study villages

is a problem. Often forest products are collected in baskets, and villagers have unreliable concepts of weight, for example, in kilograms.

Table 6.28 Forest Benefits per Village and per Hectare (US$)

Village	6%	10%
Kancheung		
per village	510,167	311,830
per household	10,628	6,496
per hectare	280	171
Mas		
per village	961, 944	580,682
per household	34, 355	20,738
per hectare	527	348
Koy		
per village	3, 005, 917	1,813,445
per household	65, 346	39,423
per hectare	1,648	994
Tangaich		
per village	604,739	365,934
per household	22,398	13,555
per hectare	331	201
Average per hectare value	748	452

Notes: Figures rounded to nearest decimal. Returns for malva nut based on 7 year harvest. Houses assumed to be built every 4 years. All other benefits assumed to occur on an annual bases

Per hectare values for Tapean forest are difficult to calculate given that villages collect forest products from a number of locations other than Tapean forest. Around five villages collect products for Tapean forest, however, the forest is most closely associated with Kancheung and Mas village. As a 'rule of thumb estimate' the average per hectare value for the four study villages is used as the per hectare value of Prey Tapean for the collection of NTFP. That is, the benefits of Tapean forest are conservatively based on the use values to only one village.

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7.0 SWIDDEN AGRICULTURE

Most of O' Chum district is located in the hilly region where upland rice production is practised (traditional swidden agriculture). An understanding of local community's dependence on the forest is not complete without an understanding of the contribution of farming to village livelihood[15] .

According to the survey results, all families own a chumgarr. Forest is cleared to established chumgarrs, and the area is farmed on the average for 8 months a year (range 5-10 months), and normally stays productive for 3 years (range 2-6 years). It is estimated that for every hectare of active swidden land, 4-5 hectares will be fallowed (Himel 1997).

One characteristic of upland agriculture is that other crops are farmed alongside rice. These can be used to supplement the daily diet, provide food security in times of rice shortage, or sold to generate income. Information on crops grown in the study villages is presented in Tables 7.3-7.5. The main crops sold are rice, sesame and corn. Black sesame is a very important income source and is also bartered for salt and clothes.

Table 7.1 summarizes the average income per household from the sale of crops, and Table 7.2 compares household income and expenditure patterns based on the survey results. Claimed expenditures can be seen to exceed income. One explanation for this may be the under-reporting of returns from wildlife. Around 65% of total cash income is from the sale of forest products.

The productivity of upland farming systems has been declining over recent years due to decreasing soil fertility and natural disasters (drought and erratic rains). Unsustainable practices are evident (e.g., farming on steeper slopes which is affecting the watershed and soil fertility), as are shorter fallow periods as land pressure intensifies (now 3-4 years, compared to 7-10 years in the past). More information on upland farming practices and their impact on the forest resource, and possible management initiatives which could ensure sustainability of the resource base is needed.

Highlanders farming chumgarrs do not adhere to a system of individual land ownership. Land is utilized by the community and families have rights only over the land they are farming. The fact that local communities have no legally recognised rights to their farm land and nearby forest areas on which they have been dependent for centuries is of real concern in the current climate of commercial development in the province.

Table 7.1 Average Income per Household from the Sale of Crops

	Mas: Income/hh [range]	% of HH who sell	Koy: Income/hh [range]	% of hh who sell	Tangaich: Income/hh [range]	% of hh who sell
Rice	25,000 riel (US$9.00)	8%	666 riel (US$2.50)	6%	13,637 riel US$5.45	8%
Sesame	375 riel (US$0.18)	17%	38,766 riel (US$14.36)	73%	20,125 riel US$7.45	66%
Corn	0	0%	8,000 riel (US$3)	6%	83 riel US$0.03	8%
Total	US$9.14		US$19.86		US$12.93	

[15] An economic analysis of sustainable swidden agriculture as a traditional land use option would be useful, but was not possible within the time frame of this study. Different management scenarios for swidden agriculture could be analyzed to determine which would be economically optimal (e.g., the analysis could incorporate the following parameters: rotation period; degree of slope; and, cultivation techniques).

Table 7.2. Income and Expenditure Patterns of Households (US$)

	Mas	Koy	Tangaich	Kancheung
Agricultural crops	9.14	19.86	12.93	?
Malva nuts	5.30	4.1	13.70	57
Traditional baskets	12.90	25.50	7.48	18.70
Manufactured goods	3.30	5.19	2.44	?
Total	30.64	54.65	36.55	75.70
Total average expenditure [1]	56.86	55.95	61.75	?
Difference	(26.22)	(1.30)	(25.20)	

Notes: 1. Based on Table 5.1

Table 7.3. Mas Village: Main Crops Grown and Sold

Crop	Average quantity produced / hh / year	Value at market price	No of families
Rice	59 baskets (887.5kg)	295,833 riel (US$109)	100%
Sesame	10 kg (0.65 baskets)	14,750 riel (US$5.46)	66%
Eggplant	0.87 baskets (total)		58%
Chili	1 kg plus 0.4 baskets	1,200 riel	58%
Bean	1 trees plus 0.6 baskets		25%
Taro	1.6 bundles		8%
Sponge Gourd	2.7 baskets plus 20 fruit		58%
Corn	196.25 kg	9,813 riel (US$3.63)	75%
Cashew	2.1 plants		25%
Banana	5.50 plants		25%
Mango	1.5 plants		25%
Potato	200 kg / 50 bundles		16%
Jackfruit	1 tree		25%
Tobacco	0.8 plants		8%
Pumpkin	15 baskets (av)		16%
Garlic	1 tree		8%
Lemongrass	0.3 trees		8%
Cassava	12.5 trees plus 3.8 baskets		25%
Sugarcane	0.08 baskets		16%
Gourd	7 baskets plus 7 fruit		25%
Pineapple	2 trees plus 1 bundle		8%
Maize	1 basket		8%
Watermelon	2 baskets		16%

Notes: Prices and measures used in Tables 7.3-7.5: Rice (15kg/basket) 5000r/ basket; Sesame (17 kg/basket) 1585/kg; Corn: (12kg/ basket) 50r/basket; Cassava (20kg/basket); Eggplant (7.5 plants / basket); Chili (20 plants/basket) 1200r/kg; Mango (15 plants/basket), 125 r/fruit; Bottle Gourd 1500 riel.

Figures rounded to the nearest decimal.

Table 7.4. Koy Village: Main Crops Grown and Sold

Crop	Average quantity produced / hh / year	Value at market price	No of families
Rice	42 baskets (626 kg)	208,667 riel (US$77.28)	100%
Sesame	48 kg 3.6 baskets	762,39 riel (US$28.23)	100%
Eggplant	2.5 baskets		53%
Chili	0.9 baskets plus 1.1 kg		53%
Sponge Gourd	4.6 baskets		27%
Corn	11.46 baskets	7,027 riel (US$2.60)	93%
Pumpkin	2.3 baskets		33%
Garlic	0.06 baskets		7%
Cassava	54 bundles plus 73 kg plus 258 baskets		66%
Sugarcane	0.8 trees		13%
Gourd	6.7 baskets		47%
Watermelon	0.2 baskets.		13%

Table 7.5. Tangaich Village: Main Crops Grown and Sold

Crop	Average quantity produced / hh / year	Value at market price	% of families
Rice	40 baskets (600kg)	179,583 riel (US$66.51)	100%
Sesame	27.5 kg	37,875 riel (US$14.03)	66%
Eggplant	1 basket		42%
Chili	0.4 baskets plus 0.4 kg		42%
Papaya	0.16 baskets		8%
Sponge Gourd	1.25 baskets		33%
Corn	208.25 kg (12.25 baskets)	10,412 riel (US$3.86)	83%
Banana	6 bunches		17%
Pumpkin	0.2 baskets plus 18 fruit		17%
Garlic	0.08 baskets		8%
Cassava	106 baskets plus 1336 kg		50%
Sugarcane	0.8 baskets		25%
Gourd	39 fruits plus 0.4 baskets plus 87 bunches		58%
Pineapple	2.5 baskets		8%
Watermelon	0.4 baskets		17%

Note: One family produced surplus cassava which they would like to sell, but there is no market

8.0 EVALUATION OF OTHER FOREST VALUES AND SERVICES

This study has focused on the monetary valuation of NTFP. However, there are many other services provided by the forest which should be taken into account when land use decisions are being made (see Table 2.1). A qualitative discussion of other important forest

values identified for Tapean forest is presented below. In some cases monetary estimates have been derived.

8.1 Recreation and Tourism

Eco-tourism could be developed in Tapean mountain and forest. The area is considered good for hiking, and visits to minority Krung villages might also be arranged. Tourism development would need to be carefully managed and kept in small-scale in order not to disturb the local people or mar the natural environment.

8.2 Research Benefits

Well-preserved forest areas such as Tapean forest can be important as research and education facilities. Valuation of forest research and education benefits could be based on specific expenditures within the park -- although such expenditures do not represent economic values per se, they do indicate a minimum willingness to pay to take advantage of the park resources (IIED 1994).

8.3 Watershed Benefits

Forests provide many watershed benefits. When forested mountain slopes are denuded, forest soils lose their water retention capacity and most rainfall disappears rapidly as surface runoff resulting in flooding along riverbeds. Flooding can damage crops, human dwellings, infrastructure and equipment, and displace local people.

Forests also protect against soil erosion due to surface water runoff and wind. If an area is deforested this soil retention capacity is reduced, allowing the erosion of fertile topsoil. This reduces the productivity of the land and results in the siltation of riverbeds and reservoirs downstream thereby affecting hydroelectric projects, fisheries, and agriculture.

Forests also play a role in the provision of fresh water supplies. The destruction of watersheds can be therefore be devastating, especially to rural poor communities that rely on natural resources for their basic requirements.

The area of Ratanakiri province forms part of three major catchments -- Tonle Se San; Tonle Srepok, and Tonle Se Kong, which can be further divided into 24 sub-watersheds. Phnom Tapean forms the upper part of O Ta Phlay watershed in Tonle Se San catchment (Himel 1997).

Tapean forest is considered to have high watershed value and the conservation of the upland and lowland forest and soils is considered vital for the retention of the areas natural balance. A summary of the state of Ratanakiri's hydrology and soils is provided below as compiled from Himel (1997).

Water resources in Ratanakiri are good as a result of: high rainfall (an average of around 2,300 mm/ year compared to the 1,200-1,500 mm in lowland Cambodia); the relatively pristine state of its upper watershed areas due to low population and resource pressures up until recently; and the good quality soil of the central plateau and hills. There is abundant groundwater in most areas and even small streams have flows throughout the year unlike the rest of Cambodia. Only the lowlands experience problems with lack of water flows in small streams. However, the recent increase in intensity of upland use is considered to have reduced dry season flows although no small streams have dried up yet.

Soils in Ratanakiri appear to be more fertile in general than those in other areas of Cambodia, the main reasons for this are (Himel 1997):

(i) The volcanic plateau and hills that formed in-between the Tonle Se San and Tonle Srepok rivers developed a deep rich red basaltic soil with high moisture holding capacity and abundant groundwater. The weathering and erosion of these soils and deposition lower down enriched the fertility of lands surrounding the red soils.

(ii) The dense vegetation grown on the red soils collected and consolidated in the depressions, flat lands and valleys around the plateau hills. This formed the most fertile soils in Cambodia, black cracking clay called regurs.

(iii) The highlands and lowland forest north of the Tonle Se San have been well preserved. The reduced velocity of runoff and increased deposition of organic matter from the preserved watersheds helps keep those areas in better condition.[16]

(iv) The lowland pressure has resulted in a relatively small amount of agricultural use and the soils have thus not been exhausted through intensive long term farming or mono-cropping. Problem soils known as 'cultural hydromorphs' have not formed.

(v) The water regime in the area is better because of higher rainfall and soil moisture holding capacity, and thick vegetative cover which regenerates quickly. This in turn reduces soil erosion and fires, and conserves soil fertility.

(vi) Even in more intensively farmed areas, pockets of forest remain for cultural reasons enabling genetic resources to survive and regenerate native vegetation during fallow periods.

8.4 Biodiversity

'Biological diversity' (biodiversity) is an umbrella term used to describe the number, variety and variability of living organisms in a given assemblage. Biodiversity may be described in terms of genes, species, and ecosystems, relating to the three fundamental and hierarchically-related levels of biological organisation. Declines in biodiversity include all changes which will reduce or simplify biological heterogeneity, from individuals or regions.

Biodiversity conservation is important for a number of reasons, some of which are summarized below.

There is an intrinsic value to biodiversity itself. Tropical forests, for example, are complex ecosystems with intricate dependencies among various species of animals and plants. Species and genetic diversity are vital for maintaining the balance of the ecosystem. The extinction of a single species can threaten the survival of other species, while the loss of genetic diversity can cause mal-adaptation of species to changing environmental conditions and increases susceptibility to diseases. Conservation of biodiversity therefore contributes to ecosystem stability and resilience.

Biodiversity conservation also prevents the loss of genetic material and species that could be of commercial value in the future. For example, medicines from wild products which are worth globally approximately US$40 billion a year.

The biodiversity value of Tapean forest is considered to be high.Cambodia is home to a number of distinctive fauna and flora species. The kouprey, Indochinese tiger, Asian elephant, gaur, banteng, brow-antlered deer, giant ibis, greater adjutant, and green peafowl, are some of the globally threatened species known to exist in the rich dipterocarp forests, but whose distribution and status remain undocumented.

While no systematic survey of wildlife has been carried out in Tapean forest, an area to the northwest of Lomphat Wild Life Sanctuary was recently surveyed (Desai and Vuthy 1996). The survey recorded a total of 44 mammals, 76 birds, and 9 reptile species.

Significant records of endangered bird species including the sighting of one giant ibis, two greater adjutant storks, and several green peafowl makes this region an important site for the conservation of large, endangered bird species. The sighting of the giant ibis is of great

[16] This category of soils postulated by Croker (1962) refers to soils which have developed an impermeable hardpan beneath the topsoil as a result of years of ploughing. This causes problems for drainage and root development as well as increasing soil erosion in ceratin types of soil.

conservation significance-- prior to 1992 it had not been sighted for nearly three decades and was feared extinct.

Habitat loss and degradation (as a result of swidden agriculture, frequent fires, planned commercial concessions, and illegal logging) is a major threat to Cambodia's diversity. Unsustainable levels of hunting also threaten Ratanakiri's biodiversity (see Section 6.9)

This study describes the impressive variety of flora known to exist in Tapean Forest (see Section 4 and Appendix 5).

8.4.1 Valuing Biodiversity

The value of biodiversity includes direct and indirect use values, option and existence value. The valuation of biodiversity is perhaps the most challenging issue in the context of economic valuation.

It is hard to use the term 'biodiversity' for the object of valuation, as this would require some idea of people's preferences for the range of species and habitats. In reality, what economic studies normally measure is the economic value of 'biological resources' rather than biodiversity. Biological resources are a more anthropocentric term for biota such as forest, wetlands and marine habitats and are simply those components of biodiversity which maintain current or potential human uses (Pearce and Moran 1995). Estimates of the value of the medicinal plants and the 'captural benefit' for ecologically important and diverse ecosystems are available in the literature (Table 8.1).

8.5 Carbon Storage

All forests store carbon. Consequently, clearing and burning of forests releases carbon dioxide into the atmosphere which will contribute to the greenhouse effect and hence to global warming. Valuing the benefit of the carbon storage function of forests is complicated for a number of reasons (IIED 1994):

(i) it is not clear what share of the total emissions of carbon is due to deforestation and how much is due to other sources (primarily fossil fuel use);

(ii) there are a variety of ways in which carbon dioxide emissions could be curbed or reduced (e.g., establishing compensatory fast growing plantations elsewhere). The value of retaining or managing forests as a carbon store therefore needs to be compared to the benefits of alternate forms of carbon capture or storage, and with the opportunity cost of not exploiting other of forest values such as timber.

(iii) the scientific evidence on climate change and the likely impacts in different parts of the world is not yet clearly understood.

Notwithstanding these issues, methodologies for valuing the carbon storage function of forests and some estimates of this value do exist (see Table 8.1).

8.6 Micro Climate Functions

Forest have a significant role in stabilizing regional climate and hydrological systems, particularly by affecting rainfall patterns. Loss of forest cover may cause changes in rainfall patterns resulting in changing patterns of vegetation. Rich biomass may be replaced by less dense shrubs and bushes which require more moisture.

8.7 Option and Existence Values

Option and existence values are rarely included in cost benefit analysis despite evidence to suggest that these values can be very high. One reason for this is that contingent valuation is the only approach which can estimate option and existence values and this is a time consuming and expensive research technique.

The option and existence value of Tapean forest is considered to be extremely high. The cultural and ethnic diversity of the area make the area unique and form part of Cambodia's heritage and natural wealth, and both Prime Ministers have indicated the need to preserve both for future generations (Paterson 1997). Preservation of the unique cultural diversity of the many indigenous groups dependent on the forest in Ratanakiri requires maintaining the forest resource intact.

Paterson argues (1997) 'It can be said that an indigenous people's culture is a product of the natural environment in which they have learned to survive, adapt and make a living over many generations. We cannot have survival of their culture unless we also have preservation of their natural environment in which their culture has evolved. Cultural survival also requires that these communities retain their rights to make informed choices about how they will develop and adapt their way of life to changing circumstances'.

8.8 Distributional Impacts

Few studies of forest land options attempt to quantify how the costs and benefits of each option will be distributed between different groups, despite the fact that such issues often deserves top priority, especially in remote areas where local dependence on forest resources is high.

Distributional issues should be at the central land use decisions in Ratanakiri. While commercial ventures are likely to bring handsome returns to a few (possibly foreign) businessmen, their negative impacts are likely to affect whole communities whose whole existence and culture is based on the forest.

As a measure of the inequity in current transactions, forest land in Ratanakiri has effectively been 'bought' from local communities at US$36 per hectare (see Section 1.2). However, according to the results of this study, the value of NTFP alone can be estimated at US$280-1648 per hectare (see Table 6.28). This represents subsistence values lost because of loss of access to the forest. However, this represents a minimum estimate of the value (compensation) of the forest to local communities.

The concomitant loss of unquantified cultural values suggests that the communities are in reality losing much more than just the largely unmarketed subsistence products identified. Moreover, the survey results show that these individuals are among the poorest in the country, as they have little or no access to the formal wage sector. This places them in a vulnerable

position: one in which the distributional impacts are of greater concern because they are not, in fact, in a position to bargain effectively with purchasers. This potential loss of livelihood and culture has not to date been reflected in the amounts offered to indigenous people.

8.9 Results from Other Studies

Some results from previous studies are presented in Table 8.1.

8.10 Indirect Value Estimates for Tapean Forest

Some estimates derived for the indirect values of Tapean forest are presented in Table 8.2.

Table 8.1. Summary of Results from Other Studies

Forest Service	Value / hectare	Valuation technique	Location of Study	Source
Watershed Functions a) Flood control b) Soil fertility	 a) US$2.3 b) US$8.00	a) Flood protection based on the expected value of loss from flooding in any one year were the forest to disappear. b) Soil fertility maintenance based on the change in productivity approach.	Korup and Oban National Park, Cameroon	Ruitenbeek, 1989
Biodiversity a) Land for medicinal plants in general b) Captural benefit for ecologically important and diverse ecosystems such as tropical forests	 b) US$0.01 - 21 b) US$30 / year	a) Land for medicinal plants based on: $V_{mp}(L) = \{N_R . p.r.a . V_i / n\} / H$ p.a where: p - probability that the biodiversity 'supported' by that land will yield a successful drug V_i - the value of the drug NR = number of plant species at risk n = number of drugs based on plant species H = number of hectares of land likely to support medicinal plants And NR = 60, 000 p = 1/ 10, 000 to 1/ 1000 r = 0.05 a = 0.1 to 1[1] V/n = 0.39 to 7.00 billion US$ H = 1 billion hectares, the approximate area of tropical forest left in the world b) based on analysis of transfers over the period 1987-1990		a) Pearce and Moran, 1995 b) Ruitenbeek, 1990[1]
Carbon Storage a) 'Carbon credit' estimate based on damage costs of forest land conversion per hectare b) One time 'opportunity cost'	a) Primary forest - agriculture: US$4000-4400 b) US$1, 300 /ha	a) Based on damage per tonne of carbon of US$20 and data on carbon released for various types of land conversion b) Based on damage estimates of US$13 per tonne of carbon. Assumes that one hectare of deforestation contributes 100 tons of carbon to the atmosphere		Pearce and Moran, 1995 Pearce and Warford, 1993

Note:

1. The amount that a developing country can 'capture' of the total value of biodiversity, in reality is significantly less than its total value. Ruitenbeek (1990) uses a 'Rainforest Supply Price' to estimate biodiversity. This estimates the amount a developing country can capture, either through genetic product development or transfers from the international community, to justify saving a particular rainforest. The factor will depend on: the licensing structure in the host countries; whether research in the host country causes other leakages in the economy; and, whether the ability exists domestically to follow out the research. This factor is therefore expected to be low in tropical low income countries.

CPE = a. EPV, *where* CPV is capturable production value, EPV is expected production value, i.e. the patent value of the discovery. If host countries could capture rents perfectly then a = 1. In reality *a* tends to be as low as 10% explaining why developing nations feel that the benefit of their efforts to conserve biodiversity is captured more by others. *a* can therefore be thought of as the coefficient of rent capture. A range of a = 0.1 - 1.0 is used in model

Table 8.2 Estimates of Forest Services, Tapean Forest

Forest Service	PV estimate/ hectare 90 years	Valuation method / assumptions
Watershed benefits (General protection of agriculture from flooding, soil erosion etc.,)	6% - 75.59 10% - 44.44	Average rice production per hh / year (47 baskets per year) * market price (5,000 riel) * number of hh affected (based on Tables 7.3 -7.5) Assumptions: Agricultural output of 93 hh (Mas and Kancheung village) protected by watershed functions. Under estimates value to extent that rice is the only crop included in analysis, and by the fact that watersheds also protect fish productivity and human dwellings.
Biodiversity	6% - 511 10% - 300	Based on US$30/hectare potentially 'captural' biodiversity benefit (Ruitenbeek, 1990). Assumes that cultural diversity and biodiversity of the area high.
Carbon storage	6% - 6.86 10% - 0.27	Based on one time 'opportunity cost' of US$1,300 / hectare (Pearce and Warford, 1993)

9.0 COMMERCIAL TIMBER EXTRACTION

Tapean forest contains timber of commercial value. One Grade 1 species (Sralao), two Grade 2 species (Khvao, Koki) ,and four Grade 3 species (Kray sor, Prous, Smach and Tramoung) are evident from the forest inventory (Appendix 5).

An analysis of the potential returns from commercial logging was carried out, in order that returns from logging could be compared to the benefits of traditional use of the forest by local communities. Two different scenarios were analyzed representing sustainable and unsustainable logging practices.

9.1 Sustainable Timber Extraction

For a level of forest to be sustainable, each harvest must be limited to the accumulated growth since the last harvest and must leave the stand in a condition to support a resumption of growth at least at the same rate (World Bank 1996).

Forest growth in Cambodia has been estimated to be 0.3 cubic metres/hectare/year. Applied to a cutting cycle of 35 years, this has been used to establish a harvest limit of 10 cubic metres or approximately 30% of the total volume viable for harvest (all merchantable trees which satisfy the corresponding diameter). This is essentially the Cambodian standard as established under Article 3 of the 'regulation on forest resources exploitation' (World Bank 1996)[17].

9.2 Unsustainable Timber Extraction

Despite the established Cambodian standard of 10 cubic metres/hectare, and the fact that Timber Licence Agreements state that harvesting has to be carried out at a sustainabie level, an intensive harvesting level of 50 cubic meters per hectare is proposed by many concessionaires (World Bank 1996). This level of harvesting would remove all commercial volume and is unlikely to result in regeneration sufficient to support a second harvest at the end of a thirty year cutting cycle.

[17] Cambodia's growth rate is substantially lower than the growth rate commonly expected in Indonesia (1.0 m^3/ hectare/year) or Malaysia (1.0 - 1.5m^3/hectare/year). In these countries all forests are equatorial evergreen forest with higher growth potential than the forests of Cambodia which include both moist evergreen and deciduous forests (World Bank, 1996)

Using a $74 per cubic meter stumpage value (considered as a conservative estimate of average economic stumpage value - World Bank, 1996)[18], returns from timber harvesting at a 10 cubic metre and 50 cubic metre/per hectare/ per year for the study area were calculated (Table 9.1). The analysis is based over a 90-year period (taken to represent three cutting cycles). Since the forest is assumed not to regenerate after the first cutting cycle under an intensive cutting regime of 50 cubic metres/hectare/year, benefits end at year 30.

Table 9.1. Benefits from Timber Harvesting at Different Harvest Intensities (US$)

	Sustainable Timber Extraction (10 cu.m. hectare)	Unsustainable Timber Extraction (50 cu.m. hectare)
Forest extent (ha)	1,813	1, 813
Log cycle	30 years	30 years
Annual cut / ha / year	60.40	60.40
Stumpage value (US$/cu.m)	74	74
Annual harvest / ha / year	10 cu.metres	50 cu.metres
Annual value/ha	24	122
NPV / ha		
6%	408	1, 697
10%	247	1, 156
Annual value	44,696	223,480
NPV / Total area		
6%	741, 001	3, 076, 164
10%	447, 616	2, 095, 181

10.0 COMPARISON OF ALTERNATIVE LAND USES

A comparison of the net benefits of commercial timber extraction and local traditional use of Tapean forest is presented in Table 10.1. It is assumed that sustainable collection of NTFP will maintain the current environmental benefits offered by the forest, while unsustainable timber production will result in the complete loss of these benefits. Sustainable timber production is assumed to reduce these benefits by half.

Projections were carried out over a 90-year time period, at 6% and 10% discount rates. At a 6% discount rate, sustainable collection of NTFP can be seen to be more economic than timber production when environmental benefits of the forest are taken into account. At a 10% discount rate the returns from unsustainable timber production are slightly higher than the benefits to households from the collection of NTFP. However, it is clear that the benefits to households are underestimated due to the omission of certain environmental functions of the forest and the significant cultural values of the area. This, coupled with equity concerns, clearly make unsustainable timber practices untenable.

Furthermore, the actual returns from timber harvesting have been heavily questioned. Without accounting for lost environmental benefits, it has been asserted that even at sustainable timber harvest levels, and with subsidized royalties, the current concessionaires are unlikely to be able to operate as planned because of low conversion rates, poor marketing strategies, and high capital costs (World Bank 1996). This suggests that the returns to timber may well be overvalued.

The benefits of traditional collection of NTFP may also be over estimated to the extent that wildlife values may not be based on sustainable harvest levels and estimates are gross not net values (although this effect is expected to be minimal). However, the value of traditional

[18] Stumpage value represents the difference between the price of logs paid by a mill or exporter and the cost of harvesting the logs and transporting them to the point of sale.

medicine is considered to be significantly undervalued, some of the indirect benefits of the forest are excluded, and, importantly cultural heritage has not been given a monetary value. All of the above biases the estimates downward.

Estimates for the sustainable collection of NTFP based on the forest inventory are significantly higher than for any other scenario. While these figures represent potential returns, there is reason to believe that considerably higher returns from malva nut harvesting could be gained by villagers based on community management and marketing of the resource.

Table 10.1. Comparison of Alternative Land Uses Benefits (NPV / hectare) US$

	Sustainable collection of NTFP[1]	Sustainable collection of NTFP (malva nuts, rattan and bamboo) per inventory[2]	Sustainable timber	Unsustainable timber production
Annual value[3]	17 (NTFP) + 35 (env.ben) = 52	366 (NTFP) + 35 (env.ben) = 401	24 (timber) -17 (env.ben) = 7	122 (timber) -35 (env.ben) =87
6%	697 (NTFP) +594 (env.ben) = *1,291*	3, 922 (NTFP) + 594 (env.ben) = 4, 514	408 (timber) - 297 (env.ben) = 151	1, 697 (timber) - 594 (env.ben) = 1,101
10%	428 + (NTFP) 344 (env. ben) = *772*	2,606 (NTFP) + 344 (env.ben) = 2, 950	247 (timber) - 172 (env.ben) = 75	1,156 (timber) - 344 (env.ben) = 812

Notes:

1 Average per hectare value for NTFP based on average value for 4 study villages (Table 6.28). It is assumed that only one village benefits from the collection of products from Tapean forest. While it is known that many villages collect from Tapean forest, this is to account for the fact that villagers collect from more than one forest area.

2.Benefits from Malva nuts based on 50% harvesting intensity (Table 6.25).

3.For annual values environmental benefits include watershed and biodiversity values only.

11.0 CONCLUSIONS AND RECOMMENDATIONS

This report presents the results of an 18-month study comparing the economic benefits of using forest land in Ratanakiri for traditional uses as opposed to commercial timber extraction. The purpose of the research exercise was to highlight to decision makers involved in the development of management strategies for the area the full range of benefits and costs associated with each land use, in order to facilitate the implementation of an optimal land use strategy. The results of this study are based on in-depth surveys of over 40 households in four villagers in the study area— Tapean Forest, a forest inventory of the area, and interpretation of aerial photographs.

The main conclusion of this study is that NTFP are worth a lot, much more than hitherto thought and are very important to the poorest sectors of society. Land use planning processes that ignore these values can lead to a loss of economic value for Cambodia and even to increased security problems and conflicts in the area. Furthermore, it is clear that local communities have the motivation, capability, and knowledge to sustainably manage their customary forest themselves.

Conversely, large scale commercial interests in the area currently threaten the environmental stability and the rich cultural heritage of Tapean forest and other areas of Ratanakiri.

Forest products have always been assumed to have zero value. This study proves the assumption wrong. Results show that in Ratanakiri, forest products have a value that may be as high as US$3,922 per hectare of forest. If this forest were to be harvested for timber, it

would have a value of less than this; no more than US$1,697 per hectare. When one considers the other environmental functions that would be lost from timber harvesting (e.g., loss of significant watershed functions and biodiversity values) then the net benefits from harvesting timber are diminished further. In short, NTFP values are an important part of the economy.

Furthermore, the rich cultural heritage of the many ethnic minorities of Ratanakiri is intricately based on the forest. The forest must remain intact if these unique values are not to be lost.

Detailed surveys in the region demonstrated that the value of NTFP is a critically important source of subsistence. All households in the sample rely on such products as a source of fuelwood, foods, and materials for house construction. Moreover, only 30% of households in the region are estimated to have a family member engaged in the wage economy. Forest products therefore provide an important natural mechanism for alleviating poverty without explicit government investments. Loss of the forest may result in a loss of this 'natural subsidy'. In addition, one forest product, the malva nut, has extremely high potential commercial value.

The results show that land use allocation decisions are currently being made to the detriment of indigenous people. Although forest products are worth a large amount, recent cash compensation levels are less than 1% of the value of NTFP; compensation has typically been of the order of US$36 per hectare, while the value of the NTFP approaches US$4, 000 per hectare. This inequity arises primarily because of the weak bargaining position of indigenous people, which is exacerbated by their economic vulnerability. Elsewhere in the world, such continued exploitation has often resulted in security problems, particularly when coupled with a de facto loss of forests.

Recommendations

The main recommendation of this study is that, based on the high economic value of NTFP in Ratanakiri coupled with the forest's extremely high social, cultural and environmental values detailed in this report, all customary forest areas in Ratanakiri should be legally recognised and officially granted exclusion from all current and future commercial concessions in the province. All current commercial activities in the province should be immediately frozen for a period sufficient to effect this revision.

As the first step in this process, support should be given to the newly formed Forest Conservation Association in Poey Commune. The 4,500 hectares of customary forest under the Association should be legally recognised as under the management of the Forest Conservation Association. This would set a precedent for granting legal status to other customary forest land throughout the province.

A committee should be set up to look in more detail at land-use planning issues (including, customary forest use, traditional agriculture, commercial activities), to come up with a more comprehensive land use plan for recommendation. Consultation with local people should be central to the committee's activities.

A more indepth study of the potential market for malva nuts, techniques for harvesting the nut and possible marketing mechanisms might be undertaken. Any decision to increase the quantity of nuts marketed should be preceded by a period of local capacity building, to ensure that local communities are strong enough to mange the malva nut resource and to ensure that the benefits from harvesting the nut remain largely within the local community.

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Appendix 1: Available Information on Traditional Medicine

Table A1.1 Traditional Medicine - Kancheung Village: Summary of Group Discussion

Name of plant / animal	Description / Use
Kramit (kr) Voir Romiet (kh)?	Headaches; processed into aspirin
Chlok Chhlous	Cough
Chombong	Fever
Konthal	Stomach ache
Puon / Pon – kind of fruit having acidic fruit	Body pain
Yan Srang	Scurvy
Kindar	Irritation / itchy skin
Tamuong / Tumoung *Crotonjoufrra Roxb.*	Malaria
Ginsin	Post pregnancy
Lotus Nelumbo speciosum Chouk	Blood disease in children
Porcupine Kambroma (kh)	Stomach used to treat pregnant women

Table A1.2. Traditional Medicine Collected by Village Healer, Kancheung Village

Translation to Khmer not possible

Name of plant / Krung	Medicine	Type of illness
Daen angkang, Rang Gung	Roots and (tree) boiled	Stomach illness
Vorl Houng, Vorl Drouch	leaves of trees boiled	Headache
Vorl Ka gtong, Chrav. Chas	root and leaves of tree boiled	?
Pray yoy, Neang Nory Term Krouch	roots and leaves boiled	Malaria
Term porn, Syay chek Korn Doul	Bark of trees boiled	diarrhoea
Term Nerng, Ta Trav	tree boiled	'Yellow illness'
Pat ill, Chulr, chrav Lout	leaf and bulb mixed together to make a paste to put on body	Body lumps
Term plorng, Chrav tang Houry, Chhok pov	leaf of tree boiled bulb boiled leaf boiled	Cold
Chrav Neoek	bulb eaten	Lower back pain
Poum dzis (Dam Loung dziar) Mlo cherm (Daiy pley)	vine and leaf boiled vapour inhaled	Child birth
Chrav Pes	bulb applied to skin	Snake bite

Table A1.3. Mas Village: Traditional Medicine Collected

Illness	Name of plant	Quantity collected per year / healer
Bone ache	Klen Tatraov	12 baskets
Cold	Tep pirou / Teprrou - *Cinnamomun tetragonum A. Cher* Kul Sloek Krey - *Cymbopongon nardus* (base of lemon grass)	12 baskets
Headache	Voar romiet - *Coscinium Usitatum Pierre* (root) Sloek russey srok - *bambous* (leaves of domestic bamboo) Meum Thnaim Chen	12 baskets
Stomach ache	Sambork svai - *mangifora indica* (the bark of mango tree) Sambork krouch - *citrus hystrix* (the skin of small sour orange fruit) Sambork Ampil- (bark /shell of tamarind fruit/tree) Sambork poun (bark of tree with acidic fruit)	48 kg
Itching / rash	Doeum Romchek - *pandamusodoratissimus* (kind of plant) Root of Reus Kuy - *Willughbia* (vine with yellow, sour, edible fruit) Doeum Lhong (Lahong) - *Carica papaya L.* (papaya) Doeum Pornhearv (type of fruit tree)	12 baskets
Eye ache	Pset Krorhorm (red mushroom) Sach chou (white alum) Angkrong (tree) Angkrorng (kind of large red ant which lives on fruit trees)	3.6 kg

Table A1.4. Koy Village: Traditional Medicine Collected

Type of illness	Name of plant (krung)
Catarrh	Kok; phang; Tun say; krola
Cold	Why worn; yeiss snoy; krameat; `kadav
Malaria	Derm krouch (kh); ka som; kraay; Oam pov; loo
Chest ache	Ta trav; pa dong; kres nerng; sok pot (kh); ka tav

Table A1.5. Tangaich Village, Traditional Medicine

Type of Illness	Name of plant	Quantity collected per year
Headache	Hamm Pang pauv Kra Mie / Voar Romiet - *Coscinium usitatum Pierre* Ann Norng/ Khan ma Horng Bababb Ta Ngch / Reurs Sbove - *saccharum spicatum* (root of kind of grass)	12 baskets
Cold	Kra; You bis Ta Ngach / Reus sbov - *saccharum spicatum* (root of kind of grass) Mass / kabbas (cotton plant) Yauv Doc Reus Trorpkhar (*solamum verbascifollium*) Loo Kong ka vat	12 baskets
Catarrh	Blang on Chay / Sloek Kreiy Kroeurng - *Cymbopoon nardus (lemon grass)* Yak Dok Chhrav Kaik An Noch	12 baskets
Bone ache	Khleom pa Dong; Kim; Ror ver; Samrong / malva nut; Chraov ut / Moeum Thaimchen	12 baskets
Malaria	Ta Ngh ra Dzouy Chhook pook Ampov Ka Dang Kannma Kam por	12 baskets

Table A1.6 Market Price of Traditional Medicine Source: Ban Lung Market, Ratanakiri

Name / Description (were known)	Use	Source	Buying Price Riel per kg	Selling Price Riel per kg	Means of Transport and cost
	Medicine for post pregnancy	Tempengchris village	5,000	7,500	basket
	Women illness	Kampong cham province	17,000	30,000	car, boat 10,000
	Ginseng		2000	2,500	
Type of vine	Used for good health		1000	1,500	
Resin	Used for caulking boats/fuel		400	600	
Porcupine stomach			3000	5,000	
Pangolin scales	Scales and blood mixed with wine. Drink for strength (especially for men)		50,000	70,000	
Bear gallbladder	Good circulation		138,000	172,500	
Snake (scales)			7,000	9,000	

Table A1.7. Modern Medicine Sold in Ban Lung Market

Type of illness / Name of medicine	Buying Price, riel/tablet	Selling price, per tablet/riel
Malaria Cloriquine 25 mg	100	150
Fever	50	70
Cold/fever	300	350
Headache	300	350
Stomach problems	800	1000
Coughs	30	100
Body pain	200	250
Ginseng/tonic	800	850
Vitamin (B1, B6, B12, B.complex, A).	50	70
Pneumonia	800	1000
Blennorrhagia	300	500
Gonorrhoea	800	1000

Appendix 2: List of Crops Grown Based on Survey Information

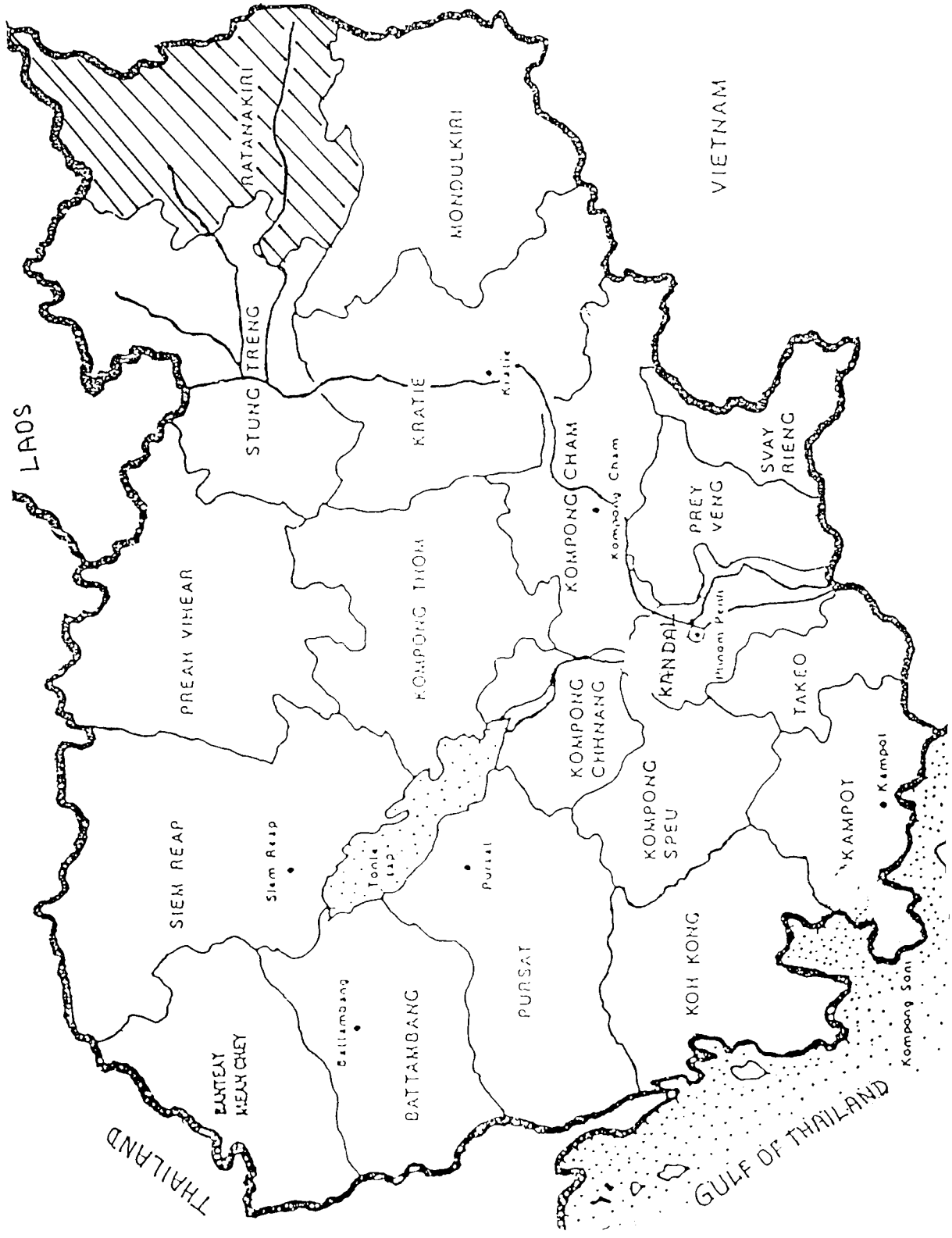
Common name	Scientific name	Khmer
Rice		Srov
Chili	*Capsicum annum ssp. (Solanaceae)*	Mteis
Corn	*Zeamays*	Lot
Banana	*Musa paradissiaca*	Cheik
Black Sesame		La ngor khav
Potato (cassava)	*Manihot esculenta (Euphoriaceae)*	Damlung
Cotton		Kabars
Sugar cane	*Saecharum afficinarum*	Doeum Ampov
Sponge gourd	*Luffa cylindrica*	Nornong
Ridge gourd / angled loofah	*Luffa acutangula (Cucurbitaceae)*	Nor Nong / Norneung
Eggplant	*Solanum melongena (Solanaceae)*	Trop
Mango	*Mangifera indica*	Svai
Bean (pigeom pea)	*Cajanus cajan (Leguminosae)*	Sorn diek
Pineapple	Ananas Comosus	Mnoirs / Mornors
Bottle gourd	*Lagenaria Siceraria (Cucurbitaceae)*	Khlok
Papaya	*Carica papaya L.*	La Hong
Lemon grass	Cymbopogon nardus	Slaek Krey
Bazil	*Ocinum basilicum (labiastae)*	Dzi
Vine		Vorr
Jackfruit	*Polyphemaiaca / Artocarpus heterophyllus*	Khnol
Cashew nut	*Anacardium occidentale*	Svay Chanty
Taro	*Colocasia esculenta (Araceae)*	Trav
Pumpkin	*Cucurbita moscata (Cucurbitaceae)*	Pouv
Cucumber	*Cucumis sativus (Cucurbitaceae)*	Tro Sork
String bean		Sangdeik Kour

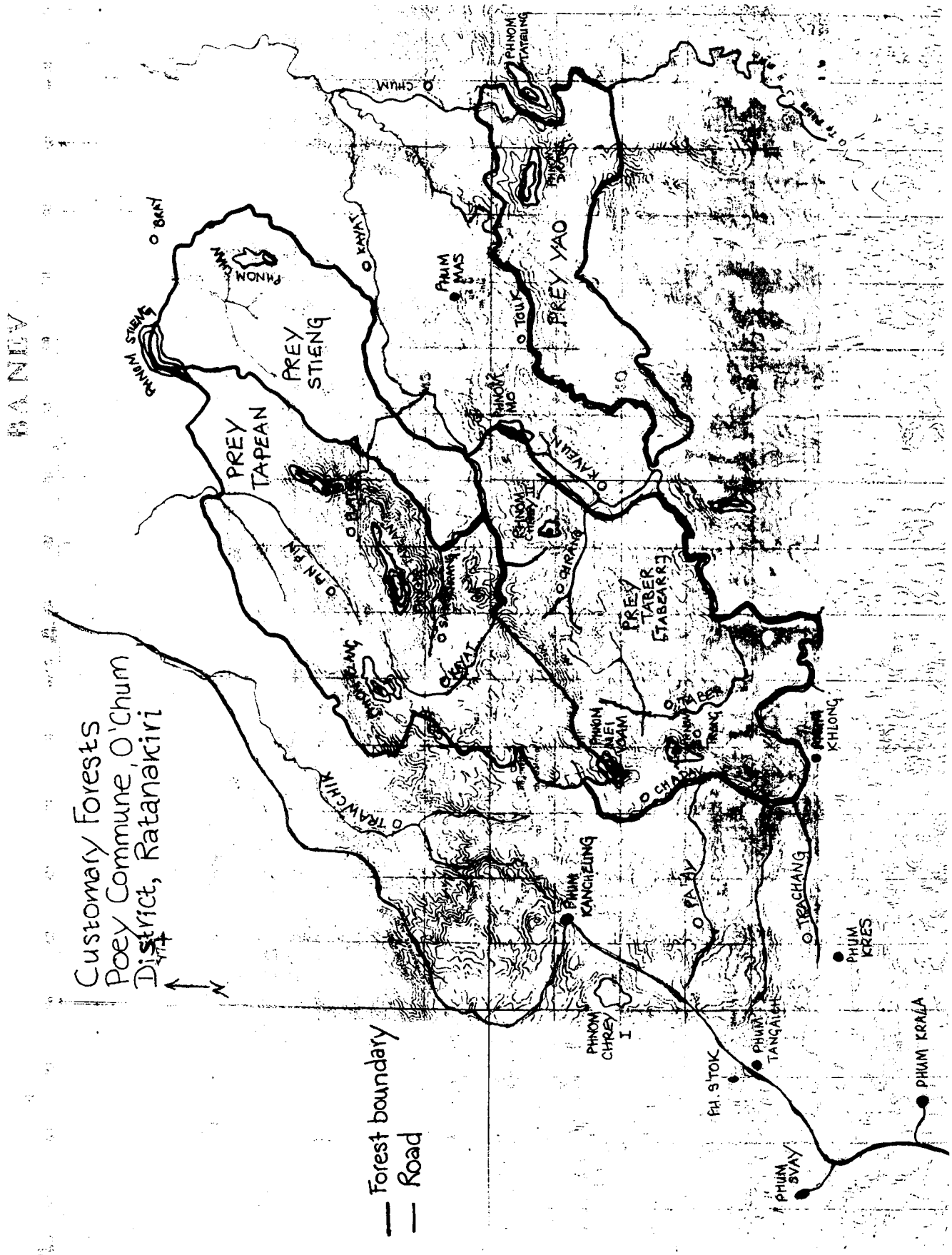
Appendix 3: List of WildLife Based on Survey Information

English Name	Scientific name	Khmer
Large deer	*Cervus arislotlis*	Proeus / Preis
Malayan sun beer	*Ursus malayanus*	Klar khnom
Wild boar/ pig	*Sus serofa*	Chrouk prey
	Nycticebus bengalensis	A guy
Barking deer	*Cervulus muntiacus*	Chhlous
Wild ox / banteng	*Bos javanicus*	Tun Saong
Sambah / Rusa deer	*Cervus unicolor*	
Asian Elephant	*Elephas maximus*	Damrey
Tiger	*Panthera tigris*	Klar Thom
Leopard	*Panthera pardus*	Klar rokhen / Klar takhen
Guar (wild buffalo)	*Bos gaurus*	Kting
Deer	*Cervus Porcinus*	Khdan
Monkey	*Macacus*	Svar
Pangolin	*Manis javanica*	Pong rool
Python	*Python reticulatus*	Pours thlan / Puuh thong
Lizard (special kind of large lizard)	*Hydrosaurus salvator*	Tunsorng / Ansorng
Mouse / rat		Kandol
Grey squirrel / possum		Danghein
Squirrel sp.	*Sciuridae sp.*	Kamprok
Porcupine	*Hystrix brachyura*	Kambroma
Otter	*Lubra sp.*	Phei / Paiye
Wild chicken / hen	*Gallus*	Maon prey / Mwan prey
Indian wild dog	*Cuon alpinus*	Chkei / Chkai Prey
Apple snail	*Pila ampullacea*	Satt Kyorng
Black giant tortoise	*Testuco nuttapundi*	Andoeuk
Black soft shelled turtle	*Trinyx cartilageneus*	Kantheary
Turtle Dove	*Turtur rigrina*	Lor Lork
Bird		Chrab

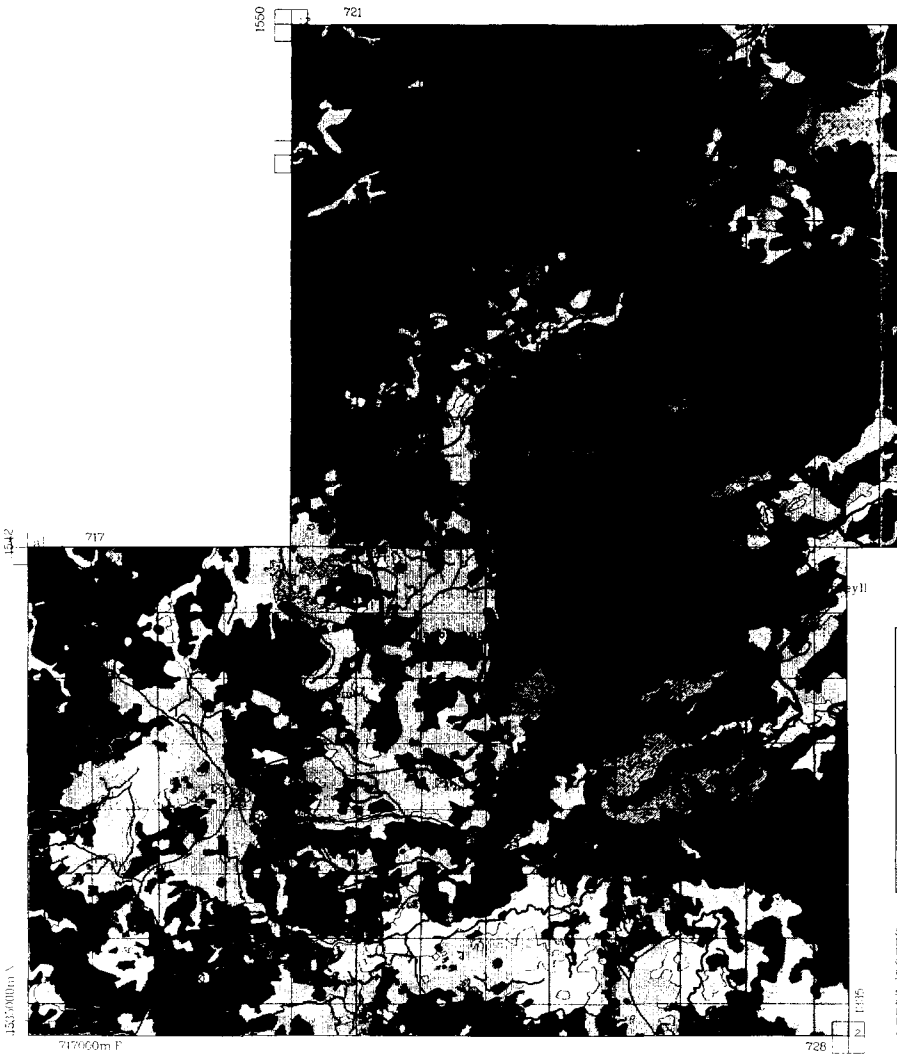
Appendix 4: List of Fish Based on Survey Information

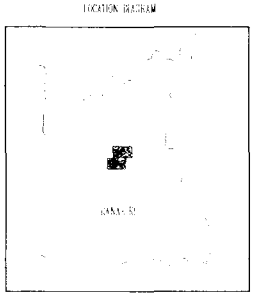
English	Scientific names	Khmer
Gunter's walking catfish	*Clarias macrocephalus*	Trey Andeng
Snakehead / Striped snakehead	*Channamicropelies / Channa Straitus*	Trey rors
Julliens mud carp	*Cirrhina gjulliene*	Trey real
Lancaster's freshwater prawn	*Macrobrrachium lancaster*	Kampeus
Silver carp	*Hypophihalmichthys molitrix*	Trey sor
Yellow mystus	*Mystus nemurus*	Trey Chlaing
Red tailed snakehead	*Channa gachua*	Trey karsar / Khasarn
Red tail barb	*Puntous altus*	Trey Krohe
Common silver barb	*Puntiius gonionoyus*	Trey chorpen
		Trey parvear
		Trey kepeit


LAOS
VIETNAM
THAILAND
GULF OF THAILAND
RATANAKIRI
MONDULKIRI
STUNG TRENG
KRATIE
KOMPONG CHAM
Kompong Cham
PREY VENG
SVAY RIENG
KANDAL
Phnom Penh
PREAM VIHEAR
KOMPONG THOM
KOMPONG CHHNANG
KOMPONG SPEU
TAKEO
SIEM REAP
Siem Reap
Tonle Sap
Pursat
KAMPOT
Kampot
Kompong Som
KOH KONG
BATTAMBANG
Battambang
PURSAT
BANTEAY MEAN CHEY


Customary Forests
Poey Commune, O'Chum
District, Ratanakiri
N
Forest boundary
Road
PREY TAPEAN
PREY STIENG
PREY YAO
PREY TABER (TABERRY)
PHNOM STIENG
PHNOM
PHUM MAS
PHNOM CHREY I
PHUM KANCHEUNG
PHUM KHLONG
PHUM KRES
PHUM TANGAIH
PHUM SVAY
PHUM KRAÀ
O CHUM
O BAAY
O KAVAT
O TOUK
O KRAVEAN
O CHRANG
O TRAMUNG CHIK
O PAAY
O TRACHANG

LAND USE/LAND COVER, PHNOM TAPEAN, O CHUM DISTRICT, RATANAKIRI





Source: [illegible] panchromatic aerial photographs, 1944-95
Mekong River Commission
Projection: [illegible] TM Zone 48
Compilation: [illegible] scanning, photo interpretation, classification and digitizing by Integrated Resource Information Center (IRIC), 1996
The photographs typically reflects condition during the year and season [illegible] was obtained. The classification system was developed for applicat[illegible]
Funding and technical support provided to IRIC under the UNDP Environmental Technical Advisory Programme (ETAP)
Average positional error: +/- 50 meters

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ECONOMIC AND ENVIRONMENT PROGRAM FOR SOUTHEAST ASIA
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And
Environmental Technical Advisory Programme (ETAP)

LEGEND

Urban/Built-up Areas
- Villages

Agriculture
- Lowland (Irrigated) Rice
- Orchard
- Plantation (Rubber, Palm Oil)

Swidden Lands
- Active
- Recently Fallow
- Secondary Growth

Subclasses
- Shrubland (0-2m)
- Bushland (2-6m)
- Forest Cover (6-10m)

Forest Cover
- Broadleaf Evergreen
- Broadleaf Deciduous
- Mixed Deciduous/Evergreen
- Bamboo Forest
- Mixed Bamboo/Deciduous/Evergreen
- Other
- Roads
- Stream
- Forest Boundary
- Watershed

N

Scale 150,000
0km 1 2 3km

Economy and Environment Program for Southeast Asia