Non-Timber Value of Forest Resources at the Community Level and A Conceptual Framework for Sustainable Forest Management - A Cambodian Case Study

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KUN Vee Lee
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ABSTRACT

Non-timber forest products have been playing a significant role in the life of the indigenous people such as the Tampuen ethnic group of Yeak Loam commune of Ratanakiri province. Despite the fact that the indigenous people have been relying on the forest for their subsistence level of survival for centuries without having actually destroyed the forest, they have become a common target of criticism for forest depletion due to their traditional practice of shifting cultivation and collection of non-timber forest products. Moreover, little information is available regarding the value of non-timber forest products since government attention has been focussed on timber value over the past decades, which is believed to have contributed to Cambodia's rapid forest degradation. The study addresses this by looking at the value of non-timber forest products to Yeak Loam communities, the dependence level of the local communities on the forest, the existing forest management institutional set-up, roles and practices of major stake-holders, Cambodia's property right status and the applicability of community forestry within the Cambodian context. This was achieved via a village-level interview at Yeak Loam commune, village-level meetings, and national level consultation with relevant government and donor agencies. It was found that 100% of the interviewed households were familiar with Yeak Loam commune forest since they were born in the area, and have been relying on the forest for non-timber forest products and rice production for most of their life. At least 92.7% of the Yeak Loam communities' total yearly income depends on the forest (i.e. non-timber forest products 43.8% and rice production 48.9%). The total annual value of non-timber forest products to Yeak Loam communities is estimated to be 309,461,426 riels (or US$77,365). In other words, sustainable management of the forest is not only important for Cambodia but also for the indigenous communities since they have few alternative options other than relying on the forest. It is felt that community-based forest management can be a potential solution in this regard. The overall conclusion drawn from this study is that it makes socio-economic sense to preserve Cambodia's forests, in particular, in the provinces where indigenous people have been living for generations.

CHAPTER ONE
BACKGROUND AND OBJECTIVES

1.1 INTRODUCTION

Non-timber forest products have been playing a significant role in the daily life of the local communities, especially the indigenous people, who have been relying on forest resources for their subsistence level of survival for centuries.

Non-timber forest products, by definition, imply a wide range of services that people obtain from forests other than timber itself. These include wild animals, fruits, vegetables, and basic construction materials such as bamboo, rattan, and so forth.

There is reason to believe that though the values of forest resources lie in both timber and non-timber forest products, it is the latter that is most often neglected. This is understandable in a war-torn country such as Cambodia, where over two decades of civil turmoil have put political and military activities on the top priority list of the national agenda. As a result, forest resources have been excessively exploited for timber, which is the quickest and most effective way of generating heavily required funds for the political and military purposes of all warring Cambodian factions involved. On the other hand, the less tangible but not necessarily less significant non-timber value of the forest resources has been to a large extent ignored.

As a consequence, Cambodian forest resources have been depleted at an alarming rate over the past decades. The major groups of people involved in the massive exploitation of the forest resources include politicians, military personnel, and powerful foreign and local businessmen. The country's widespread corruption at all levels, political instability, and lack of public awareness of the importance of sustainable forest management have somehow contributed to the worsening of Cambodia's forest situation. Worst of all, it is often the poor local communities, especially the indigenous people who shoulder most of the blame for forest destruction. This is due to their practice of shifting cultivation – an activity that has been going on for centuries, and seemed to be sustainable in the old days when the population pressure was not much of an issue.

The major rationale for this study on the non-timber value of forest resources lies in the importance of understanding the actual level of local communities' reliance on the forests for subsistence level of survival. There is reason to believe that unless the needs and concerns of local communities are understood and somehow addressed by the Royal Government, any efforts to promote sustainable forest management is unlikely to succeed due to lack of grass-root level participation and support. This is understandable in the sense that unless local communities see their long-term interest in forest protection, their active participation in any efforts of managing, preserving and monitoring forest resources will be unlikely.

1.2 OBJECTIVES OF THE RESEARCH

The main purpose of this research aims at identifying the non-timber value of forest resources at Yeak Loam commune. Such information is essential to reach a better understanding of the villagers' level of dependence on the forest resources, their needs and concerns, and alternative choices open to them, if any. This is a preliminary step to eventually pave the way for the promotion and adoption of a more sustainable community-based forest management approach in Cambodia.

There are six major objectives in this study, which are briefly summarized as follows:

To develop an overall understanding of non-timber forest products based on existing knowledge.

To identify the non-timber value of forest resources at Yeak Loam commune.

To identify the local villagers' needs, dependence level on the forest resources, concerns, and alternative solutions, if any.

To review the existing forest management policies, practices, as well as the roles of major stakeholders in Cambodia.

To review the concept of community forestry and the major constraints/challenges involved in promoting the approach within the Cambodian context.

To provide recommendations on what the Royal Government should do to replace the existing unsustainable forest management practice by a more sustainable, community-based forest management approach, taking into consideration the local indigenous cultures and traditions.

1.3 COUNTRY BACKGROUND AND FOREST RESOURCES

The Kingdom of Cambodia also known as Kampuchea is a Southeast Asian, tropical country surrounded by Thailand and Laos in the west and north, and Vietnam in the south and the east. Cambodia is composed of twenty-three provinces/cities[1] with a total land area of 181,035 square kilometers (refer to Figure 1.1, page 14), and around 60% of which is covered by forests (Council for the Development of Cambodia, 1996; First State of the Environment Report, 1994). Cambodia has an estimated population of approximately 10.2 million (Council for the Development of Cambodia, 1996). According to a study conducted in 1995, the GDP per capita was estimated at US$289 (Council for the Development of Cambodia, 1996). This low income per capita has been one of the economic factors, which imposes pressure on the exploitation of forest resources for quick revenue.

Gaining independence from the French rule in 1953, Cambodia started on an ambitious path towards modernization from an agrarian society under a constitutional monarchy led by His Majesty King Norodom Sihanouk (Songkum Reah Niyum regime). The country placed great emphasis on the massive investments in three key sectors of education, health, and infrastructure development, earning it a reputation as a regular rice exporter with steadily growing GDP (Council for the Development of Cambodia,

[1] There are 19 provinces of Takeo, Kandal, Kompong Speu, Kompong Cham, Kompong Chhnang, Kampot, Prey Veng, Svay Rieng, Kompong Thom, Kratie, Stung Treng, Ratanakiri, Mondulkiri, Preah Vihear, Koh Kong, Pursat, Battambang, Siem Reap, Banteay Meanchey, and 4 cities of Phnom Penh, Kep, Kompong Som, and Pailin.

1996). Forest resources were not a matter of concern then due to their abundance and the fact that they were not the sole contributors to the GDP.

However, getting entangled in the "Indo-China conflicts" in the late 1960s placed Cambodia in a complicated political situation, which led to the coup d'état in 1970. A new government was established in 1970 as a result of the coup d'état to replace the monarchy, marking the beginning of the civil war. Forest resource management was no longer on the government's agenda. It was either neglected or conceived as a quick source of revenue.

The government was overthrown by the extremist warring faction known as Khmer Rouge in 1975, and now started a dark age known as the genocidal regime in the Cambodian history over the successive three years. Social infrastructure was destroyed along with the elimination of human capital especially the well-educated intellectuals. Under the unique situation of struggle for survival, management of forest and other natural resources was completely neglected.

Following Vietnam's military intervention, a new Cambodian government was formulated in 1979 which had control over roughly 95% of the total territory while another 5% was occupied by the Khmer Rouge and two other guerilla groups. The guerilla warfare with the government went on for over one decade, which led to further depletion of the country's resources such as forest resources and precious stones, in both the government and guerilla's controlled areas, to meet the huge military expenses.

Though forest resources were officially recorded to contribute around 3% of GDP in the 1980s (Forest Policy Assessment, 1996), this was an under-estimation of the forest revenue and its exploitation due to the illegal logging activities in the guerrilla controlled areas, and the uncontrolled forest exploitations as a result of the widespread corruption. These revenues never contributed to the national budget. Only since the intervention of the United Nations during the period from 1992 to 1993 did the situation start to improve.

As a result of the first free election sponsored by the United Nations in 1993 under the Paris Peace Accord, the Royal Government of Cambodia was established and recognized by the international community. The Royal Government was a constitutional monarchial, coalition government among four Khmer political factions under the national reconciliation efforts of His Majesty King Norodom Sihanouk. The Khmer Rouge remained a guerilla faction since they rejected to honour the Paris Peace Accord, to which they were a signatory, and did not participate in the election process. This imposed another dilemma in forest management since the Royal Government did not have 100% control over the territory, and could hardly stop illegal logging activities in certain regions along the Cambodian-Thai border, where there was a tug of war going on between the Royal Government and the Khmer Rouge.

The coup d'etat, which tore apart the Royal Government in July 1997, plunged the country into further economic difficulties, imposing additional threats to Cambodia's fragile forest resources. Fortunately, the seventeen-month old crisis came to an end on November 30, 1998 with the formulation of a new Royal Government as a result of the recent national election in July 1998 (Infoseek News, Nov. 30, 1998). The new Government is a coalition of two major rival political parties[2] known as CPP (Cambodian People's Party) and FUNCINPEC (a French acronym for National United Front for an Independent, Neutral, Peaceful, and Cooperative Cambodia), which has eventually gained international recognition. The recently established Royal Government has inherited, from over two decades of political turmoil, problems of all kinds, ranging from a destroyed legal framework and social infrastructure to shortage of human resources, which make Cambodia one of the least developed countries in the world.

Cambodia's forest resources status has been closely related to the country's political situation over the past decades. In spite of the Royal Government's efforts, forestry problems remain pervasive and require a long-term solution, which is, however, constrained by the social and psychological effects caused by the above-mentioned genocidal regime and prolonged civil war. The zoning of 19 percent of the country into

[2] These were the two major political parties out of the four that formed the '93 coalition government until it collapsed in violence in July 1997.

protected national parks, and the drafting of the first environmental law in 1993 may hopefully pave the way for the adoption of a better forest management approach in view of the recent political stability, which has been achieved following the official end of the Khmer Rouge's guerilla fight on December 4, 1998 (Phnom Penh Post, 1998).

1.4 THE RATANAKIRI SITUATION

Ratanakiri is a remote northeast province of the Kingdom of Cambodia with a total land area of around 11,673 square kilometers (Bann, 1997). 91% of the province' area was covered with forest in 1993, making it the third most densely forested province after Preah Vihear and Koh Kong provinces (Mekong Secretariat, 1994b; cited in Forest Policy Assessment, 1996). Ratanakiri shares land borders with Vietnam to the east and Laos to the north, and borders with two provinces of Mondulkiri and Stung Treng to the ~~north~~ South and to the west respectively. Ratanakiri consists of nine districts commonly known as Ban Lung (Provincial Town), Bor Keo, Lumphat, Kon Mum, O Chum, O Ya Dao, Vuen Sai, Ta Veng, and Andong Meas (refer to Figure 1.2, page 15).

According to the information provided by a few elderly Yeak Loam commune officials in Ban Lung provincial town who have lived in Ratanakiri since their birth, Ratanakiri was a part of Stung Treng province in a similar way as Mondulkiri was a part of Kratie province during the pre-Sihanouk period. The whole Ratanakiri was then composed of only four districts known as Lumphat, Borkeo (including O Ya Dao area), Vuen Sai, and Andong Meas. The present Ratanakiri provincial town area or "Ti-roum Khet" was called "Phum Ban Lung" (Ban Lung village), which fell under the command of Khum Labang (Labang commune), Lumphat district, Stung Treng province. Ratanakiri and Mondulkiri were established as independent provinces in the 1950s under His Majesty King Norodom Sihanouk's Songkum Reah Niyum (regime).

As a significantly forested province with 1,148,600 hectares of native forest (as of 1993) (Mekong Secretariat, 1994b; cited in Forest Policy Assessment, 1996), Ratanakiri is home to eight groups of indigenous hill-tribe peoples, who constitute around 75% of the province population (Provincial Rural Development Committee, 1997). Most of these peoples have been practising shifting cultivation as well as relying on forest resources for centuries.

1.5 AN OVERVIEW OF MAJOR STAKEHOLDERS IN FOREST MANAGEMENT

The Law/Decree on Forestry Administration[3] (State Council No. 35 KR.C) signed on June 25, 1988, which remains effective (as of July 1998), indicates that Cambodia's forest resources are under state ownership, and administrated by the Ministry of Agriculture, Forestry and Fisheries on behalf of the government. This is reflected in Articles 1 and 7 of the Law respectively:

Article 1:

> *Forest resources of the People's Republic of Kampuchea, include the forest areas for afforestation, natural forests, forest plantations, forests along the river sides, ponds, streams, lakes, coastal areas and overall wildlife existing in the forests. Forest resources, in the whole territory of the State of Kampuchea, are the properties of this state and under its administration.*

Article 7:

> *...The permit for logging parcel divisions, for logging of timbers and extracting the under-growth products, the classification of timber species, minimum diameter for logging, the logging practice books, the permit for logging or seeking the timbers, and under-growth products to be extracted for the purpose of family and public uses, should be decided by the Ministry of Agriculture.*

This part of the law shows the authority of the Ministry of Agriculture in issuing logging related permits. A most senior official of the Department of Forestry states[4] that though the Department is mandated to protect and manage Cambodia's forest resources, it has no substantial implementation power since it falls under the command of the Ministry of Agriculture instead of being an independent, ministerial level institution. Despite the Department's attempts to apply for a ministerial status, they were turned down by the Government as a result of strong opposition from the Ministry

[3] This is based on an English version of the Law translated by the Forest Resources Assessment 1990 – Project FAO/RAPA (provided by the Department of Forestry in mid-May 1998).

[4] This information was obtained during a meeting with the Department of Forestry in mid-May 1998, and has been confirmed with other reliable sources, including a few donor projects.

of Agriculture during meetings at the Council of Ministers. The reason is due to the enormous financial revenue that the forestry sector creates, from which the Ministry benefits as long as the Department remains under its command.

The establishment of the Secretariat of Environment in 1993, which was later upgraded to the Ministry of Environment, seems to complicate the roles of the Department of Forestry due to some overlapping functions and poor coordination. This confusion was aggravated when the Ministry of Environment was empowered to manage the twenty-three protected areas in Cambodia, covering some 3.5 million hectares of forested land or 19% of the country (First State of the Environment Report, 1994).

The responsibilities of the local communities, military, and local authorities in forest preservation are indicated in Article 8 of the Law as follows:

Article 8:

> *All people, militaries and local authorities of all levels have the obligations to join with the forest conservation, forest protection against the bushfire and join part to reforestation too.*

The above article seems to indicate that local communities are also recognized by the Government as one of the major stakeholders. However, there is no provision in the Law with regard to incentives of any sort to promote grass-root level participation. This has created remarkable confusion among the local communities, especially the indigenous minority groups, who have been relying on forest resources for centuries, and are currently living in uncertainty.

Moreover, it has been observed that in contrast to the provisions in the Law, some military personnel are so powerful that there is little the Ministry of Agriculture and the Department of Forestry can do to stop their illegal logging activities. In addition, the logging activities, both legal and illegal, seem to be closely associated with the recent emergence of two additional groups of "stakeholders" known as "powerful business groups" and "forest concessionaires", who quite often have established good terms with either top military or government officials. The only difference between the so-called "powerful business groups" and "concessionaires" lies in the fact that the former do not

hold a forestry concession contract with the Government but get involved in the logging business whenever an opportunity arise, while the latter do.

It has been learned that although local authorities at the provincial level are responsible for management of their respective provinces, they do not always have a say in the exploitation of the natural resources within their territories of command, especially the forests. The reason is that such decisions are quite often made at a very senior level within central government.

In general, the major and official forest stakeholder is the Government, represented by the Ministry of Agriculture, Department of Forestry, and the Ministry of Environment (in case of protected areas). Other stakeholders are the local communities, local authorities (ranging from provincial to district or commune level), the military, and the two newly emerged groups of "powerful businessmen" and "concessionaires".

However, there are no clear legal provisions with regard to each stakeholder's roles and responsibilities. In reality, due to the high economic incentives created by the forestry sector, top level government officials are often directly involved in decision making instead of allowing the official channels such as the Ministry of Agriculture and the Department of Forestry to perform their tasks. More detailed analysis of the roles of the official stakeholders in forest management is in Chapter Five.

1.6 FOREST MANAGEMENT – PROBLEMS AND CONCERNS

The forestry sector has been identified by the international donor community as a most vulnerable sector in Cambodia, that needs immediate attention. The main causes as discussed in previous sections are closely associated with the complicated political and socio-economic situation of the country.

Forest resources are being excessively exploited in such a way that unless a more sustainable forest management practice is introduced, Cambodian forests will mostly likely face a similar fate to that of other neighboring countries within the Southeast Asian region. The causes are mainly due to the illegal logging activities by the guerilla

troops along the Cambodian-Thai borders[5], the uncontrolled logging activities by some powerful business groups together with military personnel, increasing demand for agricultural land in certain regions, fuel-wood consumption and charcoal production by the local villagers, uncontrolled forest fires, and shifting cultivation by the indigenous people in highland areas. All of these mainly result from the previously discussed unstable political situation and economic constraints of the country.

What is most worrying is the Royal Government's granting of a total 6,464,021 hectares of forest concessions to logging companies in the past few years in the absence of a clear forest management policy (Forest Policy Assessment, 1996). However, information provided by a senior official of the Ministry of Environment suggests that quite a few concession contracts have recently been cancelled (as of May 1998).

The last forest inventory conducted in 1969 prior to the Cambodian civil war recorded a total forest cover of 13.2 million hectares or 73% of the total country land area (First State of the Environment Report, 1994). A land use reconnaissance survey was conducted by the Bangkok-based Mekong Secretariat in 1989, using LANDSAT satellite imagery. The survey revealed a loss of 2 million hectares of forest over the past twenty years, decreasing Cambodia's forest cover to 65% (First State of the Environment Report, 1994). The joint efforts between the Land Use Mapping Office (LUMO) of the Ministry of Agriculture, Forest and Fisheries, and the Remote Sensing Unit of the Mekong Secretariat in visual interpretation of the LANDSAT remote sensing data in 1993 indicated that only 60% of the total Cambodian land area remained forested (Forest Policy Assessment, 1996). The status of the Cambodian forest resources is summarized in Table 1.1 based on the Food and Agricultural Organization (FAO) data in 1994 (cited in Forest Policy Assessment, 1996; p. 5). As of 1993, the total Cambodian forest was estimated to be eleven million, two hundred and eighty-four thousand and two hundred hectares. This figure represents a depletion of over 1.4 million hectares of forest over a period of twenty years from 1973 to 1993.

[5] This has been the case over a decade since 1979. However, since most Khmer Rouge troops have recently surrendered to the Royal Government except a few hard-liners, this situation may hopefully be improved in the near future.

Table 1.1 Change in Cambodia's Forests from 1973 to 1993

Forest Types	Year 1973	Year 1993	Increase/Decrease (Hectare)	Yearly Change (Percentage)
Dry Land Evergreen	6,876,400	4,763,300	-2,113,100	-1.5%
Coniferous	9,300	9,800	500	0.3%
Deciduous	4,792,900	4,301,200	-491,700	-0.5%
Mixed		977,300	977,300	
Secondary		517,000	517,000	
Subtotal	11,678,600	10,568,600	-1,110,000	-0.5%
Edaphic Flooded Flooded Secondary	937,900	370,700 259,800	-567,200 259,800	-3.0%
Mangrove	94,600	85,100	-9,500	-0.5%
Sub-total	1,032,500	715,600	-316,900	-1.5%
Total	12,711,100	11,284,200	1,426,900	-0.6%

Source: Food and Agriculture Organization, Cambodia: Land Cover Atlas, Mekong Secretariat, Bangkok 1994b (cited in Forest Policy Assessment, 1996, p. 5).

Though Cambodia's forests still constitute a relatively high percentage of the total land area compared to that of the neighboring countries within the sub-region, it has been a matter of concern in view of the uncontrolled and rapid deforestation. The donor community has suggested that the Royal Government establish a clear legal framework for sustainable forest management, and also an enforcement mechanism to reduce the speed of unsustainable deforestation before its impact becomes irreversible. Moreover, Cambodia's forests are ecologically crucial to maintain the stability of the environment since around 7 million hectares (63%) of the Cambodian forests are situated in mountainous watershed areas (First State of the Environment Report, 1994). The removal of forest cover in these locations could lead to serious flooding, siltation of streams, and soil erosion (First State of the Environment Report, 1994). Furthermore, in order to improve forest management a number of key constraints need to be overcome, namely:

(1) Lack of a Well-defined Environmental Legal Framework and Enforcement Mechanism:

There is no clear environmental legislation, especially forestry policy, to serve as a

baseline for sustainable natural resource and forest management. Moreover, laws and regulations have not been strictly implemented, and are hardly enforceable.

(2) Severe Shortage of Local Expertise in the Environmental and Natural Resource Management:

Most technical advice/assistance in resource management is being provided by a few international experts funded by the donor community, which can hardly meet the huge amount of the demand due to high costs involved. There are few national experts in this area, who can provide less costly service and may have the advantage of incorporating knowledge of local situation into the technical advice and decision-making processes.

(3) Lack of Technical Know-how in Sustainable Forest Management, and Funding in Most Government Institutions:

The Department of Forestry and Wildlife (under the command of the Ministry of Agriculture, Forestry and Fisheries) assumes the responsibility of managing forest resources through its countrywide network. However, similar to other government institutions, the Department of Forestry and Wildlife faces a series of constraints, ranging from a shortage of human resources to lacking technical know-how in sustainable forest management, and a shortage of operational funds.

(4) Absence of Public Awareness of the Long-term Economic and Social Benefits of Forest Resources and the Illusion of Earning "Quick Revenue":

This is a crucial factor that leads to the unsustainable forest management practice because people get confused about the immediate short-term and long-term benefits brought about by forest resources, leading to an inefficient trade-off between the present and future consumption of the resources.

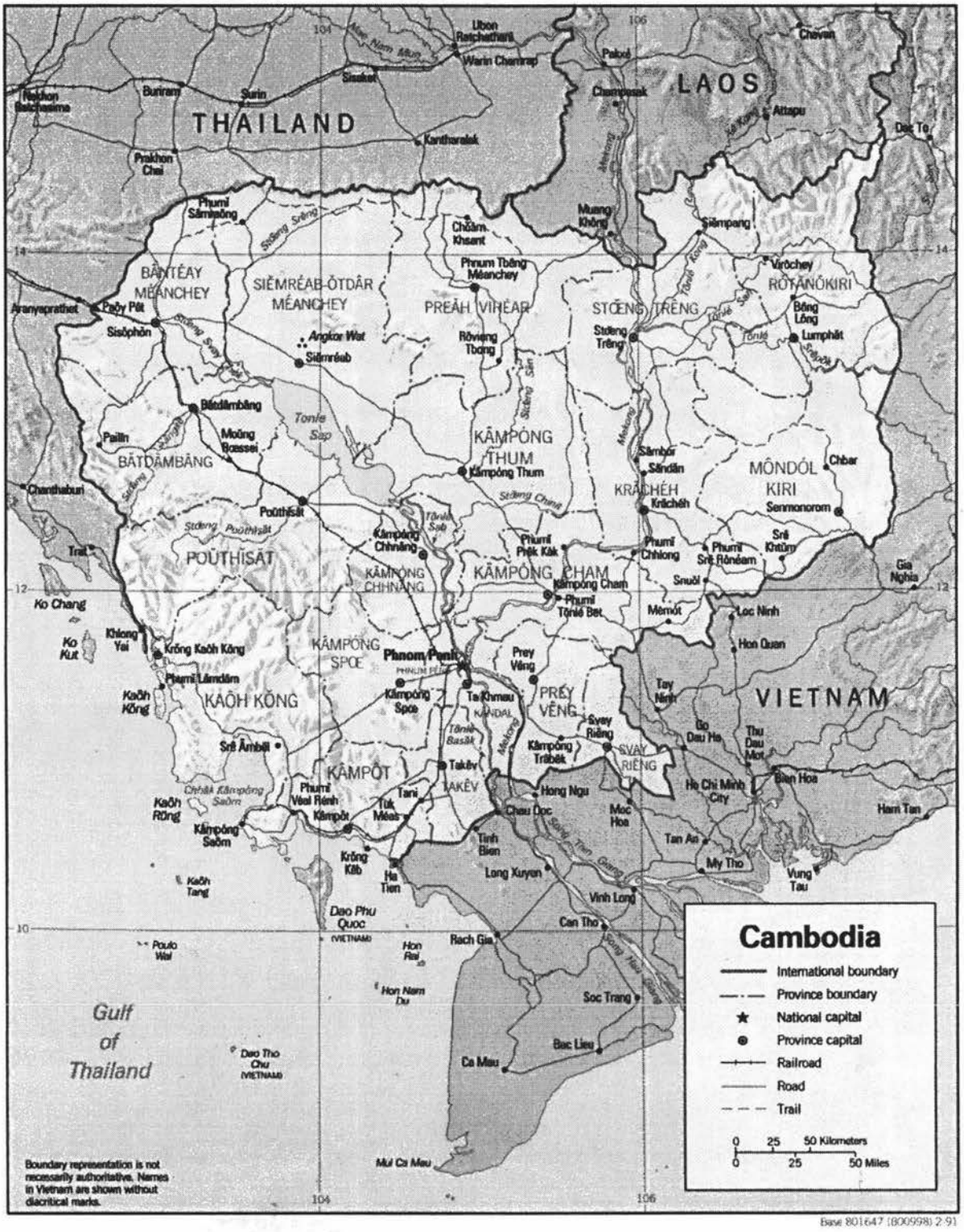
(5) Lack of Reliable Statistical Data of Forest Resources for Planning and Management Purposes:

Absence of up-to-date and reliable statistical data on forest resources as a result of the prolonged civil war has been a stumbling block for most decision-making processes since some decisions had to be made on the basis of "best guess" rather than reliable scientific information.

(6) Lack of Local and Community Participation in Forest Management:

Most decisions on forest resources have been made at the central level with little local participation. This is not effective because such a top-down approach prevents the local communities from contributing to any sustainable forest management efforts, which can hardly be achieved by the central government alone. This is most crucial in a place such as Ratanakiri, where the villagers have long been relying on the forests, and may have valuable local knowledge.

Figure 1.1 **Map of Cambodia**

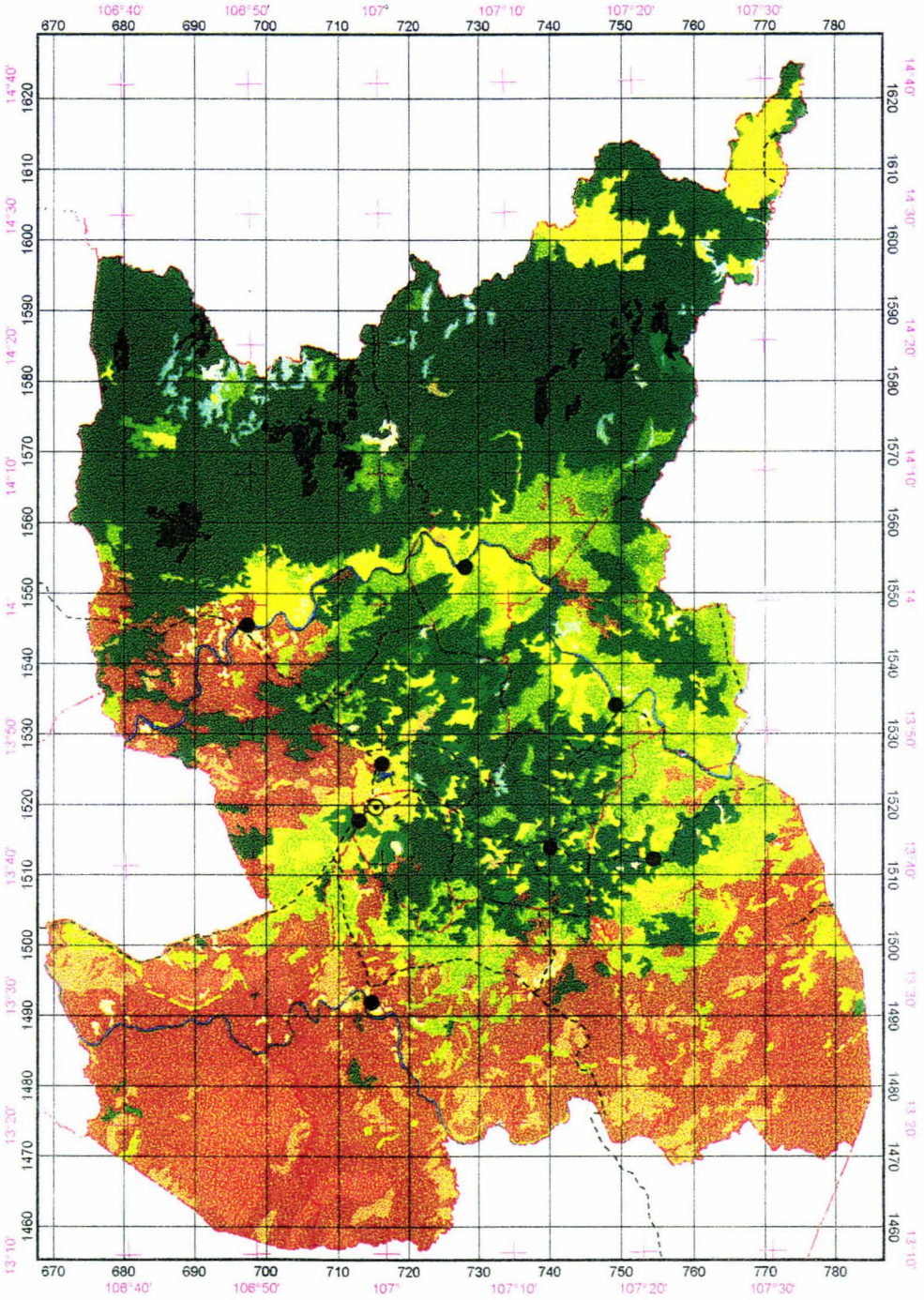


Internet Source:

http://www.lib.utexas.edu/Libs/PCL/Map_collection/middle_east_and_asia/Cambodia.GIF

Figure 1.2 FOREST TYPE & LAND COVER

RATANAKIRI PROVINCE



LEGEND

Forest

- Evergreen Dense
- Evergreen Disturbed
- Evergreen Mosaic
- Mixed Dense
- Mixed Disturbed
- Mixed Mosaic
- Deciduous
- Deciduous Mosaic
- Forest Regrowth
- Inundated Forest Regrowth
- Inundated Forest
- Mangrove Forest
- Forest Plantation
- Other Forest
- Inundated Forest Mosaic

Non-Forest

- Wood- / Shrubland Evergreen
- Grassland
- Bamboo
- Wood- / Shrubland Dry
- Wood- / Shrubland Inundated
- Mosaic of Cropping (< 30 %)
- Mosaic of Cropping (> 30 %)
- Agricultural Land
- Barren Land
- Rocks
- Urban / Built-Over Area
- Water
- Other
- Wetland
- Clouds

Other Features

- Roads
- Boundaries District
- District Center
- Village Center
- Province Center (Ban Lung)

Coordinate Systems : UTM & LL
Zone : 48
Grid : 5 Kilometers
Horizontal Datum: Indian 1960
Spheroid: Everest

Forest and Land Cover Types
mapped by FCMP from Landset
TM hardcopy Images at 1:250,000
Scale taken in 1992-93

Administrative Boundaries,
Settlement and Road Data
provided by Department of Geography

International Boundaries in this map
shoud not be cosidered authoritative

N

Map Scale 1:1,000,000

10 0 10 20 30 40 50 Kilometers

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CHAPTER TWO
LITERATURE REVIEW

In Chapter One, the issue of indigenous people and their dependence on the forests of Cambodia and the lack of forest management nationwide has been raised. In this Literature Review, I will look in more detail at the non-timber values of indigenous forests and at ways to measure them to help set the scene for later discussions on forestry management.

Valuation of these non-timber values is to make the case that leaving forests, rather than exploiting them for timber may be the most efficient strategy for Cambodia to follow in some regions. However, having proven this point may not be enough and more needs to change with regard to property rights, institutional structures, and community forestry, which will be discussed later in Chapter Five.

2.1 FORESTS AND VALUES

2.1.1 Cambodia's Forests

As reflected in Table 1.1 (Section 1.6 of Chapter One), Cambodia's forests are mainly classified into ten types of *evergreen forest, mangrove forest, coniferous forest, deciduous forest, mixed forest, secondary forest, dry land forest, flooded forest, flooded secondary forest,* and *edaphic forest.* The definitions of these types of forests are presented as follows (Forest Policy Assessment, 1996; Report on Establishment of a Forest Resources Inventory Process in Cambodia, 1998):

Evergreen forest: Multistory forest composed of over eighty percent trees of evergreen species. The major species include *Anisoptera cochinchinenesis*, *Shorea vulgaris*, *Dipterocarpus dyeri*, *Dipterocarpus costatus*, *Dipterocarpus alatus*, *Syzygium spp.*, *Hopea odorata*, and *Hopea pierrei*.

Mangrove forest: Includes both rear mangrove forest and mangrove forest on tidal saline water.

Coniferous forest: Means pine forest (mostly in Kirirom area of Cambodia).

Deciduous forest: Refers to dry deciduous *Dipterocarp* forest. Most characteristic species consist of thick bark, and are known to be resistant to fire. These include *Shorea obtusa*, *Dipterocarpus intricatus*, *Dipterocarpus obtusifolius*, *Dipterocarpus tuberculatus*, *Terminalia tomentosa*, *Pentacme siamensis*, and *Xylia dolabriformis*.

Mixed forest: Composed of both deciduous and evergreen species (with deciduous species constituting over 50 percent of the forest).

Secondary forest: Means open forest with regrowth, resulting from shifting cultivation.

Dry land forests: Consist of evergreen, deciduous, mixed, secondary, and coniferous forests.

Flooded forest: Refers mostly to flooded forest surrounding the Tonle Sap Lake of Cambodia.

Flooded secondary forest: Means flooded secondary forest with open canopy and regrowth following felling/cultivation.

Edaphic forests: Consist of mangrove, flooded, and flooded secondary forests.

Detailed information regarding the distribution of Cambodia's forest cover by province is presented in Table 3.1 (Section 3.1.1 of Chapter Three). The First State of the Environment Report (1994) indicates that Cambodia's forests are dominated by tree species belonging to the families of *Dipterocarpaceae*, *Lythraceae*, *Leguminosae*, *Fagaceae,* and *Pinaceae* (some areas only). Bamboo is quite common in Cambodia. Cambodia's forest has two major characteristics, its flora of low altitude areas resembles to that of the Indochinese floristic region, while the flora of the high altitudes

seems typical of that of the Indo-Malayan region (First State of the Environment Report, 1994).

A few rare and endangered tree species such as burmese ebony, blackwood, and siamese rosewood are also found in Cambodia (First State of the Environment Report, 1994). However, some species such as *Tectona grandis* commonly known as teak is believed to have been imported from the Indo-Burma region in the past (Dy Phon, 1970; cited in First State of the Environment Report, 1994).

Similar to the world's forests, there are a great variety of life-support functions that Cambodia's forests perform in addition to providing the society with timber required in house construction, furniture making, and so forth. These include hosting of the flora and fauna, protection of soil, and controlling of floods through a twofold buffer activity - interception of the rain by the tree canopy, and absorption and recycling of water by the humus and the roots. In addition, in Cambodia's forests live the indigenous people who are dependent on non-timber forest products such as traditional herbal medicines, nuts, fish, game, honey, vegetables, and so forth. Other important aspects of the forests are their role in maintaining the earth's climate, atmosphere, and water reserve.

Some peculiar characteristics of Cambodia's forests relate to the country's genuine rainforest, which is becoming scarce within the Southeast Asian region. Jepma (1995) states that the true rainforest has almost disappeared from continental Asia, except Malaya, Southwest Cambodia, and Southern-most Thailand. The First State of the Environment Report (1994) defines Cambodia's tropical rainforest as a diverse, high, layered forest with a height of around 30 meters, consisting of major species such as *Dipterocarpus costatus*, *Hopea odorata*, *Anisoptera costata*, *Shorea hypochra*, and *Anisoptera glabra*. The major special characteristics of the rainforest, in general, are quoted from Jacobs (1988, p. 4-6) (cited in Jepma, 1995, p. 7) as follows:

> *1) They contain the largest number of species, of animals and plants, of any known ecosystem;*
> *2) they occur generally on poor soils;*
> *3) in comparison to other forests, their potential for utilization is greatest in terms of quality, but smallest in terms of quantity;*

4) they cannot easily be cropped in quotas;

5) they contain huge capital assets in the form of timber which, unlike non-timber products, generally cannot easily be harvested without serious ecological damage;

6) they cannot be 'managed' without the loss of a large number of species;

7) they are unusually fragile, and, once damaged, do not recover, or recover too slowly for any human planning;

8) nearly all of them are situated in developing countries with shaky economies, and little or no power to implement laws on land use, if and where such laws exist;

9) they are now being logged rapidly by mechanical means since for a decade machinery has been available;

10) yet they are so complex that even their main ecological features are poorly known even to professional decision-makers and misunderstandings about them abound (p. 7).

2.1.2 Non-timber Forest Products

Non-timber forest products refer to items of biological origin (except wood and timber) and to services obtained from forests and allied land uses (Chandrasekharan, 1995). *"Wood"*, *"Timber"*, and *"services"* are defined by Chandrasekharan (1995) as (1), (2), and (3) respectively:

(1): *Stem, branches and roots of plants/trees characterized by lignified, water-conducting, strengthening and storage tissues* (p. 347).

(2): *Wood in forms suitable for heavy construction; sawnwood of more than a specified width and thickness; excludes fuelwood, wood for carving, pulp wood, small wood* (p. 347).

(3): *Provision of assistance; act of serving; work done to meet some needs; intangible, non-transferable economic goods, as distinct from physical commodities* (p. 347).

Another similar definition of *"non-timber forest products"* is quoted from the Regional

Expert Consultation on Non-Wood Forest Products for Africa (1993) (cited in Chandrasekharan, 1995, p. 348):

> *All vegetal and faunal products (other than wood) derived from forests and other wooded land and trees outside the forests; excluded are industrial round wood, wood used for energy, horticultural and livestock products* (p. 348).

Non-timber forest products can be extracted from wild sources such as indigenous forests, plantations (in case of rubber, essential oils, and so forth), or semi-wild/farmland trees to serve the purposes of household consumption, trading, or other forms of usage with social, cultural, and religious significance (Iqbal, 1995).

The distinction between non-timber forest products and agricultural crops does not always seem to be clear and straightforward, in particular, if the products are extracted from agricultural plantations or semi-wild/farmland trees (Iqbal, 1995). An example of this is the case of ginseng roots, which can be classified as either a kind of non-timber forest product or an agricultural crop due to the fact that most of the roots are cultivated in plantations (Iqbal, 1995).

For the purpose of this research, non-timber forest products mainly refer to those obtained from natural forests since the case study area, Yeak Loam commune of Ratanakiri province, is composed of indigenous forests. Firewood is included because "firewood" to the Yeak Loam commune refers to a mixture of tiny branches, leafs, and so forth that hardly qualifies for "timber". Its exclusion will lead to under-estimation of the non-timber forest value at Yeak Loam commune. In addition, other researchers such as Bann (1997) also included "firewood" in her study of non-timber forest products in Ratanakiri. Details regarding the selection of the case study area will be discussed in Chapter Three.

Though most non-timber forest products contribute in one form or another to the well-being of household and local economies, some of them are also known to have international trading values in either unprocessed or semi-processed forms (Iqbal, 1995). This seems to be a potential area, for a developing country such as Cambodia, to explore instead of solely depending on timber exploitation for foreign exchange.

Furthermore, there is reason to believe that if properly managed, non-timber forest products can assist local communities with their needs without damaging the forests (FAO, 1995).

According to a study by Iqbal (1995), 150 non-timber forest products, which include 26 kinds of essential oils, are found to be of commercial significance. These non-timber forest products of trading significance are shown in Table 2.1. They are classified into 17 categories, namely, food products; spices, culinary herbs, and condiments; industrial plant oils and waxes; plant gums; natural pigments; oleoresins; fibres and flosses; vegetable tanning materials; latex; insect products; incense woods; essential oils; plant insecticides; wild plants; medicinal plants; animals and animals' products; and miscellaneous products. Each category either consists of various products or stands by itself. Some products are further classified into sub-products such as nuts, fruits, and so forth, while others stand alone by themselves (for example, maple sugar, sandalwood, gharu, and so forth).

Moreover, Iqbal (1993) indicates that the non-timber forest products are normally exported from developing to developed countries. Quite a few of these originate from the forests of Southeast Asia, with China recently emerged as a major exporting country in natural foodstuffs and medicines (Iqbal, 1995). Other major exporting countries of non-timber forest products to the world markets are Indonesia, Malaysia, Thailand, India, and Brazil (Iqbal, 1995).

The potential role of non-timber forest products in sustainable forest management was recognized during the 1992 "Earth Summit" in Rio de Janeiro (FAO, 1995). This is due to the fact that if properly managed, non-timber forest products can help: (1) improve rural livelihood; (2) generate income for local communities; (3) maintain village-level food security and nutrition; (4) earn foreign exchange for the government; and so forth (Report of the International Expert Consultation on Non-Wood Forest Products, 1995). Non-timber Forest Products can also contribute to a reduction in timber exploitation.

Table 2.1 Major Non-timber Forest Products of Trading Significance

Categories	Products	
Foods Products (1)		
	Nuts:	*Walnuts, brazil nuts, chestnuts, malva nuts, Pignolia nuts, pine nuts.*
	Fruits:	*Sapodilla, ginkgo, jujube.*
	Edible fungi:	*Pine mushrooms, truffles, morels.*
	Vegetables:	*Bamboo shoots, palm hearts, osmunds, reindeer moss.*
	Starches:	*Sago.*
	Birds' nests.	
	Oils:	*Babassu oil, shea nuts, sal or tengkawang or illipe oil.*
	Maple sugar.	
Spices, Culinary Herbs, Condiments (2)	Nutmeg & mace, cardamom, galanga, caraway, allspice, Bay leaves, oregano, cinnamon, cassia.	
Industrial Plant Oils and Waxes (3)	Industrial Plant oils:	*Tung oil, neem oil, kemiri or candle or lumbang oil, Jojoba oil, akar wangi, babassu, oiticica, kapok oil.*
	Carnauba Wax.	
Plant Gums (4)		
	Gums for Food uses:	*Karaya gum, carob gum, tragacanth, gum arabic.*
	Technological Grade gums:	*Combretum gum, talha gum.*
Natural Pigments (5)	Annatto seeds, logwood, indigo.	
Oleoresins (6)	Pine oleoresin, copal, benzoin gum, damar, copaiba oil, Dragon's blood (benjamin), amber,	
Fibres and Flosses (7)		
	Fibres:	*Cork, esparto, rattan, xateattap, aren, osier, raffia, Bamboo, toquilla straw products, erica, and other broom grasses.*
	Flosses:	*Kapok or silk cotton.*

Table 2.1 Major Non-timber Forest Products of Trading Significance

(Continued)

Categories	Products
(8) Vegetable Tanning Materials	Mimosa, quebracho, chestnut, catha/cutch.
Latex (9)	Jelutong, natural rubber, gutta percha, sorva and chicle.
Insect Products(10)	Mulberry silk and non-mulberry silk, natural honey, beeswax, Lac and lac-dye, cochineal, kermes, aleppo galls.
Incense Woods(11)	Gharu or aloewood, sandalwood.
Essential Oils (12)	
Plant Insecticides (13)	Medang, derris, pyrethrum, peuak bong.
Wild Plants (14)	
Medicinal Plants (15)	
Animals and Animals' Products (16)	Feathers, maleo eggs, trophies, ivory, butterflies, birds, live animals, bones.
Miscellaneous Products (17)	Bidi leaves, chewing sticks, dom nuts or ivory nuts, lacquer, Soap berries (soap nut), quillaia bark, betel and cola nuts.

Source: Iqbal (1993)

2.1.3 Sustainable Forest Management and Deforestation

The interaction between human beings and forests seems to have been an on-going process for a long time in human history. This is illustrated by the fact that the beginning of deforestation can be traced back to as early as 3,000 B.C. in the form of clearing of the vast cedar forests of Lebanon (Eckholm, 1976; cited in Poffenberger, 1990). Forested areas in some parts of Greece were deforested by the fifth century B.C. (Goudie, 1986; cited in Poffenberger, 1990), while China, the Middle East, Europe, and North Africa experienced deforestation over the millennia (Poffenberger, 1990). With regard to Southeast Asia, the exploitation of the tropical forests began with the advent of neolithic man (Furtado, 1979). Partly as a consequence of deforestation, the world's

forests have reduced from approximately five to four billion hectares since the pre-agricultural times, representing a loss of one-fifth of the world's total forests (Repetto, 1988).

In a publication entitled "Introduction to World Forestry", Westoby (1989) indicates that though there may have been various changes in forest cover over millions of years, its most rapid shrinkage is believed to have occurred over the past few centuries along with the drastic increase of human population. This seems to coincide with the findings by Furtado (1979) that deforestation in Southeast Asia has become intense over the last two centuries. Moreover, rainforests were estimated to have decreased from 250 million hectares (in 1900) to less than 60 million hectares (in 1989) in Southeast Asia alone (Scott, 1989; cited in Poffenberger, 1990). As a part of the Southeast Asia, Cambodia experienced a similar fate of rapid forest loss.

Similar to most countries within the region, Cambodia experienced intensive forest exploitation by its former colonizer, and then by its own successive governments after gaining independence in 1953. It is observed that firewood gathering, logging for economic revenue, and population expansion are commonly considered to be the major driving forces behind rapid forest reduction in most developing countries such as Cambodia. There is, however, reason to believe that though the latter imposes pressure on the use of forests as well as the clearance of forested areas for agricultural land, its impact can be reduced in the presence of sound management practice and appropriate attitude towards the forests. This is in line with a statement by Westoby (1989) that there are cases, in which a large number of people may live harmoniously with the forests, while in other instances, forests are destroyed in the presence of few people.

These constitute sharp contrasting pictures, one of a group of human beings who are involved in the destruction of the forests, while another, having recognized their long-term reliance on the forests, have chosen to protect or even to generate the forests (Westoby, 1989). In other words, it is peoples' attitude, perception, and lack of understanding of the value of the forests that really matter and not the population size alone. This is also reflected in the definition of deforestation declared during the 1992 international Conference on Environment and Development (UNCED) in Rio de Janeiro organized by the United Nations, commonly known as "Earth Summit":

> *Deforestation is a result of many causes; some natural, but mainly due to human development, such as inappropriate land tenure systems and incentives, expansion of agricultural areas, increasing forest product demand and lack of information and understanding on the value of forests* (UNCED, 1992, p.58; cited in Barraclough and Ghimire, 1995, p. 2).

A statement quoted from Sargent (1990) (cited in Rietbergen, 1993, p. 4) seems to suggest that the importance of the concept of sustainable forest management was actually recognized as early as the fourth century B.C.:

> *If the seasons of husbandry be not interfered with, the grain will be more than can be eaten. If close nets are not allowed to enter the pools and ponds, the fishes and turtles will be more than can be consumed. If the axes and bills enter the hills and forests only at the proper time, the wood will be more than can be used. When the grain and fish and turtles are more than can be eaten, and there is more wood than can be used, this enables the people to nourish their living and mourn for their dead, without any feelings against any* (Mencius, China, 4th Century BC; cited in Rietbergen, 1993, p. 4).

This appears to show that awareness alone is not sufficient unless there is a will for implementation, which never seems to have happened in the Chinese history. The concept of sustainable forest management seems to have remarkably drawn the world's attention since the past decades, yet its implementation in most developing Southeast Asian countries, in particular, Cambodia has not been materialized. The major reasons are twofold. Firstly, a lack of proper, public understanding of the concept which constitutes a major obstacle to its implementation. Secondly, the reliance by developing countries, including Cambodia, on forests to achieve economic growth and national security. This seems to underline the major split in opinions between most developing and developed countries since the latter view tropical forests as an important source of biodiversity and carbon fixation that need to be preserved (Barraclough & Ghimire, 1995).

There seems to be no single definition of "sustainable" within the context of development or forest management. Two general definitions of "sustainable

development" and "sustainable management" are quoted as follows:

> *Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs* (WCED, 1988, page 43).

> *..."sustainable management" means managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well being and for their health and safety while –*
> *(a) Sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and*
> *(b) Safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and*
> (c) *Avoiding, remedying, or mitigating any adverse effects of activities on the environment* (The Resource Management Act, 1991; Part II Purpose and Principles, Section 5).

Within the context of forest management, "sustainable" can be defined as an approach that leads to the most efficient use of the services provided by the forests for the long-term benefits of the society, while ensuring minimal damage to the life-support system of the forests themselves. In other words, sustainable forest management refers to management of forest resources in a sustainable way, which efficiently balances the needs for socio-economic development and resource/environmental preservation (i.e. timber exploitation can be only allowed on the basis of the maximum annual allowable cut estimated based on an updated forest inventory, balancing both ecological concerns and socio-economic requirements). To achieve sustainable forest management, it is believed that three major issues need to be addressed, namely poverty alleviation, enhancing public livelihood and participation, and resource and environmental protection. This is because unless people's basic livelihood and welfare are promoted, sustainable forest management can hardly be accomplished due to the absence of local support.

In addition, sustainable forest management needs the presence of effective institutions,

whether legal, administrative, or market-based (Ferguson, 1996). In a study by Ferguson (1996), he makes four key points: Firstly, to achieve sustainable forest management, property rights need to be properly allocated through land-use planning and other means. Secondly, the supply of forest services should be managed through relevant management plans, supported by enforceable forestry legislation. Thirdly, there should be demand management to ease population or other demand pressures on forests along with public participation in forest management due to the public's duel role as consumers and owners. Finally, sustainable forest management is a long-term process, and is by no means inexpensive.

2.1.4 Indigenous Peoples and Forests

The definition of "indigenous peoples" is quoted from the World Bank (1990a) (cited in Colchester, 1993), which clearly reflects the difficulties that they face in the modern society:

> *The term indigenous covers indigenous, tribal, low-caste and ethnic minority groups. Despite their historical and cultural differences, they often have a limited capacity to participate in the national development process because of cultural barriers or low social and political status* (World Bank; 1990a:1; cited in Colchester, 1993; p. 65).

There are eight major groups of indigenous peoples residing in the Northeast, in particular, Ratanakiri province of Cambodia, who are characterized by their animist religion and related belief system, as well as their semi-settled shifting cultivation practice (White, 1995). These indigenous peoples are composed of Tampuen, Kreung, Kachok, Kavet, Jarai, Prov, Phnong, and Lun (Provincial Rural Development Committee, 1997). Among these groups of highland people, Tampuen is mostly found in Yeak Loam commune of Ratanakiri province, which is the research area.

Having lived in the forests for generations, indigenous peoples constitute an integral part of the forest ecosystem, and have adjusted to it (Rapaport, 1976; Sioli, 1985; cited in Park, 1994). This is reflected in the fact that indigenous peoples seem to live in harmony with the forests and not the other way round, while this is not the case for more developed societies, who tend to view forests as an opportunity for exploitation

for economic gains (Park, 1994). Similar comments on the Tampuen indigenous people of Yeak Loam commune (Ratanakiri province) were made by Sokhom et al. (1996) in the sense that they live harmoniously with, and rely on the natural environment, including forests.

In a study, Park (1994) presents three ways in which tribal peoples maintain their harmonious co-existence with forests for centuries: through physical adaptation, beliefs, and sustainable practices. Physical adaptation refers to the fact that indigenous peoples have developed the ability to survive under the heat conditions of the rainforest through gradual changes in the physiological characteristics over generations, resulting in some specific responses in the body dynamics (Caufield, 1985; cited in Park, 1994). Park (1994) describes these responses as the ability to generate less heat or to disperse heat more rapidly than non-tribal people to avoid overheating. Other characteristics are a lower level of sweating and protein requirements (Park, 1994).

With regard to beliefs, Park (1994) indicates that indigenous peoples have belief systems that are different from those in developed countries. The indigenous peoples are attached to the natural world, which they view as full of spirits. They consider themselves as a part of the natural world in very much the same way the trees around them are (Park, 1994). This seems somehow similar with the observation made by Sokhom et al. (1996) that the Tampuen indigenous people of Yeak Loam commune are animists, who have the belief that they are surrounded by spirits identified with physical objects such as forests, trees, lakes, and so forth. This underlines a major cultural difference between Cambodia's indigenous peoples, in particular, Tampuen (also known as "Khmer highlander") and the low-land Khmer people.

In addition, there exists a close interaction between the indigenous peoples and the forests in the sense that human activities affect as well as rely on the services of the forests. This is reflected in the traditional shifting cultivation that permits sustainable and effective use of the poor forest soils (Park, 1994). Shifting cultivation will be discussed in details in Section 2.1.5.

Park (1994) further indicates that long-term reliance on forests has provided the indigenous peoples with practical knowledge of the forests, their associated potential

uses, and the wildlife within them. It is through that knowledge, together with their respect for fellow human beings, that a highly adapted and sustainable lifestyle was developed within the indigenous peoples' communities (Park, 1994). This seems to explain why indigenous peoples, including the Tampuen people of Ratanakiri, have been able to maintain their unique survival patterns for centuries.

2.1.5 Shifting Cultivation

Shifting cultivation or slash and burn farming (also known as swidden agriculture) constitutes the central theme of the livelihood of the indigenous peoples. Shifting cultivation, by definition, implies a highland farming practice that involves periodic abandonment of cultivated areas (when the soils become unfertile), the clearance of forests for plantation (based on a mixed cropping approach), and the eventual return to the old fallow sites after a certain interval.

Kunstadter and Chapman (1978) point out that there are three types of shifting cultivation: (1) swiddeners repeatedly make cyclical cultivation on the same fields and stay in the same villages that they have settled for centuries; (2) shifting cultivators are nomadic, and move on to new villages when the fields become unfertile; (3) farmers who practise shifting cultivation to supplement the use of irrigated fields (in the areas where there is scarcity of irrigable land).

Similar to most of other ethnic highland groups, the Tampuen indigenous people of Yeak Loam commune, who seem to belong to the combination of the first and second categories mentioned above, have been practising shifting cultivation for centuries. Shifting cultivation has evolved into a major part of the ethnic group's culture and tradition besides also being a means to support basic livelihood. Ironically, it is also the main leverage used by some individuals to blame the ethnic highland group for rapidly destroying the forest resources, which are in fact, being excessively exploited by powerful individuals for the benefits of a few and the loss of all in a long-term perspective. Similar comments on the blaming of shifting cultivation for forest loss were made by Park (1994) and Hirsch (1997). Furthermore, Hirsch (1997) points out that despite favorable anthropological and ecological evidence for the sustainability of traditional swidden agriculture, the negative image of slash and burn farming has persisted since the post-colonial period. As a consequence of most governments'

prolonged contemptuous attitudes towards shifting cultivation, it seems that the negative impression of swidden agriculture has been shifted towards shifting cultivators, who are mostly highland people (Hirsch, 1997). This seems to underline one of the major challenges in the promotion of community-based forest management, specifically for Cambodia, which will be discussed later on in Chapter Five.

Chomkar is the Cambodian word (Khmer language) for ethnic highlanders' "shifting cultivated rice field" – a place where the plantation of rice is mixed with a great variety of other agricultural produce such as banana, papaya, pineapple, watermelon, mango, corn, taro, cucumber, pumpkin, wax gourd, bottle gourd, ginger, red pepper, lemon grass, and so forth.

According to the information provided by a few Yeak Loam commune officials and village elders, a *chomkar* or "shifting cultivated rice field" is only productive for four to five years since ethnic highland villagers neither use fertilizers nor plow the land properly the way most low-land Khmer farmers do. The current common practice has been to burn forests to make a new *chomkar* or "shifting cultivated rice field" when the old one becomes less productive. Villagers normally return to the original fallow *chomkar* after 10 years to re-start a new cycle of shifting cultivation. This coincides with the observation made by Emerson (1997). In addition, two key factors involved in determining the fallow interval are the degree of tree regrowth and the absence of weeds (Emerson, 1997).

Emerson (1997) emphasizes that *chomkar* or "shifting cultivated rice fields" do not normally meet the basic needs of the swiddeners, who always have to turn to forests for non-timber forest products such as wildlife, fruits, herbal medicines, and so forth. Such a living pattern has been going on for generations in Ratanakiri (Emerson, 1997). This seems to underline the close connection between indigenous peoples and forests. The sustainable management of Cambodia's forest resources is, therefore, not only vital for the country but also, in particular, for the indigenous peoples such as the Tampuen ethnic group of Yeak Loam commune of Ratanakiri province. In other words, given the level of closeness between the indigenous people and the forests, their participation in the management of Cambodia's forests seems to be a matter of high priority to ensure sustainability of the country's forest resources.

2.1.6 Valuation of Cambodia's Forests

Similar to other resources, Cambodia's forests or forests, in general, have value. Forest value can be related to the direct and indirect benefits humans derive from forests. These include timber, some non-timber forest products, flood and climate control functions, recreation, ecotourism, and so forth. Other values associated with forests are those which are independent of benefits to human beings such as for example, existence value. Environmentalists from the deep ecology school of thought may even argue that a forest has value of itself, regardless of human preferences.

From an economic standpoint, the value of a resource, here a forest, is measured on the basis of individual preferences. Perman et al. (1996) state that individual preferences for resources indicate the utilities that are anticipated to be obtained from the use or existence of those specific resources. Utility is based on the principle of *utilitarianism*, which is defined by Solow (1974b) as an approach that measures welfare or social good as function of the utilities of a society's individual members (cited in Perman et al, 1996).

The values of forest can be measured based on the framework of *total economic value* (TEV). *Total economic value* (TEV) consists of both *use value* and *non-use value* (Pearce, 1993). *Use value* is further classified into three categories of *direct use value*, *indirect use value*, and *option value*, while *non-use value* is divided into *existence value, and bequest value*. *Total economic value* (TEV) can be expressed as:

TEV = Use value + Non-use value = (Direct use value + Indirect use value + Option value) + (Existence value + Bequest value)

Intrinsic value, being a specific case of *non-use value*, is not included in the calculation of *total economic value*. Its exclusion does not imply that *intrinsic value* is not important or should be left out in decision-making. The main reason is simply because the concept of *total economic value* denotes the whole class of values that are based on human preferences only, which can be analyzed within the framework of economics (Perman et al, 1996).

An example of the application of the concept of *total economic value* can be reflected

in a forested land use policy-level decision. The basic principle of economic efficiency (underlying the tool of benefit-cost analysis) indicates that a development decision should go ahead only if the present value of the net social benefits of development is positive. Mathematically, it can be expressed as:

$$NPV = \sum_{t=0}^{t} \frac{(B_t - C_t)}{(1+r)^t} > 0 \qquad B_t = \text{benefit at time } t; C_t = \text{cost at time } t; r = \text{discount rate}$$

(Department of Finance, 1993)

For the land use policy to proceed, Pearce et al.(1994) state that the following condition should be satisfied:

$(B_{dev} - C_{dev}) - (B_{con} - C_{con}) > 0$ (all discounted in the present value (PV))

or $(B_{dev} - C_{dev}) - (TEV_{pv} - C_{con}) > 0$ (all discounted in the present value (PV))

With B_{dev} = PV benefit of development; C_{dev}= PV cost of development

B_{con} = PV benefit of forest conservation; C_{con} = PV cost of forest conservation

TEV_{pv} = discounted total economic value of the forest

In other words, the net present value of land use development minus the net present value of conservation (i.e. all the non-timber values in the *total economic value* of forests) should be positive if the land-use development is to proceed.

A brief description of the definitions of the previously discussed use and non-use values is presented below.

2.1.6.1 Use Value

Use value refers to the utility one may obtain from actually using a resource (including future potential use), which can be either through a direct or indirect way.

Direct use value means the utility that one obtains from directly consuming a resource or service. In other words, it implies any one of the resources or services generated directly by the forest such as timber, medicine, food, recreation, human habitat, and so forth. However, measurement of *direct use value* in economic terms is not always

straightforward (Pearce, 1993). An example of this is reflected in the value of traditional medicine, which may not be easy to measure due to lack of market information, while the value of wild bamboo shoots can be easier to identify.

Indirect use value resembles the environmentalist's idea of "ecological functions" (Pearce, 1993). An example of this is reflected in a wide range of forest functions that have an indirect impact on human welfare such as protection of watershed, carbon reservoir, air pollution control, nutrient preservation, biodiversity, and micro-climate regulation.

Option value refers to the option of using a resource or service in the future. It is likened to an insurance scheme to guarantee the continuous availability of an environmental good such as the forest especially if the good's future supply seems uncertain. This is because if human beings are sure of their future preferences as well as the future supply of the resource, there will be no option value (Perman et al., 1996). The contrary is also true in the sense that human beings may be happy to pay a premium (i.e. the option value) to maintain the option of future use of a resource or service, if there exists uncertainty with regard to human preferences and the availability of such a resource or service in the future.

2.1.6.2 Non-use Value

Non-use value refers to the attitudes, concern, and respect of human beings towards a resource, natural service, or future generations, regardless of the fact that these have no use or connection to the individuals involved.

Existence value reflects rather unique human preferences to keep a resource in its current form regardless of the fact that there may not be any actual or future potential use of the resource. An example of this can be seen in people's willingness to pay for the preservation of an endangered specie, or a unique ecosystem.

Bequest value is defined by Pearce (1994) as the utility that human beings may obtain simply from learning that a resource or service will be preserved for future generations (cited in Perman et al., 1996). There seems to be two schools of thought with regard to *bequest value*. Some people consider *bequest value* as a separate component of

economic value, while others suggest that it is part of *existence value* (Pearce, 1993).

Intrinsic value means the value of a resource or service by itself, completely independent of human beings and their valuation in whatever form. It is excluded in the *total economic value* for the reason mentioned earlier.

2.1.6.3 Forest Values

Classification of the *total economic value* of Cambodia's forests is summarized in Table 2.2 below.

Table 2.2 A Summary of the Total Economic Value of Cambodia's Forests

Types of values	Use Values			Non-use Values	
Value categories	DUV	IUV	OV	EV	BQ
Values	Timber Supply	Biodiversity	Uses in Future	Biodiversity	Biodiversity
	Fuel	Watershed Protection	(DUV+IUV)	Forest	
	Major NTFP	Nutrient Maintenance		Cultural Heritage	
	Medicine	Micro Climate Regulation			
	Recreation	Air Pollution Control			
	Eco-tourism	Carbon Reservoir			
	Agri. Land	Food Chain Balance			
	Human Habitat				
	Foreign Exchange				

Key abbreviations:

DUV	=	Direct Use Value
IUV	=	Indirect Use Value
OV	=	Option Value
EV	=	Existence Value
BQ	=	Bequest Value
NTFP	=	Non-timber forest product(s)
Agri.	=	Agriculture

Major Justifications:

With regard to direct use values, timber supply for both domestic and international markets has been a most important use of Cambodia's forest, which somehow accounts for the country's rapid deforestation over the past decades. Fuel is commonly collected from Cambodia's forests in the form of chopped wood, small tree branches, dried

leaves, and charcoal. It remains in popular use in both rural and some urban areas due to lack of alternative energies such as electricity or cooking gas, which are only affordable by the middle class households or higher. The term "major non-timber forest products" specifically refers to a few key forest products (excluding medicine and forest services in this context) that local communities have been gathering from the forests such as wild animals, fruits, vegetables, honey, and so forth. Herbal medicine is essential for remote areas, where there are few doctors and medicines are too expensive for poor villagers. This situation is serious in a country such as Cambodia, where social welfare barely exists.

Recreation and eco-tourism are two potential uses of the forests in view of the country's recent regaining of peace and national reconciliation, after two decades of civil conflict and guerrilla warfare. Moreover, the Royal Government's plans to promote eco-tourism underline the importance of these uses of the forests.

In addition, forests have been cleared for agricultural land and housing construction in remote forested areas. Such a pressure on the forests for agriculture land and human habitat may become more serious in view of the recent return of the refugees from the Thai-Cambodian border, since a large portion of the existing agriculture land is still under the threats of land mines. Furthermore, forests also constitute a major source of badly needed foreign currencies for the poverty-stricken country such as Cambodia.

Indirect use values of Cambodia's forests are related to ecological functions. These include biodiversity, watershed protection, nutrient cycling or maintenance, micro climate regulation, air pollution control/decrease, and carbon storage/reservoir (Pearce, 1993). Another important feature of indirect use values is believed to be food chain balance, which may be disturbed once the forests are destroyed.

Finally, the existence values of Cambodia's forests are based on the consideration regarding the rather unique characteristics of the forest itself, its biodiversity, and cultural heritage (i.e. the indigenous cultures).

2.1.7 Valuation Techniques

There are a variety of valuation techniques to identify the above-indicated values of Cambodia's forests. The most straightforward method is the market values approach, which uses market values as a basis for valuation. The "market value" of an item refers to its sale price on the open market (Fraser et al., 1985). A sale price of a good denotes a realized value instead of an estimated value, and can be used as a valuation basis for other items (Fraser et al., 1985), provided that they are similar. A major underlying condition for market prices to reflect social values is that markets should be working efficiently, without any market imperfections. This is because under such a scenario, the market price will equal the marginal consumers' willingness to pay and the opportunity cost of providing that resource. Otherwise, market prices might fail to indicate social values or real opportunity costs. Social values, in principle, are represented by people's willingness to pay for the goods or services.

In reality, market values are often missing for environmental goods, and alternative methods are required. Some of the more common techniques are the hedonic pricing method, the travel cost method, and the contingent valuation method. Hedonic pricing and travel cost methods are also known as surrogate market approaches, which rely on actual market values to deduce the probably behavior of a non-existent market. Non-market valuation methods and their welfare theory basis will be briefly discussed in Sections 2.1.8, 2.1.9, and 2.2.

In general, direct use values can be measured through the application of various methods such as market values approach, travel cost method, hedonic pricing method, contingent valuation method, opportunity cost approach, direct substitute approach, and replacement cost approach, and so forth. Indirect use values can be calculated by methods such as damage costs avoided, replacement cost approach, and so forth (Bann, 1997). In addition, option and existence values can be estimated by using the contingent valuation method.

Lastly, the main focus of this research concentrates on identifying direct use values of non-timber forest products to the local communities in Yeak Loam commune of Ratanakiri province. The valuation is, in general, conducted by the application of the market values approach as well as the direct substitute approach, whenever appropriate.

The direct substitute approach will be discussed in Section 2.2.4. Two major types of values are estimated in this regard. Firstly, the actual monetary values of the non-timber forest products obtained by households, are used in the calculation of the total value of the non-timber forest products to Yeak Loam commune as a whole since there is no way for these households/villagers to trade their products at the market price. The calculations use weighted-average for values. This is because not all households have sold their non-timber forest products, and some price data are, therefore, not available for some interviewed households/villagers. Secondly, the market price (the sale price) is used in the calculation of the value of the non-timber forest products to the society for the purpose of comparative analysis. This serves to answer the question of how much the non-timber forest products may mean to the villagers and the society as a whole. Direct substitute approach is used in valuation whenever the actual market price of a good is missing.

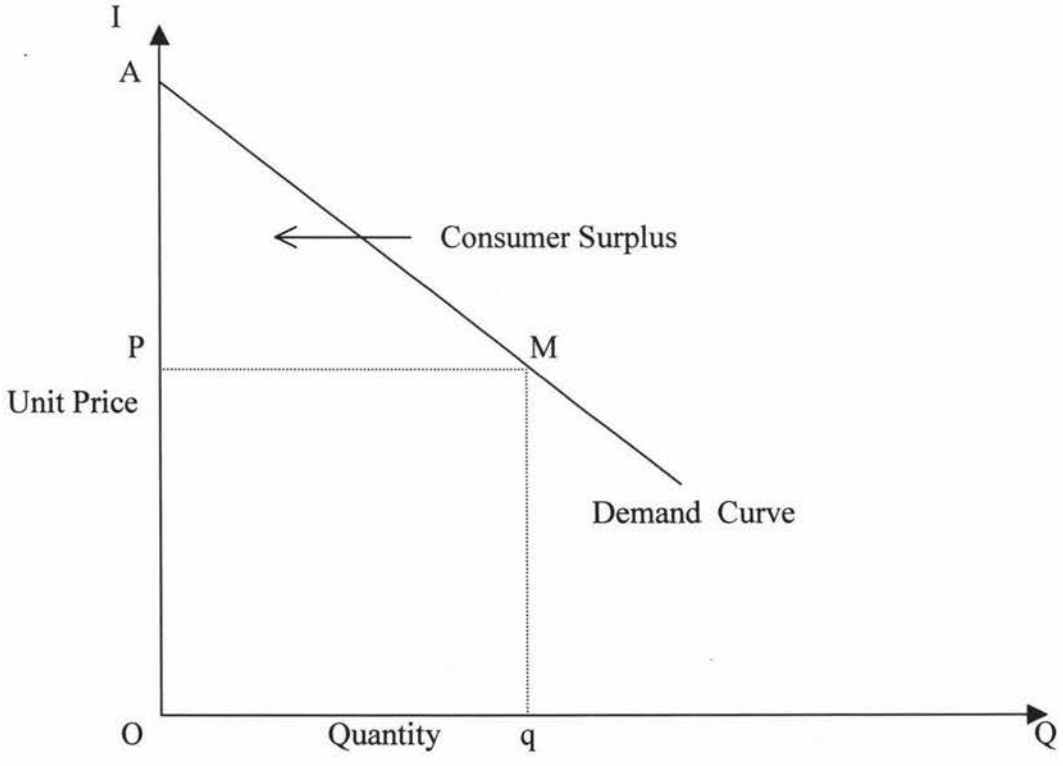
With regard to indirect use values, in a remote highland province like Ratanakiri, it is not possible to estimate values such as biodiversity, watershed protection, and so forth. The reasons are threefold. Firstly, there are hardly any physical data available on environmental functions in Ratanakiri, making therefore valuation infeasible (Bann 1997). Secondly, in a place like Ratanakiri, where most people are illiterate, and can hardly lead a subsistence level of survival, it is not possible to obtain information regarding their willingness to pay on issues that do not seem to have immediate and visible impact on their day-to-day life such as biodiversity preservation, recreation values of the forest, and so forth. This is partly due to the absence of local understanding of such concepts. Thirdly, as a result of over two decades' warfare, Cambodians, in general, are more concerned with the fulfillment of their basic material requirements than with aesthetic ones such as nature and landscape appreciation, and so forth. The country's poor security status has also complicated the situation. In view of the country's recent political improvement, such an attitude towards nature may change gradually, but the process will take time. Currently people's attitude towards forests is influenced by the presence of land mines, which makes it difficult for them to appreciate the real value. However, it is important to emphasize even though valuation of most indirect use values of the forests in Cambodia, in particular, Ratanakiri is not feasible at this stage, the values do exist and should not be ignored in decision making.

2.1.8 Consumer Surplus – Measurement of Change in Welfare

Non-market valuation methods are solidly grounded in welfare economics and the concept of net economic surplus. In this section, measures of changes in economic welfare along with their relationship to non-market valuation techniques will be discussed.

Net economic surplus is the difference between the total utility people derive from the consumption of a certain quantity of a commodity and the total cost, and is measured as the sum of consumer and producer surplus. Consumer surplus or Marshallian consumer surplus, by definition, refers to the difference between the value of a resource or service and its price. In other words, it implies the difference between a consumer's willingness to pay and what the consumer must pay for a resource or service as reflected in Figure 2.1. Consumer surplus is represented by the triangular area APM, with P denoting the actual unit price of a resource/service. The demand curve AM is also a marginal willingness-to-pay curve. Based on the principle of diminishing marginal utility, it seems intuitive that a consumer of a resource or service always makes consumer surplus (i.e. APM).

Figure 2.1 The Marshallian Consumer Surplus



The consumer surplus theory owes its origin by Dupuit in 1844, and has gone through various modification and criticisms (Lock, 1992). In view of the fact that utility is not observable, Marshall introduced the use of money as a cardinal utility index to measure the effects on welfare, resulting from changes in the quantity of a resource (Perman et al., 1996). This is possible because under Marshall's approach, the consumer's demand curve for a resource is considered the consumer's marginal utility function for the specific resource. As a result, changes in a consumer's utility are reflected by the changes in the area under the demand curve whenever the quantity/price of the resource/good changes. Furthermore, a major underlying assumption regarding Marshall's approach is that there exists a constant relationship between units of money and units of utility, or in other words, money income is governed by a constant marginal utility (Perman et al., 1996). This is in line with the comments made by Devine (1987) that since the Marshallian consumer surplus represents an income equivalent measure of the impact when price changes, and does not directly measure change in utility, such a change in income when price changes can not be interpreted as an equivalent change in utility if the principle of the constant marginal utility of income is violated.

Furthermore, the change in the consumer surplus denotes the welfare change, resulting from changes in price or quantity (Devine, 1987). However, the related key problem lies in the fact that change in price may generate two impacts. Firstly, if the unit price of a resource increases, the consumer reserves the option of switching towards another resource with a lower price. Secondly, the consumer can be moved to a different level of welfare as a result of the real income effect.

Consumer surplus theory was redefined by Hicks in 1943, who used an ordinal system of indifference curves in which utility is held constant (Currie et al., 1971; Lock, 1992). He derives four major ways to measure consumer surplus, these are: compensating variation, equivalent variation, compensating surplus, and equivalent surplus.

2.1.8.1 The Compensating Variation

This implies the amount of income paid or received as compensation, which will allow the consumer to remain in his/her original utility or welfare level after the price change, provided that he/she can purchase any amount of the good at the new price.

2.1.8.2 The Equivalent Variation

This means the amount of income paid or received as compensation, which will bring the consumer to his/her subsequent utility or welfare level if the actual price change does not occur and he/she can purchase any amount of the good at the old price.

2.1.8.3 Compensating Surplus

This is the amount of income paid or received as compensation, which will allow the consumer to remain in his/her original utility or welfare level after the price change, provided that he/she is restricted to purchase, at the new price, the amount of the good that they might have bought in the absence of compensation.

2.1.8.4 Equivalent Surplus

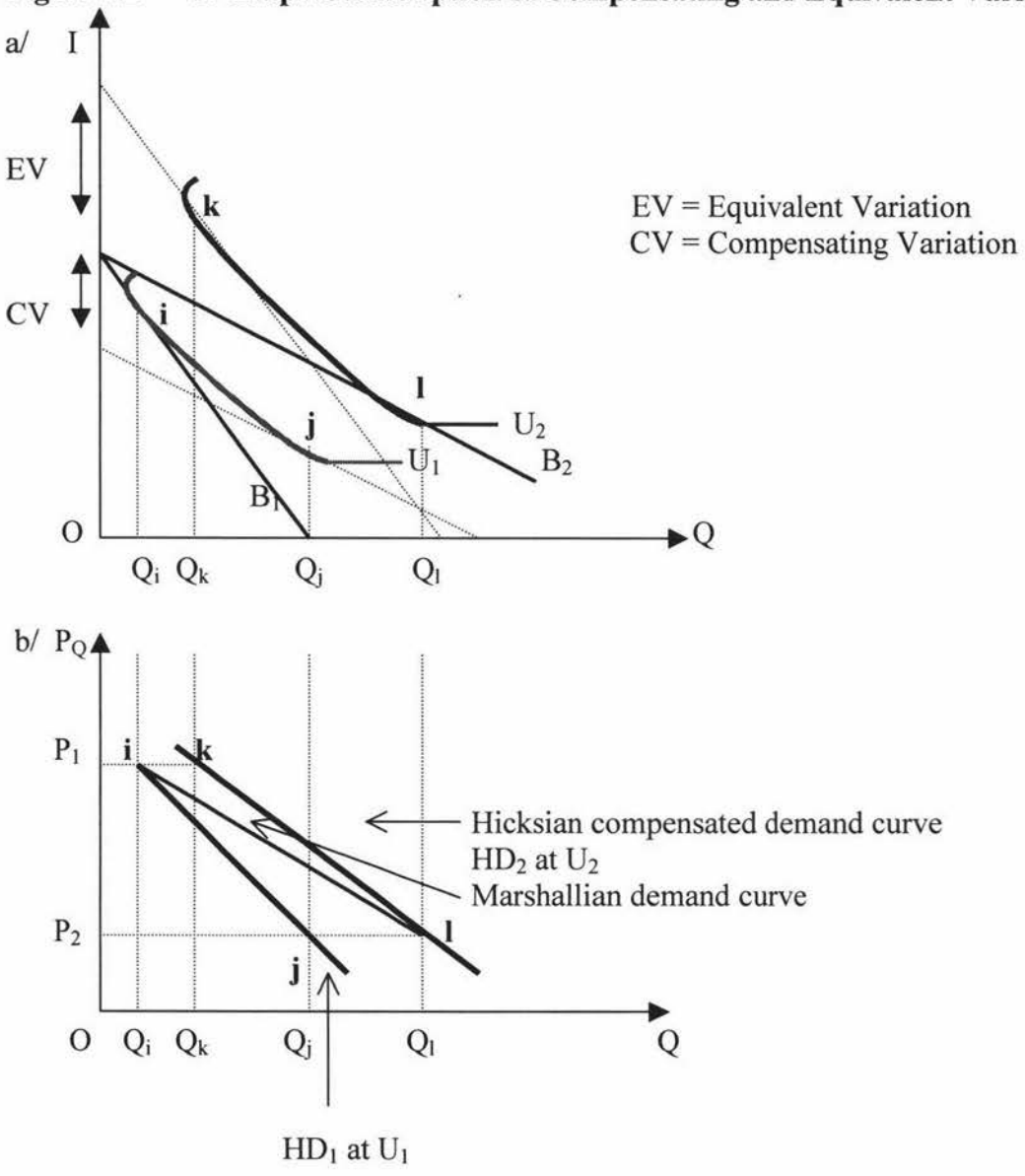
This implies the amount of income paid or received as compensation, which will bring the consumer to his/her subsequent utility or welfare level if the actual price change does not occur, provided that he/she is restricted to purchase, at the old price, the amount of the good that they might have obtained in the absence of compensation.

Graphically, the above four concepts are presented in Figures 2.2a, 2.2b, and 2.3 (Devine, 1987).

Figures 2.2a and 2.2b show that when the price of a resource drops from the level of P_1 to P_2, the consumer's budget line shifts in such a way that Q_l (point **l**) will be consumed instead of Q_i (point **i**), as the result of the new price. The compensating variation (CV) is reflected in both Figure 2.2a, and by the area P_1P_2**ji** of Figure 2.2b.

If compensating variation (CV) is taken away from the consumer, he/she will remain as well off as before but will consume Q_j (point **j**). This is because if the price of a resource decreases, the compensating variation means the maximum income that can be extracted from the consumer, without making him worse-off. $HD_1(U_1)$ is the Hicksian compensated demand curve that shows the quantities required at various prices when the consumer pays or receives compensation to remain at the initial welfare or utility level (U_1).

Figure 2.2 A Graphic Description of Compensating and Equivalent Variations



One of the major differences between the equivalent and compensating variations is that the former takes as reference the subsequent utility level, while the latter adopts the original utility level as its reference level. The equivalent variation (EV) is indicated in Figure 2.2a and is equal to the area P_1P_2**lk** in Figure 2.2b. Furthermore, as reflected in Figure 2.2a, since the equivalent variation (EV) stands for the minimal compensation to be paid to the consumer so that he/she can remain as well off as under the price change, the consumer will consume Q_k (point **k)** upon the receipt of compensation. As a result, the Hicksian compensated demand curve will be shifted up to an alternative utility level U_2 (i.e. HD_2 (U_2)) as shown in Figure 2.2b. In addition, it can be seen from Figure 2.2b that under the case of reduction in price, the compensating variation (P_1P_2**ji)** is less than

the Marshallian measure, while the equivalent variation (P_1P_2**lk)** is greater than the Marshallian measure. This can also be expressed as:

Compensating variance ≤ the Marshallian consumer surplus (or measure) ≤ equivalent variance

However, in the case of a potential welfare loss (i.e. price increase), the reverse is true in the sense that:

Equivalent variance ≤ the Marshallian consumer surplus (or measure) ≤ compensating variance

In addition, movement along the indifference curve U_1 from **i** to **j** of Figure 2.2a is governed by the substitution effect, which is followed by the income effect to shift from **j** to **l**. Figure 2.2b shows that only the substitution effect is included in the quantity change in the Hicksian compensated demand curves, while the Marshallian demand curve has the substitution and income effects. Devine (1987) indicates that in case that the income elasticity of demand of price change is zero (a zero income effect), all of the above-indicated three measures will be similar (i.e. EV = CV = the Marshallian consumer surplus or measure). Moreover, in the case of insignificant price change, the income effect is minor and the Mashallian measure is reasonably accurate (Devine, 1987). This seems in line with the statements quoted from Willig (1976) that:

> *...I will show that observed consumer's surplus can be rigorously utilized to estimate the unobservable compensating and equivalent variations – the correct theoretical measures of the welfare impact of changes in prices and income on an individual...the results imply that consumer's surplus is usually a very good approximation to the appropriate welfare measures* (p.589).

Differing from compensating and equivalent variations, which are to be based on the assumption that the consumer can reduce the impact of price change by consuming more or less of a resource, compensating surplus (CS) and equivalent surplus (ES) limit the quantity of the resource consumed to be either the level of the subsequent state (the

case of CS) or the original state (ES) as shown in Figure 2.3.

Figure 2.3 A Graphic Description of Compensating and Equivalent Surplus

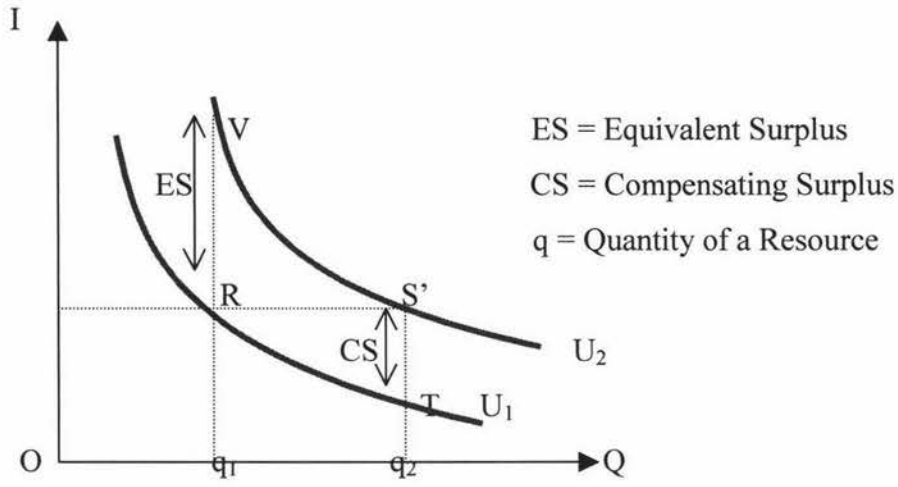


Figure 2.3 indicates that the change in income brings the consumer to a higher utility level (i.e. the consumption of q_2 instead of q_1). S'T is the compensating surplus, while the equivalent surplus is represented by the distance RV shown in Figure 2.3.

Finally, with regard to the choice of a relevant measure of change in welfare, two major factors are to be taken into consideration: (1) the nature of the problem such as if quantity restrictions or compensation issue is involved; and (2) the extent of the change in policy (i.e. if income effect is almost zero, the Marshallian consumer surplus can be used instead of other measures).

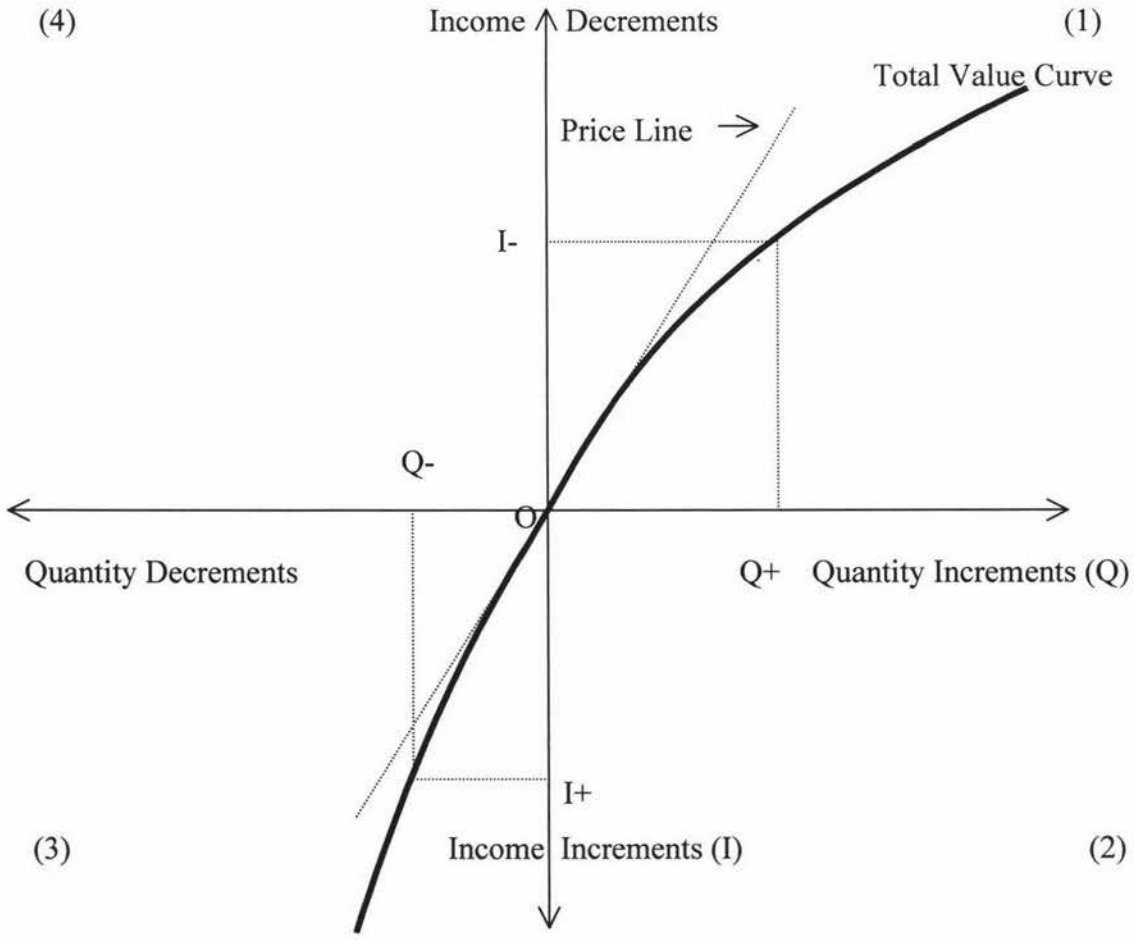
2.1.9 Willingness to Pay, Willingness to Accept, and the Total Value Curve

The benefit of a price or quantity change of a resource or service to the consumer can be estimated by applying the criteria of either willingness to pay (WTP) or willingness to accept (WTA) (Perman et al., 1996). Willingness to pay (WTP) implies what a person would be ready to pay in the monetary term either to enhance the existing welfare situation or to eliminate the threats of its deterioration. On the other hand, willingness to accept (WTA) means what a person would agree to accept in the monetary term as a form of compensation for either relinguishing a welfare enhancement or accepting the deterioration of the existing welfare situation.

Goodstein (1995) states that theoretically, willingness to pay (WTP) and willingness to

accept (WTA) are good approximations to the change in consumer surplus from a small change in an environmental good. In practice, willingness to accept (WTA) exceeds consumer surplus since people will become wealthier if compensation actually occurs, while willingness to pay (WTP) may be less than consumer surplus because their wealth will shrink if they are to pay for the enhancement of the environment. In addition, it seems that valuation of an environmental good by willingness to pay (WTP) or willingness to accept (WTA) approach tends to generate a higher value if the target groups are well-off, while a lower value if the subjects are poor. This is because the rich may be willing to pay more for welfare improvement, and require a higher compensation for suffering of any welfare loss, compared to that of the poor. Willingness to pay (WTP) and willingness to accept (WTA) are actually based on the *total value curve* (Figure 2.4), which is an indifference curve between the quantity of a resource/service to be consumed and the income of the consumer (Randall, 1987).

Figure 2.4 The Total Value Curve for an Individual Consumer



The *total value curve* coincides with the previously discussed Hicksian compensating measures of value, which are basically what the consumer is willing to pay for a welfare gain as well as willing to accept for a welfare loss (Randall, 1987). The diagram of the *total value curve* is divided into four quadrants of (1), (2), (3), and (4) as indicated in the above Figure 2.4.

"O" represents the consumer's starting position or initial welfare level, which is passed through by the continuous *total value curve* as shown in Figure 2.4. Quadrant (1) reflects the consumer's willingness to pay in the monetary term in order to gain a positive quantity increase of the resource/service, resulting in his/her income shrinkage (Randall, 1987). On the other hand, quadrant (3) shows the consumer's willingness to accept in the monetary term as compensation for a quantity decrease of the resource/service, while enjoying an income increase (Randall, 1987).

As shown in Figure 2.4, the *total value curve* seems to be useful in creating an overall framework to estimate the values of quantity decrements or increments of a resource/service. In addition, Randall (1987) states that the total value of the decrease or increase in the quantity of a resource or service to each individual can be measured in line with the potential Pareto Improvement criterion. Moreover, individual total values can be aggregated across the appropriate population (Randall, 1987). A special case of the *total value curve* that is worthy of mentioning is that if there are small changes in quantity of a resource or service relative to the total quantities exchanged in highly competitive markets, which are characterized by very low transaction costs, the price line will be completely tangent to the *total value curve* (Randall, 1987). Under such a scenario, the price line constitutes a reasonably adequate estimate of the total value of the resource or service (Randall, 1987; Lock, 1992).

2.2 NON-MARKET VALUATION TECHNIQUES

Valuation of a non-market good implies the identification of either the Hicksian measure of compensating variation or equivalent variation. There are a wide range of methods available for this purpose, three of the most commonly used methods are known as the hedonic pricing, travel cost, and contingent valuation. Other related methods include opportunity cost approach, replacement cost approach, and so forth as

mentioned in Section 2.1.7.

2.2.1 The Hedonic Pricing

As one of the commonly used techniques for the valuation of environmental goods, the hedonic pricing method was initially developed by Ridker (1967) (Lesser et al., 1997). The hedonic pricing method is based on the revealed preference approach (also known as the surrogate market approach) that utilizes the market information on the preferences people have revealed.

In terms of the use of data, the hedonic pricing method can be sub-classified into two approaches known as the Property Value and Wage Differential approach. The former is most popular, and relies on property values for the estimation of the value of related environmental quality, while the latter relies on factors such as age, education, skills, location, and environmental risks in order to eventually determine the additional salary compensation required for workers' exposure to environment risk (i.e. the value of health risks from pollution) (Winpenny, 1993). The approach using wage differentials is based on the premise that in the case of a perfectly competitive equilibrium, labor demand equals the value of the workers' marginal product, while labor supply depends on both wages and working/living conditions (Dixon et al., 1988).

The hedonic pricing method operates under the premise that goods are composed of bundles of characteristics, and their demand function is based on these attributes (Fisher, 1987). An example of this is reflected in the fact that since different neighborhood areas consist of varied environmental and other attributes, property values vary accordingly (Pearce and Turner, 1990).

There are two major steps in the Property Value approach. Firstly, to identify the portion of the observed differences in property values that results from environmental quality through multiple regression analysis. Secondly, to measure people's willingness to pay for environmental enhancement (Freeman, 1979; Pearce and Markandya, 1989). Furthermore, Pearce and Turner (1990) state that all relevant attributes have to be included in the analysis process in order to determine the impact of any of these variables on a property's value. These include a wide range of "property" variables, "neighborhood" variables, "accessibility" variables, and "environmental"

variables. Omission of one of these attributes in the analysis process may result in bias (Pearce and Turner, 1990).

The applicability of the hedonic pricing method is somehow restricted. This is indicated by the fact that it is best applied in measuring the costs of noise and air pollution on the residential environment but it performs badly in other kinds of pollution that are either unknown to the persons affected or difficult to quantify (Pearce and Markandya, 1989; cited in Winpenny, 1993).

In addition, some major difficulties involved in the application of the hedonic pricing method are: (1) an intensive demand for data, sophisticated statistical modeling for the analysis, and the specified relationships between hedonic prices and demand functions (Winpenny, 1993); (2) the environmental attributes should be quantifiable such as air, noise, and water quality. Certain elements of purity, for example, can hardly be detected. These include taste, smell, visibility, and so forth (Winpenny, 1993); (3) strict reliance on a number of key assumptions such as an equilibrium housing market, perfect information to house buyers (the case of Property Value) (Fisher, 1987); the existence of a perfect labor market, perfect information to workers on environmental risks, and so forth (the case of Wage Differential approach) (Winpenny, 1993); (4) inapplicability to the estimation of non-use values (OECD, 1992). Finally, the application of the hedonic pricing method encounters certain level of uncertainty with regard to the identification of appropriate variables, which is by no means straightforward.

2.2.2 Travel Cost

It seems that the travel cost method was initially suggested by Hotelling (1931), and later on formulated by Clawson (1959) and Clawson and Knetsch (1966) (Perman et al., 1996). The travel cost method is similar to the hedonic pricing method in the sense that it is based on the revealed preference approach, and is not applicable in the estimation of non-use values. The travel cost method is frequently used to measure the value of recreation sites that have either a token or a zero admission fee.

Three observations constitute the basis of the travel cost method: (1) the admission fee is less than the actual cost of using a recreation site, which may consist of travelling

cost, opportunity cost in the form of travelling time, and other associated expenses; (2) depending on the distance from home to a recreation site, visitors face different costs; (3) assuming the value that visitors place on a recreation site does not change systematically with distance, travel cost can be treated as a price proxy in the estimation of a demand curve for the recreation site (Lesser et al, 1997).

There are a few major steps involved in the travel cost method: (1) the surrounding area of the recreation site is classified into concentric circles, where the "contours" connect points of the same travel distance (Winpenny, 1993); (2) using participant surveys and other relevant means, information regarding sampled visitors' zones of origin is collected. Visitation rates are estimated for each zone, making use of information such as the number of visitors from each zone, the population size of each respective zone, and so forth; (3) a demand curve for site visits, which estimates visitors' consumer surplus, is calculated by regression analysis for each zone relating visitation rates to travel cost and relevant socio-economic factors such as income, education, and so forth (Winpenny, 1993); travel cost, by definition, consists of monetary and time costs of travelling.

The limitation of the travel cost method lies in the fact that it can only estimate that subset of values that people are willing to pay (Perman et al, 1996). Other factors that may complicate the application of the travel cost method include multiple purpose visits, visits of varying duration, and so forth since these are related to the calculation of travel cost. The results obtained by the travel cost method are site specific (Pearce, 1993).

2.2.3 Contingent Valuation

The contingent valuation method is composed of two forms, one of which adopts an experimental approach and the other is survey-based. The first form of the contingent valuation method focuses on simulations or game analysis while the latter relies on data obtained from questionnaire or survey methods (Perman et al., 1996).

The contingent valuation method utilizes either one of two Hicksian measures of consumer surplus, namely, compensating variation (CV) or equivalent variation (EV), which were presented in Sections 2.1.8.1 and 2.1.8.2 respectively. Differing from the

hedonic pricing or travel cost methods, the contingency valuation method is based on the stated preference approach, which aims at obtaining information regarding the values that individuals would place on some environmental changes by directly questioning a selected sample (Winpenny, 1993). Furthermore, the contingent valuation method is one of the most flexible technique in the sense that it does not require to rely on market transactions, and it can be applied in the estimation of both use and non-use values.

The major principle of the contingent valuation method is to identify individuals' preferences, and to discover either individuals' willingness to pay or willingness to accept compensation for changes in the environment (Lesser et al., 1997). This method is based on two key assumptions that individuals are the best judges of their best interest, and are rational in ranking their preferences.

There are three basic steps involved in the application of the contingent valuation method (Lesser et al., 1997): (1) a clear description of the environmental good under study; (2) development of a method or "payment vehicle" by which individuals' payments (either hypothetical or real) can be made; an example of this is that a study of the value of a national park might require a "user fee" or a "tax increase" as the "payment vehicle". Moreover, the choice of the "payment vehicle" should be based on two criteria of realism and neutrality in order to ensure more reliable responses (Mitchell and Carson, 1981). "Trust fund", for example, seems to be rather neutral to be used as a "payment vehicle"; and (3) development of an approach to convert individual payments into overall willingness to pay or willingness to accept values.

There are different approaches available for the application of the contingent valuation method. These consist of bidding games, payment-card formats, take-it-or-leave-it experiments, trade-off games, open-ended questions, closed-ended or dichotomous-choice questions, contingent-ranking techniques, and the Delphi technique. Also there are several sources of bias in applying the contingent valuation techniques. As discussed previously (Section 2.1.7), the case study area doesn't lend itself to the application of the contingent valuation technique. For that reason the technique will not be used here and the various implementation approaches and biases will not be discussed.

2.2.4 The Opportunity Cost Approach, the Direct Substitute Approach, and the Replacement Cost Approach

These are commonly used techniques in economic analysis. Opportunity cost approaches are based on the economic theory that resources are scarce, and the use of a resource imposes a cost on society in the form of an alternative forgone value (Perman et al., 1996). This is in line with an example stated by Pearce and Turner (1990) that the opportunity cost of non-marketed wetland functions can be measured from the foregone benefits of potential development uses.

The direct substitute approach is a technique to determine the value of a non-marketed good by utilizing the value of its closest substitute, which has a market price (Bann, 1997). In other words, fuel obtained from the forest can be valued based on the price of its substitute - charcoal.

The replacement cost approach is a widely used technique that relies on the cost of replacing or repairing a damaged good to its initial state for the estimation of the value of restoration (Pearce, 1994). Information related to the replacement costs can normally be obtained from observation of actual spending in reparation or from relevant professional estimates. However, the technique is applicable only if it can be justified that the restoration is unavoidable due to certain legal obligations or standards.

2.2.5 The Applicability of Non-market Valuation Techniques in the Case Study Area

Even though non-market valuation techniques were discussed above, most of them are, unfortunately, not applicable in this study due to serious data constraints in Yeak Loam commune of Ratanakiri. This research relies on market values and direct substitute approach.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 IDENTIFICATION OF THE CASE STUDY AREA

3.1.1 Ratanakiri Province

There are various reasons for the selection of Yeak Loam commune of Ratanakiri province as the case study area. Firstly, Ratanakiri is a most significant forested province, which came third in terms of the country's total forested areas (1,148,600 hectares, 91% of the province or 10.18% of the country's total forest area) after provinces of Preah Vihear (1,259,100 hectares, 93% of the province or 11.16% of the total forest area), and Koh Kong (1,190,000, 92% of the province or 10.55% of the total forest area) as reflected in Table 3.1.

Table 3.1 1993 Forest Area by Province/City

Provinces/Cities	Total Area (Ha.)	Forest Area (Ha.)	Percentage (Out of Tot. Area)	Total Forest Cover Percentage (Out of Cambodia's tot. Forest Area)
Preah Vihear	1,358,600	1,259,100	93%	11.16%
Koh Kong	1,296,300	1,190,000	92%	10.55%
Ratanakiri	1,256,100	1,148,600	91%	10.18%
Mondulkiri	1,370,200	1,122,200	82%	9.94%
Siem Reap	1,572,600	971,400	62%	8.61%
Stung Treng	1,117,500	952,500	85%	8.44%
Kratie	1,206,100	951,100	79%	8.43%
Pursat	1,145,700	781,500	68%	6.93%
Kompong Thom	1,307,600	743,500	57%	6.59%
Battambang	1,250,100	619,800	50%	5.49%
Kompong Speu	675,600	366,700	54%	3.25%
Kampot	501,900	274,800	55%	2.44%
Kompong Cham	935,800	274,300	29%	2.43%
Kompong Chhnang	527,800	218,000	41%	1.93%
Banteay Meanchey	748,100	183,600	25%	1.63%
Kompong Som	142,600	110,800	78%	0.98%
Kandal	366,300	73,400	20%	0.65%
Takeo	343,000	24,200	7%	0.21%
Prey Veng	484,700	12,000	2%	0.11%
Svay Rieng	285,000	4,700	2%	0.04%
Phnom Penh	40,200	2,000	5%	0.02%
(Tonle Sap Lake)	221,700			
Total	18,153,500	11,284,200	62%	100%

Source: Food and Agriculture Organization, Cambodia: Land Cover Atlas, Mekong Secretariat, Bangkok 1994b (cited in Forest Policy Assessment,1996; p. 49).

Secondly, Ratanakiri was the province where access to its forest area was feasible in view of the security and land mine situation[1] while this was not the case for provinces such as Preah Vihear and Koh Kong. Access and security were important as the field research was conducted in Cambodia from May to July 1998 prior to the national election - the peak of political tension.

Thirdly, as a long-term home of the indigenous highlanders, who constitute over 75% of the province' population, Ratanakiri is one of the few provinces, where the interaction between human beings and the nature, especially forest resources remains very strong. This is reflected in the fact that indigenous highlanders have been relying on forests for non-timber forest products as well as shifting cultivation for centuries. However, what is most worrying is the rate of deforestation in the province, which results from secret deals among powerful local and foreign business groups, senior government officials at the national and provincial levels, and the military. Such unsustainable forest exploitation is threatening the basic livelihood of the local indigenous villagers, who hardly have any other alternative solutions, and are, ironically, being blamed for forest depletion due to their traditional practice of shifting cultivation.

Fourthly, since most easily accessible low-land provinces such as Kompong Cham, Kandal, Prey Veng, Svay Rieng, and so forth barely have any forests left as indicated in Table 3.1 (2.43%, 0.65%, 0.11%, and 0.04% respectively of the country's total forest area), there is an increasing tendency for migrants, loggers, and concession companies to target northeast highland provinces such as Ratanakiri, Mondulkiri, and Stung Treng due to the comparatively significant levels of forests and good security situations (10.18%, 9.94%, and 8.44% respectively of the total forest cover). Other provinces close to Thailand such as Preah Vihear (11.16%), Siem Reap (8.61%), and Battambang (5.49%) are facing a high level of insecurity in the forest areas and land mines. This imposes further pressure on the region's few remaining forest resources, especially those of Ratanakiri.

[1] Seven to ten million land mines are believed to remain in 40% of Cambodia's arable land, and may require many decades before they are removed (First State of the Environment Report, 1994).

Lastly, as a potential province for the promotion of eco-tourism following the establishment of the new Royal Government and the end of the civil conflicts, the choice of Ratanakiri as a case study area will contribute to the existing pool of knowledge on local indigenous cultures as well as the needs, problems and concerns of the local indigenous communities. Such an understanding is essential for the Royal Government to factor into their overall forest policy formulation in order to promote sustainable management of the country's forest resources along with the preservation of the indigenous cultures, which have been somehow neglected partly due to both geographic isolation and the prolonged civil turmoil over the past decades.

3.1.2 Yeak Loam Commune

With regard to the research site within Ratanakiri, Yeak Loam commune (in Ban Lung district) was selected for the following reasons. First of all, given the constraints of time and financial resources, it was not feasible to conduct the fieldwork in the whole Ratanakiri province, and a case study area needed to be selected.

Secondly, Yeak Loam commune consists of five villages of Soel, Lapoe, Lorn, Chree, and Phnom, which rely heavily on the same forests. This is important in that it will help to ensure that the samples, properly selected from these five villages, will be representative of the whole commune since there is not very much difference among these villages. Moreover, the relatively easy accessibility to the Ban Lung market of Ratanakiri makes the sustainability of Yeak Loam commune's non-timber forest products a matter of great concern, compared to that of most other areas in the province. The rapid depletion of the forests along with the natural resources are threatening the basic livelihood of the villagers, who barely have any other alternative options.

Thirdly, the size and location of Yeak Loam commune are neither too large nor too inaccessible to be physically infeasible for face-to-face interviews in view of the following major difficulties in Ratanakiri in terms of: (1) absence of an operational mailing system from the provincial town to the villages, which are located close to the forested areas; (2) gaining access to the villages is difficult due to the absence of the public transportation means; (3) gaining access to villagers' "shifting cultivated rice-fields" or "chomkar" relies on hours and hours of walking and mountain climbing since

most villagers stay at their shifting cultivated rice-fields over six months a year[2], and the villagers' shifting cultivated rice-fields are normally located around one kilometer apart from each other within the forests; (4) the majority of the villagers are of Tampuen minority group, and are illiterate; (5) meeting with or interviewing villagers takes an enormous amount of time and patience, imposing additional constraints on the time limit.

Finally, the up-coming election made it necessary for the actual fieldwork in Ratanakiri, which started in the third week of May to be completed before the first week of July 1998 due to increasing political tension during the pre-election campaign period.

In view of the above-stated factors, Yeak Loam commune was identified to be a most suitable research site, taking into account the critical status of the commune's non-timber forest products, and the limited, available time and financial resources.

3.2 RESEARCH APPROACH

A variety of methods are available for research activities of a social dimension. These mainly include structured observation, participant observation, interview and questionnaire methods (Wilson, 1996). Wilson (1996) defines structured observation as a method that involves the systematic observation of behaviour without direct questioning of the subjects observed. Differing from structured observation, participant observation may require questioning of the subjects observed (Wilson, 1996). The questions used in participant observation may emerge naturally during observation instead of being part of a more explicit researcher's role though there are times when more formal interview techniques are also applied (Wilson, 1996).

Wilson (1996) classifies interview and questionnaire methods into four categories of face-to-face interviews employing an interview schedule, the telephone interview, postal questionnaires, and face-to-face interviews in a free format.

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[2] Most villagers had been staying in their "shifting cultivated rice-fields" since April or earlier, and would continue staying there until around October 1998. They only returned to the villages once in a while. The villages were most of the time left vacant during the research period in Ratanakiri.

Face-to-face interviews employing an interview schedule or structured face-to-face interviews can be defined as an interview process that applies exactly the same questions in the same order for each of the respondents. In other words, there is little room for the interviewer to modify either the wording of questions or the order of asking (Wilson, 1996).

The telephone interview is similar to the structured face-to-face interview except that it is carried out over the phone.

Postal questionnaires or mail survey is conducted by sending a questionnaire to each respondent for answering by either ticking the relevant "answer boxes", completing the "blanks", or ringing the researcher if he/she prefers. Except the case of answering by phone, the completed questionnaire can be returned to the researcher, using a prepaid envelope provided.

Face-to-face interviews in a free format or semi-structured face-to-face interviews can be defined as a process of interviewing that is conducted in a similar way like that of natural conversations between two people (Wilson, 1996). Such an interview process is not based on a questionnaire but on a list of topics regardless of the fact that the wording of particular questions is not standardized (Wilson, 1996).

3.2.1 Selection of Research Instruments - Justifications

For the purpose of this study, both the structured and semi-structured face-to-face interview methods are applied with some slight modification. These were initially developed along with the concept of the research project, which was initiated in close consultation with the researcher's master degree's supervisors at Massey University.

The major research instruments are an interview schedule or survey questionnaire accompanied by an information sheet (Appendix 3.1), checklists of major topics to be covered in semi-structured interviews at village and national level meetings (Appendices 3.2 & 3.3), and a general checklist of activities to be covered during the three-month fieldwork in Cambodia (Appendix 3.4). The main justifications are six-fold.

Firstly, since a key objective of the research is to quantify the value of non-timber forest products at Yeak Loam commune, both methods of structured observation and participant observation do not seem to be relevant since the major focus of the study lies in quantitative analysis.

Secondly, in view of the rather unique situation of Yeak Loam commune of Ratanakiri, neither telephone interview nor a mail survey is applicable due to six major obstacles, most of which were mentioned in Section 3.1.2. These are: (1) absence of a functional postal system at the commune and village levels; (2) no telephone facilities at the commune and village levels since they are only available to very few provincial level government departments and business corporations; (3) limited means of public transportation are available to and from the village areas, and villagers are mostly away at their shifting cultivated rice-fields in the forests; (4) villagers' shifting cultivated rice-fields are accessible only by travelling on foot for hours; (5) most of the Yeak Loam commune residents are illiterate; and (6) as a result of the prolonged civil conflicts and political intimidation, Cambodians tend to feel more comfortable to express their viewpoints or to release information under a verbal rather than a written form since they are generally scared to be held responsible for their words.

Thirdly, structured face-to-face interviews may secure a higher response rate along with a higher quality of the research results, compared with that of mail surveys. This is because the researcher is provided with the chance to ensure that the questionnaire is properly understood by the respondents prior to responding. This is in line with a statement by Emory and Cooper (1991) that the greatest advantage of such an interview is reflected in the depth and details of information that can be secured compared to that of a mail survey. In addition, the interviewer has the possibility of probing with additional questions, if required, as well as gathering supplementary information through observation. The disadvantages lie in the costs and time involved as well as a possible misleading of the interviewees should the interviewer lose his/her neutrality in the interview process.

Fourthly, another strength of structured face-to-face interviews lies in the fact that incomplete or unclear answers can be clarified on the spot by the researcher. The respondents' confidence level will normally be enhanced through the interaction with

the researcher, which will, hopefully, improve their willingness to cooperate as well as honesty in response. Furthermore, the beauty of a structured face-to-face interview over a mail survey is that it can ascertain that it is the randomly selected respondent, who has given the informed consent, who actually provides the information and not anybody else.

Fifthly, a structured face-to-face interview has the advantage, over a telephone interview and a mail survey, that it has the flexibility of providing visual aids to help respondents understand some complicated or open-ended questions. It is most important for the case of Yeak Loam commune of Ratanakiri province, in which most indigenous people have difficulty in abstract thinking due to the absence of basic education and the high illiteracy rate.

Finally, at the commune and village levels, semi-structured face-to-face interviews are essential to collect research-related information of a more general nature. The additional information can be used to counter check or verify survey answers. Moreover, at the national level, semi-structured face-to-face interviews are instrumental for the collection of information on current forest management and policy issues. These interviews were conducted, in the form of meetings and consultations, with relevant senior government and international donor agency officials.

3.3 MEETINGS WITH RELEVANT STAKEHOLDERS AT THE NATIONAL LEVEL

A checklist for semi-structured interviews was prepared prior to the start of national-level meetings with the key government ministries, departments, and international donor organizations that include the United Nations agencies, projects, and non-governmental organizations. The meetings took place over two separate periods, 4-18 May and 1-19 July 1998 in Phnom Penh - capital city of the Kingdom of Cambodia. The names of the major institutions and organizations consulted are also included in the checklist (Appendix 3.3). The checklist for the meetings covers the following major topics:

- Who is responsible for what in forest management?

- What are the roles and responsibilities of key stakeholders such as the Department of Forestry, the Ministry of Agriculture, Forestry and Fisheries, the Ministry of Environment, and the Land Titles Department?
- Are there any coordination issues among these key government ministries/departments? If yes, why?
- What are the major constraints in forest management, especially in terms of illegal logging activities?
- What policies, strategies, and concrete actions have been adopted by the government and the donor community to deal with the forestry problems? And why?
- What progress has been achieved so far?
- Has the concept of community forestry been developed or adopted in Cambodia?
- If not, what are the major obstacles?
- Any additional comments on the status of Cambodia's forest management?

These meetings are important to obtain an overall understanding of Cambodia's on-going forest management issues at the policy level, major problems, concerns, and alternative solutions, if any. Moreover, discussions with both the government and the donor community can help ensure a more balanced and neutral information collection process.

3.4 VILLAGE-LEVEL INTERVIEW/SURVEY DESIGN AND IMPLEMENTATION

3.4.1 Questionnaire Design

The village-level questionnaire was designed on the basis of the major principles of good question writing suggested by Neuman (1994):

- To refrain from using abbreviations, jargon, and slang;
- To avoid confusion, ambiguity, and vagueness;
- To avoid emotional wording and prestige bias by using neutral language;
- To avoid double-barreled questions or the combination of two questions or more in one;

- To refrain from using questions that may lead the respondents to select one response over another by its wording;
- To refrain from raising questions that are beyond the capabilities of respondents;
- To avoid the use of false premises by raising and demanding choices regarding a question that may consist of a premise that respondents may disagree;
- To refrain from raising questions related to future intentions;
- To avoid the use of double negatives;
- To refrain from using unbalanced or overlapping response categories.

Dillman (1978)'s "Total Design Method" was also taken into consideration during the preparation of the questionnaire. Dillman (1978) indicates that the construction of mail questionnaires should be based on the following key ordering principles:

- Questions should be arranged along a descending order of importance or usefulness;
- Questions that are similar in content should be grouped together;
- For those questions within content areas, grouping needs to be done by type of question;
- Questions need to be grouped in such an order as to take advantage of their cognitive ties in order to construct a sense of flow and continuity;
- Questions should be arranged in an ascending order of their sensitive natures.

Dillman (1978) further indicates that the opening question of a questionnaire should demonstrate a sense of neutrality, and should be both interesting and generally applicable to all respondents. Other important elements include an appealing design, clarity in the directions for answering, and pretesting (Dillman, 1978; Lock 1992).

An information sheet and a questionnaire were prepared, and submitted to Massey University's Human Ethics Committee for review on 8 April 1998 prior to the researcher's departure for fieldwork in Cambodia in early May 1998.

The original questionnaire consists of thirty-two questions, focussing on the non-timber forest products and their values at the commune level, as well as basic household information. The study is conducted on the basis of the whole household. The main

objective of the two-page information sheet is to provide an overview of the nature of the research and its purposes. Another key purpose is to inform the potential respondents of their rights, which are summarized as follows:

- To decline to participate;
- To refuse to answer any particular questions;
- To withdraw from the study at any time;
- To ask any questions about the study at any time during participation;
- To provide information on the understanding that their names will not be used in published results;
- To be given access to a summary of the findings of the study when it is concluded.

The original information sheet and questionnaire were later revised in Ratanakiri province of Cambodia, incorporating relevant comments from the Human Ethics Committee. The questionnaire was slightly rephrased and expanded to include six questions related to villagers' socio-economic status, making a total of thirty-eight (Appendix 3.1). Both the information sheet and the survey questionnaire were also translated into simple Cambodian official language (Khmer) for distribution. Detailed discussion on the development of each question is presented in Section 3.4.2.

Most of the thirty-eight questions are either opened-ended or partially open-ended while a few are close-ended. Open-ended questions refer to questions that allow unstructured and free-response while partially open-ended questions imply questions that offer a set of fixed selections with a final open option of "other" (Neuman, 1994). Differing from open-ended questions, closed-ended ones offer a set of fixed choices.

The major advantage of open-ended questions lies in the fact that they allow an unlimited number of possible responses, which can be detailed and clarified, if required (Neuman, 1994). Moreover, open-ended questions may avoid unexpected omission of important information since they do not force respondents/interviewees to limit their responses within a few categories designed by the researcher (Neuman, 1994). Other advantages include sufficient answers to complex subjects, creativity and self-expression, and demonstration of respondents' thinking process and logic (Neuman, 1994). Somehow similar to open-ended questions, the advantage of partially open-

ended questions lies in creating the possibility for respondents to provide a response omitted by the researcher, while such a case does not exist for close-ended questions.

There is, therefore, reason to believe that a combination of questions with open-ended, partially open-ended, and close-ended features may be appropriate for the purpose of this research. Furthermore, mixing both open-ended and close-ended questions in a questionnaire can help formulate rapport by a change of pace (Neuman, 1994). In addition, a complete dependence on closed questions may lead to distorted outputs (Neuman, 1994), which is also supported by a comment on close-ended questions made by Schuman and Presser (1979) (cited in Neuman, 1994, p. 234):

> *Almost all respondents work within the substantive framework of the priorities provided by the investigators*....(p. 234).

3.4.2 Major Rationale for the Development of the Questions

The thirty-eight questions of the questionnaire can be generally classified into three categories of forest awareness and use, a history of involvement in forest use and concerns, and household information. These are represented by Part I (Questions 1 to 19), Part II (Questions 20 to 27), and Part III (Questions 28 to 38) respectively (Appendix 3.1). As indicated by the title itself, Part I *"Awareness and Use of the Forest in this Village"* of the questionnaire is designed to respond to a major thesis objective of identifying the value of non-timber forest products at Yeak Loam commune. This is achieved by starting with information on the awareness of "the forest"[3] to a wide range of other related issues. These include the frequency of travelling to the forest, the time spent for each relevant activity, the types of forest services obtained, their values in the monetary terms, and comparison of the change of these services over time.

Part II *"A Brief History of Your Involvement in the Use of the Forest and Major Concerns"* is aimed at establishing the association level of the interviewed households with the forest as well as identifying their major problems and concerns in forest use

[3] "The forest" refers to Yeak Loam commune forests, which are being heavily relied upon by the five villages of Chree, Lapoe, Soel, Lorn, and Phnum. Such a definition was specified and emphasized during the interview.

along with the causes, if any. This is to complement the information obtained from Part I.

Part III *"Information Concerning Your Household"* focuses on the collection of information related to sexes, age groups, occupations, additional annual incomes (excluding those from non-timber forest products), social-economic status, satisfaction levels of the current forest management, and feedback on the interviews. The main purpose of this part is to provide an overall understanding of the sampled households as well as their evaluation of the interview process to somehow assess the quality and reliability of the research results.

The major purposes and justifications of each question are summarized in Table 3.2:

Table 3.2 Development of the Questionnaire

Part I:	**Awareness and Use of the Forest in this Village**
Questions:	*Major Purposes and Justifications*
1.	To countercheck if the interviewed household has any genuine knowledge or connection with the forest prior to the interview, or if the household's knowledge of the forest simply results from the research itself.
2.	To reflect the level of the household's reliance on the forest by the frequency of travelling to the forest for major activities such as hunting, fishing, and so forth.
3.	To rank the types of activities that the household relies on the forest in terms of actual time spent per month. This is to get an idea of what major activities actually occupy most of the household's time.
4.	To identify the three most significant services that the household obtains from the forest.
5.	To see if any other alternatives may exist for the household except the forest. This is to ascertain the extent of importance of sustainable forest management to the local community, especially if it has few alternative choices.

6. To identify what products the household actually obtains from the forest (including the corresponding quantities).

7. To identify the unit value of each forest product that the household may obtain from selling or trading, which is used in the calculation of the weighted average unit price per item, and thus the total value of services/items that each averaged-sized household benefits from the forest. Such information is essential for policy-makers to take into consideration in promoting community-based forest management through relevant incentive schemes.

8. To identify how the forest products are used. This is important to understand in what patterns the products contribute to the household's daily life.

9. To identify the unit value of each product that the household obtains from trading, if it is the major practice. This is important if the selling price is not available.

10-11. To see where selling or trading activities mostly take place. This is to get an overview of what sort of market mechanism is in place for the local community. Furthermore, if the market price approach is used, this may help identify the most reasonable unit prices for the forest products since it is not appropriate to choose the prices from a market that the villagers can hardly gain access to due to long distance. Should there be more than one markets involved for the same items, the market that most villagers rely on for trading or selling of their forest products would be considered most seriously.

12-16. To see how the household gets to the selling/trading places, and if there are costs involved in terms of transportation and time (there is an opportunity cost of time in the form of income foregone if the household is fully employed). This is used to determine the value of each forest product to the local community. Moreover, not all villages may have easy access to the market place. The farther is the village located from the market could mean the less value of the forest products to that specific village due to higher transportation and associated costs. In addition, not all villagers within the same village may have the same access to the market place due to various reasons such as absence of the means of transportation or different travelling distances.

17-19. To see if there has been/will be any change in the household's level of dependence on the forest in the past and future. If the household's demand for forest products as well as hunting, fishing, wild fruit and other collection efforts do not change remarkably over time, an increasing or decreasing level of dependence could be an indicator of the

change of the forest resources, provided that the community's population level as a whole does not change significantly.

Part II: A Brief History of Your Involvement in the Use of the Forest and Major Concerns

20. To see how long the household has been relying on the forest (based on the oldest living family member's experience). This aims at determining if the sampled households actually rely on the forest most of the time or else. It will also indicate whether the majority of the households are genuine users of the forest or simply temporary residents of the forested areas, who may not be so keen in the long-term management of the forest other than its quick exploitation.

21-22. To determine if the sampled households may have significant and reliable knowledge of the Yeak Loam commune forest situation.

23-25. To see if the household is prevented from gaining access to the forest resources for whatever reasons, and since when. This aims at clarifying what has actually happened to villagers following the government's claiming of property rights over the forest as well as all natural resources especially, after 1979 (post-Khmer Rouge period). Should this be the case in practice, there would unlikely be any motivation for the villagers to sustain the forest unless a reasonable solution be identified to promote community-based forest management.

26-27. To identify what concern that the household may have with regard to future use of the forest.

Part III: Information Concerning Your Household

28. To somehow indicate if people of different sexes, age groups, and occupations have been randomly selected for the interview/survey to better represent the whole village population to avoid any bias that may arise due to interviewing of a single group of people.

29. This information is required to calculate the average total annual income per household, and to measure how significant the annual income contribution is from the non-timber forest products or the level of dependence on non-timber forest products.

30-33. To get an overall understanding of the social-economic situation of the sampled households.

34-35.	To obtain the household's assessment of the current forest status.
36-38.	To seek feedback from the interviewed household on the interview process for future improvement.

3.4.3 Sampling and Sampling Frame

Sampling can be defined to be a set of elements chosen in one way or another from a population[4] with the goal of saving time, energy, and financial resources. If properly selected, sampling may lead to accurate generalization of results to all cases from the initial study of the smaller set of cases (Neuman, 1994). This coincides with the main idea of the research to generalize the results to Yeak Loam commune by studying the randomly selected samples from the five villages of Chree, Lapoe, Soel, Lorn, and Phnom.

Neuman (1994) defines a sampling frame as a particular list that closely approximates all the elements in a population. This is in line with the following definition quoted from Schofield (1996, p. 27):

> *...the sampling frame provides access to the individual elements of the population under study, either via sampling units, or directly when these and the population elements are identical (for example, where we are sampling people from a finite population and we have a complete list of the names of the population)* (p. 27).

In view of the rather specific situation of the Yeak Loam commune of Ratanakiri province, where there were neither telephone directories nor tax records, the researcher managed to obtain a list of the names of all household heads of the total population of three hundred and forty-six households[5] in Yeak Loam commune from the local authorities. The list was classified by village and was counterchecked with the respective village civic leaders to ensure its completeness and reliability. It was used as the sampling frame because the research was based on households, and the list met the

[4] Statistically, a population is defined to be composed of elements, which could be events, people, or anything of research interest (Schofield, 1996).

[5] A household is defined to be a group of close family members living together under the same roof, sharing the same food, and contributing to the household's income in case of an adult, under a head.

above-indicated criteria by Schofield (1996). The distribution of households by village in Yeak Loam commune is reflected in Table 3.3 of Section 3.4.4.

3.4.4 Sample Size

Neuman (1994) indicates that the question with regard to sample size depends on three major factors, namely, the number of different variables examined simultaneously in data analysis, the level of accuracy required, and the level of variability in the population targeted. Neuman (1994) points out that a large sample size alone does not necessarily imply that it is representative because it is also the quality of sampling process and sampling frame that matter. In addition, an underlying principle governing sample sizes is that the smaller the population, the larger the sampling ratio is required to ensure accuracy (Neuman, 1994). The contrary is also true in the sense that a larger population may allow a smaller sampling ratio to guarantee a similarly reliable sample (Neuman, 1994).

For the purpose of this study, it was initially decided to randomly select seventy-eight samples out of the total three hundred and forty-six households as indicated in the following Table 3.3:

Table 3.3 Planned Household Sample Selection by Village in Yeak Loam Commune

Village	Total Population (Household)	Planned Samples (Household)	Sampling Ratio
Chree	55	13	23.6%
Lapoe	103	22	21.4%
Soel	65	14	21.5%
Lorn	84	18	21.4%
Phnom	39	11	28.2%
Total:	**346**	**78**	**22.5%**
(Yeak Loam Commune)			

The above decision was made based on the following considerations: (1) the financial and time constraints; (2) the relatively homogeneous nature of the Yeak Loam commune villagers, who are mostly low-income highland farmers; and (3) the desire

that at least 20% of each of the five villages[6] should be covered.

3.4.5 Sampling Procedure

The sampling procedure applied in this research is based on the principle of probability sampling, which depends on random processes, and consists of three major types known as: (1) simple random sampling; (2) stratified random sampling; and (3) cluster sampling (Sincich, 1996). Systematic sampling – a variant of simple random sampling is also a type of probability sampling. Neuman (1994) defines "random" as a process that leads to a mathematically random result. Furthermore, a selection or sampling process is considered random if each element of the population stands an equal probability or chance of being chosen. The major benefit of random sampling lies in the fact that it most likely results in a sample that is representative of the population (Neuman, 1994). Moreover, it allows the calculation of the size of the sampling error, which means the deviation between sample results and a population parameter, resulting from random processes (Neuman, 1994).

From the above-indicated types of probability sampling, simple random sampling was selected for the purpose of this research due to its simplicity and reliability in application. A manual process based on the principle of a fair lottery was used in the actual selection due to the unavailability of the relevant computer software at the research site.

There were four major steps involved in the application of the technique. Firstly, a complete list of the heads of the households of Yeak Loam commune was obtained (classified by village) as mentioned in Section 3.4.3.

Secondly, each head of the households was assigned a code number on a small piece of paper (the code numbers range from 1 to 346). Households belonging to the same village were grouped together in a pile of carefully folded pieces of paper (there were five separate piles of paper in total). All pieces of paper were identical in size, shape, and color, and were folded in such a way that nobody could tell what code numbers

[6] Around 28.2% and 23.6% of the population were selected from Phnom and Chree illages respectivelyas samples due to these villages' relatively small population sizes, compared with those of others.

were inside without having actually unfolded those pieces of paper (the size of each folded piece of paper was around 2 square centimeters).

Thirdly, a pile of folded paper was put inside a big plastic jar, which was then covered by a lid. The researcher closed the eyes and shook the jar evenly for a few minutes prior to picking a piece of paper. The selected piece of paper was not replaced for a second round simply because it would not make sense to interview the same household twice. Moreover, Schofield (1996) points out that though, in theory, "simple random sampling" implies selection with replacement; however, in practice, samples in survey research are small compared with the number of elements potentially available for sampling, and the impact of non-replacement will be insignificant. Similarly, Neuman (1994) indicates that in a simple random sampling, elements selected into the sample can be ignored. The researcher repeated the above procedure until the relevant sample numbers of the first pile were achieved (for example, 14 pieces of paper/samples for Soel village, and so forth). The jar was then emptied of the leftover unselected paper, and the whole process repeated until all five piles of folded paper were used for sampling one by one (each pile consisted of the code numbers of the households of each specific village).

Finally, a list of interview samples was created based on the code numbers written on each of the seventy-eight pieces of paper randomly collected.

3.4.6 Pretesting

As an important small-scale trial prior to the start-up of either a mail-survey or a face-to-face interview, pretesting serves to test the adequacy level of both the research design and related instruments such as questionnaires or interview schedules. It is an essential step to improve the actual, full-scale implementation of research activities.

Wilson (1996) states that there are five major areas that constitute the main purposes of pretesting: (1) to ascertain if the questions, as they currently stand, are understandable by respondents; (2) to check if the respondents may need any hinting to come up with all the possible responses to any specific question; (3) to determine if the respondents may lose patience due to the length of the interview schedule or questionnaire; (4) to identify what the best order for the questions could be; (5) to find

out if the questions may discriminate effectively between various respondents.

Pretesting of the initial questionnaire was conducted around mid-April 1998 in Palmerston North prior to departure for field research in Ratanakiri. Nine pilot interviews were conducted. Since the questionnaire was designed for village-level survey in a forested area, where survival relies on forest products, it was not possible to locate potential interviewees who might fit the category. It was then decided to select people from various background and ethnicity with a major aim of testing if the objectives were clear, if the questions were reasonably understandable and could be answered had the interviewees got the information. Another criterion for the selection was people with experience in Asian countries since the questionnaire would be used in Cambodia.

Twelve potential pilot interviewees were contacted, and three refused to participate on the ground of not having knowledge in the area of study. This represented a response rate of 75 percent. The nine pilot interviewees came from four Asian countries of Cambodia, Vietnam, China, and Taiwan. Some information on the interviewees was indicated in Table 3.4:

Table 3.4 A Brief Summary of the Background of Nine Pilot Interviewees

Council Area	Sex	Country of Origin	Background	Occupation
Palmerston N.	Male	Cambodia	Agricultural Engineering	Student
Palmerston N.	Male	Cambodia	Agriculture	Student
Palmerston N.	Female	Cambodia	Farming	Factory Worker
Palmerston N.	Male	Cambodia	Farming/Soldier	Factory Worker
Palmerston N.	Female	Vietnam	Animal Science	Student
Palermston N.	Male	China	Construction	Unemployed
Wellington	Male	Taiwan	Business Administration	Entrepreneur
Wellington	Male	Taiwan	Insurance	Student
Wellington	Female	China	Forestry	Unemployed

The major problem encountered during the pilot interviews was that since the questionnaire was designed for villagers in forested areas, quite a few questions relating to non-timber forest products could not receive a response due the

interviewees' lack of background information in the area. However, it was beneficial to receive some feedback on wording, and especially, comments that it might be necessary to objectively facilitate villagers' thinking process in order to receive reliable responses to a few more complex questions such as Questions 3 and 6 (Appendix 3.1). Minor rephrasing of the wording was conducted following the pretesting.

In addition to the above pretesting, the original questionnaire was also sent to the United Nations Development Programme Country Office in Cambodia and its project office in Ratanakiri for comments. Finalization of the questionnaire was completed around the fourth week of May 1998 in Ratanakiri, taking into account the actual situation and various comments from Massey University's Human Ethics Committee, pretesting, and relevant United Nations personnel.

3.4.7 Interview Implementation

The researcher arrived in Ratanakiri by air on 19 May 1998 after spending two weeks meeting with relevant government ministries/departments and donor agencies as mentioned in Section 3.3.

The first twelve days of the research in Ratanakiri were spent in meetings with Cambodia Rehabilitation and Regeneration Project (CARERE)[7], the Non Timber Forest Products Project[8], and relevant government departments. Other activities included a literature search, identification of the case study area, sampling, modification of the survey/interview questionnaire, and preparation for the actual interview.

The fieldwork started with an informal meeting with some Yeak Loam commune officials and village elders on 2 June 1998 to distribute the Khmer information sheets and to brief them on the main objectives and approaches of the field research as well as the rights of the participants (Yeak Loam commune authorities issued a letter of support to the researcher as attached in Appendix 3.5). Seventy-eight randomly

[7]CARERE is a major donor project, partly funded by the United Nations Development Programme.
[8]Non Timber Forest Product Project is a project funded by NOVIB, OXFAM UK&I.

identified households were contacted (based on the interview list mentioned in Section 3.4.5). Their rights to participate or not to participate were communicated to them along with the explanation of the information sheet and the questionnaire. This was not always straightforward. Five households declined to participate in the interview process. Four of them claimed to be too busy for the interview while one was reluctant to talk. This seems understandable at a time of high political tension and uncertainty when political parties were fighting for a place at the National Assembly. As a result, seventy-three households were interviewed out of the total seventy-eight contacted, constituting a response rate of 93.6 percent. This is summarized in Table 3.5:

Table 3.5 Response Rate to Interviews, Sampling Ratio by Village in Yeak Loam Commune

Village	Total Population (Household)	Contacted Samples (Household)	Interviewed Samples (Household)	Response Rate	Actual Sampling Ratio (%)
Chree	55	13	12	92.3%	21.8%
Lapoe	103	22	21	95.5%	20.4%
Soel	65	14	13	92.9%	20.0%
Lorn	84	18	17	94.4%	20.2%
Phnom	39	11	10	90.9%	25.6%
Total:	**346**	**78**	**73**	**93.6%**	**21.1%**
(Yeak Loam Commune)					

A male interpreter from Khmer language to Tampuen dialect was hired on 1 June 1998 to facilitate the interview process. Most of the time, the researcher communicated directly with the interviewees in Khmer where this was feasible. Interpretation from Khmer to Tampuen or vice versa was only used on an occasional basis to minimize unnecessary information error or loss arising from interpretation. Another female interpreter was also hired later on in the research process to create more gender balance within the research team, and to prevent bias towards male interviewees only. This proved important because it was later observed that female interviewees seemed to be more relaxed and comfortable in the presence of the female interpreter.

Both the male and female interpreters are of Tampuen origin from the villages of Chree and Lapoe respectively. The two interpreters were also requested to sign a declaration to keep the confidentiality of whatever personal information that they might come across during the interview (Appendices 3.6a and 3.6b). This is to serve the interests and rights of the interviewees.

Verbal informed consent was obtained prior to the start of each interview. The first interview was in the afternoon of 3 June 1998. Each interview lasted longer than expected due to the amount of time required to ensure that the interviewee had fully understood the questions. Phum Chree was the first village that the interview took place, which was then followed by other villages such as Lorn, Lapoe, Phnom, and Soel. However, sometimes unexpected changes in the interview timetable had to be made due to outside factors such as the unavailability of the interview participants on a specific day that had previously been agreed upon. The interview process lasted three weeks, and was mostly conducted in the "shifting cultivated rice-fields" or "chomkar" instead of the villages since villagers were busy working at their "shifting cultivated rice-fields" at the time of the year. This remarkably slowed down the interview process[9] since it normally took half an hour or more to walk from one interviewee's "shifting cultivated rice-field" to another. The researcher also made use of the interview process to obtain additional information on villagers' culture, tradition, customs, and way of life, whenever appropriate.

It was observed that most villagers would only spend a couple of months in their villages, and would spend the remaining months to work in the "shifting cultivated rice-fields". During the working months, they normally stay at the "shifting cultivated rice-fields" for three or four days continuously before returning to the village homes for one day or so, and then return to the "shifting cultivated rice-fields" again. There were times when the interview process was conducted in the villages. Those were possible when villagers returned to the villages for some major events such as registration for the July National Election.

[9] On an average, around four households could be interviewed per day.

3.4.8 Interview Techniques

The overall approach adopted during the interviews was to promote the interviewees' participation and to facilitate their thinking process. This aimed at leading them through a thinking process to reach a most reliable conclusion for themselves and the researcher.

The approach focussed on the facilitation of the interviewees' thinking by breaking down the original questions into simpler ones whenever required. Once the preliminary answers were obtained, the researcher proceeded with further questions step by step until the final answer was satisfactorily acquired. An example is the breaking down of the question "How much fish do you catch per year? into "How much fish do you catch each time? How many times do you catch per month? And how many months do you catch per year? and so forth".

In doing so, the researcher always kept in mind the following major principles: (1) to promote cooperation and rapport without losing neutrality and objectivity; (2) to build interviewees' confidence, and reduce their suspicion in order to obtain more reliable information; (3) to monitor the pace and direction of the communication along with the interviewees' responses and behaviour; (4) to avoid revealing the researcher's viewpoints through words or actions at all times. This can be done by politely redirecting the interviewees and suggesting that such questions are irrelevant; (5) to refrain from being judgmental; (6) to encourage the interviewees to provide serious and truthful response; and (7) to keep a consistently warm but serious and objective tone at all times (Gordon, 1980; Sudman and Bradburn, 1983; cited in Neuman, 1994).

Whenever the information obtained was in doubt, efforts to clarify it were made until a more reliable conclusion was reached. Occasionally, the researcher asked for permission to do some physical testing of the responses such as actual measurement of the length of a piece of bamboo or checking the quantity of the fish caught for the day to see if it matched the answer given verbally. This is essential to confirm some of the results obtained since villagers seem to have difficulty in telling time, weight, and length. Quite often the researcher intentionally repeated the information provided in a wrong manner towards the end of an interview in order to check the extent of reliability of the information obtained. Surprisingly, the interviewees corrected the researcher.

This somehow indicates the reliability of the information obtained so far because had the interviewees been lying, they would not have been able to repeat the exact figures that they mentioned over an hour ago.

This approach as a whole proved effective though it took more time than previously planned to complete each interview. Most of the time, an interview lasted 1.5 to 2 hours as opposed to the originally planned 40 minutes. There were a few cases that lasted up to 3 hours (the researcher informed the interviewees of their rights to stop whenever they wished during the interview. However, none of them chose to do so). It was also made clear to the villagers prior to the interview that they should only provide information to the best of their knowledge, if they choose to do so. They were urged not to communicate to the researcher information that they were not certain or believed to be untrue.

Direct communication is an important factor that is believed to have a great impact on the whole interview process. The researcher managed to communicate directly with the interviewees in Khmer language most of the time, and the intervention of the interpreters was only used in case of real necessity. This was to prevent the interpreters from influencing the interviewees' viewpoints. It is believed that no matter how clear an instruction may have been given to an interpreter, it is often his/her cultural practice to help the fellow country persons, especially if the interpreter is of the same ethnic group like that of the interviewees. A great deal of valuable information may either be lost or distorted during the interpretation process. Moreover, interpretation may bore the interviewees, who may soon lose interest in the whole process. In order to perform well in the interview, a very crucial thing is that the researcher should always know the questionnaire well, and must possess a comprehensive picture of the study so that sound judgement and reaction towards whatever information obtained can be done instantly during the interview. The benefits are to avoid the scenario in which the interviewer has to re-visit the interviewees later on for clarification.

One last thing about the interview technique is that whenever the researcher felt that an interviewee started contradicting himself/herself, the researcher informed him/her of the concern, and asked for clarification prior to moving on with the interview. This is

important to prevent receiving unreliable information since no information will still be better than unreliable one.

3.4.9 Representativeness of the Sampled Households

Due to the unavailability of most of the corresponding commune data, comparison is mainly made between the demographic data obtained from the interviews and the 1997 provincial data (Source: Ratanakiri Statistical Office of the Department of Planning), and the 1996 national data (Demographic Survey of Cambodia, 1996). Wherever the 1996 national data are missing, the 1998 mid year estimated data are used instead (US Bureau of the Census; International Data Base, 1998). The interview samples are, in general, representative of the commune though there are differences as reflected in Table 3.6.

Table 3.6 A Brief Summary of Selected Household Demographic Statistics

Major Characteristics	Percentage (Survey)	Percentage (Commune	Provincial	National)
Sex				
Female	50%	52.95% (1)	50.82% (2)	52.17% (3)
Male	50%	47.05% (1)	49.18% (2)	47.83% (3)
Age Range (Year)				
0 – 4	12.81%		14.28% (2)	13.40% (3)
5 – 9	15.27%		13.61% (2)	15.40% (3)
10 – 14	11.58%		11.22% (2)	15.10% (3)
15 – 19	9.36%		7.88% (2)	10.40% (3)
20 – 24	7.64%		5.30% (2)	7.10% (3)
25 – 29	8.13%		8.99% (2)	7.80% (3)
30 – 34	5.91%		7.73% (2)	6.50% (3)
35 – 39	4.93%		6.60% (2)	5.90% (3)
40 – 44	5.42%		4.28% (2)	4.30% (3)
45 – 49	4.19%		4.03% (2)	3.80% (3)
50 – 54	4.68%		3.63% (2)	2.70% (3)
55 – 59	2.22%		3.08% (2)	2.30% (3)
60 – 64	2.71%		1.30% (2)	1.80% (3)
65 – 69	0.99%		1.65% (2)	1.50% (3)
70 – 74	1.72%		1.80% (2)	1.00% (3)
75 – 79	1.23%		1.67% (2)	0.56% (4)
80 and over	1.23%		2.86% (2)	0.31% (4)
Major Employment Categories				
Agriculture	94.63%		75.62% (2)	81.60% (3)
Non-agriculture	5.37%		24.38% (2)	18.40% (3)

(1) = 1995 Yeak Loam commune data (Sokhom et al, 1996).
(2) = 1997 Ratanakiri provincial data. Source: Ratanakiri Statistical Office of Department of Planning.
(3) = 1996 national data (Demographic Survey of Cambodia, 1996).
(4) = 1998 mid year estimated data (US Bureau of the Census; International Data Base, 1998).

Counting all the members of the seventy-three interviewed households shows that there are 203 males and 203 females in total, which means that the percentages of both male and female are 50% each. This is slightly different from the 1995 commune data (male 47.05%; female 52.95%), 1997 provincial data (male 49.18%; female 50.82%), and 1996 national data (male 47.83%; and female 52.17%). In other words, male percentage is somehow slightly over-estimated by the samples.

Out of the total seventy-three interviewed households, forty-six interviewed samples were composed of both male and female respondents, who were mostly husband and wife to each other, and chose to take part in the interview simultaneously (63.01%). Another nineteen samples were each represented by a male interviewee only (26.03%), and the remaining eight households nominated a female interviewee each (10.96%). This means that the male respondents exceeded the female respondents by 15.07%.

Table 3.6 indicates that there are cases in which the sample data are very close to the provincial data, and deviate slightly from the national data (age ranges 10-14, 25-29, and so forth). There are also occasions in which the sample data are closer to the national than the provincial data (for example, age ranges 0-4, 5-9). The interviewed samples also seem to slightly under-estimate people at the age ranges of 30 to 34 and 35 to 39 respectively, and over-estimate age ranges from 40 to 54. The implications could mean the under-estimation of the major younger and less experienced labor force participants, and the over-estimation of more senior and experienced groups of labor force, especially in terms of hunting and fishing, and so forth.

Information on occupation is classified into two major categories of agriculture and non-agriculture as indicated in Table 3.6. This is due to the significant difference between the major occupations of Yeak Loam commune and those of Ratanakiri or Cambodia as a whole. According to the information provided by Yeak Loam commune authorities, almost a hundred percent of Yeak Loam commune villagers are farmers, who rely heavily on the forest for subsistence level of survival. This is not the case for Ratanakiri or Cambodia as a whole, due to the existence of a wide range of employment sectors other than agriculture. Table 3.6 clearly indicates that the samples cover a high percentage of people that identified themselves as farmers (94.63%), while farmers, in general, only constitute 75.62% of the province or 81.6% of the country.

This seems to coincide with the above-stated information provided by Yeak Loam commune authorities with regard to the fact that agriculture is the major employment sector of the commune as a whole.

Finally, with regard to the ages of a total of one hundred and nineteen interviewed individuals, who represented seventy-three households, it can be easily seen from Table 3.7 that most of the age ranges are included, ranging from below 20 up to 80 and above.

Table 3.7 Interviewed Samples by Age

Total Interviewed Individuals:		119	(Out of 73 Households)					
Age Ranges:	**Below 20**	**20-29**	**30-39**	**40-49**	**50-59**	**60-69**	**70-79**	**80 & above**
Interviewed Ind.:	3	19	29	32	17	9	8	2
Percentages:	2.52%	15.97%	24.37%	26.89%	14.29%	7.56%	6.72%	1.68%

In addition, it can be seen from Table 3.7 that interviewees were over represented at the three major age ranges of 20-29, 30-39, and 40-49, which constituted some 67.23% out of the total one hundred and nineteen respondents (representing seventy-three households). People at these age ranges are most active in various kinds of activities, ranging from hunting to fishing, and so forth, and would be expected to benefit more from the forest in terms of major non-timber forest products.

3.5 VILLAGE-LEVEL MEETINGS

In addition to the village-level structured interviews mentioned in Section 3.4.7, semi-structured interviews were conducted in the form of informal meetings with village elders/civic leaders, and most of the villagers, who participated in the structured interview process. The purposes of the meetings were to have further understanding of major problems and concerns of the local community on issues related to security, forest use, management, the collection of non-timber forest products, and agricultural yield situation. The major justifications for the use of semi-structured interview technique were indicated in Section 3.2.1.

The meetings were conducted based on an interview checklist (Appendix 3.2), which covers the following major topics:

- The overall security situation in Yeak Loam commune as a whole, and its impact on villagers' life;
- Access to the forest and difficulties encountered;
- Rice production situation over the past three or four years.

The benefits of the meetings are the acquisition of relevant information of a general nature to complement the more specific results obtained from the structured interviews, and the gaining of an overall understanding of the local situation. In addition, the background information obtained from the meetings helps detect any doubtful results from the structured interviews so that clarification could be sought prior to the completion of the field research in Cambodia.

3.6 ANALYSIS TECHNIQUES

Raw data were first entered into Excel spreadsheet. The data were analyzed, using simple statistical techniques of mean, weighted average, median, standard deviation, Pearson's coefficients of skewness, frequency, and so forth. Statistical tests such as *t*-test Paired Two Sample for Means (one-tail), the sign test for a large sample (one-tail), Chi-square test (two-tail), and Fisher's exact test (two-tail) were applied. The analysis was conducted on Microsoft Excel 97 (Microsoft Office 1997), Epi Info 6, and Minitab. The analysis techniques are indicated in Appendix 3.7.

CHAPTER FOUR
RESEARCH RESULTS

4.1 A CASE STUDY OF THE FIVE VILLAGES OF YEAK LOAM COMMUNE

4.1.1 Demographic and Geographic Background - Yeak Loam Commune

Yeak Loam commune is well-known for its "Yeak Loam Lake", which is located approximately 4.5 kilometres by road from the central Ban Lung area (the first roundabout) as per Figure 4.1 (p.81). In terms of the provincial administrative hierarchy, Yeak Loam commune falls under Ban Lung district of Ratanakiri province.

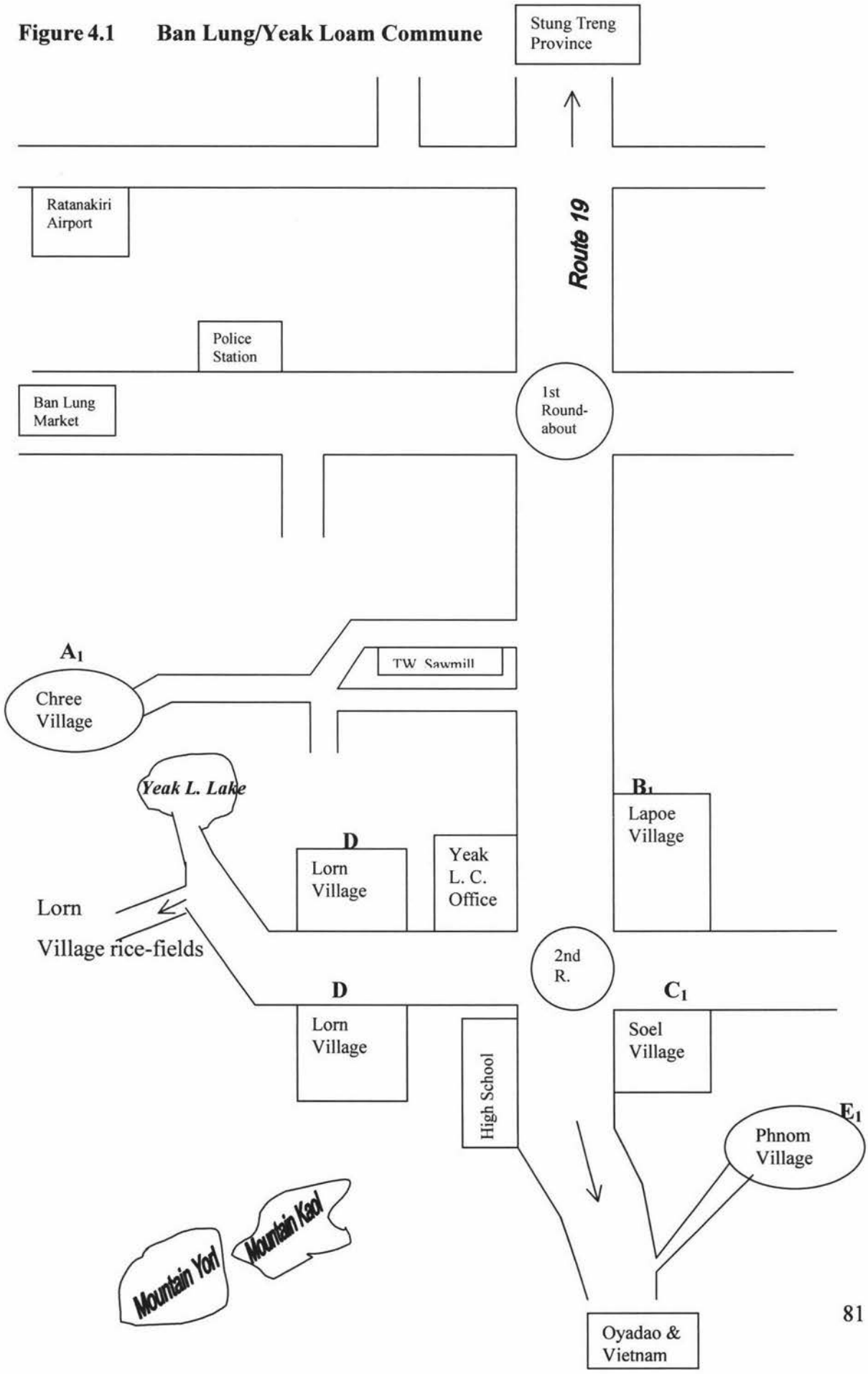
Yeak Loam consists of five villages of Chree, Lapoe, Soel, Lorn and Phnom as previously discussed in Section 3.1.2 of Chapter Three. The majority of people in Yeak Loam belong to the Tampuen ethnic group but there are some Khmer migrants as well. Three villages of Chree, Lapoe, and Soel have the same culture because they originated from one common village known as Phum Ban Lung (Ban Lung village, Labang commune, Lum Phat district). The two remaining villages of Lorn and Phnom used to have slightly different cultures though they have become very similar now. Phnom village was originated from Vuen Sai district (which has slightly different living conditions, compared to those of Ban Lung). Lorn village was from Patang commune of Lum Phat district during His Majesty King Norodom Sihanouk's Songkum Reah Niyum era (1953 – 1970).

According to Yeak Loam commune officials, there are currently a total of 346 families staying in Yeak Loam commune. This means an increase of 27 families since there were only 319 families in 1996 (Sokhom et al., 1996). With regard to forests, some Yeak Loam commune officials indicate that there are currently around 500 hectares of old forests in the east of Yorl Mountain and east of O Trung area (stream). Yorl Mountain is dominated by the dense evergreen old forest, and is a major area for the collection of non-timber forest products (Sokhom et al., 1996). There seems to be very few forests left in Kaol Mountain, which consist of mainly semi-dense *lagerstroemia* forest and a highly disturbed bamboo

bush (Sokhom et al, 1996). Yeak Laom Lake is surrounded by the semi-moist *lagerstroemia* and *dipterocarp* forest, while the south of the Lake are 500 hectares of rubber plantations planted in 1961 (Sokhom et al., 1996). These rubber plantations have been providing resin for export to the Vietnam market.

The general observation is that even though there have been numerous movements of the five villages since the past decades, most of them do not seem to have physically moved far away from their respective current locations except for Phnom village.

Figure 4.1 Ban Lung/Yeak Loam Commune



4.1.1.1 Chree Village

Chree village is situated 1.1 kilometres[1] on the right side off National Road 19 in the direction towards O Ya Dao or on the left if one is travelling towards the central Ban Lung area (Figure 4.1, p. 81). It is accessible by either one of the mud roads passing on the east or west side of the Taiwanese sawmill[2]. The main streams that flow through the village area are O Chree, O Katung, O Jung Me At, and O Rung Seng. "O" is a Khmer word, standing for "stream" in English.

There are currently 55 families in Chree village. Out of these families, 47 are of Tampuen origin and the remaining 8 families are of Khmer ethnicity. According to some Yeak Loam commune officials, Khmer migration mostly started during the period from 1983 to 1984.

Most of Chree village's shifting cultivated rice-fields or "chomkar" are located in the Southwest of Yeak Loam Lake. The major streams that villagers rely on at Chree village are O Kassah, O Katung, O Chree, and O Kreng (Barton, 1997). There are also five wells within the village. Along these streams, one can find the shifting cultivated rice-fields of Chree's villagers. It is not surprising that one can also find some Khmer farms and a coffee plantation site within the territory of Chree village. However, it is interesting to observe that no ethnic highlanders from other villages seem to own chomkar in Chree village's area. This coincides with the previous findings by Barton (1997).

4.1.1.2 Lapoe Village

Lapoe village is the first village on the left along National Road 19 if one is travelling towards the direction of O Ya Dao (Figure 4.1, p. 81). The village can be entered from the roundabout of National Route 19 and the mud road to Yeak Loam Lake. It is around 3 kilometres from the first roundabout in central Ban Lung area. It is separated from Soel village by a small lane that leads to O Rokse (stream) (Barton, 1997).

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[1] The exact distance was physically measured by relying on a new vehicle's odometer.
[2] This is the only large sawmill close to Chree village, commonly called "The Taiwanese Sawmill".

There are currently 103 families staying in Lapoe village. 88 families are of Tampuen ethnicity while the remaining 15 are Khmer by origin (Yeak Loam commune officials).

There have been various stories on the establishment of Lapoe village. Most of the interviewed village elders indicated that the village was established in 1957, and relies heavily on two major streams commonly known as O Katung Loe (Katung upstream) and O Kassah Loe (Kassah upstream). There is a well in Lapoe village but it is not in use. Lapoe village's shifting cultivated rice-fields are scattered in four major areas, namely West of Yorl Mountain, South of Yorl Mountain, North of Yorl Mountain, and Kaol Mountain. It was observed that Lapoe village's shifting cultivated rice-fields are often mixed with those of Soel village's. The researcher was informed by some elderly civic leaders and villagers of Lapoe and Soel that these two villages used to be one large village in the past. This is also reflected in the fact that Lapoe and Soel villages share the same custom, tradition, and religious belief of "Arak Niek Ta" (spirits).

The most common explanation for the split has been the size of the village itself, which was getting too large. However, the major underlying fact revealed by some villagers seems to suggest that there was a great dispute among two groups of villagers in the past, who later decided to split the village into two - a reality that they do not often share with outsiders.

4.1.1.3 Soel Village

Soel village is located next to Lapoe village on the left at the roundabout if one is heading for the direction of O Ya Dao from the central Ban Lung area along National Road 19 (Figure 4.1, p. 81). It is separated from Lapoe village by a small mud lane. Soel village is around 3 kilometres from the provincial center roundabout between National Road 19 and the road that leads to Ban Lung market. According to the village chief and Yeak Loam commune officials, Soel village consists of 65 families. 63 families are of Tampuen origin and the remaining 2 are Khmer by birth.

Soel village depends on three major streams of O Kases, O Katung, and O Kan Toei. Most of Soel village's shifting cultivated rice-fields are in the areas of Yorl Mountain and Kaol Mountain. It normally takes 2 to 3 hours to walk from the village to the shifting cultivated rice-fields if one is not a professional athlete.

4.1.1.4 Lorn Village

Lorn village is situated along two sides of the road leading to Yeak Loam Lake. It is around 300 metres from the roundabout of the villages of Lapoe and Soel.

The village is composed of 74 Tampuen and 10 Khmer families, which add up to a total of 84 families.

The researcher was told by village elders that O Katung Loe (O Katung upstream) and O Droung are the main streams that villagers rely on for their daily activities though there is a well in the village. The village's shifting cultivated rice-fields are mostly located in the Southeast of Yeak Loam Lake (near Yorl Mountain).

4.1.1.5 Phnom Village

Phnom village is the farthest one from the provincial town compared to other villages in Yeak Loam commune. The entrance mud road to the village is 1.5 kilometres along National Road 19 from the roundabout of the villages of Lapoe and Soel (on the left if one is heading from Ban Lung town). The village is situated another 400 metres from the entrance of the mud road, and is around 4.9 kilometres from the first roundabout of the central Ban Lung town area (Figure 4.1, p. 81).

There are currently 39 Tampuen families living in the village (no Khmer or other ethnic groups). The researcher was informed by some Yeak Loam officials that Phnom village has somehow adapted its slightly different traditions and customs to fit into the whole Yeak Loam community.

The major streams of significance to the village's daily life are O Chuit, O Tit, O Chea, O Mong, and O Ho. There is also a well within the village. The village's shifting cultivated rice-fields are mainly located in the areas of Kaol Mountain, Yorl Mountain, and along the O Chum (stream).

4.1.2 The Socio-economic Situation

4.1.2.1 An Overview

Yeak Loam commune is a typical example of an indigenous community that relies heavily on the forest for their subsistence level of survival, while facing a continuous threat of uncertainty with regard to the sustainability of their source of livelihood. There are three major factors. Firstly, the closeness to the market brings with it a higher demand for non-timber forest products and other forest services. This tends to accelerate the exploitation of the natural resources in the absence of a long-term vision, proper legislation and enforcement. What's worse is the level of uncertainty of the indigenous people's future with regard to resource and land use, which has somehow contributed to the unsustainable exploitation.

Secondly, given a lack of understanding of the rapidly changing society along with government regulations, indigenous people are vulnerable to sophisticated cheating techniques by some local businesspersons/speculators. An example of this is the selling of fallow land by some indigenous villagers in Lorn village at a low price (Yeak Loam commune officials). Some of this resulted from the persuasion by the local investors that if they did not trade their land for cash, the Government could seize it anyway sooner or later without any form of compensation (Emerson, 1997).

Thirdly, the increasing number of Khmer migrants, who continue to apply unsustainable resource exploitation practices such as fishing by the means of electric shock, have generated pressure on the existing resources, and set a bad example for the indigenous people. This creates a scenario, in which there are few incentives for any preservation

efforts since no one feels comfortable with the idea of preserving the forest while not knowing if others may choose to do the same.

Shifting cultivation and collection of non-timber forest products constitute a major lifestyle of the Yeak Loam commune villagers. Similar to most indigenous peoples, full-time employment is not common among Yeak Loam communities. There are two major reasons. Firstly, it seems that the Tampuen indigenous villagers have difficulty in committing themselves to any form of employment on a long-term basis since they are used to their traditional way of life. Secondly, employment opportunities are scarce in Ratanakiri, in particular for the indigenous peoples since there is a high tendency for most Khmer entrepreneurs to hire Khmer workers from elsewhere such as Kompong Cham province due to higher work efficiency and commitment. This coincides with the results from the interviews (Table 4.1) that farmer, and farmer and hunter are two major occupations (36% and 17.7% respectively) among the total 406 population (or the 73 interviewed households), while only 2.2% and 0.5% of the individuals belong to the civil servant and teacher categories. Furthermore, villagers, who are employed as civil servants or teachers, retain the occupation as farmer and hunter. This is because it is a common practice in remote areas of Cambodia that civil servants work a few hours a day, and get other jobs to survive due to low payment.

Table 4.1 Classification of Villagers by Occupation

Jobs	Farmer/Hunter	Civil Servant, Farmer/Hunter	Teacher, Farmer/Hunter	Farmer	Soldier	Student	Child
Individuals	72	9	2	146	1	12	164
Percentage	17.7%	2.2%	0.5%	36%	0.2%	3%	40.4%
(Out of the total **406** family members of the 73 interviewed households)							

With regard to villagers' farming status, each household owns an average of two shifting cultivated rice-fields[3], each of which has an average size of 0.877 hectare. This means that

[3] The actual numerical figure is "1.575". However, since it does not make sense to mean the number of rice-fields, the closest figure "2" is used instead.

each household has around one and a half hectares of rice-fields. Out of the total 73 interviewed samples, 54 households raise chickens; 46 families own pigs; dogs and cows are raised by 40 and 35 families respectively. Buffaloes are raised by 7 families while cats by 2. This seems to suggest that chickens are the most popular farm animals in Yeak Loam, which are followed by pigs, dogs, cows, buffaloes, and cats. According to some villagers, raising pigs, cows, and chickens needs a period of two years, three years, and half a year respectively before they are ready to be sold. However, the death rate seems to be high for farm animals such as pigs in Ratanakiri, which creates uncertainty for villagers since they never know if all the efforts made will pay off. Worst of all, theft has increased since 1995. Lapoe Villagers complained that farm animals such as buffaloes, cows, pigs, and chicken had been missing quite often in the village, which has become a matter of concern.

In addition, similar to most indigenous peoples, widespread poverty is a great concern that hampers the Tampuen villagers of Yeak Loam commune from gaining access to basic health care, education, which are mostly available in the provincial town area. Furthermore, use of these facilities involves monetary payment that the villagers can hardly afford since there is no such a thing as free medicine or education in a war-torn country like Cambodia.

The health situation becomes more complicated in view of the poor sanitation partly due to water usage. It is believed that since water is mostly collected from the stream, where bathing, washing, and laundry take place, contamination seems unavoidable. This is further complicated by the fact that water is drunk without any boiling efforts. Other factors that may contribute to the worsening of the health situation are believed to be poor nutrition, polluted environment, insects, and so forth. Another detrimental factor is believed to be superstition. Some villagers state that sometimes when a person gets seriously sick, his/her family may spend money preparing sacrificial services instead of sending the person to hospital for relevant treatment. It is strongly felt that as a basic precautionary step, public awareness needs to be raised with regard to basic hygienic

practices within the ethnic highland communities to reduce unnecessary mishap from repeating itself again and again.

4.1.2.2 Villagers and the Forests

100% of the interviewed households indicated that they were familiar with the forests in Yeak Loam commune area since they were native born in their respective villages and have been living there most of their life (excluding the Khmer Rouge regime). These villagers are closely associated with the forests. The analysis shows that on average, each household visits the forests 36.2 times a month for major activities such as hunting, firewood collection, and so forth (Appendix 4.1).

With regard to villagers' daily activities, results show that hunting occupies most of the villagers' time (24.9% of the total time for various activities), which is followed by firewood gathering (22.5%) and vegetable collection (19.6%). Rattan seeking (0.4%) and herbal medicine collection (0.5%) seem to occupy the least of the villagers' time (Appendix 4.2).

Three main uses of the forests have been identified in order of importance by the villagers. The majority (71.2%) of the 73 interviewed households indicated that timber (construction materials) was the first most important use of the forests (category one). Regarding the second most important use, bamboo was suggested by the majority (31.5%) of the interviewed households (category two), while firewood was believed to be the third most important use by 32.9% of the households (category three) as per the following Tables 4.2a, 4.2b, 4.2c, and Appendix 4.3.

Table 4.2a (i) The First Most Important Use of the Forests (Category One)

Items	Firewood	Timber (Construction M.)	S.C.Rice-fields	Food	Bamboo	Water
Households	12	52	4	2	1	2
Percentage	16.4%	71.2%	5.5%	2.7%	1.4%	2.7%
(Out of the total 73 interviewed households)						

* Only one vote/per household for each category of forest use.

Construction M. = Construction Materials.

S.C.Rice-fields = Shifting Cultivated Rice-fields.

Table 4.2b (ii) The Second Most Important Use of the Forests (Category Two)

Items	Water	Firewood	Timber	Bamboo	Fruit	S.C. Rice-fields	Food (Meat &Veg.)
Households	7	21	14	23	1	3	4
Percentage	9.6%	28.8%	19.2%	31.5%	1.4%	4.1%	5.5%
(Out of the total 73 interviewed households)							

* Only one vote/per household for each category of forest use.

Veg. = Vegetable(s).

Table 4.2c (iii) The Third Most Important Use of the Forest (Category Three)

Items	Food (M&V)	Honey	Fruit	Bamboo	Firewood	S.C. Rice-fields	Straw	Water	Medicine	Timber	Rattan
Households	7	2	2	16	24	2	1	14	2	2	1
Percentage	9.6%	2.7%	2.7%	21.9%	32.9%	2.7%	1.4%	19.2%	2.7%	2.7%	1.4%
(Out of the total 73 interviewed households)											

* Only one vote/per household for each category of forest use.

M &V = Meat and Vegetable(s).

The significance of the forests to the villagers is reflected in the result that out of the total seventy-three interviewed households, seventy-one (97.3%) confirmed that they would have no alternative solutions, due to poverty, should forest services cease to be available. One household (1.4%) indicated moving somewhere else as an alternative solution while another one (1.4%) stated that looking for employment would be the solution. This seems to suggest that the majority of the villagers have little choice besides relying on the forest resources.

Information based on the oldest surviving family member of each interviewed household shows that a high percentage (21.9%) of the interviewed households have family members

that have been relying on the forest for a duration of 51 to 60 years. The majority (61.6%) of the interviewed households in Yeak Loam commune has been relying on forests for 31 to 60 years as indicated in Table 4.3.

Table 4.3 Villagers' Dependence on the Forests by Years

Year Ranges	20 & Below	21-30	31-40	41-50	51-60	61-70	71-80	81 & Over
*Households	2	9	14	15	16	8	7	2
Percentage	2.7%	12.3%	19.2%	20.5%	21.9%	11%	9.6%	2.7%
(Out of the total 73 interviewed households)								

* This is based on information regarding the oldest surviving family member of each interviewed household.

Comparing the current level of dependence on the forest with that of 10 years ago, 93.2% of the interviewed households state that it is much less; 4.1% reply "unknown"; 1.4 % each reply either "little less" or "the same" respectively. Nobody replied either "little more" or "much more". Comparing the present level of reliance on the forest with that of 20 years ago, 65.8% of the total interviewed households indicate that it is much less while the remaining 34.2% choose "unknown". With regard to the situation of 30 years ago, 39.7% reply "much less" and the majority of 60.3% choose "unknown" as the response. When asked about estimation of the level of reliance on the forest in ten years from the present, 79.5% of the interviewed households think that it will be much less; 4.1% believe that it will be little less; 1.4% reply that it will be the same while 15.1% reply "unknown". Nobody answers either "little more" or "much more". This seems to suggest some sort of negative impacts on villagers' livelihood as a result of the decline of forest resources over the past decades. This also coincides with the recollection of quite a few village elders during the interview process that 30 years ago, Phum Ban Lung (now Ratanakiri provincial town area) used to consist of large, dense forests occupied by various kinds of wildlife including tigers!

100% of the interviewed households in Yeak Loam commune indicate that they still enjoy

free access to the forests at this stage despite the provincial government's classification of Yeak Loam Lake as a provincial protected area. Villagers' assessment of the current management of forest was unsatisfactory (an average mark of 6.9 was given on a 1-10 scoring scale, with 1 and 10 stand for two extremes of "very satisfied" and "very unsatisfied" respectively). 59% of the total 73 interviewed households indicate that they are worried about the way forests are being used at present, 3% state that it is fine while the remaining 38% have no comments on this matter.

When the villagers were asked if they might have any concern about the use of forest in the future (Question 26), 77% replied "yes" and "23 %" answered "no" out of the total 73 samples. With regard to the question on villagers' major concern (Question 27), 38 households (52%) out of the total 73 samples indicate rapid forest loss as the major concern; 8 households (11%) believe that rapid forest and land losses are the main things to worry; 6 household (8%) say that rapid forest, food, and wildlife losses are the key issues; 3 households (4%) underline rapid forest loss and drought as the concern; only 1 household (1%) shows concern about the loss of wild fruit; finally, 17 households (23%) who responded "no" in Question 26 say that Question 27 is not applicable to them.

This seems to suggest that the majority of the interviewed households have realized that the current rapid forest loss is a matter of concern, which is followed by other factors in the order of importance such as land, food, wildlife, drought, and fruit. Of course, there are some people who do not seem to view the current forestry situation a matter of concern at all. However, it needs to be emphasized that despite some emerging, local awareness of the rapid forest depletion, it seems that quite a few villagers have difficulty imagining that forests will soon be gone unless they are properly managed. The villagers seem to maintain the overall illusion that forest resources are inexhaustible.

Though a wide range of efforts have been made by various donor agencies to promote the concept of community forestry in Ratanakiri, the researcher got the gut feeling during the contacts with villagers that they seemed to interpret "community forestry" as a means and

excuse to obtain full rights over the use of the forests rather than a way to adopt a new attitude towards more sustainable management of the few forest resources left. Community forestry will be discussed in detail in Chapter Five.

4.1.3 The Level of Villagers' Dependence on Non-timber Forest Products

4.1.3.1 Hunting and Collection Techniques

Hunting is a major task mostly performed by men while women play a crucial role in trading the game for cash to buy major daily necessities such as salt, sodium glutamate, and "prohok" (fish paste). According to some village elders, there is little difference in the hunting techniques among Tampuen and some other ethnic highlander groups such as Brou, Jarai, and Krung. There are four common ways of hunting namely, shooting, using traps, snares, and laying resin-type of mixture or "dat joa" in Khmer.

Shooting either takes place in December and November when villagers are free or during the period from June to September of every year (rainy season). Many of the interviewees explained that the benefits of shooting during rainy season lie in higher chance of success due to the fact that movement in the jungle creates less distinguish-able noise when the ground is wet, and may less likely alert target animals from distance. Shooting mostly aims at pigeons, birds, and small animals. Shooting often takes place very early in the morning. The hunter normally hides inside a very small makeshift construction placed near trees with small wild fruits, waiting for the targets. Most of them complained that it was much harder to shoot large animals nowadays since they no longer possessed guns, and had to rely on the self-made crossbows. Quite a few interviewees also complained about increasing difficulty in locating target animals as a result of excessive loss of forests and wildlife along with increasing population.

Traps are designed to target animals of all sizes. They were also used against human beings during the civil war (mostly made of sharpened bamboo stems and commonly known as pitfall trap). No animal survives once it gets caught by a fence trap or "on-kup"

in Khmer because it is often made of a big, heavy trunk, which will hit and remain pressing on the body of the animal trapped until removed by the hunter.

A fence trap may last 2-3 years, and can sometimes be prepared at a rate of 3 traps per day by a professional Tampuen hunter (with at least one additional labor force helping with moving of big trunks). Some people may spend 7 to 15 days, depending on the number of traps made. The traps are connected to a bamboo wall (1 meter high), which surrounds the shifting cultivated rice-fields. There are numerous holes in the wall, which are 3 meters apart from each other. The animals going out through the holes from the rice-fields or coming into the rice-fields from outside will trigger the traps (which are usually made of 4 to 5 meter long trunks with a diameter of 250 centimeters or more). This kind of trap targets animals such as wild chickens (gallus gallus), wild pigs, barking deer (cervus muntiacus), snakes, pchong, sompoiyt/civet sp., pangolins, trokout (varanus nebulosus), porcupine, and so forth.

The second type of trap is designed for smaller animals such as field rats, squirrel sp./komprok, squirrel sp./konghain etc. commonly known as the small household mouse-trap. Another is called arrow-shooting snare or "khna" in Khmer. It is basically composed of a hidden arrow, which will be triggered off if anything touches the string by accident. It is designed for large animals (was also used against human beings during in the war). The Tampuen belief is that if they are preparing arrow-shooting snares or "khna", they will not offer anything to any visitors such as agricultural produce, rice, and so forth; otherwise, no animals will be trapped by the "khna".

Noose snares or "on tiet" in Khmer are designed to catch small animals such as pigeons, wild chickens, civet sp., and so forth. Noose snares are normally laid 20 meters outside the rice-field area, and need 2 to 6 days to prepare from the bamboo (russey b'or). They may last one year. Lastly, a resin-type of mixture is sometimes left surrounding the rice-field area to trap birds or pigeons when they land to drink water and eventually get stuck. The mixture is made of "lovia" or "vou kui" mixed with "choa tuk" (resin) of "chhoetiel tree"

(Dipterocarpus alatus). Dogs are also used to hunt some small animals besides looking after the house when the owners are away. The researcher was told by village elders that the Tampuen ethnic group does not eat dogs or cats like other ethnic groups even though they consume a wide range of wildlife. Hunting of small animals such as field rats, squirrel sp./konghain, pigeons, and birds is essential for villagers to protect their crops from being attacked besides having additional food to be added to the simple diet, which is mostly composed of vegetables.

Fishing seems to be an important source of protein for villagers since they can get fish, crab, shrimp, and frogs. The four major ways of fishing are using a bamboo fishing pole (composed of a bamboo rod, string, and a hook), laying a fishing net, draining water to catch fish, and using a bamboo fish trap. The bamboo fishing pole can be used most time of the year, depending on the availability of fish. Laying a fishing net is possible during the rainy season when the water level is high. However, since there are few fish left in most of the streams, this is often only feasible for around two months a year. The process involves laying the net early in the morning (normally from around 6 AM to 10 AM), and returning to the site in the afternoon (2 to 4 PM) of the next day to check the catch.

During the dry season (January to May), water flow in part of the stream is blocked when the water level is very low, and the area is drained in order to catch fish with a basket. This activity often involves men and women at the same time. Another way is the blocking of water flow by a bamboo fishing trap, which is composed of a densely woven bamboo net with a few holes. Behind the holes of the net are bamboo dead-end stems made from "russey pok" or "russey b'or". Once a fish is flushed into or enters the bamboo stem, it cannot escape. In general, due to the few fish available, quite a few people only fish 2 months a year using this method (mostly in February and March), while others may fish the year round by using the fishing rod. Villagers also complained that there used to be an abundance of big fish in Yeak Loam commune, and there are hardly any now due to the previously discussed unsustainable way of fishing with electric shock from a car battery by some Khmer people, who seem to have learned the trick from the Vietnamese soldiers in

the past. Fishing mostly takes place in the streams of Yorl Mountain (Phnum Yorl), O Katung Loe, O Kaseng, and O Ro Veng, and so forth.

4.1.3.2 Yeak Loam's Non-timber Forest Products

As discussed in Chapter Two, non-timber forest products have been playing an important role in the Cambodian society, especially in the remote, rural area of Yeak Loam, where people rely on the forest for subsistence level of survival. However, little public attention has been drawn to this reality until the recent past, in contrast to timber exploitation which has been a matter of high profile since the past few decades in developing countries like Cambodia.

An example of the importance of non-timber forest products is reflected in the estimation by the Food and Agriculture Organization of the United Nations (FAO) that over 5.2 million cubic meters of wood were harvested for fuel in Cambodia in 1989 (Dennis and Woodsworth, 1992; cited in Sadoff, 1993) though most of this consumption was not recorded as an economic activity since it never passed through formal economic markets (Sadoff, 1993). This coincides with the statement by Kumari (1995) regarding a Malaysian case study that although most non-timber forest products do not enter the market, they do constitute a significant part of the subsistence requirements of the local population. This clearly under-lines the importance of the non-timber value of forest resources despite the difficulty in its quantification.

The non-timber forest products are classified into three major groups of aquatic animals and wildlife; herbal medicine, honey, fruits and vegetables; construction and burning materials. The results are summarized in the following Tables 4.4a, 4.4b, 4.4c, 4.4d, 4.4e, and Appendix 4.4.

Table 4.4a demonstrates the total yearly quantities (for 73 households) and the average annual quantities (per household) of the non-timber forest products such as fish, frog, crab, shrimp, small snail sp. or Kachau in Khmer, terapin sp. or Konthie, terapin sp. or Ondaek,

deer, and barking deer or Chhlus. Fish, for example, is caught at a total annual quantity of 538.1 kilograms by the 73 interviewed households. Each household may obtain an average of 7.37 kilograms of fish per year. However, both standard deviation (9.55) and Pearson's coefficient of skewness (0.74) show that the distribution of fish does not seem to follow a normal distribution pattern. Since Pearson's coefficient of skewness is greater than zero, it means that fish distribution among households follows a skewed to the right pattern as reflected by Appendix 4.4. It needs to point out that the non-timber forest products at Yeak Loam commune do not follow a normal distribution pattern since only a few households get most of the products while the remaining obtain a very small quantity. In other words, the "mean" quantity needs to be treated with caution.

Furthermore, Appendix 4.4 shows that 52 households out of the 73 (or 71.2% of the population) obtain from 0 to 7.4 kilograms of fish per year, while only 28.8% of the population obtain a quantity of fish per year greater than 7.4 kilograms/year. In addition, Table 4.4a also indicates that fish is caught by each household in a larger quantity than other comparable items such as frog (3.05 kilograms/household), and so forth.

Table 4.4a Quantities of Non-timber Forest Products - Aquatic Animals & Wildlife (On A Yearly Basis)

Items	Fish (kg)	Frog (kg)	Crab (kg)	Shrimp (kg)	S. Snail sp./ Kachauv (kg)	Terapin sp./ Konthie (h)	Terapin sp./ Ondaek (h)	Deer / Proes (h)	B. Deer/ Chlus (h)
Tot. Q.	538.10	223.00	219.50	168.50	147.50	4.00	6.00	1.00	20.00
Aver. Q.	7.37	3.05	3.01	2.31	2.02	0.05	0.08	0.01	0.27
Median	5.00	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00
SD	9.55	7.02	5.40	7.12	4.84	0.33	0.60	0.12	0.71
Pearson's C.S.	0.74	1.31	1.11	0.55	1.25	0.50	0.41	0.35	1.15

(h) = head (measurement unit); (kg) = kilogram;
S. = Small; sp. = species;
Tot. Q. = Total Quantity (73 households);
Aver. Q. = Average Quantity (per household);
SD = Standard Deviation; Pearson's C.S. = Pearson's Coefficient of Skewness;
B. Deer = Barking Deer.

Table 4.4b Annual Quantities of Non-timber Forest Products -Wildlife

Items	W. Pig (h)	W. Chicken (h)	Chicken sp./ Moang To (h)	Civet sp. (h)	Porcupine sp. (h)	Field Rat (h)	Squirrel sp./ Konghain (h)	Squirrel sp./ Komprok (h)
Tot. Q.	48	265	28	76	57	3,561	1,660	1,116
Aver. Q.	0.66	3.63	0.38	1.04	0.78	48.78	22.74	15.29
Median	0.0	0.0	0.0	0.0	0.0	20.0	10.0	5.0
SD	3.56	6.92	2.39	3.26	2.56	97.87	62.79	47.89
Pearson's C.S.	0.55	1.57	0.48	0.96	0.91	0.88	0.61	0.64

(h) = head (measurement unit); W. = Wild; Tot. Q. = Total Quantity (73 households); Aver. Q. = Average Quantity (per household); SD = standard deviation; Pearson's C.S. = Pearson's Coefficient of Skewness.

Similar to Table 4.4a, Tables 4.4b, 4.4c, and 4.4d indicate the quantities of the non-timber forest products collected by the indigenous villagers. Wild pigs, for example, are hunted 48 heads per year by the total 73 interviewed households. However, standard deviation (3.56) and Pearson's coefficient of skewness (0.55) show that the distribution of wild pigs may not follow a normal distribution pattern, but is positively skewed with the mean to the right of the median and greater than it (i.e. $0.66 > 0$). Appendix 4.4 reflects that 82.19% of the population obtain below the average level of wild pigs.

Table 4.4c Annual Quantities of Non-timber Forest Products - Wildlife

Items	A-Nhi (h)	Pchong (h)	Trokout (h)	Snake sp. (h)	Pigeon (h)	Bird (h)	Monkey (h)	Pangolin (h)
Tot. Q.	80	195	40	21	401	462	5	3
Aver. Q.	1.1	2.67	0.55	0.29	5.49	6.33	0.068	0.041
Median	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SD	6.06	12.03	1.66	0.89	9.94	24.46	0.59	0.26
Pearson's C.S.	0.54	0.67	0.99	0.97	1.66	0.78	0.35	0.47

(h) = head (measurement unit);
*A Nhi, Pchong, and Trokout are wild animals found in Ratanakiri.

Table 4.4d Annual Quantities of Non-timber Forest Products - Medicine, Honey, Fruits and Vegetables

Items	H. Medicine (basket)	Honey (litre)	Rambutan (basket)	Mango (basket)	Phnieu (basket)	Malva Nuts (basket)	Bamboo Shoots (basket)	Vegetables (basket)
Tot. Q.	37.5	110.0	87.0	49.5	63.0	18.7	853.3	2,213.0
Aver. Q.	0.51	1.51	1.19	0.68	0.86	0.26	11.69	30.32
Median	0.0	0.0	0.0	0.0	0.0	0.0	5.0	12.0
S D	1.87	3.65	2.54	1.63	1.93	0.91	26.3	57.3
Pearson's C.S.	0.82	1.24	1.41	1.25	1.34	0.84	0.76	0.96

H. Medicine = Herbal Medicine;
*Phnieu is a kind of wild fruit.

Table 4.4e Annual Quantities of Non-timber Forest Products - Construction and Burning Materials

Items	S. Bamboo/ R. Pok (st)	L. Bamboo/ R. B'or (st)	S. Bamboo/ R. Kley (st)	S.Bamboo/ R. Prey (st)	S. Bamboo/ R. Srok (st)	Rattan (vine)	Firewood (basket)
Tot. Q.	15,863.20	4,698.90	1,078.00	503.00	20.00	6,44.30	1,3654.00
Aver. Q.	217.30	64.37	14.77	6.89	0.27	8.83	187.04
Median	40.00	8.00	0.00	0.00	0.00	0.00	120.00
SD	374.12	240.01	28.67	29.15	2.34	19.76	189.77
Pearson's C.S.	1.42	0.70	1.55	0.71	0.35	1.34	1.06

(st) = stem (measurement unit)
S. Bamboo = Small Bamboo
L. Bamboo = Large Bamboo
R. Pok = Russey Pok
R. B'or = Russey B'or
R. Kley = Russey Kley
R. Prey = Russey Prey
R. Srok = Russey Srok

Table 4.4e shows the quantities of various kinds of bamboo, rattan, and firewood that villagers obtain from the forest annually. Since bamboo is mostly used in house construction, it is not usually collected yearly so the quantity collected per year is the actual quantity collected divided by the corresponding number of years (i.e. if bamboo was used for building a house. The total quantities collected for such a purpose are divided by the number of years that the house lasted, and so forth). Similar treatment of data has been applied to malva nuts of Table 4.4d since they are not available annually (only once every three years or more under normal circumstances).

In addition, a few major non-timber forest products that play a significant role in the Yeak Loam indigenous communities' life are presented in details as below.

Fish, Shrimp, Crab, and Frog

As an important part of villagers' diet, fish seems to have reduced significantly along with other forms of wildlife partly due to reduced availability and the rapid loss of the forests and wildlife habitat. The most commonly found fish are "trey on daeng" (catfish sp.), "trey chongvar", "trey tut", "trey kasan" (channa gachua), and "trey ros" or the so-called snakehead (found on an occasional basis). Along with fish are small crab, small snail (kachau), shrimp, and frog. The researcher eye-witnessed the catch of the fish for the day by a few interviewed households. Each fish is around 100 centimeter long, and the quantity of each catch is small.

Shrimp, Crab, and Frog are quite often caught simultaneously with fish. As reflected in Table 4.4a, each household is estimated to catch an average of 2.31 kgs of shrimp, 3.01 kgs of crab, and 3.05 kgs of frog per year. According to most villagers, fish is a more preferred food than crab or shrimp due to its relatively larger size. None of these aquatic animals seem to be as abundant as before partly due to increasing population pressure, the unsustainable fishing approach, and rapid loss of forests and habitats.

Wild Pig, Wild Chicken, Pchong, Porcupine, and A Nhi

Wild pigs are often trapped by a fence-trap. The same for other kinds of wildlife such as wild chicken, Pchong, porcupine, and A Nhi. Wild pigs normally weigh 45 kilograms each, and villagers complained about their increasing scarcity compared to that of a few years ago. Wild pigs are sold by head to the market, while wild chickens are mostly for consumption though some Tampuen villagers are bound by some sort of superstitious belief that chicken is a sacred animal, and can not be caught or eaten. Chickens are sometimes caught alive by a noose snare.

Pchong is the Khmer name for a kind of wildlife found in Ratanakiri. It is called "Shongkoi" in Tampuen, and weighs around 1 to 2 kilos each. Porcupines weigh around 5 kilos each, and are an animal with high medical value to the villagers. Porcupines are mostly used for family consumption except for their stomachs, which have a great market demand. Porcupines stomachs are dried in the sun and fried (without oil) to make into powder for women to drink with wine. Most village elders indicate that porcupines normally eat 1000 kinds of plants, and are an important source of medicine for women's post-delivery period. A Nhi is the Khmer name for a kind of wildlife found in Ratanakiri. It weighs around 2 kilos each, and has some medical value in additional to the nutrient one. According to some interviewed villagers, A Nhi has the highest medical value during dry season.

Field Rat, Squirrel sp./Konghain, Squirrel sp./Komprok

Unlike most of the larger animals, field rats, konghain and komprok (Khmer words for two different kinds of squirrel), are very popular among the villagers since they are easily caught in a large quantity. These small animals constitute an important daily source of protein for Tampuen villagers even though they can barely be found in the menu of normal city dwellers.

Firewood, Small Bamboo/Russey Pok, Large Bamboo/Russey B'or, and Others

Firewood is a most important burning material for the villagers to use in daily cooking activities. By Ratanakiri standard, the term "firewood" refers to anything that can be burnt such as small branches, dried leafs, or chopped wood, which may not have timber value. Firewood is used to cook breakfast in the early morning, and the fire is sometimes left burning straight through lunch and dinnertime. Firewood is mostly collected in baskets by women from the shifting cultivated rice-fields and forested areas. Men may help with firewood collection on an occasional basis. Depending on the availability of firewood and the distance from home, it may take from 30 minutes to 2 hours each time to complete a daily firewood collection process. Some villagers may collect firewood on a daily basis while others may spend up to half a day each time and restrict the whole process to only a few months a year. Most of the firewood is used to serve daily fuel requirements while some is traded for cash to buy other daily necessities such as salt, fish paste (prohok), and sodium glutamate.

Bamboo is an important construction and hunting material for villagers. There are five major types of bamboo known as *russey b'or* in Khmer (or large bamboo), *russey pok*, *russey kley*, *russey prey*, and *russey srok*. Russey b'or is the thickest and largest of all kinds of bamboo, and is mostly found in O Trung (O Trung stream area). It is around 5 to 10 meters long, and has a diameter of 100 centimeters or more. It is mostly used to weave the floor, roof, and bamboo beds. The bottom end of russey b'or can also be used to make a pillar or a bow. Russey pok is smaller than russey b'or in diameter, and is used to weave roof and wall. Each piece of roof consists of 200 centimeters in width and 500 centimeters in length, and a ten-meter long bamboo stem can be woven into 10 to 15 pieces of roof. Bamboo is normally measured and cut in the jungle, and then brought back home to weave.

Russey prey, russey srok, and russey pok are almost the same size but less thick and

smaller than russey b'or. Russey srok and russey prey are of the same price, and can be used to make beds like russey b'or. However, both russey srok and russey prey are not favorable since they are easily bitten by insects and termites. Russey kley is long but smaller than other types of bamboo such as russey prey. Both russey pok and russey kley are found in Yorl Mountain.

Rattan is a very important non-timber forest product to the local communities. Its usage covers a wide range of areas such as building of houses, weaving of baskets and furniture, and so forth. A basket made from rattan may last 1 to 2 years, and is essential to villagers' daily life activities. It is characterized by its elasticity and toughness, which can not be replaced by other forest products such as vines. However, partly due to rapid forest loss in the area, rattan seems to be fast disappearing from Yeak Loam commune. Once considered abundant and inexhaustible, rattan can now hardly be found in Mountain Yorl area. According to some villagers, rattan is mostly collected from O Trung forest, Phnum Chu area, or Vuen Sai district.

Vegetables and Fruits

Vegetables constitute a most important part of Tampuen villagers' daily menu, which consists of very little meat. The major vegetables from the forests are commonly known in Khmer as trau ondak (taro), sloek kondieu (a kind of green leafy vegetable), sloek kondan (a leafy vegetable), sloek rien (barringtonia leaf), sloek chi chruk (leaf), and so forth. Wild leafy vegetables are edible for 4 months from January to April during the dry season. Most wild vegetables except taro become bitter during the rainy season, and are not good for consumption. However, quite a few people rely on the forests for vegetables for around 6 months (January to June). Villagers have to rely on their rice-fields for vegetables during the remaining 6 to 8 months of the year. Vegetables are collected by women on a daily basis. On an average, each household gets over 30 baskets of vegetables from the forests per year. As a part of the vegetable family, bamboo shoots constitute the second most important component of villagers' daily foodstuff. Bamboo shoots are in season three

months of the year (June, July, and August) since they start growing old in September. Bamboo shoots are normally plucked in baskets by women from Mountain Yorl area. The earliest bamboo shoots of the year are mostly from *russey srok,* and are most expensive. There seems to be no definite rule with regard to the consumption patterns since some people may find bamboo shoots as early as May and continue collecting them through September (5 months). Some may only consume bamboo shoots 2 or 3 months per year (July and August, or June, July, and August).

Rambutan and mangoes are popular fruits for villagers' consumption and trading for cash. Compared to those planted at the rice-fields, wild rambutan and mangoes look smaller and taste more sour. Fruit plucking normally takes place around April, and involves women and men at the same time. The wild fruit that has the greatest value is known as malva nuts, the market potential of which will be discussed in Section 4.5. The major physical characteristics of malva nuts is that, once in touch with water, the nuts increase in size greatly, and are used to prepare sweet desserts. Malva nuts are not a yearly crop like most of the wild fruits. On the contrary, malva nuts are only available once every three years. Villagers' long-term observation seems to suggest that whenever malva nuts become abundant, other fruits are not available. According to most village elders in Yeak Loam commune, people have been felling malva nut trees in order to collect the nuts, resulting in the fact that it takes up to seven or ten years for new malva nut trees to bear fruits. The researcher was also informed that during the 1980s, malva nuts were not a fruit of first choice for villagers since there was no market demand. During that time, people used to pick up the fallen nuts from the ground rather than felling the trees for the nuts.

Honey and Medicine

Honey and herbal medicine are collected by men from the forests. Some villagers indicate that honey searching starts from January to May of every year. Honey is mostly collected by using the smoke to scare the bees away, which is quite a dangerous task and requires caution and experiences. There are only a few men in each village, who are professional in

honey collection. Honey is normally sold by housewives at the average price of over 3700 riels/per liter to buy other daily necessities. Herbal medicine seems to play an important role within the Tampuen communities at Yeak Loam commune, who can hardly afford normal medical treatment like most lowland Khmer people. Two traditional male doctors were identified during the field-work in Ratanakiri. One was from Soel village and another one from Phnom village. The gentleman from Soel village was a "doctor" during the Khmer Rouge regime. Depending on the seriousness of the disease, each treatment by the traditional doctor may cost 20,000 to 30,000 riels or more. According to the "traditional medical doctor" in Phnom village, herbal plants are quite often mixed together to treat a disease. An example is the case of mixing up to 50 kinds of various plants in a small pack as a recipe for women's disease. The pack is sold at the price of 3,000 riels each in Phnom village. There are quite a few village elders, who have some knowledge of herbal medicine. The following herbs were advised to have some medical value by experienced village elders (Tables 4.5):

Table 4.5 Herbal Medicines Commonly Used by Villagers

Tampuen Names	**Medical Effects**
Prum Ten	Treatment of women's post-pregnancy
Pum Prean	Treatment of women's post-pregnancy
Kup Chham Khoay	Treatment of women's post-pregnancy
Troi	Stomach problem during pregnancy
Tam Konit Reng, Tam Pchung, Tam Chon Den, Tam U Som, & Tam Pislean, Tam Hat Show, Tam Upong, Tam Chan Den (8 items mixed together)	Treatment of women's hemorrhage after delivery
Ou Ham Nhi	Stop bleeding

Table 4.5 Herbal Medicines Commonly Used by Villagers

(Continued)

Tampuen Names	Medical Effects
Kontao	Treatment of stomachache
Ek Vat	Treatment of stomachache
Tam Kong, Tam Chhet, Hat Show, Tam Pet, Tam Ritsdit, Tam Propes (6 items mixed together)	Treatment of stomachache
Sa Pren, On Pok, Pla Klop, Thra, Kan To (stems) (5 items mixed together)	Treatment of diarrhea
Kong	Treatment of dysentery
Su-Ung, Tam Lum Pei, Ta Kroit, Lan Ung Hoel, Khtam La, Proit Rove (6 items mixed together)	Treatment of cold
Lam Poi (roots)	Treatment of malaria
Tam Ho, Tam Krai, Tam Perot, Tam Hen, Tam Long (5 items mixed together)	Treatment of malaria
Tam Kropes	Treatment of yellow skin disease (liver problem)
Tam Smo	Treatment of yellow skin disease (liver problem)
Tam Nhau	Treatment of yellow skin disease (liver problem)
Tam Long Am	Treatment of yellow skin disease (liver problem)
Tam Poveat	Treatment of yellow skin disease (liver problem)
Tam Lapuk	Treatment of yellow skin disease (liver problem)
Tam Ngu Sang.	Treatment of yellow skin disease (liver problem)

Sourse: Yeak Loam Village Elders

* Most herbal medicine is composed of stems, roots, or leaves of a plant.

4.1.3.3 Decline of Non-timber Forest Products

Despite the absence of quantitative information regarding the decrease of non-timber forest products over the past decades, villagers seem to insist that non-timber forest products have reduced significantly partly due to unsustainable exploitation practices as well as rapid forest loss.

Statistical tests on the reduction of non-timber forest products based on the current information and that of 1980s[4] seems to suggest the reduction of a few non-timber forest products such as fish, frog, shrimp, field rat, squirrel sp./Konghain, and squirrel sp./Komprok as reflected in Table 4.6. However, the results need to be treated with caution since there are too many factors involved such as change in the total population size of Ratanakiri, change in the number of hunters, and so forth.

Table 4.6 Reduction of Non-timber Forest Products (1980s – 1998)

NTFP Items	Comparable Sample Size (Out of 73)	Sign Test for Median Reduction (H_0: Present – Past ≥0; H_a: Present – Past <0)	*t*-Test/Paired Two Samples for Means Reduction (H_0: Present – Past ≥0; H_a: Present – Past <0)
Fish	37	Yes (P = 0.0068 < 0.05)	Yes (P = 0.001 < 0.05)
Frog	26	Yes (P= 0.0000 < 0.05)	Yes (P = 0.006 < 0.05)
Shrimp	31	Yes (P= 0.0000 < 0.05)	Yes (P = 0.028 < 0.05)
Field Rat	27	Yes (P= 0.0133 < 0.05)	Yes (P = 0.017 < 0.05)
Squirrel/Konghain	30	Yes (P= 0.0173 < 0.05)	Yes (P = 0.044 < 0.05)
Squirrel/Komprok	32	Yes (P= 0.0096 < 0.05)	Yes (P = 0.026 < 0.05)

*These results represent those of one-tailed P-value.

**Corresponding present and past data on NTFP are compared only if relevant similar efforts (i.e. fishing, hunting, or fruit plucking etc…) have been made in both the present and the past.

***All NTFP items with the comparable sample size less than 25 are excluded in this analysis.

[4] Data on the annual NTFP obtained by villagers in 1980s were collected from Q. 19 of the questionnaire.

Normality tests of the data on the yearly non-timber forest products suggest that they mostly likely do not follow a normal distribution pattern due to small P-values (Appendix 4.5). This is because if P-value is less than 5%, the null hypothesis of a normal distribution is rejected, which means that the distribution may not follow a normal pattern. Moreover, Appendix 4.5 shows that graphically the points do not fall on a straight line (analysis technique is presented in Appendix 3.7). This coincides with the interpretation of the standard deviations and Pearson's coefficients of skewness discussed in Section 4.1.3.2, which suggests skewness. In other words, the results of the sign tests should be accepted instead of the *t*-tests since the latter is not applicable if the distribution does not follow a relatively normal pattern (Appendix 3.7). Table 4.6 shows that compared between 1998 and 1980s, the reduction of NTFP items such as fish, frog, shrimp, field rat, squirrel sp./Konghain, and squirrel sp./Komprok seems to be statistically significant. Detailed printouts of the sign test and *t*-test are presented in Appendices 4.6 and 4.7 respectively.

4.1.4 Valuation

As discussed in Section 2.1.7 (Chapter Two), the greatest difficulty encountered in the valuation of the non-timber forest products (based on the actual monetary value of each item sold) lies in the fact that villagers do not sell all the products that they obtain from the forests since they do keep quite a few of these for family consumption. Hence, some households may not know the value of some products. This is reflected in the feedback received from Question 8 of the interview/survey questionnaire that out of the total 73 interviewed households, 71 responses stress the reliance of non-timber forest products for both family consumption and cash while the remaining 2 households underline family consumption as the main use of the products, making it a major usage. To calculate the value of non-timber forest products, a weighted average price was calculated from those survey responses that provided both a quantity and a price. The weighted average price was then used to value the total quantity of non-timber forest products. The formula is presented below:

$$P = [\Sigma(q_j * p_j)]/\Sigma q_j \qquad \text{With } j = 1....73 \text{ (interviewed household)}$$

P = Weighted average price/per NTFP item;

q = Total quantity of each NTFP item obtained by each interviewed household;

p = Unit price of each corresponding NTFP item sold by the household

The total annual value of the non-timber forest products to Yeak Loam commune (V_{ntfp}) is calculated as follows:

$$\mathbf{V_{ntfp} = \sum[(P*Q/73)*346]}$$

With Q = The total quantity of each NTFP item obtained by the 73 interviewed households (including the quantities obtained by those households that do not know the unit price); 346 stands for the total number of Yeak Loam households. The fact that some households do not sell the NTFP items does not mean that the items are valueless because should the households choose to trade them for cash, they might, in principle, be able to sell at the average unit prices that their fellow villagers obtain.

Analysis of the responses received for Questions 9-16 shows that bartering is not a common practice in Yeak Loam commune. This is partly due to its closeness to the market. Out of the total of 73 responses, 63 responses (86.3%) indicate that trading of non-timber forest products (NTFP) mostly takes place in the Ban Lung market, 6 answers (8.22%) show that trading takes place in both the market and within the village. Another 2 households (2.74%) stress that trading only occurs within the village, while the remaining 2 households or 2.74% point out that no trading ever occurs for them. Moreover, no costs seem to be incurred during the trading process of NTFP. This is because 90% of the interviewed households get to the market on foot (around 1.7 hours/per trip) while 10% by their own bicycle (0.6 hour/trip), which are both considered cost-less. The reason is employment opportunities barely exist for ethnic highlanders like Tampuen in Ratanakiri. Time is, therefore, treated as cost-less in this regard.

Some NTFP items such as field rats, squirrel sp. (konghain), squirrel sp. (komprok), and

birds have somehow limited market demand. Most trading of these items takes place among the Tampuen villagers within their respective villages. These constitute important sources of protein for the villagers since they are more abundant and regularly catch-able while most of the other forms of wildlife are only available on an occasional basis.

Tables 4.7a, 4.7b, 4.7c, 4.7d, 4.7e show the weighted average unit prices of various non-timber forest products in Cambodian currency *riel* (1 US$ = 4,000 *riels*). Barking deer, for example, has a weighted average price of 33,438 *riels* per head (Table 4.7a).

Table 4.7a Weighted Average Unit Prices of the Non-timber Forest Products - Aquatic Animals & Wildlife

Items	Fish (kg)	Frog (kg)	Crab (kg)	Shrimp (kg)	S. Snail sp./ Kachauv (kg)	Terapin sp./ Konthie (h)	Terapin sp./ Ondaek (h)	Deer / Proes (h)	*B. Deer / Chlus (h)
W.A.P (Riels)	2,648	2,639	1,564	2,302	713	22,500	4,667	200,000	33,438

W.A.P = Weighted Average Price/Unit
(kg) = kilogram; (h) = head (measurement unit)
*Barking deer has an average weight of 20 kilos each.

Table 4.7b Weighted Average Unit Prices of the Non-timber Forest Products - Wildlife

Items	W. Pig (h)	W. Chicken (h)	Chicken sp./ Moang To (h)	Civet sp. (h)	Porcupine sp. (h)	Field Rat (h)	Squirrel sp./ Konghain (h)	Squirrel sp./ Komprok (h)
W.A.P (Riels)	65,455	4,017	5,964	4,071	16,250	519	846	827

W.A.P = Weighted Average Price/Unit
(h) = head (measurement unit)
Civet sp. or Sompoiyt in Khmer has an average weight of around 2.5 kilos each.

Table 4.7c Weighted Average Unit Prices of the Non-timber Forest Products - Wildlife

Items	A-Nhi (h)	Pchong (h)	*Trokout (h)	Snake sp. (h)	Pigeon (h)	Bird (h)	Monkey (h)	Pangolin (h)
W.AP (Riels)	9,775	5,253	5,765	13,375	985	200	5,000	130,000

W.A.P = Weighted Average Price/Unit; (h) = head (measurement unit)
*Trokout is also known as "Varanus nebulosus", and weighs around 4.5 kilos each.

Table 4.7d Weighted Average Unit Prices of the Non-timber Forest Products - Medicine, Honey, Fruits and Vegetables

Items	Herbal Medicine (basket)	Honey (litre)	Rambutan (basket)	Mango (basket)	Phnieu (basket)	Malva Nuts (basket)	Bamboo Shoots (basket)	Vegetables (basket)
W. A.P. (Riels)	7,273	3,743	4,961	5,416	4,150	9,451	3,733	2,209

W.A.P = Weighted Average Price/Unit

Table 4.7e Weighted Average Unit Prices of the Non-timber Forest Products - Construction and Burning Materials

Items	S. Bamboo/ Russey Pok (st)	L. Bamboo/ Russey B'or (st)	S. Bamboo/ Russey Kley (st)	S.Bamboo/ Russey Prey (st)	S. Bamboo/ Russey Srok (st)	Rattan (vine)	Firewood (basket)
W. A.P. (Riels)	535	917	225	319	800	490	1,833

W.A.P = Weighted Average Price/Unit
(st) = stem (measurement unit).
S. = Small; L. = Large.

4.2 NON-TIMBER VALUE OF FOREST RESOURCES IN YEAK LOAM COMMUNE, RATANAKIRI PROVINCE

As previously discussed, the actual, monetary value of non-timber forest products to Yeak Loam local communities was calculated based on the weighted average price approach. Another calculation based on the market value approach was also conducted to reflect the value of non-timber forest products to Yeak Loam society as a whole. This is to serve the purpose of a comparative analysis between what benefits the villagers actually get from non-timber forest products and what benefits society derives from them.

4.2.1 Monetary Value to the Local Community

Based on the weighted average unit prices, the values of the non-timber forest products to the local community are estimated as per Table 4.8. More detailed results of the calculation are indicated in Appendix 4.8.

Table 4.8 Total Estimated Value of the Non-timber Forest Products to Yeak Loam Commune/Per Year

Items	Medic., Honey, Fruits & Veg.	Wildlife	*Con./B. Materials	**NTFP Yrly Value to Yeak Loam C. (Total)
Riels	46,906,235	79,811,352	182,743,839	**309,461,426**
US$ Dollars	US$11,727	US$19,953	US$45,686	**US$77,365**
Percentage	15%	26%	59%	**100%**

*NTFP Yrly Value to Yeak Loam C.= Non-timber Forest Product Yearly Value to Yeak Loam Commune.
Medic. = Herbal Medicine; Veg. = Vegetables; Con./B. = Construction/Burning.
Exchange rate: 4,000 Cambodian Riels = 1US$ Dollar (Sept. 98).
* Construction and burning materials include bamboo, rattan, and firewood/fuel etc...(excluding wood poles or timber).

The results of the research (Table 4.8) show that non-timber forest products contribute at least $US77,365 (or 309,461,426 *Riels*) to Yeak Loam indigenous communities per year (this is based on the actual prices that villagers obtained from selling the NTFP, which are

lower than market prices). Among the three groups of non-timber forest products, construction and burning materials constitute 59% of the total value. This is followed by aquatic animals/wildlife (26%), and medicine/honey/fruits and vegetables (15%).

In addition, firewood alone contributes 118,648,619 *riels* (US$29,662) to Yeak Loam villagers per annum or 64.9% of the total contribution by the construction and burning material group (182,743,839 *riels*). With regard to the aquatic animal and wildlife group, five non-timber forest products that rank highest in terms of the total monetary values are wild pig, field rat, fish, squirrel sp./*konghain*, and wild chicken, which constitute an annual value of $42,096,886 *riels* ($US10,524) to Yeak Loam communities or around 53% of the total contribution by the whole group (79,811,352 *riels*). Furthermore, vegetables and bamboo shoots constitute a yearly contribution of 38,270,507 *riels* (US$9,568) or 82% of the contribution by the group of medicine, honey, fruits and vegetables (46,906,235 *riels*).

4.2.2 Value to Society

Applying the market values and direct substitute approaches, the total value of non-timber forest products to the community surveyed as a whole is estimated to be around 577,214,313 *riels* or US$144,304 dollars per year as per Table 4.9.

The valuation of a few NTFP items is based on the direct substitute approach (i.e. the use of the market price of a farm chicken due to the absence of the market value of the wild chicken; commonly sold fish versus fish of varying species caught by the indigenous people, and so forth). These NTFP include fish, wild chicken, chicken sp./MoangTo, snake sp., and vegetable. The major criteria used are: (1) based on the market price at the same month/season with that of the interview period. This is because market prices may vary significantly in different seasons; (2) unit market price is multiplied by the average weight of each item (i.e. according to most interviewees, a wild chicken normally weighs around 1 kilogram, so its market value will be the sale price of one kilogram of a farm chicken).

Table 4.9 Total Estimated Yearly Value of the Non-timber Forest Products to Society (Based on Market Price)

Items	Medic., Honey, Fruits & Veg.	Wildlife	Construction/B. Materials	NTFP Yrly Value to Society (Total)
Riels	92,178,192	153,939,429	331,096,692	**577,214,313**
US$ Dollars	US$23,045	US$38,485	US$82,774	**US$144,304**
Percentage	16%	27%	57%	**100%**

Medic. = Herbal Medicine; Veg. = Vegetable; Construction/B. Materials = Construction and Burning Materials.
1 US$ = 4,000 Cambodian *riels*

Table 4.9 indicates that construction and burning materials constitute 57% of the total non-timber forest value to society as a whole. Wildlife/aquatic animals add up to 27% and other items such as herbal medicine, fruits, vegetables, and honey make up 16% of the total annual NTFP value to society.

4.2.3 Comparison Analysis

As presented in Sections 4.2.1 and 4.2.2, it can be seen that the actual monetary values (309,461,426 riels) that the indigenous villagers obtain from the non-timber forest products are much less than the social values of these resources (577,214,313 riels). In other words the total annual values of the non-timber forest products to the local communities of Yeak Loam commune are only equal to 54% of the actual values of these resources to Yeak Loam society. This seems to somehow reflect the difficulties faced by the indigenous peoples and the fact that they are disadvantaged in marketing – the situation that needs to be improved.

This is believed to result from a few major factors. Firstly, non-fluency in Khmer language reduces the indigenous peoples' negotiation capability. Secondly, lack of understanding of the existing market system and prices imposes difficulty for them to bargain to obtain the true market price for each product sold. Thirdly, urgent need for cash to purchase other daily necessities, and lacking patience and confidence in trading lead to hasty acceptance of poor offer by potential buyers, in particular, when they criticize or pretend not to be very

"interested" in the commodity. Finally, there appears to be a tendency for traders at the market to offer a much lower price to ethnic highlanders than Khmer or Chinese venders for the same commodity.

4.3 OTHER SOURCES OF INCOME AND RICE PRODUCTION

In addition to the previously discussed income generated by non-timber forest products, each household obtains an average additional income of 149,452.055 *riels* ($US37.36) per year as per the feedback received for Question 29 (excluding the monetary value of rice produced from the shifting cultivated rice fields). This is mainly cash income that villagers mostly earn from selling agricultural produce, livestock, and/or salary as a civil servant, and so forth. Multiplying the above figure by the total number of households (i.e. 346) gives 51,710,411 *riels* ($US12,927.6), which is the estimated total additional cash income for Yeak Loam commune each year (excluding NTFP and rice production). This figure is by far smaller than that of the non-timber forest products (valued at $US77,365.4 or 309,461,426 *riels*).

The annual monetary value of rice production for each household is estimated to be around 998,214.91 riels ($US249.55). This is calculated on the basis of information indicated in Section 4.1.2.1 and Appendix 4.9 (yield per hectare). This includes the average number of shifting cultivated rice-fields owned by each household (i.e. 1.575), the average size of each rice-field (i.e. 0.877 hectare), the average yield per hectare (i.e.722.56 kilos of rice/hectare), and the price of 1,000 *riels*/kilo that was obtained by most interviewed Tampuen villagers. The "average yield per hectare" is estimated based on the information provided by 35 out of the 73 interviewed households, representing a 47.95% response rate. However, since some information is still better than no information, this figure is used despite the slight possibility of bias.

Furthermore, most rice produced is just sufficient to serve the villagers' daily consumption, and trading of rice only takes place on an occasional basis to meet other needs. In other

words, rice production does not necessarily constitute cash income but the potential revenue whenever rice is traded in the market.

4.4 YEAK LOAM COMMUNE VILLAGERS' ESTIMATED TOTAL INCOME

4.4.1 Total Annual Income

There are three major sources of income for Yeak Loam commune villagers. These include monetary revenue from non-timber forest products (Section 4.2.1), income in the form of rice-production, and other income (Section 4.3) as reflected in Table 4.10.

Table 4.10 Total Estimated Annual Income by Commune and Household

Income Sources	Yeak Loam Commune	Each Household	Percentage (Tot. Inc.)
NTFP	309,461,426 (US$77,365.4)	894,397 (US$223.6)	43.8%
Rice Production	345,382,360 (US$86,345.6)	998,215 (US$249.6)	48.9%
Others	51,710,411 (US$12,927.6)	149,452 (US$37.4)	7.3%
Total	706,554,197 (US$176,638.6)	2,042,064 (US$510.6)	100%

*Unless specified, all figures in this table refer to Cambodian currency (*Riels*).
Tot. Inc. = Total Income.
US$1 = 4,000 *riels* (1998)

Table 4.10 indicates that out of the total estimated annual revenue of 706,554,197 *riels* generated by Yeak Loam communities, non-timber forest products contribute 309,461,426 *riels* (43.8%), rice production 345,382,360 *riels* (48.9%), and other sources 51,710,411 *riels* or 7.3%. This clearly shows the significance of forest resources to Yeak Loam communities because the two major sources of income (i.e. NTFP and rice production), which are closely associated with the forest, constitute around 92.7% of the whole commune's yearly revenue. In other words, unless Yeak Loam commune's forest resources are managed in a sustainable way, the local communities' subsistence level of survival will be severely affected, in particular, when alternative solutions such as employment opportunities are not favorable for indigenous peoples.

4.4.2 Association among Occupations, Activities, and Incomes

In order to have further understanding of various factors that may affect the indigenous peoples' life, Chi-square tests were conducted to verify if association exists among different occupations, activities, and incomes. The results are summarized in Table 4.11. Relevant detailed results are presented in Appendix 4.10.

Table 4.11 Occupations, Activities, and Incomes

Types of Activities/Occupations	Types of Incomes	Association	Chi-Square/Fisher's Exact P-Value (two-tail)
Fishing	NTFP Yearly Income	Yes	P=0.04396 < 0.05 (Fisher's E.) *P=0.0255 < 0.05 (Chi-sq. T.)
Hunting	NTFP Yearly Income	No	P=0.43314 > 0.05 (Fisher's E.) *P=0.3197 > 0.05 (Chi-sq. T.)
Rattan Collection	NTFP Yearly Income	No	P=0.93336 > 0.05 (Chi-sq. T.)
Vegetable Collection	NTFP Yearly Income	No	P=1.0000 > 0.05 (Fisher's E.) *P=0.77879 > 0.05 (Chi-sq. T.)
Chicken Raising	Other Annual Income	No	P=0.47905 > 0.05 (Chi-sq. T.)
Cow Raising	Other Annual Income	No	P=0.80044 > 0.05 (Chi-sq. T.)
Pig Raising	Other Annual Income	No	P=0.1070 > 0.05 (Chi-sq. T.)
Herbal Medicine Collection	Total Annual Income	Yes	P=0.04183 < 0.05 (Chi-sq. T.)
Hunter (Occupation)	NTFP Yearly Income	No	P=0.2685 > 0.05 (Fisher's E.) *P=0.2269 > 0.05 (Chi-sq. T.)
Student (Occupation)	Total Annual Income	Yes	P=0.02846 < 0.05 (Fisher's E.) *P=0.01452 < 0.05 (Chi-sq. T.)

*The P-value of Chi-square test is not reliable in this case since an expected cell value is below 5. Fisher's exact should be used instead.

Table 4.11 shows that there seems to be association between fishing efforts and annual non-timber forest product income, herbal medicine collection and total yearly income, and so forth. This seems to somehow coincide with the previously discussed important roles played by herbal medicine and fishing activities within the Tampuen communities of Yeak Loam (Sections 4.1.3.2 and 4.2.1). In addition, households that consist of family members, who are students, may shoulder additional economic burden in the absence of any sort of

social welfare in this respect. This can be due to more expenses that may have an impact on the already limited household income. On the other hand, there is not sufficient statistical evidence to confirm the association among other activities, occupations and incomes as reflected in Table 4.11. This can possibly be due to the relatively small sample size of this research. Any further research in this respect in future will be useful to reach a better understanding of various factors that actually affect the life of the indigenous communities.

4.5 POTENTIAL INCOME EARNING FOR THE NATION

Among the previously discussed non-timber forest products in Ratanakiri (Section 4.1.3.2), malva nuts are believed to have market potential to generate revenue for the nation if properly managed, since it is a delicacy in countries such as Vietnam, Hong Kong, and China (Bann, 1997). To achieve this potential, collaboration is needed between the Government and local communities.

Malva nuts are sold by villagers at an average rate of 9,451 riels ($US2.4)/per basket or around 2,300 to 3,000 riels/kilo, which is very low compared to the market price. Information provided by a few randomly selected stallholders trading in malva nuts is summarized in Table 4.12 as follows:

Table 4.12 Comparison of the Market Prices of Malva Nuts

Market Areas	Malva Nut Retail Selling Price/Kg	Malva Nut wholesale Buying Price/Kg
Ban Lung - Ratanakiri	6,000 riels ($US1.5)	Unknown[5]
Orrusey – Phnom Penh	17,000 riels ($US4.25)	14,000 riels ($US3.5)
Ho Chi Minh[6] - Vietnam	100,000 VN dong[7] ($US7.7)	80,000 VN dong ($US6.2)
Pleiku, Vietnam	90,000 VN dong ($US6.9)	75,000 VN dong ($US5.8)

Source: Stall-holders Trading in Malva Nuts in Cambodia and Vietnam

According to some stall-holders in Orrusey market in Phnom Penh city, malva nuts (dried) are normally sold at $17000 riels/kg and bought at $14000 riels/kg as per Table 4.12. Occasionally, the selling price may plummet to $5000 or $6000 riels/kg and the buying price is $3000 riels/kg when they are excessively abundant. Malva nuts are mostly bought from Veal Rin and Ream (National Route 4) of Kampot province; Sre Omboel (National Route 4) of Koh Kong province; and occasionally from Ratanakiri (Orrusey stall-holders). The Orrusey stall-holders indicate that Ratanakiri seem to produce more malva nuts than other provinces such as Kampot and Koh Kong in 1998[8].

Though there is virtually no difference in the price of malva nuts from the above-indicated provinces, most stall-holders claim that malva nuts from Ratanakiri are slightly better in quality.

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[5]People seem to be reluctant to reveal information on the actual buying prices in Ratanakiri. It seems that the common practice in Ratanakiri has been to press the buying prices down to a minimal possible level, especially if the sellers are "chunchiet" or ethnic highlanders.

[6] Most supply of malva nuts to Ho Chi Minh city was confirmed to be from Pleiku, a neighboring highland province with Ratanakiri of Cambodia.

[7]The exchange rate in Vietnam at the time of research in July 1998 was 12,980 VN dong = $1US dollar.

[8] In general, it seems that two provinces of Kampot and Koh Kong produce more malva nuts than Ratanakiri (further research is required in this respect).

Table 4.12 indicates that the price of the malva nut is many times higher in Vietnam than in Cambodia. This seems to suggest the existence of a potential export market, if it is properly controlled in terms of management and exports (i.e. sustainable harvest of the malva nut, excluding the possibility of smuggling across the border by the middle business persons, and so forth). The malva nut may generate revenue to the country, since the cropping cycle can be maintained at the traditional rate of once every three years, along with relevant tax collection.

The major questions are how to exploit the international market potential of the malva nut, and to promote its sustainability as a long-term source of income for the ethnic highlanders and for the Government by changing the current unsustainable harvesting and management practices as indicated in Section 4.1.3.2.

It is felt that five major steps may be worth considering. Firstly, an agreement needs to be achieved between the provincial government and the local communities on the share of responsibilities and benefits in the sustainable management of the malva nut. This can be in the form that actual management tasks lie with local villagers, while the provincial authorities take charge of technical input and facilitation of exports to an international market such as Vietnam, for example. Secondly, a control and monitoring mechanism, operated by the local community, needs to be established, which has to be supported by a transparent and enforceable, penalty system for trespassers. This requires close collaboration between the local communities and the provincial authorities. Thirdly, standard procedures governing the harvesting of malva nuts need to be developed with wide acceptance by the local communities and the Government authorities involved (further research is required in this). Outsiders need to be excluded from harvesting the resource except those from the local communities that have entered the agreement with the Government. Fourthly, taxing needs to be applied to the harvesting of malva nuts so that some funds can be created to promote the whole communities' common interest. This is to ensure that even those villagers who do not get the malva nuts have an incentive to jointly protect them for the public interest. In addition, Bann (1997) suggests that taxation be

based on either the quantity taken out of the forest or on the number of days of malva nut collection. Finally, public awareness of the long-term economic benefits of sustainable management of malva nuts needs to be raised to promote participation and collaboration.

Furthermore, it is important to stress that the above recommendation is based on the assumption that the Government may eventually recognize the roles of the indigenous communities in community-based forest management, the major policy implication of which will be further discussed in Section 6.3.2.

CHAPTER FIVE
INSTITUTIONAL FRAMEWORK
FOR FOREST MANAGEMENT

5.1 PROPERTY RIGHTS

5.1.1 Private and Public Goods

A private good, by definition, refers to a good that possesses the characteristics of divisibility and excludability (Perman et al., 1996). Divisibility implies that the consumption of a unit of a good by one person means that the specific unit of the good is no longer available for consumption by others. Divisibility is also referred to as rivalness or depletability by Perman et al. (1996). As a special characteristic of a private good, excludability means that whoever owns a unit of a good can prevent others from either gaining access to or consuming the unit of the good.

There are two schools of thought on the concept of a public good. Different from a private good, a public good can be defined to possess either the features of indivisibility and non-excludability, or indivisibility with or without non-excludability (Perman et al., 1996). Most environmental resources such as the national park, for example, meet the criteria of a public good. This is because an individual's visit to the park will not prevent others from doing so unless the number of visitors has reached such a high level as to cause congestion. The fact is straightforward in the sense that the services provided by the park such as recreation, wildlife experiences, and so forth are generally indivisible under a certain limit. In terms of excludability, two main issues are involved. Firstly, unless property rights of the park are allocated to an individual or organization by the government, no single individual can prevent others from visiting the park. Secondly, if property rights are allocated to an individual or organization, there is a certain level of exclusion such as gaining access to the park is subject to the payment of the entrance fee and compliance with certain regulations. However, such exclusion may not necessarily be enforceable, in particular, the case of a large park due to its physical characteristics (i.e. insufficient staffing to put it under control) (Perman et al., 1996).

5.1.2 Indigenous People and Property Right Issues in Cambodia

Property rights refer to the issue of entitlements, which define the owner's rights, privileges, and limitations for the use of the resource (Tietenberg, 1996). Property rights constitute an essential basis for a perfectly operating market system especially in the presence of externalities. An efficient property right structure is composed of four key characteristics such as *universality*, *exclusivity*, *transferability*, and *enforceability* (Tietenberg, 1996).

Universality implies that once private property rights to a resource are granted to an owner, all of the entitlements will be clearly specified. *Exclusivity* refers to the fact that only the resource owner has the entitlements of using or gaining benefits from the ownership of the resource, which can be in a direct or indirect way. Whatever costs are incurred from owning of the resource should also be shouldered by the owner. Non-owners require the permission from the owner prior to using or benefiting from the resource. *Transferability* is the possible transfer of property rights from one owner to another on a voluntary basis. Finally, *enforceability* implies the protection of the property rights from being violated.

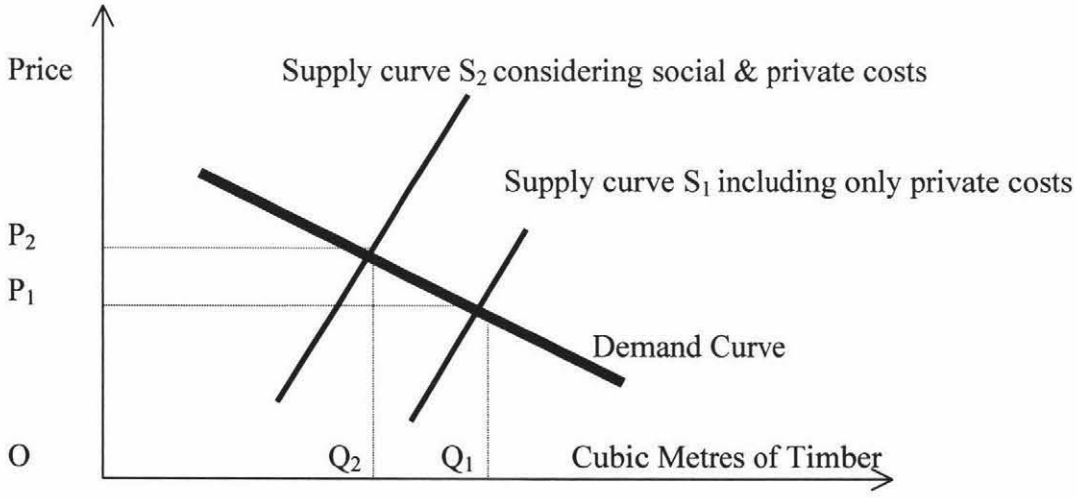
There are four main categories of property rights systems, which are commonly known as *private property*, *state property, common property*, and *open access property* (Bromley, 1991). *Private property* refers to the fact that the resource owner has rights in the use of the resource within a socially acceptable standard. Non-resource owners must avoid preventing socially acceptable uses of the resource by the owner while reserve the right to expect only socially acceptable uses to take place. *State property* implies that all potential users of the resource have the privilege of using the resource provided that they follow certain use and access rules determined by the responsible government institution. *Common property* implies the joint ownership of the resource by a group of individuals or a community, who possesses the right to prevent non-members from using the resource. In addition, such exclusion must be complied with by non-members. All members of the group or community are responsible for maintaining the resource. *Open access property* means that the resource has not been allocated to an individual or group. Everyone is entitled to using the resource and nobody has the right to prevent anyone else from gaining access to the resource. Nobody is made responsible of maintaining the resource.

The concept of property rights is continuously evolving. It is dynamic because it will change according to society's development of a new value basis, technology, and understanding.

Despite of the fact that Cambodia's forests are considered to be under the ownership of the state based on the Law-Decree on Forestry Administration (State Council No. 35 KR.C) and Article 58 of Chapter 5 of the Constitution (adopted on 21 September, 1993), they are, *de facto*, an open-access property. This is because exclusion and rule enforcement are not possible due to a wide range of factors such as lack of financial resources for monitoring by the responsible institution, poor law enforcement, non-compliance by individuals in power, widespread corruption, inaccessibility of certain regions due security and land mine concern. Furthermore, if the property rights of the country's forests can not be enforced, they are non-existent.

The major problem with an open access resource, such as Cambodia's forests, lies in the fact that when individuals weigh private benefits against private and not social costs of deforestation, there exists a tendency of over-exploitation of timber resource (Goodstein, 1995). This can be briefly presented in Figure 5.1 as below.

Figure 5.1 Exploitation of Cambodia's Forests - Social versus Private Costs



If property rights of Cambodia's forests are well-defined, law enforcement is efficient, and all concessionaires are forced to cover full social costs of timber extraction, supply curve can be shifted up (from S_1 to S_2) which means that less of the timber is supplied to society and at a higher price. This is under the assumption illegal logging ceases to

exist. As a result, there will be less forest exploitation. This scenario is, unfortunately, too perfect to be true for Cambodia in view of the current forest management challenges. The contrary is true in the sense that there exists an incentive to exploit timber as much as possible (S_1) due to the absence of relevant property right allocation, legal framework, and poor law enforcement. Moreover, the weakness of an open access property is that nobody has the incentive to control his/her level of exploitation since if he/she were to do so, there would be no guarantee that others would do the same. In addition, the possibility of being caught in excessively exploiting the resource in the case of an open access property is not that large, compared to the potential benefits.

Property rights are, in general, a most controversial issue in Cambodia. The legal framework and the concept of ownership for both private and public goods were destroyed during the Khmer Rouge's rule from 17 April, 1975 to 6 January, 1979. Cities were evacuated and emptied of residents, who were sent to remote villages to start a new lifestyle –"collective farming". The so-called "collective farming" under Khmer Rouge's rule meant nothing but labor-intensive and inefficient[1] work, hunger, torture, disease, and death. Millions of Cambodia people, who were trapped in the country during the Khmer Rouge regime, were ripped off any sorts of ownership and basic rights as human beings. For the Cambodian people during the Khmer Rouge's rule, nothing was worth more than one of human beings' basic requirements – rice.

Following the over-turn of the Khmer Rouge regime on 7 January, 1979, the newly established communist government at that time claimed ownership of virtually all resources, ranging from forest to land, housing, and so forth. During the early period of the newly established communist regime, whoever broke into a vacant house could easily claimed the rights to live, to let, or to sell without having to go through any sort of serious legal procedures except the agreement of the local authorities at the district level. On the other hand, those ex-owners that managed to retain the pre-1975 legal ownership documents could do nothing about this because the whole property right system simply ceased to exist. A private property right system was officially reintroduced many years afterwards under the form of the so-called 1992 Land Law.

[1] "Inefficient" in the sense that people have no incentive to work but to keep them alive under gunpoint.

However, no corrective measures have been taken with regard to the results of the previously mentioned chaotic situation. In other words, those who physically occupied others' properties right after the Khmer Rouge's rule can become legitimate owners under the Law, while the rights of the ex-owners are not recognized.

A question is hereby raised with regard to the customary forest land use rights of the indigenous peoples, who have been surviving in the same piece of the forest for centuries, and are now deprived of their presumed rights over the forest simply because the government has transferred land use rights to more well-off and powerful forest concessionaires. Worst of all, differing from the indigenous peoples, who have been relying on the forest for the sole goal of sustainable livelihood for generations, most of the concessionaires share a common goal – to maximize the investment profits by exploiting the forest as fast as possible, and stay ready to move on to a new place when nothing of value actually remains of the forest.

Furthermore, there have been numerous unsystematic allocations of land over the past few years by the central government. Among these are forest concessions (39% of the national territory), agricultural concessions (4%), military concessions (4%), leasing of fishing lots (4%), and protected areas (19%) (Butterfield, 1998). This has generated land use conflicts between the local communities and the concessionaires since the customary access right of the former to these forested areas have been challenged, while the latter have been granted exclusive right to exploit the areas. The fact that a large proportion of concessions were granted in the recent past in the areas where quite a few communities have been relying on the forests for subsistence level of survival has worsened the situation. Similar observation was made by Butterfield (1998) in this regard.

In a case study on Ratanakiri, Butterfield (1998) states that the recent influx of low-land Khmer migrants with the government's informal blessing has threatened the livelihood of the indigenous highland peoples in two ways. Firstly, these migrants are encroaching on the lands that the indigenous peoples claim through customary tenure systems. Secondly, these migrants can easily apply for land title (Butterfield, 1998). This clearly imposes serious land use pressure on the indigenous communities of Ratanakiri province of Cambodia.

In a similar study on land ownership, Colm (1997) states that most individuals, who have been granted land title in Ratanakiri, are either low-land Khmer or ethnic Lao residents. Most indigenous peoples or "highlanders" face four major obstacles in the application for land ownership. Firstly, despite the fact that indigenous peoples are considered Cambodian citizens, they do not normally possess identification documents, and are not proficient in Khmer language. This makes them either reluctant to approach relevant government departments/ministries for assistance, or inefficient in negotiation. Secondly, the extent of isolation of the indigenous communities from both the provincial town of Ratanakiri and Phnom Penh capital city constitutes an obstacle for the indigenous peoples in their attempts to contact relevant departments/ministries on administrative matters such as application for land title. Furthermore, financial difficulties make long distance travel impossible. Thirdly, unfamiliarity with both the 1992 Land Law and the concept of individual land ownership complicates the situation of the indigenous peoples (Colm, 1997). Little understanding and access to courts or legal assistance makes indigenous peoples vulnerable to cheating by more sophisticated land speculators, middlemen, or companies (Colm, 1997). Lastly, the unreasonably complex procedures in the application for land titling, unclear and non-standardized application fees make it almost impossible for the indigenous peoples to apply for land title due to financial constraints (Colm, 1997).

In general, most of the problems associated with property rights remain unsolved in Cambodia as of today, due to lack of clear and enforceable legislation and wide spread corruption. There are various recent efforts by the donor agencies to address issues related to Ratanakiri's indigenous land tenure. These include the International Seminar on Development in the Northeast in 1996, the International Development Research Center (IDRC) project in Yeak Loam commune in 1996 and 1997, and so forth.

The situation of Cambodia's indigenous peoples is by no means unique. A review of the existing literature shows that six Malaysian hilltribe groups of Borneo, the Penan, Iban, the Kayan, the Kelabit, and the Kenyah in Sarawak have been fighting to protect their homelands (Peng, 1989; cited in Park, 1994). This is because a lease of three-fifths of the forested area of Sarawak of Malaysia is granted to logging companies, which are clearing over 2000 square kilometres per year in the forest on which these indigenous peoples depend for survival (Park, 1994). Moreover, similar to different

indigenous peoples, the homelands of the Penan indigenous people were allocated to concessionaires unilaterally by the government (Park, 1994; Barraclough and Ghimire, 1995, p.132). Following various appeals to state and federal authorities for the recognition of the Penan group's traditional land rights which were completely ignored, the Penan started direct action against the loggers – an activity that later ended due to the intervention of armed police; however, the Penan people's fight goes on (Park, 1994; Barraclough and Ghimire, 1995).

History seems to suggest that no government policy will succeed without grass-root level support. The government's ignorance of the indigenous people's customary forest use right may do more harm than good. This is best reflected in a statement quoted by Srivastava and Chaturvedi (1989; page 92):

> *On the other hand if the natural resources of rural and tribal people are to be usurped and no alternative made available to them, the course of action for such people are few: they either steal, die of poverty, or are forced to migrate. The first opposition involves a continuous process of criminalization of people by the state* (p. 92).

In view of this inefficient situation and the open-access problems resulting from the current allocation of property rights, it is believed that indigenous peoples' customary use right over Cambodia's forests should be conditionally recognized by the Royal Government. This can be in the form of communal property rights over the forests with two major restrictions: (1) the property rights of the forests are not transferable (i.e. can not be sold), but can be passed on from one generation to the next within the community; (2) the communal ownership is in the form of a twenty to thirty year contract, which is renewable upon the satisfactory management by the local community.

The major reasons are fivefold. Firstly, the concept of communal property right is similar to most indigenous peoples' customary land tenure systems since the forested lands of the highland peoples have always been considered under the joint ownership of the whole community rather than individuals. In addition, it coincides with Article 10

of the existing 1992 Land Law, which is translated from the original Khmer document as follows:

Article 10:

> *Real estates and the rights on those estates can sometimes be under private ownership of a single person or many persons that have a share of that one property or that one right which may not be separable; sometimes, it is a communal property jointly owned by one group of people or the whole population...*

Secondly, Article 74 of the 1992 Land Law seems to suggest that highland peoples be entitled to land ownership in view of their long-term reliance on the forested areas. This Article is translated as below:

Article 74:

> *With regard to real estate, whoever possesses a piece of land peacefully, honestly, publicly and unambiguously for a period of five consecutive years, provided that the land is available and has not been recorded under the official registry as under the ownership of anyone else, the temporary possessor can be granted legitimate ownership of the land.*

In addition, Article 70 is as below:

Article 70:

> *The behavior of leaving land vacant to allow fertilization is not considered as abandonment. Such a manner of keeping the land is also considered as continuous possession of the land.*

This Article seems to indicate that the indigenous peoples' fallow "shifting cultivated rice-fields" should remain under their ownership even though they may not use these for a few years.

Thirdly, since the government is not likened to a private corporation, which has the sole goal of profit maximization, the indigenous peoples' issues should be viewed from a wider perspectives such as culture values, indigenous rights, and so forth. Indigenous rights are reflected in a statement quoted from Article 27 of the International Covenant on Civil and Political Rights (ICCPR), which Cambodia has acceded to:

> *In those States in which ethnic, religious or linguistic minorities exist, persons belonging to such minorities shall not be denied the right, in community with the other members of their group, to enjoy their own culture, to profess and practice their own religion, or to use their own language* (Article 27, p. 10).

In other words, indigenous peoples should be given a chance to make their own decisions and choices. By saying so does not imply that indigenous peoples have the exclusive right to be protected over other low-land Cambodian people. The main thing is that, given the poor understanding of the modern society by the indigenous peoples due to their isolated lifestyle and limited access to education, compared to that of the low-land Cambodian people, the indigenous peoples should be provided with some sort of protection until they are capable of making informed choices of their own whether to retain the current lifestyle or to adapt to the rapidly changing world.

Fourthly, it is observed that by transferring the property rights of forests to the concessionaires, little revenue has actually been collected for national benefits partly due to the cheating behavior by some concessionaires, who either under-declare the amount of timber exploitation to reduce taxation costs or get involved in illegal logging activities under the auspices of the legal concession contracts (information provided by the Ministry of Environment). This seems to be in line with a statement by Forest Policy Assessment (1996) that Cambodia's total revenues from the forest was only US$20 million in 1995 as opposed to the estimated US$100 million per year due to underdeveloped policies and weak forest administration. A crucial question arises here is that since the allocation of the property rights of the forest to private concessionaires may not necessarily ensure sustainable forest management, is it not justifiable to transfer property rights of parts of the forest to indigenous communities, who have been relying on the forest for centuries without having actually destroyed them?

Finally, once forests are transferred to the local indigenous communities under the conditions that they can not be sold, and are subject to the government's review in twenty to thirty years, these forests will become a kind of "common property jointly owned by the whole community". If the specification of property rights to forest resources clearly indicate local communities' rights to manage the forest resources in a sustainable way, and have a share of the forest revenue (i.e. non-timber forest products), this will generate an economic incentive for the local communities.

Once the villagers realize that any breach of sustainable principle may result in the cancellation of the communal forest rights, they may formulate a kind of binding agreement among themselves that each of them has equal rights and duties to preserve the resource for the whole community's benefits, which is similar to the so-called community-based resource management approach. The scenario of an open access property may cease to exist.

5.2 FOREST MANAGEMENT STRUCTURES AND POLICIES IN CAMBODIA

5.2.1 An Overview

Cambodia's government structures are composed of two major levels, namely, the central or national government, and the municipal/provincial authorities. Below the municipal/provincial levels we have district, commune, and village levels.

The central government is represented by a body known as Council of Ministers, which is chaired by the Prime Minister. The composition of the Council mainly consists of Prime Minister, Deputy Prime Minister, Senior Minister, Minister, and Secretary of State (Law on the Organization and Functioning of the Council of Ministers adopted by the National Assembly on July 19, 1994). There are twenty-seven ministries/state secretariats in Cambodia.

Each of the Municipal or Provincial authorities is led by a Mayor or Provincial Governor respectively. Some of the technical ministries are duplicated at the municipal and/or provincial levels respectively such as Municipal Department of Agriculture, Provincial Department of Agriculture, Provincial Department of Rural Development,

and so forth. These municipal/provincial level departments report directly to either the respective Mayor or Provincial Governor, who then reports to the Co-Ministers of Interior. Communication between the municipal/provincial level departments and the respective ministries is only on an occasional basis. In addition, various development committees have been established, in particular, in the Northeast provinces of Cambodia. The Provincial Rural Development Committee (PRDC), which is chaired by the Provincial Governor, consists of representatives of various provincial-level technical departments. Below the Provincial Rural Development Committee (PRDC) are the District Development Committee (DDC), the Commune Development Committee (CDC), and the Village Development Committee (VDC).

As previously discussed in Chapter One, the major official players in forest management are the Department of Forestry and Wildlife (under the Ministry of Agriculture), and the Ministry of Environment (protected areas only). In addition, although the Department of Land Title is not an official key player in forest management, its functions do have some linkage in this regard since it is in charge of administrating the 1992 Land Law. In other words, it deals with the conversion of completely degraded forested land into agricultural land upon the recommendation of the Department of Forestry and Wildlife. It is such interpretation of which land can be converted into agricultural land that constitutes a matter of concern due to lack of clarity and transparency. The Department of Land Title reports directly to the Council of Ministers, and has a nation-wide network of Provincial Departments of Land Title. The major official institutions involved in forest management are presented below.

5.2.2 Department of Forestry and Wildlife

The Department of Forestry and Wildlife is Phnom Penh based, and has been under the command of the Ministry of Agriculture, Forestry and Fisheries since 1979. There is a network of Forestry Offices, which are based at the municipal/provincial levels, and fall under the operational command of the respective Municipal or Provincial Departments of Agriculture. There is no clear specification with regard to the responsibilities at the different operational levels between the Department and the Provincial Forestry Offices (Report on Establishment of a Forest Resources Inventory Process in Cambodia, 1998). In addition, provincial authorities have remarkable power in forest exploitation (Report on Establishment of a Forest Resources Inventory Process in Cambodia, 1998).

There are around 800 foresters working for the Department of Forestry and the Municipal/Provincial Forestry Offices, who were recruited by the Ministry of Agriculture, Forestry and Fisheries from candidates nominated by the Ministry of Public Works and Transportation (information obtained from the Department of Forestry in May 1998). However, only a small fraction of these staff members are actually qualified by the international standard.

According to senior Department officials, during the pre-1970 period, the Department of Forestry used to play the role of a national body fully responsible for forest management before the law, and forest management was not within the authority of Provincial Governors. The channel of command was straight-line from the Department of Forestry to the Forestry Zones since the Kingdom of Cambodia was mainly divided into four Forestry Inspection Zones known as Coastal Zone (Koh Kong, Kampot, and Kompong Som city), East Mekong river, North Tonle Sap lake, and South Tonle Sap lake. In each Forestry Zone was a Forestry Inspection, Forestry Division, and Section. As forest management occupied a much less important position within the mind of the subsequent leaders in various regimes after 1970, the roles of the Department faded accordingly.

With regard to reporting procedures, national reports to the Royal Government are normally prepared and submitted by the Ministry of Agriculture and not the Department of Forestry and Wildlife, while provincial level reports are compiled by the Provincial Departments of Agriculture and not the Provincial Forestry Offices. This creates a major difficulty for the Department to perform its tasks since it does not have a direct voice on issues related to forest management as opposed to its mandate.

5.2.3 Ministry of Agriculture, Forestry and Fisheries

The Ministry of Agriculture was established under a sub-decree no. 18 on 2 October, 1984. The Ministry is in charge of the whole agriculture sector of the Kingdom of Cambodia, and consists of a network of Provincial Departments of Agriculture throughout the country.

In terms of institutional set-up, the Ministry of Agriculture is composed of both internal and external departments. Internal departments are physically stationed within the

Ministry compound, and provide administrative support to the operation of the Ministry. These include Departments of Accounting, Planning, Personnel, Administration, and Inspection. Differing from internal departments, external departments are physically located outside of the Ministry building, and perform a wide range of independent, technical functions. These consist of Department of Forestry and Wildlife, Department of Fisheries, Department of Agronomy, Department of Agricultural Machinery, Department of Agriculture and Extension, and Veterinary Department. Department of Hydrology used to fall under the command of the Ministry, and has recently been upgraded into a ministerial level body following the July election in 1998.

5.2.4 Ministry of Environment

The Ministry of Environment was upgraded from the State Secretariat for Environment, which was established in 1993. The Ministry of Environment consists of 200 to 300 staff members nation-wide, yet it is short of forestry staff. It consists of six major departments known as Department of Nature Conservation and Protection, Department of Planning and Legal Affairs, Department of Environmental Impact Assessment, Department of Inspection, Department of Environmental Data Analysis and Social Economy, and Department of Environmental Education. In addition, the Ministry has 23 provincial and municipal offices.

As a newly established ministry, the Ministry faces various constraints, ranging from financial to human resources. According to the information obtained from a project of the United Nations Development Programme in May 1998 (ETAP), the 1998 national budget allocation for the Ministry dropped significantly. A question is raised with regard to the role of the Ministry. Is it going to be given the power to perform its major tasks in monitoring the country's environmental situation and preservation of the "protected forest areas"? Or is it existing simply to please the international donor community?

At the provincial level, Provincial Departments of Environment now report to both the Governor and the Ministry of Environment instead of reporting to the Governor first prior to being forwarded to the Ministry as before. This seems to be a major

improvement in the line of communication but how effective it can be is unknown at this early stage.

5.2.5 Major Coordination and Policy Issues

There seems to be serious coordination issues among and within different ministries/departments in forest management. The major causes stem from problems such as absence of a functional institutional system guided by clear procedures and guidelines, attitude issues, and lack of trust among individuals concerned. Leaders are generally reluctant to decentralize their power to junior staff members while staff members are afraid to take initiatives due to the fear of being made accountable for any unexpected bad consequences. Ministries do not often collaborate directly with departments due to their "seniority". In addition, information means power in Cambodia. The above factors hamper sharing of experiences or information for mutual improvement and progress. This is manifested in the fact that the Department of Forestry and Wildlife does not have the necessary power to perform its task since there is a tendency for other institutions to bypass the Department by directly approaching the Ministry of Agriculture, Forestry and Fisheries for assistance. The Ministry of Environment coordinates with the Ministry of Agriculture directly instead of the Department of Forestry and Wildlife. Sometimes, the coordination only takes place at a very senior policy level with very little technical inputs by technical departments. Similarly are the dilemma faced by the Provincial Forestry Offices since both the Provincial Departments of Agriculture and Provincial Governors have a final say in the overall decision-making process.

In addition, in a case study on land use, Butterfield (1998a) indicates that due to fact that the responsibilities for enforcement of central government decisions are poorly defined between central and provincial institutions, little enforcement of regulations has materialized. Very often actual enforcement or non-enforcement relies on the local levels such as province, district, commune, and village (Butterfield, 1998a). Moreover, vertical coordination between the central government and provincial governments is very poor (Butterfield, 1998a). An example is the central government's approval of forest concessions without consulting or informing provincial authorities or provincial technical departments (Butterfield, 1998a). The consequences were that some of villagers' rice-fields were included in the concessions.

With regard to forest policies, Cambodia still very much relies on the Law/Decree on Forestry Administration (State Council No. 35 KR.C), which was adopted in 1988 when the concept of sustainable forest management was still alien to the country. No integrated and comprehensive legislation on forest management has been developed to provide a solid foundation for sound policies in this regard. The absence of a well-defined coherent forest policy along with excessive logging and political instability are threatening the existence of Cambodia's forests (Report on Establishment of a Forest Resources Inventory Process in Cambodia, 1998).

5.3 COMMUNITY FORESTRY

5.3.1 An Overview

Community forestry refers to community-based forest management, which emphasizes the role played by forest-dependent communities in the management and sharing benefits of forest resources. It is socially oriented in terms of goals and implementation, and may involve the local community either on the basis of a community or an individual (Fox, 1997). Community forestry may cover various activities such as sustainable management of forests, agroforestry, reforestation, and roadside plantations (Ford Foundation, 1998).

It seems that there are two major schools of thought with regard to the interpretation of the term "community forestry". Some studies either consider the term "community forestry" synonymous with "social forestry" or use these terms interchangeably, while others treat them separately. An example is the statement by Ford Foundation (1998) that "community forestry" may be referred to as *upland development* in the Philippines, *social forestry* in Thailand, and *joint forest management* in India. Other commonly used terminology include *rural development forestry*, *community-based forestry*, and *forestry for sustainable rural development* (Ford Foundation, 1998). Similarly, Fox (1997) considers the above terms to be interchangeable. On the other hand, Rerkasem et al. (1997) indicate that distinction exists between these terms "community forestry" and "social forestry". Rerkasem et al. (1997) quoted a definition of "community forestry" by Gilmour and Fisher (1991) as below:

> *...the control and management of forest resources by the rural people who use them especially for domestic purposes and as an integral part of their farming systems* (p. 11; cited in Rerkasem et al., 1997).

According to a model developed during a community forestry workshop participated by delegations from Thailand, Laos, and Vietnam, social forestry is composed of community forestry (community-managed systems) and farm forestry (individual-managed systems) (Rerkasem et al., 1997).

First State of the Environment Report (1994) indicates that community forestry consists of two major characteristics. First, forest management agreements are based on local communities' existing resource management approaches. Second, there should be community participation in the preparation of forest management plans and benefit sharing agreements, taking into account local needs. In addition, decentralization of the management systems is down to the village level.

It is this definition that constitutes the focus of this research since the major target groups are the Tampuen indigenous villagers of Yeak Loam commune. As opposed to "community forestry", "social forestry" may refer to the types of community projects in the Philippines and India during the 1970s, in which community participation was utilized as a form of cheap labor either to accomplish government reforestation purposes or to serve commercial plantations (First State of the Environment Report, 1994). Such centrally managed initiatives involve little local participation in decision-making (First State of the Environment Report, 1994).

In addition, Fisher and Gilmour (1990) indicate that different from the classical approach in forest management, which focuses on the important roles of forestry professionals in three stages of problem identification, strategy determination, and actual implementation, the recent people-centered approach relies on both forestry professionals and users/local villagers in carrying out the above three steps (cited in Rerkasem et al., 1997). In other words, this seems to reflect the current change in forest management approach that calls for more community participation rather than the traditional top-down style, and may be referred to as community-based forest management or community forestry.

Community forestry is a new concept in Cambodia. It was mainly introduced into the country by international donor agencies, which brought with them experiences of other countries. Reforestation was initiated by the government in 1985, which has been based on the top-down approach with little participation by the local communities, resulting in disputes between local communities and forestry officials in early 1990s (First State of the Environment Report, 1994). This called for the need to adopt a more participatory approach in forest management, which would be based on a partnership basis between the government and local communities.

The first of this kind was introduced by CONCERN in 1990 in the form of a reforestation program of Acacia species in the district of Kompong Tralaugh, Kompong Chhnang province. The ultimate aim of the initiative is to eventually transfer management responsibilities to the local communities instead of being a donor-driven exercise. Similarly, Mennonite Central Committee (MCC) collaborated with the Department of Forestry and Wildlife in 1992 in a community forestry initiative in the "Prey Ler forest" of Tramkok district, Takeo province.

A most recent development of the concept of community forest in Cambodia is reflected in the 4,500 hectares of evergreen forest known as "Ya Poey Forest" of Ratanakiri province, which has been granted by the Ratanakiri provincial authorities to six villages of the Kreung minority group for management (Paterson, 1997). "Ya Poey Forest" is the place where these villages have been traditionally relying on for non-timber forest products. This is the first time such a decision is made by the provincial authorities, pending final endorsement by the Ministry of Agriculture, Forestry and Fisheries.

The concept of community forestry has become popular following increasing awareness of the importance of a joint partnership between the government and local communities since there is no way for the government to complete such a task on its own. Community forestry has been adopted by various countries in Southeast Asia such as Thailand though its implementation has not been straight-forward, which will be briefly presented as below.

5.3.2 Thai Experiences

With a total land area of 514,000 square kilometres, Thailand's forest cover constituted 53 percent of the land area in 1961, and was reduced to 29 percent by 1988 (Attisongkroh, 1989). Having realized the potential implications of rapid forest depletion, the Thai government was forced to react. This is manifested in the preparation of a Thai Forestry Sector Masterplan in 1992 and the current on-going process of preparing the Community Forestry Act (Rerkasem et al., 1997).

Community forestry initiatives began in 1987 in Thailand under the form of a Thailand Upland Social Forestry Pilot Project, aiming at assisting the Royal Forest Department to achieve government policy objectives through the development of social forestry approaches and field techniques required in the implementation of the Royal Forest Department programmes (Royal Forest Department, 1989; cited in Rerkasem et al., 1997). These approaches and techniques were essential for use in reserved forested areas where most of the local indigenous communities lived.

What is most controversial in the case of Thailand is that since most of the few remaining natural forests are located in Northern Thailand, they are classified as "conservation forest", and this greatly threatens the livelihood of the indigenous peoples living in the area. Since the government's relocation programmes targeting these villagers failed in the past due to a variety of factors such as food insufficiency, poor resettlement area, and so forth, the current alternative approach is to regroup hilltribe communities in the crucial protected areas on a voluntary basis (Rerkasem and Apichatpongchai, 1997). How successful the current solution will be still remains questionable.

Finally, the previously discussed draft Community Forest Act serves two major purposes (Rerkasem and Apichatpongchai, 1997): (1) to allow the local communities to apply for land use right; and (2) to promote community participation in the long-term rehabilitation of degraded forests. However, the major concern about the draft Act is that it is not applicable in the natural forest, where most indigenous communities have been living since a long time ago (Ganjanaphan, 1996). In other words, indigenous peoples' customary practices in forest management are not taken into consideration. This seems to indicate that the so-called "community forestry" in Thailand is *de facto*

government driven "top-down approach" rather than "people-centered and participatory approach" as defined in the true sense of the term "community forestry".

5.3.3 Major Challenges of Implementing Community Forestry in Cambodia

As discussed in Section 5.1.2, the conditional allocation of property rights of the forest to the local communities or community forestry can be an effective way of promoting sustainable forest management. This is because there is reason to believe that centralization of forest management at the national level, little community participation at the local level, and other factors such as corruption, excessive exploitation of forests for economic revenue lead to unsustainable forest management. In addition, Poffenberger (1990) proposes a joint management approach between the responsible government institutions and the local communities instead of transfer of all forest rights to the communities as a possible solution. There are two major advantages of this approach. First, joint management provides the relevant government institutions with the possibility to intervene whenever there is a violation of the principle of sustainable management of forest resources by local communities. Second, community participation and profit-sharing may enable the responsible institutions to benefit from the local knowledge and labor of local communities in fine-tuning management practices to adapt to the unique hydrological, biological, and economic situations of smaller tracts of forest (Poffenberger, 1990). However, the potential constraints of joint management of community forestry lie in the fact that government institutions do not always collaborate effectively with local communities. The reason is mainly due to the bureaucracy of the institutions as well as the bureaucratic attitudes of most government officials, who tend to believe that they are better educated and informed than the local villagers.

Furthermore, similar to most less developed countries in Southeast Asia, Cambodia faces a wide range of major constraints, which need to be overcome if community forestry is to be successful. Firstly, due to low education level and illiteracy, local communities may not necessarily understand the term "community forestry" in the right sense of the word. In other words, efforts should be made to raise their understanding of the "obligations and responsibilities" involved in "community forestry". Secondly, caution should be made with regard to who actually represent the local communities. This is because it is almost a common practice to consider chief of

a village, for example, as someone who represents the village. This may not necessarily be true because some village chiefs are just people who have close relations with the local authorities. It is therefore important to ensure that whoever represents a local community in the negotiation with the government must be a genuine advocate of the community's interest. Thirdly, it is a challenge for government officials to change their attitudes towards the local communities since they have been practising "top-down approach" for decades. Fourthly, Cambodia's community forestry initiatives are still happening on a haphazard basis, and it may take time to convince the central government that the approach of community forestry really works.

In addition, as reflected in the Thai experiences, there seems to be no perfect blueprint for the implementation of community forestry since it relies on the government's policies and political agenda. However, two major points can be drawn from the Thai lesson is that community forestry does not mean anything if there are no concrete efforts of involving local communities in decision-making that may affect their life. In addition, advance planning is crucial to avoid the scenario in which the government has to continue doing things on a trial and error basis.

In general, community forestry is a potential solution to Cambodia's forest management problems because as previously indicated the success of any government policies relies on local support. This, however, can only be effectively mobilized if there are appropriate economic incentives attached such as a reasonable and fair share of the benefits of sustainable forest management, and so forth.

CHAPTER SIX

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 SUMMARY - ACHIEVEMENT OF RESEARCH OBJECTIVES

Six major objectives were set prior to the implementation of the study (Section 1.2). These objectives have been achieved by this study as presented below:

6.1.1 Objective One

To develop an overall understanding of non-timber forest products based on existing knowledge.

The achievement of this objective is reflected in the extensive review of the existing literature on non-timber forest products and their market potential in income generation presented in Chapter Two. Furthermore, the survey results provide a clear picture of Cambodia's major non-timber forest products and their roles in the livelihood of the Tampuen villagers at Yeak Loam commune of Ratanakiri (Chapter Four).

The major findings under this objective are threefold. Firstly, Cambodia's forests are valuable in terms of species diversity, but that in the main these forests have not been managed in the past for non-timber except timber revenue. The contribution of non-timber forest products to the livelihood of the local indigenous communities appeared not to be important to the Cambodian Government, even though various overseas studies have shown the important role played by non-timber forest products in income earning of other Asian countries.

Secondly, Yeak Loam commune is a typical forest dependent area, where the indigenous local Tampuen communities have been relying on the forest for non-timber forest products and shifting cultivated land, among others, for generations. This is manifested in the fact that 100% of the interviewed households stated that they were familiar with the Yeak Loam forest since they were born in their respective villages within the commune.

Thirdly, Yeak Loam commune villagers rely heavily on three major groups of non-timber forest products, namely aquatic animals and wildlife; herbal medicine, honey, fruits and vegetables; and construction and burning materials. Among these non-timber forest products, malva nuts are found to have a great market potential as discussed in detail in Section 4.5.

6.1.2 Objective Two

To identify the non-timber value of forest resources at Yeak Loam commune.

This objective has been achieved in the sense that the values of non-timber forest products to Yeak Loam commune were estimated based on returns to the villagers and on returns to society (Chapter Four).

The findings are threefold. Firstly, the total estimated yearly contribution of non-timber forest products to Yeak Loam communities is 309,461,426 *riels* (or US$77,365.4), which constitutes an average of 43.8% of the total annual income generated by the whole commune. Yeak Loam commune's total annual income consists of the income from non-timber forest products, rice production 345,382,360 *riels* (US$86,345.6 or 48.9% of the total yearly income), and income from other sources 51,710,411 *riels* (US$12,927.6 or 7.3%). Secondly, at the household level, each household is estimated to earn, on a yearly basis, an average of 894,397 *riels* (or US$223.6) from non-timber forest products.

Thirdly, the annual value of non-timber forest products to society (based on the market value) is estimated to be 577,214,313 *riels* (or US$144,304). The difference between the returns to the villagers and society shows that indigenous communities experience marketing difficulties and are often disadvantaged in trading compared to other Cambodian ethnic groups such as Khmer or Chinese due to Khmer language barrier, little education and understanding of the Cambodian society. The monetary value that the indigenous people obtain from trading the non-timber forest products is only equal to 54% of the actual value of these resources to society (i.e. the value that people are willing to pay in Ratanakiri). One may argue that the difference in the above values can be due to middlemen margins. This is, however, not true in the sense that even when indigenous people trade their goods directly at the market (quite a few

interviewed households did), they can not get any better price than what they currently obtain. This is not the case for other Cambodian ethnic groups such as Khmer or Chinese.

6.1.3 Objective Three

To identify the local villagers' needs, dependence level on the forest resources, concerns, and alternative solutions, if any.

This objective has been accomplished through addressing issues such as the local communities' level of dependence on the forest, their needs, concerns, and options in Chapter Four.

The main findings are fivefold. Firstly, at least 92.7% of the Yeak Loam communities' total annual income relies on the forest. This clearly indicates that sustainable forest management is not only important for the country but also for these local communities.

Secondly, Yeak Loam commune seemed to have suffered a serious loss in forest resources over the past decades. 93.2% of the interviewed households indicated that the current level of dependence on the forest was much less compared to that of 10 years ago. Furthermore, 65.8% of the interviewed households stated that the current reliance on the forest was much less compared to that of 20 years ago, and so forth. This seemed to coincide with the recollection of quite a few village elders that the present Ratanakiri provincial town area used to be covered by dense forests that were occupied by a great variety of wildlife.

Thirdly, data analysis also indicated that there seemed to have been a significant reduction of some non-timber forest products such as fish, frog, shrimp, and so forth, between the 1980s and 1998. This seemed to coincide with villagers' claim that non-timber forest products had decreased as a result of unsustainable exploitation and forest loss.

Fourthly, there is an emerging awareness by Yeak Loam communities of the possible impact of unsustainable forest exploitation on their livelihood. 59% of the total interviewed households expressed concern about current forest use, while 77% of the total interviewed households indicated concern in the use of the forest in future. The

major causes of concern were rapid forest loss (52% of the total interviewed households), rapid forest and land losses (11%), rapid forest and food/wildlife losses (8%), and so forth. The villagers' overall assessment of the current forest management was unsatisfactory.

Finally, 97.3% of the interviewed households indicated that they had no alternative solutions except relying on the forest, 1.4% stated that moving elsewhere could be an option while another 1.4% thought of seeking employment as an alternative.

6.1.4 Objective Four

To review the existing forest management policies, practices, as well as the roles of major stakeholders in Cambodia.

This objective has been achieved by the discussion of existing institutional forest management set-up, practices, and the roles of major stakeholders in Cambodia in Chapter Five.

Two major findings, which are a matter of grave concern, are presented as follows. Firstly, with regard to the institutional forest management set-up, information obtained from some studies and government institutions seemed to indicate that there were coordination problems between central and municipal/provincial governments as well as within and among various government ministries and departments. Secondly, the Department of Forestry and Wildlife was mandated to manage Cambodia's forests without actually having the power to do so, in the absence of an integrated forest management policy, and with overlapping roles and responsibilities among various ministries/departments.

6.1.5 Objective Five

To review the concept of community forestry and the major constraints/challenges involved in promoting the approach within the Cambodian context.

The accomplishment of this objective is manifested in the detailed discussion of Cambodia's property right situation and the applicability of community forestry within

the Cambodian context (Chapter Five).

The main findings under this objective are twofold. Firstly, some studies have made the suggestion that the indigenous communities' customary forest land use right should be recognized by the Government. This could avoid conflicts and create incentives for better forest management since it might not be possible for the Government to achieve sustainable forest management alone without local participation.

Secondly, the existing literature seemed to somehow indicate that community forestry could be a potential solution to Cambodia's forest management problems though the challenge could be great since it implied the shift from the current top-down management to a people centered participatory approach. Other possible obstacles might include poor local understanding of the obligations involved in the concept of community forestry, the government officials' bureaucratic attitudes towards the local communities, and so forth.

6.1.6 Objective Six

To provide recommendations on what the Royal Government should do to replace the existing unsustainable forest management practice by a more sustainable, community-based forest management approach, taking into consideration the local indigenous cultures and traditions.

This objective has been achieved as reflected in Section 6.4 of this chapter that provides recommendations on the essential steps to achieve sustainable forest management.

In general, this study relied on information obtained from village-level interviews with 73 households of the five villages of Chree, Lapoe, Soel, Lorn, and Phnom of Yeak Loam commune, from meetings with Yeak Loam commune civic leaders and village elders, from meetings with a wide range of related government institutions and donor agencies, and from the existing literature.

6.2 CONCLUSIONS

A few major conclusions can be drawn from this study. Firstly, it does make socio-economic sense to preserve Cambodia's forests, in particular, in the provinces where indigenous people have been living for generations such as Ratanakiri, Mondulkiri, and Stung Treng, which constitute 10.18%, 9.94%, and 8.44% respectively of the country's total forest cover (Section 3.1.1).

The reasons are six-fold, namely: (1) Cambodia's forests generate a wide range of non-timber forest products, which are of a significant value to society and will be destroyed when the forests are exploited; (2) if properly managed, non-timber forest products have a great potential in generating revenue for the country, in particular, foreign exchange from exports (i.e. the malva nut) without creating negative impact on the forests or environment like timber exploitation; (3) as a result of poor management and law enforcement, only a small fraction of the current revenue from timber exploitation is actually contributed to national budget (Section 5.1.2), which means a loss to the country if timber exploitation continues in the present manner; (4) non-timber forest products have been playing an essential role in the subsistence survival of the local indigenous communities, who have no alternative livelihood opportunities. If forests are exploited for timber, these non-timber forest products will cease to be available and the local communities' life will be jeopardized. The consequences can be more pressure on whatever forest land remains and a wide range of social problems; (5) conservation of the forests also means preservation of the indigenous cultures and rights, which are part of the Government's commitment since it has acceded to the International Covenant on Civil and Political Rights (Section 5.1.2). Furthermore, preservation of indigenous cultures is the foundation for the Government's promotion of eco-tourism; (6) there are further environmental benefits such as biodiversity, watershed protection, carbon storage, and so forth, which were not measured due to data constraints but which also present reasons for preservation of the forests.

Secondly, limited understanding of Cambodia's non-timber forest products by the Government has led to over-reliance on timber as a major source of national income, while down-sizing the potential benefits of non-timber forest products. This is worsened by lack of a detailed and updated forest inventory, which imposes difficulty

in forest management, and is believed to have contributed to Cambodia's unsustainable forest exploitation. In other words, forest preservation is a better option in the absence of the guarantee that timber exploitation can be conducted on a sustainable basis.

At the moment there is little reason for expecting that current timber exploitation can be conducted sustainably. This is because of three major factors. First, the maximum annual allowable cut is based on outdated data (i.e. the last forest inventory was conducted in 1969 as discussed in Section 1.6). Second, the country is governed by widespread corruption and law enforcement, which does not contribute to controlled exploitation. Third, concession contracts and deforestation plans are not based on updated forestry data, and can put the country's forests at the risk of overexploitation. For all these reasons, sustainable management is clearly not what is happening today and the current situation, which does not allow regeneration of the forest, could lead to a collapse of the whole eco-system.

Thirdly, there is a great deal of local indigenous knowledge on forests and non-timber forest products, which is based on the villagers' long-term experiences. If such local experiences can be properly used along with relevant scientific forestry management techniques, it is believed that Cambodia's forests can be managed in a more sustainable way. This is because it is the local indigenous communities, who have been living in the area for generations without having actually destroyed the forests, know better than anybody else how the forests can be best managed to the interest of the local communities and the country as a whole. Moreover, unless management is adapted to the specific local situation, needs and concerns, sustainability can hardly be achieved in the absence of local support.

6.3 POLICY IMPLICATIONS

6.3.1 Policy Implication of the Non-timber Value of Forest Resources to the Local Indigenous Community

Based on the results presented in Chapter Four, a few policy implications on non-timber forest value to Yeak Loam communities can be drawn as follows:

The contribution of non-timber forest products to the local Yeak Loam communities is significant. Any policies on timber exploitation which do not take into account local concerns will seriously affect villagers' livelihood, and may generate conflicts that can have a negative impact on forest management.

Yeak Loam commune is a typical forest dependent area. Sustainable management of the area's forest should be a matter of high priority for both the provincial government and local communities in view of the long-term partnership between the local communities and forest, the rapid forest depletion over the past decades, and the provincial government's recognition of Yeak Loam Lake as a provincial protected area. The term 'sustainable management' refers to 'sustainable forest management that allows timber exploitation based on the yearly maximum allowable cut estimated from updated forest inventory data' presented in Section 2.1.3.

Considering the local communities' long-term reliance on the forest for both non-timber forest products and shifting cultivated land for rice production, there will be incentives for the local communities to manage the forest in a sustainable way if they can be assured of their land use right as well as relevant non-timber forest benefits. It is a potential model on which to base a formal community forestry set-up if the Government chooses to do so.

Whenever there is a decision to exploit forest for timber in Yeak Loam area, the value of non-timber forest products should be taken into account, among others, as a cost to society (based on market price, which are free of tax in Cambodia). In addition, compensation can be at least made to the local communities based on the monetary value of non-timber forest products to them if their collection of non-timber forest products is affected.

If a decision is made to allocate the forest to a concession company, the affected communities need to be compensated for loss in monetary revenue from non-timber forest products since they can hardly find an alternative solution in a short-term perspective.

The livelihood of Yeak Loam communities needs to be promoted by the provincial government through relevant assistance in marketing to help the indigenous communities from being disadvantaged in trading. This will reduce the impact of unfair trading towards the indigenous communities. The benefits of such an approach are to promote the indigenous peoples' basic livelihood, which seems essential if the Government wishes to avoid a possible scenario of over-exploiting the natural resources because of low prices and incomes.

Technical collaboration needs to be promoted between Yeak Loam communities and the Provincial Agriculture Department to increase the annual rice yield per hectare and the duration that a shifting cultivated rice-field remains fertile and suitable for plantation purpose. This aims at reducing the needs to clear forestland for new shifting cultivated rice fields.

There is emerging local awareness on the significance of sustainable forest management. Continuous awareness raising efforts by the provincial authorities in collaboration with donor agencies will generate positive results.

6.3.2 Policy Implication of the Implementation of Community Forestry in Cambodia

As discussed in Chapter Five, community forestry can be a potential solution to Cambodia's forests, depending on where forest management stands within the Government's political agenda. It is felt that such a potential is greater in areas such as Yeak Loam, where a close interaction between local communities and the forest has existed for generations. This is because in areas where the forest is the main source of survival for the local communities, motivation will exist for these communities to protect the forest, provided that their rights and benefits are secured.

The major policy implication for the implementation of community forestry is that it requires political will and significant changes in policies and practice. These include the recognition of the local communities' forest land use right and the replacement of the on-going top-down approach type of forest management by a 'bottom-up' or 'people-centered' one as discussed in Chapter

Five. This can be a great challenge since it requires a change in government officials' attitudes.

With regard to legislation, it remains unclear when the community forestry law will be finalized and eventually approved. Senior officials from both the Ministry of Agriculture and the Department of Forestry indicated that a draft community forestry sub-decree was prepared, and was still being reviewed by the Council of Ministers.

6.4 RECOMMENDATIONS

Six major recommendations on forest preservation are presented below. These are followed by other more specific recommendations that focus on two levels, namely the commune level and the provincial level.

6.4.1 Major Recommendations

Firstly, to promote 'bottom-up' or 'people-centred' participatory forest management, the law for community forestry needs to be finalized and adopted by the Government. Consultation needs to take place with local communities regarding the law in order to take into account their needs and concerns. The law should cover the following major elements, namely: (1) recognition of the local communities' basic land use rights; (2) decentralisation of the day-to-day management of the forests to the local communities with the government technical agency such as the Department of Forestry and Wildlife playing a technical advisory and monitoring role; and, (3) agreement needs to be reached between the local communities and the Government on the sharing of benefits in sustainable forest management.

Secondly, the Government needs to seek donor assistance in conducting a comprehensive forest inventory for the country in order to formulate a proper forest management plan for Cambodia, balancing the need for the exploitation of timber and non-timber forest products. This is important because in the absence of such information, management of Cambodia's forest resources is not practical since there is no baseline for formulation of an integrated forestry policy. Similar considerations should be given to the exploitation of non-timber forest products by the indigenous

communities since it is not possible to set reliable guidelines and standards for sustainable harvest of non-timber forest products.

Thirdly, government assistance needs to be provided to the local indigenous communities to promote marketing of their non-timber forest products and agricultural produce with the aim of enhancing their livelihood. This may help ease the pressure on non-timber forest products in a long-term perspective.

Fourthly, the Government needs to take a leading role in exploiting international market for the malva nut in order to generate long-term revenue for both the country and the local communities as discussed in Sections 4.1.3.2 and 4.5.

Fifthly, awareness raising programs need to be formulated for government officials in sustainable forest management through the adoption of 'bottom-up' and 'people-centred' participatory approach. This is essential to change government officials' attitudes towards forests and local communities since the success of community-based forest management relies on good partnership between relevant government ministries/departments and the local communities concerned. In addition, relevant education and extension programs need to be established to provide the local communities with technical assistance required in sustainable management of the country's forests. Donor support may be required in this regard.

Finally, the Department of Forestry and Wildlife needs to have direct control of forest management decisions, ranging from the national to provincial levels. In other words, the Provincial Forestry Offices need to report directly to the Department of Forestry and Wildlife for all issues related to forest management or exploitation. All previously discussed "short-cut" or "by-pass" situations need to be terminated. This is because if there is only one single institution in charge of forest management, wrong doings can be more easily detected and accounted for. Other related ministries such as the Ministry of Environment, for example, can serve as a kind of monitoring and policing force in forest management. Furthermore, the roles of the military, other business groups, or concessionaires' in forest exploitation need to be terminated. On top of these, it is essential to establish clear and integrated forest management legislation and a severe penalty system for trespassers, regardless of social or political status. This is

because according to the Cambodian Constitution, every Cambodian is equal in front of the law. In addition, part of the tax or fines collected need to go to ministries/departments or individuals actively involved in crime fighting in this regard. This aims at generating economic incentives for fighting against any unsustainable forest management practices or breach of the forest management law.

6.4.2 Yeak Loam Commune Level

It seems that two immediate steps are available for Yeak Loam communities to improve their livelihood. Firstly, Yeak Loam communities need to jointly form an indigenous association to negotiate selling prices of non-timber forest products with the market stall-holders. The major negotiators have to be relatively fluent in Khmer language. This is because if all villagers consistently demand the same prices for the same items, the chance of success can be higher. Moreover, the right to establish an association is recognized by the Cambodian Constitution. Secondly, such an association can initiate dialogue with the provincial authorities regarding the communal ownership of the shifting cultivated rice-fields and the forest as per the example of "Ya Poey Forest of Ratanakiri" previously discussed in Section 5.3.1. The Yeak Loam communities can probably approach Ratanakiri-based donor projects such as CARERE or Non Timber Forest Product Project for technical assistance (Section 3.4.7). This is because if the local communities do not stand up for their rights, it is difficult to expect government intervention due to the huge number of problems that remain to be solved. Furthermore, collective request may carry more weight than individual ones

6.4.3 Provincial Authorities

It is the researcher's personal viewpoint that if the provincial authorities wish to have more say in the management of forest resources within their territory, Yeak Loam commune seems to be a good case for community-based forest management according to the interpretation of the existing 1992 Land Law and various arguments presented in Section 5.1.2.

6.4.4 Further Research

The areas that require further research are the impact on Yeak Loam Tampuen villagers' life by the ecological functions of the change in forest cover over the past decades, the criteria for the extraction of non-timber forest products in Yeak Loam, and

the comparative difference between the Yeak Loam commune forest with that of other areas of Ratanakiri.

6.5 LIMITATIONS

There are a few limitations of this study. Firstly, the research is conducted on the basis of randomly selected household samples of Yeak Loam commune of Ratanakiri province. This means that the results can be quite site specific to the small case study area, and some other aspects of Cambodia's forests can probably be overlooked. Secondly, since the nature of most interview questions demands heavy reliance on villagers' memories and perceptions regarding their life, problems and concern, the results can be somehow subjective. Thirdly, despite the researcher's efforts to make the interview process as neutral and reliable as possible, the whole process was dependent on villagers' honesty in responding. Finally, due to serious data constraints in Ratanakiri, valuation of non-timber forest products has only focussed on direct use values while indirect use values are not included. This means under-estimation of the total non-timber value to Yeak Loam commune since important forest services such as watershed protection, carbon storage, and so forth, are neglected.

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DIRECT INFORMATION/DATA SOURCES

Department of Forestry and Wildlife.

Malva nut stall-holders of Orrusey market in Phnom Penh, Ban Lung market in Ratanakiri, and Vietnam.

Ministry of Agriculture.

Ministry of Environment.

Ratanakiri Statistical Office of the Department of Planning.

UNDP Project (ETAP).

Yeak Loam Commune Authorities/Officials.

Yeak Loam Commune Village Elders and Villagers.

APPENDIX 3.1 INFORMATION SHEET

FOREST USE SURVEY

Date:

Dear Householder,

We are pleased to introduce ourselves as a research group from the Department of Applied and International Economics of Massey University in New Zealand. We are conducting a village-level survey to find the non-timber value of forest resources to the local community. Forest resources have been recognized for the timber value over the past decades, which led to rapid degradation of the resources. However, little is known regarding the non-timber value of forest resources such as the provision of food, honey, and medicine that villagers have long been relying on throughout history.

There is reason to believe that lack of understanding of, and recognition in, the non-timber value of forest resources has somehow contributed to rapid deforestation, resulting in various environmental calamities, which have and will continue to affect human lives in the decades to come.

The survey will be conducted by the researcher under the guidance of the professors at Massey University. The researcher is a staff member of the United Nations Development Programme Cambodia Country Office, who is currently on special leave without pay to pursue his postgraduate study at Massey University. This interview/survey is part of a thesis requirement for the researcher towards a Master's degree in natural resource economics. We would like to invite you to participate in either the interview or mail survey (should your timetable be in conflicts with of that of the researcher). The interview will be conducted in the form of a person-to-person interview, while the mail survey will be completed and returned by the participant in a pre-paid envelop to the researcher. Please be advised that the questionnaire mainly consists of 38 questions, and both the person-to-person interview and mail survey are expected to last no more than 40 minutes.

Should you be interested in our study, we would like to advise you of your rights as a potential participant as follows:

- to decline to participate;
- to refuse to answer any particular questions;
- to withdraw from the study at any time;
- to ask any questions about the study at any time during participation;

- to provide information on the understanding that your name will not be used in published results;
- to be given access to a summary of the findings of the study when it is concluded.

Moreover, we wish to stress that whatever personal information we may get from either the interview or mail survey will be treated strictly confidentially, and all the information collected will only serve the purpose of academic research. Kindly also be advised that participation to either the interview or mail survey is on a completely voluntary basis.

Lastly, we would like to take this very opportunity to thank you for taking time to read this information sheet, and look forward to welcoming you to participate in our research.

Yours Sincerely,

Kun Veelee
Researcher

Supervisors:

Dr. Anton D. Meister
Professor of Natural Resource and Environmental Economics
Department of Applied and International Economics
Massey University, Private Bag 11222, Palmerston North, New Zealand
Tel: (64 6) 3505371
Fax: (64 6) 3505660

Dr. Robert Alexander
Senior Lecturer in Natural Resource and Environmental Economics
Department of Applied and International Economics
Massey University, Private Bag 11222, Palmerston North, New Zealand
Tel: (64 6) 3505514
Fax: (64 6) 3505660

APPENDIX 3.1 **FOREST USE SURVEY (Final)**
1998

Instructions: Kindly answer the following questions by either completing the space provided or circling an answer, or both. Should you find a question difficult to understand, please say so by writing in the margin. Please be advised that this questionnaire only serves the purpose of an academic research project, and all personal information will be treated confidentially. Kindly note that as an interviewee, you reserve the following rights:

- to refuse to participate;
- to decline to answer any particular questions;
- to withdraw from the interview/survey at any moment;
- to raise any questions about the research at any time during participation;
- to provide information on the understanding that your name will not be used unless you give such permission to the researcher;
- to gain access to a summary of the findings of the research when it is completed.

Part I: *Awareness and Use of the Forest in this Village*

1. Prior to reading this survey were you or your family members familiar with the forests in this Yeak Loam Commune area? (Please circle the right answer)

   Yes/No

2. On average, how many times a month have you, your family members, and your whole household visited the forests during the past 12 months?
   (Please circle either (i) or (ii). If your choice is (i), then fill in the appropriate space provided)

a. You	b. Your Family Members	c. Your Whole Household
(i).....	.....	.....

   (ii) none

   If your answer is "(ii) none", then skip to Question 4.

3. For each of the activities listed below, indicate in the appropriate spaces provided on the right the number of hours per month in the past 12 months that you and your whole household spent in the forest:

	No. of Hrs/per month a. (You)	No. of Hrs/month b. (Your W. H.)	How Often? c.
Fishing	.....	.....	.....
Hunting	.....	.....	.....
Bird shooting	.....	.....	.....
Logging	.....	.....	.....
Rattan gathering	.....	.....	.....
Firewood gathering	.....	.....	.....
H. medicine searching	.....	.....	.....
Honey searching	.....	.....	.....
Fruit plucking	.....	.....	.....
Flower plucking	.....	.....	.....
Nature appreciation	.....	.....	.....
Scientific research	.....	.....	.....
Camping	.....	.....	.....
Others (please specify)			
.....	.....	.....	.....
.....	.....	.....	.....
.....	.....	.....	.....
.....	.....	.....	.....

4. What are the three <u>main</u> uses of the forest for you and your whole household in order of importance from most to least? (Please fill in the appropriate blanks below)

a. You	b. Your Whole Household
(i).....	.....
(ii).....	.....
(iii).....	.....

5. If the above non-timber forest products or services cease to be available, what could you do? (Please fill in the space provided)

.....

6. Could you quantify the services/items that you and your whole household have been relying on from the forest such as game, firewood, honey, medicine and so forth?
(Please fill in the appropriates blanks, and specify the measurement units such as kilogramme, gramme, head, etc..)

Types of Services/Items	How Much/Many (per year)?	
	a.(You)	b.(Your Whole Household)
....	....	....
....	....	....
....	....	....
....	....	....
....	....	....
....	....	....
....	....	....
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7. How much do you or your household receive per unit in selling the above items in monetary terms? (Please complete the blanks below, and specify the units of measurement such as how many riels per kilo or per head sold etc…)

Types of Services/Items	Unit Price/Value
....	....
....	....
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8. What is your major use of the services/items?
(Circle all that apply)

(i) Trade for other goods
(ii) Sell for cash
(iii) Family consumption
(iv) Others.....(please specify)

If you circled "(i) trade for other goods", proceed to question 9 now. If you did not circle "(i) trade for other goods" but did circle "(ii) sell for cash", proceed to question 10. If your did not circle "(i) trade for other goods" or "(ii) sell for cash", please proceed to question 17.

9. If you trade forest products for other goods, please complete the following blanks or an additional piece of paper, if necessary:

(i)Goods traded away (specify unit)	(ii)Goods received (specify unit)	(iii)How much/many received for one unit of the goods traded away?
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....
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.....	.....	.....
.....	.....	.....

10. Where does the trading or selling normally take place?
(Circle all that apply)

(i) In a market
(ii) In the neighborhood
(iii) Within the village

11. If you trade or sell in a market, then which one is it?
.....

12. How do you or your family members get there?
(Circle all that apply)

(i) On foot
(ii) By your own bicycle
(iii) By your own motorcycle
(iv) By bicycle-taxi
(v) By motorcycle-taxi
(vi) By bus
(vii) By boat
(viii) Others.....(please specify)

13. How much does it cost to get there per trip?
(Please complete the blank below, and specify the currency used)
.....

14. How long does it take to get to the marketplace per trip?
(Please complete the appropriate blank below)

(i).....minutes
(ii).....hours
(iii).....days

15. Are there any additional costs?
(Please circle the right answer)

Yes/No

16. If so, what are the additional costs for the whole return trip?
(Please complete the blank, and specify the currency used)
.....

17. To compare the current level of your dependence on the forest with that of the past, what was the change? (Please circle the appropriate answer)

(i) Compared to that of 10 years ago, the current level of dependence is:

a/ Much less
b/ Little less
c/ The same
d/ Little more
e/ Much more
f/ Unknown

(ii) Compared to that of 20 years ago, the current level of dependence is:

a/ Much less
b/ Little less
c/ The same
d/ Little more
e/ Much more
f/ Unknown

(iii) Compared to that of 30 years ago, the current level of dependence is:

a/ Much less
b/ Little less
c/ The same
d/ Little more
e/ Much more
f/ Unknown

18. Compared to that of 10 years from now, the current dependence level is expected to be (please circle the appropriate answer):

a/ Much less
b/ Little less
c/ The same
d/ Little more
e/ Much more
f/ Unknown

19. Looking back into the early 1980s, could you quantify the services/items that you and your whole household used to obtain from the forests such as game, firewood, honey, medicine and so forth?
(Please fill in the appropriates blanks, and specify the measurement units such as kilogramme, gramme, head, etc..)

Types of Services/Items	How Much/Many (per year)?	
	a.(You)	b.(Your Whole Household)
………………………..	………………………..	………………………..
………………………..	………………………..	………………………..
………………………..	………………………..	………………………..
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Part II: *A Brief History of Your Involvement in the Use of the Forest and Major Concerns*

20. For how many years have you or your immediate household been relying on the use of the forest?
(Please complete the blanks below)

a. (You)	b. (Your Household)
.....	.....

21. Were you born in this village or did you migrate here?
(Please circle either (i) or (ii). If your choice is (ii), please also indicate the year that you migrated here)

(i) Born in the village
(ii) Migrated in.....(year)

22. For how many years have you or your immediate household lived in this village?
(Please complete the blanks below)

a. (You)	b. (Your Household)
.....	.....

23. Do you or your family members currently have free access to the forest?
(Please circle one)

Yes/No

If the answer is "no", please respond to questions 24 & 25. Otherwise, skip to question 26.

24. What hampers you from doing so?
(Please fill in the blank)
.....

25. And since when?
(Please fill in the blank)
.....

26. Do you have any concern about the use of forest in the future?
(Please circle one)

Yes/No

If the answer is "no", please skip to question 28. Otherwise, proceed to question 27.

27. What constitutes your major concern?
(Please fill in the blank)
.....

Part III. *Information Concerning Your Household*

This information will be held confidential and will not be personally identifiable in the research. The information is required to ensure that the researcher has a sample, which is representative of all villagers.

28. Kindly provide the following personal information regarding yourself and your household members by filling in the blanks provided:

Family Size	Family Members	Sex	Age	Profession
	(You)	Male/Female	.....	.....
.....	.....	Male/Female	.....	.....
	.....	Male/Female	.....	.....
	.....	Male/Female	.....	.....
	.....	Male/Female	.....	.....
	.....	Male/Female	.....	.....
	.....	Male/Female	.....	.....
	.....	Male/Female	.....	.....
	.....	Male/Female	.....	.....
	.....	Male/Female	.....	.....
	.....	Male/Female	.....	.....
	.....	Male/Female	.....	.....
	.....	Male/Female	.....	.....
	.....	Male/Female	.....	.....

28. (Continued)

.....	Male/Female	.....	.....
.....	Male/Female	.....	.....
.....	Male/Female	.....	.....
.....	Male/Female	.....	.....
.....	Male/Female	.....	.....
.....	Male/Female	.....	.....
.....	Male/Female	.....	.....

29. Please indicate your annual total income, and your annual total household income from all sources except that already talked about from forest (please complete the blanks below).

a. You	b. Your Household including You
.....	.....

30. How many Chomcars/mixed rice-fields do you have? (please complete the blanks below)

.....

31. How big are your Chomcars/mixed rice-fields excluding the inactive ones? (please fill in the appropriate spaces below)

Chomcar(s)	a. Size	b. Total Size
1	.....	
2	.....	
3	.....	
4	.....	
5	.....	
6	.....	.....

32. What animals or livestocks do you raise in your Chomcars?
(Please circle the appropriate answers below)

(i) Pigs
(ii) Cows
(iii) Buffalos
(iv) Chickens
(v) Ducks
(vi) Dogs
(vii) Others (Please specify)
.....

33. How many do you raise? (Please complete the appropriate spaces below)

a.Animals		Total Number (Head)
(i)	Pigs	.....
(ii)	Cows	.....
(iii)	Buffalos	.....
(iv)	Chickens	.....
(v)	Ducks	.....
(vi)	Dogs	.....
(vii)	Others (Please specify)	
.....		.....
.....		.....

34. How satisfied are you with the current management of forest?
(Please give a rating from 1 to 10, with 1 representing very satisfied; 5 neither satisfied nor unsatisfied; and 10 very unsatisfied)
.....

35. What are your comments on the current use of forest?
(Please complete the blank below)
.....

36. Are there any questions in this survey that you do not understand?
(Please circle one)

Yes/No

37. If so, which one(s)?
(Please complete the blank below)
.....

38. What are your comments of the survey/research?
(Please fill in the blank provided)
.....

Many Thanks For Your Cooperation
Kindly Return Your Completed Questionnaire
In The Pre-paid Envelope Provided

APPENDIX 3.2 CHECKLIST OF VILLAGE-LEVEL DISCUSSION TOPICS

I. Purpose:

This checklist aims at providing an overall guidance to the researcher with regard to major topics to be covered during village-level meetings or semi-structured interviews.

II. Discussion Topics:

(1) *Security Situation in Yeak Loam Commune:*

- What is the overall security situation of this commune?
- Is there any major security concern in the village or commune?
- If so, what is it?
- Is there any theft, robbery, or murder?
- What local structures are in place to provide security to each village and the commune as a whole?
- Do villagers face the risk of landmines when they work at the "shifting cultivated rice-fields" or inside the forest?
- If so, are there any demining operations going on?
- Are there any conflicts going on in the village or the commune? Whenever a conflict occurs in a village, who plays a mediating role?
- In view of the existing security situation, has the daily life of the villagers been affected?
- If so, how?

(2) *Access to the Forest and Difficulties Encountered:*

- What do villagers get from the forest?
- Do villagers rely on the forest for survival?
- If so, since when?

- Is there any restriction on villagers' gaining access to the forest imposed by either the local authorities or forest concessionaires?
- If so, since when?
- How has that affected villagers' life?
- Are there any other difficulties involved in gaining access to the forest?
- If so, what are they?

(3) *Agricultural, Rice Production Situation:*

- What agricultural produce do villagers grow on the "shifting cultivated rice-fields"?
- Do villagers rely on the "shifting cultivated rice-fields" for vegetables and fruits?
- Is rice the major product?
- On an average, how much rice has been produced per hectare of the "shifting cultivated rice-fields" over the past three years or so?
- What could be the level of rice production per hectare during a bad year?
- Has rice production ever been sufficient during the past few years to allow some trading for cash?
- If so, how many "riels" was sold for one kilogram of rice?
- On an average, how much rice is consumed per household per day?
- In general, how many hectares of "shifting cultivated rice field" are required be sufficient for an average family of 6 persons?

III. Major Organisations/Projects/Individuals Met

1. Ratanakiri provincial authorities.

2. Yeak Loam commune authorities.

3. Village elders and villagers (Yeak Loam commune).

4. CARERE Office in Ratanakiri.

5. Oxfam UK and Novib – NTFP Project in Ratanakiri.

APPENDIX 3.3 CHECKLIST OF NATIONAL-LEVEL MEETINGS

I. Major Discussion Topics:

1. Who is responsible for what in forest management?
2. What are the roles and responsibilities of key stakeholders such as the Department of Forestry and Wildlife, the Ministry of Agriculture, Forest and Fisheries, the Ministry of Environment, and the Land Titles Department?
3. Are there any coordination issues among and within these key government ministries/departments? If yes, why?
4. Are there any coordination issues between national and municipal/provincial governments? If yes, why?
5. What are the major constraints in forest management, especially in terms of illegal logging activities?
6. What policies, strategies, and concrete actions have been adopted by the Government and the donor community to deal with the forestry problems? And why?
7. What progress has been achieved so far?
8. Has the concept of community forestry been developed or adopted in Cambodia?
9. If not, what are the major obstacles?
10. Any additional comments on the status of Cambodia's forest management?

II. Government Ministries/Departments Met

Ministry of Agriculture, Forest and Fisheries.
Department of Forestry & Wildlife.
Land Use Mapping Office (LUMO) (of the Ministry of Agriculture, Forest and Fisheries).
Wildlife Protection Office (of the Department of Forestry and Wildlife).
Ministry of Environment.
Department of Nature Conservation and Protection (of the Ministry of Environment).

Community Forestry Office (of the Ministry of Environment).

Ministry of Rural Development.

Geographic Department.

Land Titles Department.

III. Donor Agencies/Projects Met

United Nations Development Program Country Office in Cambodia (UNDP).

UNDP/FAO Forestry Inventory Project Office.

UNDP/ETAP Project Office.

CARERE Project Office in Phnom Penh.

Food and Agriculture Organization of the United Nations Country Office in Cambodia (FAO).

United Nations Center for Human Rights (UNCHR).

Oxfam UK.

CCC.

THE NGO FORUM IN CAMBODIA.

CIDSE.

CONCERN WORLDWIDE.

Center For Advanced Study.

The World Bank Project (at the Ministry of Planning).

Forest Economist Log Monitoring & Logging Control Project, DAI (at the Department of Forestry & Wildlife).

Forest Policy Review Project, ARD (at the Department of Forestry and Wildlife).

Forest Concession Management Project, FORTECH (at the Department of Forestry and Wildlife).

APPENDIX 3.4 GENERAL CHECK-LIST

Actions	Status
1. Finalization of the information sheet and survey questionnaire as per the comments of the Human Ethnic Committee.	To be done upon receipt of the feedback, if any. A soft copy of the submitted version will be left with Prof. Meister in case if the feedback is not received before the end of this week.
2. Logistic arrangements such as procurement of stationery for survey, canned food, accommodation in Ratanakiri, finalization of flight schedule to Ratanakiri.	To be done in Phnom Penh in consultation with CARERE Ratanakiri.
3. Meeting arrangement for Ratanakiri.	To be arranged by CARERE Ratanakiri. This matter will be discussed with Tonie in P. Penh.
4. Selection of a survey site (to keep Prof. Meister informed of the final choice).	To be done upon arrival in Ratanakiri in consultation with CARERE Ratanakiri; to keep Prof. Meister/Dr. Alexander informed in this regard.
5. Meeting arrangement with civic leaders, and logistic arrangement for the site visit.	To be done upon arrival in Ratanakiri in consultation with CARERE Ratanakiri.
6. Slight modification of the survey questionnaire, if required (to be E-mailed or faxed to Prof. Meister for approval).	To be done upon arrival in Ratanakiri in consultation with CARERE Ratanakiri; to submit to Prof. Meister for approval.
7. Recruitment of an interpreter (the interpreter will be requested to sign a statement to keep confidence of all information/data collected)	To be done upon arrival in Ratanakiri in consultation with CARERE Ratanakiri
8. Identification of potential participants.	To be done upon arrival in Ratanakiri in consultation with CARERE Ratanakiri
9. Seeking the participants' agreement to take part in the survey.	To be done upon arrival in Ratanakiri in consultation with CARERE Ratanakiri
10. Maintain regular weekly contact with Prof. Meister & Dr. Alexander under the form of weekly report (through E-mail, fax, or phone call in case of emergency).	To send weekly report to Prof. Meister and Dr. Alexander through the E-mail facilities.

APPENDIX 3.5 YEAK LOAM COMMUNE LETTER OF SUPPORT AND PERMIT

Kingdom of Cambodia

Nation-Religion-King

Letter of Support and Permit

We, Yeak Loam Committee civic leaders and Yeak Loam commune elders, have the pleasure to authorize Mr. Kun Veelee from Massey University to conduct a thesis research on non-timber value of the forest to the local community in all villages at our commune.

Mr. Kun Veelee has clearly provided us with information regarding his study (Information Sheet) and the rights of potential participants to his interview/survey. All interview participants have given their informed verbal consent prior to the start-up of the interview.

All of us at this commune wish him success in this thesis research.

Yeak Loam Commune Committee

02 June, 1998

(signed and sealed)

Hung Teo (Commune Chief)

APPENDIX 3.5 YEAK LOAM COMMUNE RESEARCH PERMIT

ព្រះរាជាណាចក្រ កម្ពុជា

ជាតិ សាសនា ព្រះមហាក្សត្រ

លិខិតតាំង និង អនុញ្ញាតិ

យើងខ្ញុំទាំងអស់គ្នាជាគណកម្មការ និង ចាស់ទំនៅក្នុង ឃុំ យក្សឡោម មានសេចក្តីរីករាយបានឯកភាពនិងអនុញ្ញាតិអោយលោក គុណ វិលី (KUN VEELEE) មកពី សកលវិទ្យាល័យ ម៉ាស សុី (MASSEY) ដើម្បីធ្វើការសិក្សាស្រាវជ្រាវ អំពី (NON-TIMBER VALUE OF THE FOREST TO THE LOCAL COMMUNITY) នៅក្នុងភូមិទាំងឡាយនៃឃុំយើងខ្ញុំ ។

លោក គុណ វិលី បានផ្តល់ពតិមានអំពីការសិក្សា (INFORMATION SHEET) និងសិទ្ធិរបស់អ្នកចូលរួមសំភាសន៍ទាំងឡាយយ៉ាងច្បាស់លាស់ និងអ្នកដែលត្រូវបានជួបសំភាសន៍ និមួយៗបានឯកភាពមុនពេលធ្វើការសំភាសន៍ ។

យើងខ្ញុំទាំងអស់គ្នានៅក្នុងឃុំនេះសូមជូនពរអោយលោក បានទទួលជ័យជំនះក្នុងការសិក្សាស្រាវជ្រាវនេះ

គណកម្មការ ឃុំយក្សឡោម

ថ្ងៃទី ០២ ខែ មិថុនា ឆ្នាំ ១៩៩៨

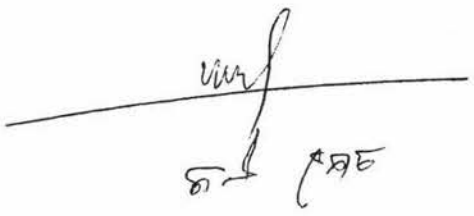
ហ៊ីន-ភេច

APPENDIX 3.6a RESEARCH AGREEMENT LETTER BY THE MALE INTERPRETER

1 June 1998

Dear Sir/Madam,

I undersigned herewith, [illegible] have agreed to work for Mr. Kun Veelee, Massey University Postgraduate Student, as a Khmer-Tampuen Interpreter during his research in Yeak Loam Commune, Ratanakiri province. I fully understand and agree that whatever information I may acquire during the interpretation will be kept strictly confidential.



APPENDIX 3.6b RESEARCH AGREEMTN LETTER BY THE FEMALE INTERPRETER

1 June 1998

Dear Sir/Madam,

I undersigned herewith, [illegible], have agreed to work for Mr. Kun Veelee, Massey University Postgraduate Student, as a Khmer-Tampuen Interpreter during his research in Yeak Loam Commune, Ratanakiri province. I fully understand and agree that whatever information I may acquire during the interpretation will be kept strictly confidential.

APPENDIX 3.7 ANALYSIS TECHNIQUES

3.7.1 Mean and Weighted Average

3.7.1.1 The Arithmetic Mean

For a variable x with a series of values such as x_1, x_2, x_3, x_4,.....,x_i,.....x_n, the *mean* is calculated by summing the values of the variable and dividing by the number of items. Mathematically, this is represented by the formula:

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$$ With $\bar{x}$ representing "mean"; n denoting the number of items; $\sum$ is "the sum of". (McClave et al., 1998)

3.7.1.2 The Weighted Arithmetic Mean

The *weighted arithmetic mean* or *weighted average* is calculated by the following formulae:

$$\text{Weighted mean} = \frac{\sum_{i=1}^{n} w_i x_i}{\sum_{i=1}^{n} w_i}$$ With w representing "weight"; n denoting "the number of items"; and x is a variable with a series of values such as $x_1, x_2, x_3, x_4, \ldots\ldots x_i, \ldots\ldots x_n$.
(adapted from Ingram and Hoyle (1992))

3.7.2 Median

For a set of quantitative data, the *median* (m) is the value of the middle item of a distribution, when it is arranged in ascending order. The *median* (m) can be calculated by two steps. Firstly, arrange the n measurements of the data in ascending order. Secondly, m is the middle number if n is an odd number (McClave et al, 1998), or m is the value of the $((n+1)/2)$th item. In case if n is an even number, m is the mean of the middle two numbers (McClave et al., 1998).

3.7.3 Standard Deviation

For a set of data of n different measures (x_1, x_2, x_3, x_4,....,x_i,....x_n), the *standard deviation* (*SD*) aims at measuring the degree of deviations from the *mean*. The *standard deviation* (*SD*) is calculated by the formulae:

(adapted from Calder (1996)).

$$SD = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}}$$

With n representing "the number of items"; $\bar{x}$denoting the *mean.*

3.7.4 Pearson's No. 2 Coefficient of Skewness

As a measure of skewness, Pearson's No. 2 Coefficient of Skewness aims at measuring the extent of asymmetry in a distribution. The direction and degree of skewness are denoted by the sign and value of the coefficient respectively. A positive value of the coefficient (except 0) would mean that the distribution is positively skewed, with the mean to the right of the median and larger than it (Ingram & Hoyle, 1992). On the other hand, a negative coefficient implies that the distribution is negatively skewed, with the mean to the left of the median and smaller than it. A coefficient of 0 would imply a symmetrical distribution. The coefficient is calculated by using the formulae:

$$\frac{3(\bar{x} - m)}{SD}$$ (Ingram & Hoyle,1992)

With $\bar{x}$ representing the mean, m denoting the median, and *SD* the standard deviation.

3.7.5 Hypothesis Testing

Four major types of hypothesis testing known as the *t*-test Paired Two Sample for Means (one-tailed), the sign test for a large sample, Chi-square statistic (two-tailed), and Fisher's exact test were used in this study. The *t*-test Paired Two Sample for Means (one-tailed) is used to verify if there is any reduction of non-timber forest products over time based on information obtained from the sampled households. The sign test is used instead of the *t*-test when the distribution of a data set is skewed to the right or left. Chi-square distribution is used to identify if any association may exist between related elements such as hunting efforts and income, and so forth. During the calculation of the Chi-square distribution, if an expected cell has a value below five, Fisher's exact test is required since Chi-square results could not be used under such a

circumstance. Detailed descriptions of these tests are indicated in Sections 3.7.6, 3.7.8, 3.7.9, and 3.7.10 respectively.

3.7.6 *T*-test: Paired Two Sample for Means (One-tailed)

There are two major steps involved in hypothesis testing, namely the establishment of the null and alternative hypotheses (represented by H_0 and H_a respectively), and the identification of evidence for the rejection of the null hypothesis. Mathematically, the process can be depicted as follows:

<u>One-tailed Test</u>

Let	H_0:	$(\mu_1-\mu_2) = 0$	With $\mu_1-\mu_2$ denoting difference in means
To test either	H_a:	$(\mu_1-\mu_2) < 0$	between data sets 1 & 2 (i.e. *present* and
or	[H_a:	$(\mu_1-\mu_2) > 0$]	*past* in this study)

In case of a large sample ($n \geq 30$):

Test statistic (t): $$t = \frac{\bar{d}}{\sigma_d/\sqrt{n}} \approx \frac{\bar{d}}{s_d/\sqrt{n}}$$ (Sincich, 1996)

With $\bar{d} = \frac{\sum_{i=1}^{n} x_{1i} - x_{2i}}{n}$ or "mean of difference between paired data sets 1 & 2".

S_d = Standard deviation; x_1 and x_2 represent the quantities of the paired items of data sets 1 and 2 respective ly.

The rejection zone for the large sample is:

$Z > Z_\alpha$ (upper tail), or $Z < -Z_\alpha$ (lower tail) (α is normally 5% at a 95% level of confidence).

In case of a small sample ($n < 30$):

Test statistic (t): $$t = \frac{\bar{d}}{s_d/\sqrt{n}}$$ (Sincich,1996)

The rejection area for the small sample is:

$t > t_\alpha$ (upper tail), or $t < -t_\alpha$ (lower tail) (α is normally 5% at a 95% level of confidence).

The distribution of t is based on (n-1) degrees of freedom. In addition, t_α denotes the t value in such a way that $P\ (t > t_\alpha) = \alpha$ (i.e. 5%) (Sincich, 1992). P stands for "disagreement" probability or p-value. The smaller is the p-value, the larger is the degree of disagreement between the data and the null hypothesis or the more significant is the outcome (Sincich, 1992).

There are two major underlying assumptions governing the use of the above testing. Firstly, the two sets of data under study should follow a relatively normal distribution pattern. Secondly, the paired differences should be chosen from the population of differences in a random manner (Sincich, 1996).

3.7.7 Normality Test

Normality test has been conducted by using the Minitab software. By the generation of a normal probability plot and hypothesis testing, it aims at verifying if the data follow a normal distribution pattern based on: (1) the null hypothesis (H_0) that data are normally distributed; and (2) the alternative hypothesis (H_a) that data are not normally distributed. This is important to decide if the data may qualify for the t-test or the sign test.

Sincich (1992) indicates that there are four major steps in the construction of a normal probability plot for a set of data. Firstly, the observations in the data set are ordered in an ascending manner. Secondly, the corresponding tail area A of the standard normal z distribution is calculated for each item by the formulae:

$A = (i - 0.375)/(n+0.25)$ (Sincich, 1992)

With i representing the ith order of an observation, while n is the size of the sample.

Thirdly, the estimated expected value of an observation x_i (i=1,2,3.....n) under normality is calculated:

$E(x_i) = (s)[Z(A)]$ (Sincich, 1992)

s denotes standard deviation, while Z(A) means the z value, which separates an area A situated in the lower tail of the standard normal distribution.

Finally, x_i can be plotted on the vertical axis while the corresponding estimated expected values $E(x_i)$ on the horizontal one to construct a normal probability plot. In case of a relatively normal distribution, the points reflected by the plot will be almost on a straight line.

3.7.8 Sign Test for a Large Sample (One-tailed)

Known as a test for location, the sign test is a nonparametric technique, which is designed to conduct hypothesis testing on the median of any continuous population. It can be demonstrated as follows:

<u>One-tailed Test:</u>

The null hypothesis:	H_0:	$\eta = \eta_0$	(η means "the population median
The alternative hypothesis:	H_a:	$\eta < \eta_0$	at *present*", while η_0 denotes "the
Or	[H_a:	$\eta > \eta_0$]	population median in the *past*".)

Test Statistic : $$z = \frac{S - 0.5n}{0.5\sqrt{n}}$$ (Sincich, 1996)

S represents either "the number of sample observations smaller than η_0" (-) or "the number of sample observations larger than η_0" (+). n denotes the actual size of the paired data when "ties" or "paired items of the same value" are excluded.

A sample is considered large enough to qualify for this specific sign test if $n \geq 10$.

The rejection zone is the area where $Z > Z_\alpha$ (i.e. $\alpha = 5\%$ and the tabulated value of Z_α can be found in the Statistical Table for Normal Curve Areas).

3.7.9 Chi-squared Statistic: A Test of Hypothesis About Category Probabilities – the 2 x 2 Contingency Table

As a technique used to test the hypothesis that the row and the column variables are independent, the Chi-squared statistic (χ^2) is calculated by the formulae:

$$\chi^2 = \sum_{a=1}^{nr}\sum_{b=1}^{nc}\frac{(O_{ab} - E_{ab})^2}{E_{ab}}$$

(Sincich, 1996)

where *nr* stands for "number of rows in the 2 x 2 contingency table"

nc means "number of columns in the 2 x 2 contingency table"

O_{ab} denotes "observed number of responses in the cell in row *a* & column *b*"

E_{ab} represents "expected number of responses in the cell in row *a* & column *b*"

E_{ab} is computed by the formulae: $(R_a)(C_b)/n$ (Sincich, 1996)

With R_a= sum of values by row *a* of the 2 x 2 table; C_b = sum of values by column *b* of the 2 x 2 table; and *n* = total sample size

The rejection zone is: $\chi^2 > \chi^2_\alpha$

In addition, χ^2_α is the tabulated value of the Chi-square distribution on the basis of (*nr*-1)(*nc*-1) degrees of freedom, provided that $P(\chi^2 > \chi^2_\alpha) = \alpha$

3.7.10 Fisher's Exact Test

Differing from the Chi-squared test, which applies the Normal approximation to the binomial, Fisher's exact test is an analysis technique that calculates exact P-values on the basis of binomial distribution. Fisher's exact test is conducted, using Epi Info 6, whenever a cell of the 2 x 2 contingency table has an expected value less than 5.

Let *a, b, c, d* be the four cells of the 2 x 2 contingency table. The first probability P_1 associated with the observed value is calculated by the formulae:

$$P_1 = \frac{(a+c)!(b+d)!(c+d)!(a+b)!}{a!b!c!d!n!}$$ With $n = a+b+c+d$ (total sample size)

(Ostle and Malone, 1988)

Since it is essential to add the probabilities of more divergent fractions to P_1 in order get the final probability for evaluating the null hypothesis, a and d are reduced by unity, while b and c are increased by unity in the calculation of P_2 (under the assumption that $a/(a+b) < c/(c+d)$) (Ostle and Malone, 1988).

$$P_2 = \frac{(a+c)!(b+d)!(c+d)!(a+b)!}{(a-1)!(b+1)!(c+1)!(d-1)!n!}$$

(Ostle and Malone, 1988)

Following the above approach, P_3 is calculated. The whole process continues until P_{a+1} is obtained.

Ostle and Malone (1988) point out that the major underlying principle of Fisher's exact test is that the null hypothesis (H: $p_1=p_2$; with p_1 & p_2 being the parameters of two binomial populations) can be rejected, provided that the final probability P is either equal to or less than α. P is calculated by the formulae:

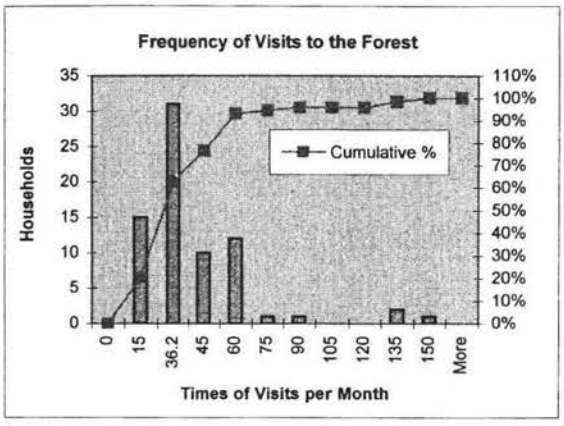
$$P = \sum_{i=1}^{a+1} P_i$$

(Ostle and Malone, 1988)

APPENDIX 4.1

Frequency of Visits to the Forest

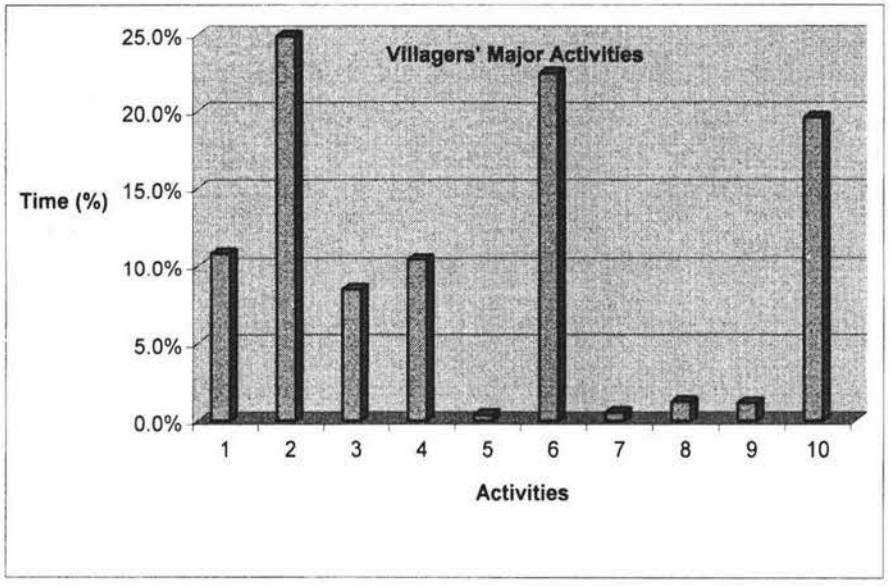
Times/Month	*Households*	*Cumulative %*
0	0	.0%
15	15	20.5%
36.2	31	63.0%
45	10	76.7%
60	12	93.2%
75	1	94.5%
90	1	95.9%
105	0	95.9%
120	0	95.9%
135	2	98.6%
150	1	100.0%
More	0	100.0%
	73	



APPENDIX 4.2

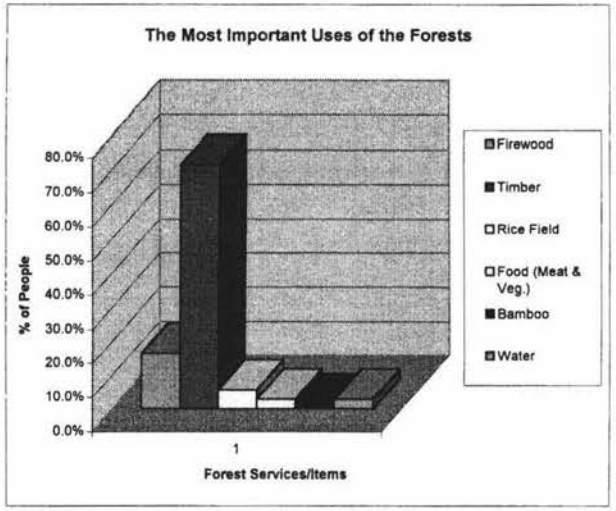
Villagers' Time Allocation for Major Activities

Activities:	1 Fishing	2 Hunting	3 Bird Shooting	4 Logging	5 Rattan Collection	6 Firewood Collection	7 H.Medicine Searching	8 Honey Collection	9 Wild Fruit Plucking	10 Vegetable Collection
Tot. hrs/per activity (73 Households)	1,005	2,307	785	969	35	2,086	49	114	106	1,815
Total hrs (all activities)	9,272									
% of time	10.8%	24.9%	8.5%	10.5%	0.4%	22.5%	0.5%	1.2%	1.1%	19.6%

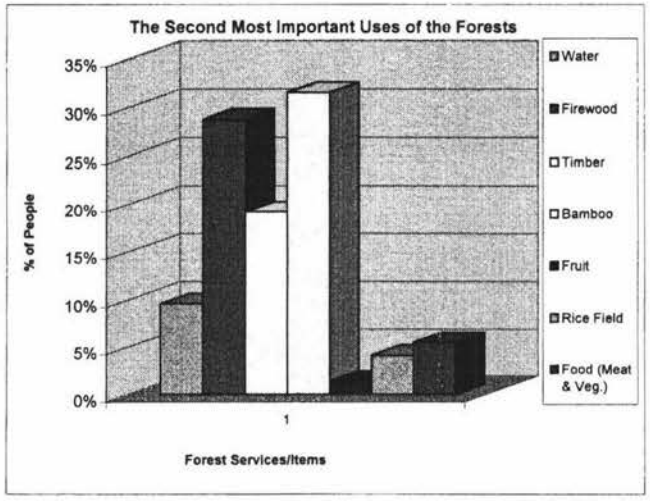


APPENDIX 4.3 THE MOST IMPORTANCE USE OF THE FORESTS

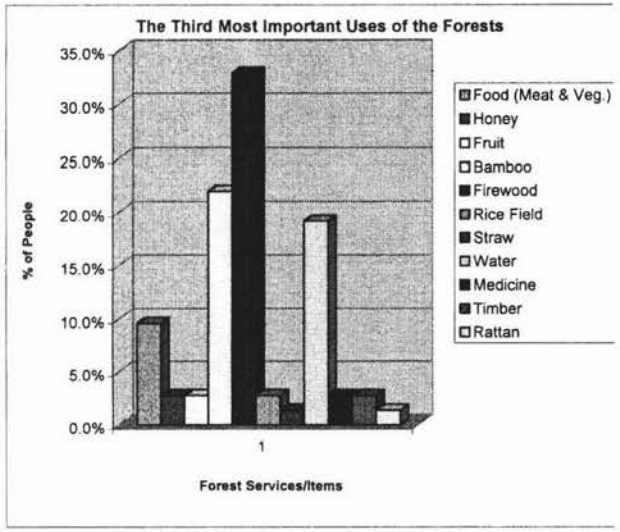
The First Most Important Uses (i)



The Second Most Important Uses (ii)



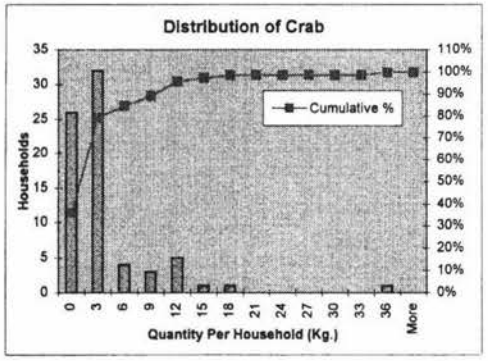
The Third Most Important Uses (iii)



APPENDIX 4.4 DISTRIBUTION PATTERN OF NON-TIMBER FOREST PRODUCTS

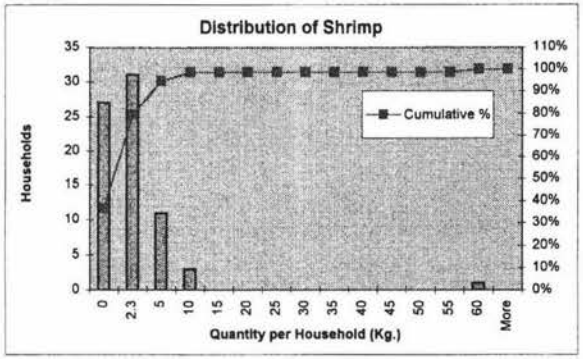
Distribution of Crab

Quantity (Kg.)/Year	*Households*	*Cumulative %*
0	26	35.6%
3	32	79.5%
6	4	84.9%
9	3	89.0%
12	5	95.9%
15	1	97.3%
18	1	98.6%
21	0	98.6%
24	0	98.6%
27	0	98.6%
30	0	98.6%
33	0	98.6%
36	1	100.0%
More	0	100.0%
	73	



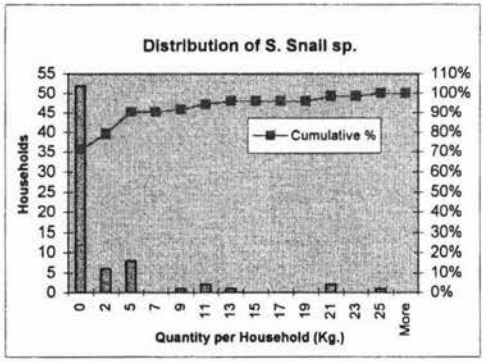
Distribution of Shrimp

Quantity (H.)/Year	*Households*	*Cumulative %*
0	27	37.0%
2.3	31	79.5%
5	11	94.5%
10	3	98.6%
15	0	98.6%
20	0	98.6%
25	0	98.6%
30	0	98.6%
35	0	98.6%
40	0	98.6%
45	0	98.6%
50	0	98.6%
55	0	98.6%
60	1	100.0%
More	0	100.0%
	73	



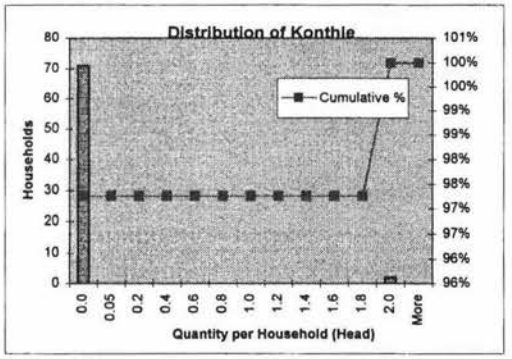
Distribution of Small Snail sp. (Kg.)

Quantity (Kg.)/Year	*Households*	*Cumulative %*
0	52	71.2%
2	6	79.5%
5	8	90.4%
7	0	90.4%
9	1	91.8%
11	2	94.5%
13	1	95.9%
15	0	95.9%
17	0	95.9%
19	0	95.9%
21	2	98.6%
23	0	98.6%
25	1	100.0%
More	0	100.0%
	73	



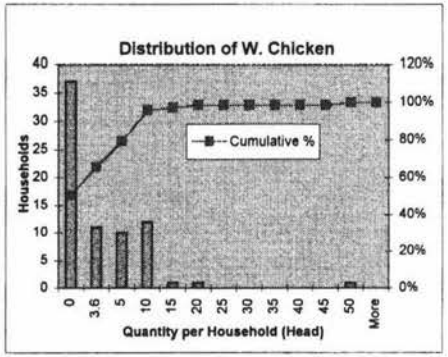
Distribution of Konthie/Terapin sp.

Quantity (H.)/Year	*Households*	*Cumulative %*
0.0	71	97.3%
0.05	0	97.3%
0.2	0	97.3%
0.4	0	97.3%
0.6	0	97.3%
0.8	0	97.3%
1.0	0	97.3%
1.2	0	97.3%
1.4	0	97.3%
1.6	0	97.3%
1.8	0	97.3%
2.0	2	100.0%
More	0	100.0%
	73	



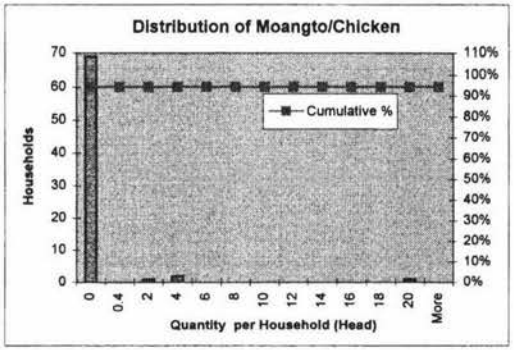
Distribution of Wild Chicken

Quantity (H.)/Year	*Households*	*Cumulative %*
0	37	50.7%
3.6	11	65.8%
5	10	79.5%
10	12	95.9%
15	1	97.3%
20	1	98.6%
25	0	98.6%
30	0	98.6%
35	0	98.6%
40	0	98.6%
45	0	98.6%
50	1	100.0%
More	0	100.0%
	73	



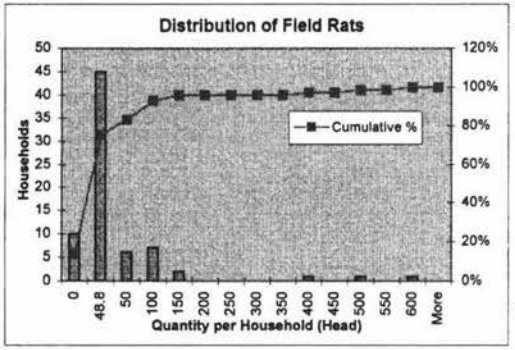
Distribution of Moang To/Chicken

Quantity (H.)/Year	*Households*	*Cumulative %*
0	69	94.5%
0.4	0	94.5%
2	1	94.5%
4	2	94.5%
6	0	94.5%
8	0	94.5%
10	0	94.5%
12	0	94.5%
14	0	94.5%
16	0	94.5%
18	0	94.5%
20	1	94.5%
More	0	94.5%
	73	



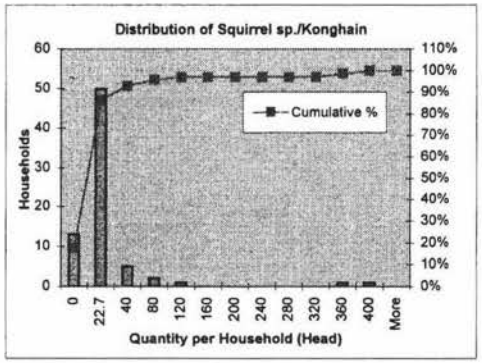
Distribution of Field Rats

Quantity (H.)/Year	*Households*	*Cumulative %*
0	10	13.7%
48.8	45	75.3%
50	6	83.6%
100	7	93.2%
150	2	95.9%
200	0	95.9%
250	0	95.9%
300	0	95.9%
350	0	95.9%
400	1	97.3%
450	0	97.3%
500	1	98.6%
550	0	98.6%
600	1	100.0%
More	0	100.0%
	73	



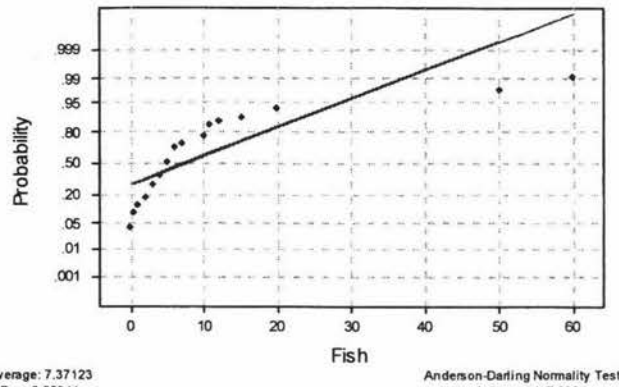
Distribution of Squirrel sp./Konghain

Quantity (H.)/Year	*Households*	*Cumulative %*
0	13	17.8%
22.7	50	86.3%
40	5	93.2%
80	2	95.9%
120	1	97.3%
160	0	97.3%
200	0	97.3%
240	0	97.3%
280	0	97.3%
320	0	97.3%
360	1	98.6%
400	1	100.0%
More	0	100.0%
	73	



APPENDIX 4.5 NORMALITY TESTS

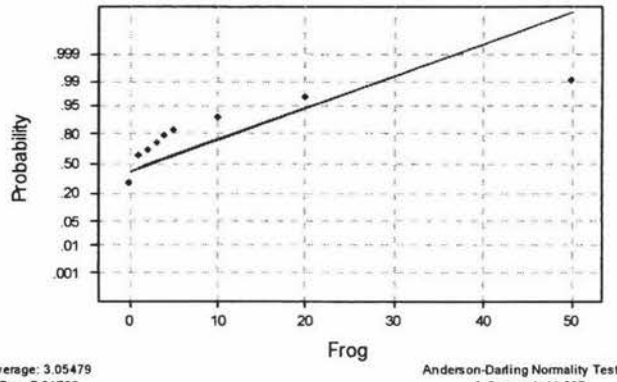
Current Fish Data Normality Test



Average: 7.37123
StDev: 9.55341
N: 73

Anderson-Darling Normality Test
A-Squared: 7.932
P-Value: 0.000

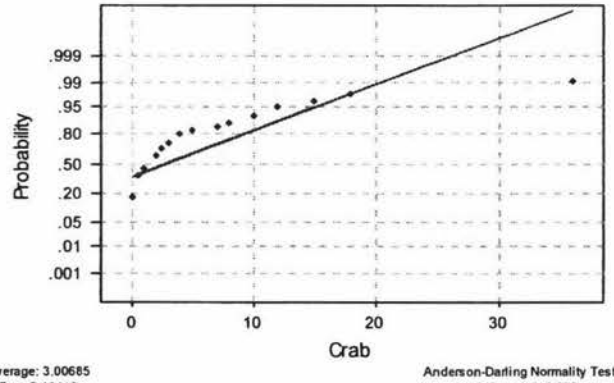
Current Frog Data Normality Test



Average: 3.05479
StDev: 7.01762
N: 73

Anderson-Darling Normality Test
A-Squared: 11.897
P-Value: 0.000

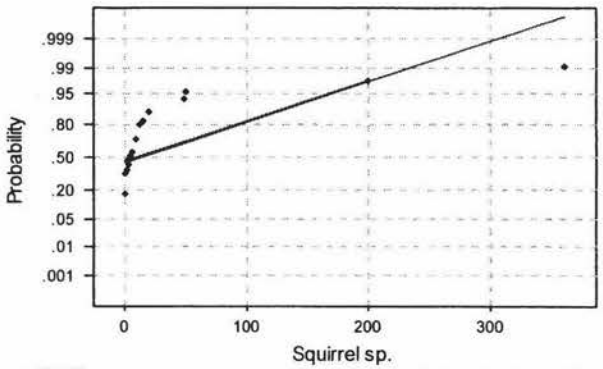
Current Crab Data Normality Test



Average: 3.00685
StDev: 5.40415
N: 73

Anderson-Darling Normality Test
A-Squared: 9.233
P-Value: 0.000

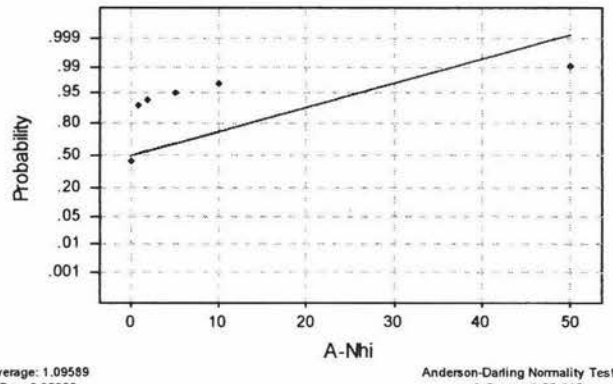
Current Squirrel sp. (I) Data Normality Test



Average: 15.2877
StDev: 47.8857
N: 73

Anderson-Darling Normality Test
A-Squared: 17.317
P-Value: 0.000

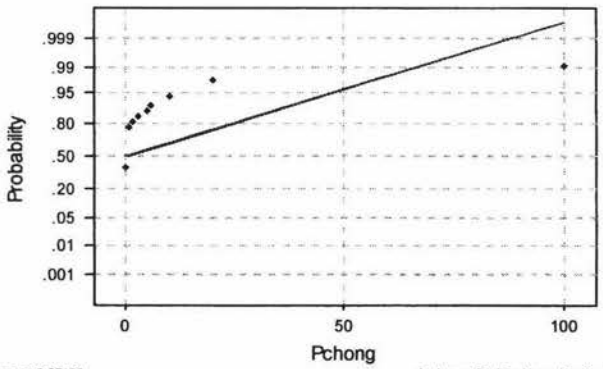
Current A-Nhi Data Normality Test



Average: 1.09589
StDev: 6.06255
N: 73

Anderson-Darling Normality Test
A-Squared: 23.115
P-Value: 0.000

Current Pchong Data Normality Test



Average: 2.67123
StDev: 12.0313
N: 73

Anderson-Darling Normality Test
A-Squared: 19.662
P-Value: 0.000

Minitab Outputs: Sign Test for Median

Sign test of median = 0.00000 versus < 0.00000

	N	Below	Equal	Above	P	Median
Fish	37	24	4	9	0.0068	-5.000
Frog	26	20	5	1	0.0000	-3.000
Shrimp	31	26	2	3	0.0000	-4.000
S. Snail Sp.	8	6	2	0	0.0156	-4.000
Terapin Sp. (big)	5	4	1	0	0.0625	-1.000
Deer	8	8	0	0	0.0039	-2.000
Barking Deer	19	18	1	0	0.0000	-2.000
W. Pig	20	17	3	0	0.0000	-3.000
W. Chick	18	14	2	2	0.0021	-5.000
Chicken SP.	5	4	1	0	0.0625	-5.000

Minitab Outputs: Sign Test for Median (Continued - 1)

	N	Below	Equal	Above	P	Median
Civet. SP.	13	13	0	0	0.0001	-5.000

	N	Below	Equal	Above	P	Median
Porcupine SP.	18	16	1	1	0.0001	-4.000

	N	Below	Equal	Above	P	Median
Field Rat	27	16	6	5	0.0133	-10.00

	N	Below	Equal	Above	P	Median
Squirrel(S) (Konghain)	30	17	7	6	0.0173	-5.500

	N	Below	Equal	Above	P	Median
Squirrel(L) (Komprok)	32	20	5	7	0.0096	-9.000

	N	Below	Equal	Above	P	Median
A-Nhi	13	12	0	1	0.0017	-3.000

	N	Below	Equal	Above	P	Median
Pchong	20	18	1	1	0.0000	-5.000

	N	Below	Equal	Above	P	Median
Trokout	9	9	0	0	0.0020	-9.000

	N	Below	Equal	Above	P	Median
Pigeon	12	11	1	0	0.0005	-5.000

	N	Below	Equal	Above	P	Median
Rambutan	19	17	1	1	0.0001	-3.000

Minitab Outputs: Sign Test for Median (Continued – 2)

	N	Below	Equal	Above	P	Median
Mongo	16	13	2	1	0.0009	-1.750

	N	Below	Equal	Above	P	Median
Phnieu	16	13	2	1	0.0009	-3.000

	N	Below	Equal	Above	P	Median
Malva Nuts	6	3	2	1	0.3125	-0.5000

	N	Below	Equal	Above	P	Median
Bamboo Shoots	25	8	7	10	0.7597	0.00000

	N	Below	Equal	Above	P	Median
Vegetables	5	2	2	1	0.5000	0.00000

APPENDIX 4.7

Comparison between the Current Level of Fish Caught with That of the 1980s

Present Fish (kg.)	1980s Fish (kg.)
5	180
0	50
1	4
3	20
20	10
5	3
5	3
1	60
10	100
20	6
5	10
12	100
5	5
10	5
60	50
3	3
10	100
3	30
2	10
1	100
12	20
5	20
2	5
5	7
6	3
2	5
5	20
5	3
5	3
5	5
10	30
5	30
2	20
4	5
5	15
20	20
5	10
Sub-total:	**284**	**1,070**
Mean:	**7.676**	**28.919**

Hypothesis:

H_0: Present $_{f.}$ - Past $_{f.} \geq 0$

H_a: Present $_{f.}$ - Past $_{f.} < 0$

t-Test: Paired Two Sample for Means

	Present	*Past (1980s)*
Mean	7.676	28.919
Variance	104.336	1,557.965
Observations	37	37
Pearson Correlation	0.090	
Hypothesized Mean Difference	0	
df	36	
t Stat	-3.241	
P(T<=t) one-tail	0.001	
t Critical one-tail	1.688	
P(T<=t) two-tail	0.003	
t Critical two-tail	2.028	

P(T<=t) one-tail

0.001 <0.05

T-Value or t Stat = -3.241 < -1.688 and lies inside the reject area of the lower tail.
The null hypothesis is rejected.
There seems to be reduction in the average quantity of fish caught by each household, comparing the current level to that of the 1980s. T-test shows that the reduction is statistically significant (P=0.001)

Comparison between the Current Level of Frog Caught with That of the 1980s

Present Frog /On-Kep(kg.)	1980s Frog /On-Kep(kg.)
3	6
1	3
10	10
0	1
10	50
0	10
10	100
3	3
10	50
3	3
2	3
10	30
3	200
50	200
0	20
1	50
10	10
0	1
4	7
5	3
2	10
0	20
0	2
0	1
2	2
0	20
Sub-total:	**139**	**815**
Mean:	**5.346**	**31.346**

Hypothesis:

H_0: Present $_{frog}$ - Past $_{frog} \geq 0$

H_a: Present $_{frog}$ - Past $_{frog} < 0$

t-Test: Paired Two Sample for Means

	Present	*Past (1980s)*
Mean	5.346	31.346
Variance	97.915	2,983.755
Observations	26	26
Pearson Correlation	0.659	
Hypothesized Mean Difference	0	
df	25	
t Stat	-2.724	
P(T<=t) one-tail	0.006	
t Critical one-tail	1.708	
P(T<=t) two-tail	0.012	
t Critical two-tail	2.060	

P(T<=t) one-tail

0.006 <0.05

t Stat = -2.724 < -1.708 and lies inside the reject area of the lower tail. The null hypothesis is rejected.

There seems to be reduction in the average quantity of frog caught by each household, comparing the current level to that of the 1980s. T-test shows that the reduction is statistically significant (P=0.006)

Comparison between the Current Level of Shrimp Caught with That of the 1980s

Present Shrimp (kg.)	1980s Shrimp (kg.)
1	72
1	7
0	1
1	5
2	1
2	3
3	10
2	5
4	15
5	3
4	9
60	20
1	200
1	10
1	5
1	50
3	5
2	10
1	5
2	5
2	2
0	5
0	6
0	3
1	10
3	30
0.5	20
2	6
2	5
10	10
1	6
Sub-total: **118.5**	**544.0**
Mean: **3.823**	**17.548**

Hypothesis:

H_0: Present$_{s.}$ - Past$_{s.} \geq 0$

H_a: Present$_{s.}$ - Past$_{s.} < 0$

t-Test: Paired Two Sample for Means

	Present	*Past (1980s)*
Mean	3.823	17.548
Variance	112.442	1,367.789
Observations	31	31
Pearson Correlation	-0.007	
Hypothesized Mean Difference	0	
df	30	
t Stat	-1.983	
P(T<=t) one-tail	0.028	
t Critical one-tail	1.697	
P(T<=t) two-tail	0.057	
t Critical two-tail	2.042	

P(T<=t) one-tail

0.028 <0.05

t Stat = -1.983 < -1.697 and lies inside the reject area of the lower tail. The null hypothesis is rejected.

There seems to be reduction in the average quantity of shrimp caught by each household, comparing the current level to that of the 1980s. T-test shows that the reduction is statistically significant (P=0.028)

Comparison between the Current Level of Field Rat Caught with That of the 1980s

Present Field Rat /Kondol (h.)	1980s Field Rat /Kondol (h.)
15	120
15	20
50	100
120	20
100	30
100	200
100	100
20	20
20	100
30	30
360	500
20	30
60	100
20	50
10	15
30	20
20	30
20	10
10	30
20	30
100	100
20	20
10	30
20	10
500	600
50	50
20	100
Sub-total:	**1,860**	**2,465**
Mean:	**68.889**	**91.296**

Hypothesis:

H_0: $\text{Present}_{\text{f. r.}} - \text{Past}_{\text{f. r.}} \geq 0$

H_a: $\text{Present}_{\text{f. r.}} - \text{Past}_{\text{f. r.}} < 0$

t-Test: Paired Two Sample for Means

	Present	*Past (1980s)*
Mean	68.889	91.296
Variance	12,346.795	19,733.832
Observations	27	27
Pearson Correlation	0.940	
Hypothesized Mean Difference	0	
df	26	
t Stat	-2.225	
P(T<=t) one-tail	0.017	
t Critical one-tail	1.706	
P(T<=t) two-tail	0.035	
t Critical two-tail	2.056	

P(T<=t) one-tail

0.017 <0.05

t Stat = -2.225<-1.706 and inside the reject area of the lower tail.

The null hypothesis is rejected.

The reduction seems to be statistically significant.

Comparison between the Current Level of Squirrel sp./Konghain Caught with That of the 1980s

Present Squirrel sp /Konghain (h.)	1980s Squirrel sp /Konghain (h.)
10	120
3	15
20	30
50	50
10	20
120	20
20	6
20	200
5	30
0	20
10	20
10	10
20	10
360	500
10	20
30	30
5	20
4	7
10	10
3	4
0	20
10	5
2	10
10	30
20	20
15	10
10	5
40	40
30	30
10	30
Sub-total:	**867**	**1,342**
Mean:	**28.900**	**44.733**

Hypothesis:

H_0: $\text{Present}_{\text{kongh.}} - \text{Past}_{\text{kongh.}} \geq 0$

H_a: $\text{Present}_{\text{kongh.}} - \text{Past}_{\text{kongh.}} < 0$

t-Test: Paired Two Sample for Means

	Present	*Past (1980s)*
Mean	28.900	44.733
Variance	4,419.197	8,894.616
Observations	30	30
Pearson Correlation	0.869	
Hypothesized Mean Difference	0	
df	29	
t Stat	-1.765	
P(T<=t) one-tail	0.044	
t Critical one-tail	1.699	
P(T<=t) two-tail	0.088	
t Critical two-tail	2.045	

P(T<=t) one-tail

0.044 <0.05

t Stat = -1.765<-1.699 and lies inside the reject area of the lower tail.

The null hypothesis is rejected.

The reduction in squirrel sp. seems statistically significant.

Comparison between the Current Level of Squirrel sp./Komprok Caught with That of the 1980s

Present Squirrel sp /Komprok (h.)	1980s Squirrel sp /Komprok (h.)
10	120
0	20
2	10
20	10
20	50
10	20
48	20
50	30
20	6
10	360
50	10
10	20
5	20
0	20
0	3
10	10
360	500
0	20
10	20
3	10
3	4
10	10
20	20
10	10
5	30
10	6
0	100
10	20
20	15
3	20
20	20
0	15
Sub-total: **749**	**1,549**
Mean: **23.406**	**48.406**

Hypothesis:

H_0: $\text{Present}_{\text{komp.}} - \text{Past}_{\text{komp.}} \geq 0$

H_a: $\text{Present}_{\text{komp.}} - \text{Past}_{\text{komp.}} < 0$

t-Test: Paired Two Sample for Means

	Present	*Past (1980s)*
Mean	23.406	48.406
Variance	3,963.023	10,947.281
Observations	32	32
Pearson Correlation	0.761	
Hypothesized Mean Difference	0	
df	31	
t Stat	-2.024	
P(T<=t) one-tail	0.026	
t Critical one-tail	1.696	
P(T<=t) two-tail	0.052	
t Critical two-tail	2.040	

P(T<=t) one-tail

0.026 <0.05

t Stat =-2.024<-1.696 and lies in the reject area of the lower tail.

The null hypothesis is rejected.

The reduction in squirrel sp. seems statistically significant.

Appendix 4.8 Non-timber value of Forest Resources to Yeak Loam Commune

		Fish (kg.)	Frog /On-Kep(kg.)	Crab (kg.)	Shrimp (kg.)	S. Snail sp /Kachauv (kg.)
		(p*q; with p = unit price, q = quantity)				
(1)	Sub-total (Value)	1,283,900	533,000	223,700	306,100	103,000
(2)	q(exclu. those without price)	485	202	143	133	145
(3)=(1)/(2)	**Weighted Aver. Price** (per unit)	**2,648**	**2,639**	**1,564**	**2,302**	**713**
	Q (includ. those with & without price) (Q =quantity)	538	223	220	169	148
(3)-A = (3)*Q	Total NTFP Value (riels) (per item)(for 73 household)	1,425,055	588,411	343,372	387,803	105,138
(3)-B=((3)-A)/73*346	Total NTFP Value for Yeak Loam Commune (per item)	6,754,370	2,788,906	1,627,488	1,838,082	498,327
(4)	Total NTFP Value (riels) (73 samples)	65,290,994		16,323	(US$ dollars)	
(5)=((4)/73)*346	Tot.Yrly NTFP Value for Yeak Loam Commune (riels)	309,461,426 (Yeak Loam Commune)		**77,365** (Yeak Loam Commune)	(US$ dollars)	
(6)=(4)/73	NTFP Value/ each household/ annual basis	894,397		$ 224	(US$ dollars)	

	US$		Riel$
Total NTFP (for Yeak Loam Commune)	**$**	**77,365**	**309,461,426**

Some figures may not seem to match due to rounding effects.

Appendix 4.8 (Continued -1) **Non-timber value of Forest Resources to Yeak Loam Commune**

		Terapin sp. (big) /Konthie(h.)	Terapin sp. (small) /Ondaek(h.)	Deer /Proes (h.)	Barking Deer /Chlus (h.)	W. Pig (h.)
(1)	Sub-total (Value)	90,000	28,000	200,000	535,000	2,880,000
(2)	q(exclu. those without/p)	4	6	1	16	44
(3)=(1)/(2)	**Weighted Aver. Price** (per unit)	**22,500**	**4,667**	**200,000**	**33,438**	**65,455**
	Q (includ. those with & without price)	4	6	1	20	48
(3)-A = (3)*Q	Total NTFP Value (riels) (per item)(for 73 household)	90,000	28,000	200,000	668,750	3,141,818
(3)-B=((3)-A)/73*346	Total NTFP Value for Yeak Loam Commune (per item)	426,575	132,712	947,945	3,169,692	14,891,357
	Ex Rate: US1=Riel	4000				

Appendix 4.8 (Continued - 2) **Non-timber value of Forest Resources to Yeak Loam Commune**

		W. Chicken (h.)	Chicken sp/ Moang To (h.)	Civet sp. /Sompoiyt(h.)	Porcupine sp /Kambromaa (h.)	Field Rat /Kondol (h.)
(1)	Sub-total (Value)	956,000	167,000	228,000	910,000	280,000
(2)	q(exclu. those without/p)	238	28	56	56	540
(3)=(1)/(2)	**Weighted Aver. Price** (per unit)	**4,017**	**5,964**	**4,071**	**16,250**	**519**
	Q (includ. those with & without price)	265	28	76	57	3,561
(3)-A = (3)*Q	Total NTFP Value (riels) (per item)(for 73 household)	1,064,454	167,000	309,429	926,250	1,846,444
(3)-B=((3)-A)/73*346	Total NTFP Value for Yeak Loam Commune (per item)	5,045,219	791,534	1,466,607	4,390,171	8,751,641

Appendix 4.8 (Continued - 3) **Non-timber value of Forest Resources to Yeak Loam Commune**

		Squirrel sp /Konghain (h.)	Squirrel sp /Komprok (h.)	A-Nhi (h.)	Pchong(h.)	Trokout (h.)	Snake sp /Pouhs(h.)
(1)	Sub-total (Value)	1,074,100	743,500	782,000	956,000	196,000	160,500
(2)	q(exclu. those without/p)	1,270	899	80	182	34	12
(3)=(1)/(2)	**Weighted Aver. Price** (per unit)	**846**	**827**	**9,775**	**5,253**	**5,765**	**13,375**
	Q (includ. those with & without price)	1,660	1,116	80	195	40	21
(3)-A = (3)*Q	Total NTFP Value (riels) (per item)(for 73 household)	1,403,942	922,966	782,000	1,024,286	230,588	280,875
(3)-B=((3)-A)/73*346	Total NTFP Value for Yeak Loam Commune (per item)	6,654,299	4,374,604	3,706,466	4,854,834	1,092,925	1,331,271

Appendix 4.8 (Continued - 4) **Non-timber value of Forest Resources to Yeak Loam Commune**

		Pigeon /Lolork(h.)	Bird (h.)	Monkey (h.)	Pangolin Pongrool(h.)	S. Bamboo (stem) /Russey Pok	L. Bamboo(st.) /Russey B'or
(1)	Sub-total (Value)	268,800	6,000	25,000	390,000	4,770,919	2,089,495
(2)	q(exclu. those without/p)	273	30	5	3	8,924	2,279
(3)=(1)/(2)	**Weighted Aver. Price** (per unit)	**985**	**200**	**5,000**	**130,000**	**535**	**917**
	Q (includ. those with & without price)	401	462	5	3	15,863	4,699
(3)-A = (3)*Q	Total NTFP Value (riels) (per item)(for 73 household)	394,831	92,400	25,000	390,000	8,480,862	4,307,437
(3)-B=((3)-A)/73*346	Total NTFP Value for Yeak Loam Commune (per item)	1,871,390	437,951	118,493	1,848,493	40,196,961	20,416,070

Appendix 4.8 (Continued - 5) **Non-timber value of Forest Resources to Yeak Loam Commune**

		S. Bamboo(st.) /Russey Kley	S. Bamboo(st.) /Russey Prey	S. Bamboo(st.) /Russey Srok	Rattan (st.)	Firewood (basket)
(1)	Sub-total (Value)	140,317	145,533	16,000	273,200	17,835,000
(2)	q(exclu. those without/p)	624	457	20	557	9,728
(3)=(1)/(2)	**Weighted Aver. Price** (per unit)	**225**	**319**	**800**	**490**	**1,833**
	Q (includ. those with & without price)	1,078	503	20	644	13,654
(3)-A = (3)*Q	Total NTFP Value (riels) (per item)(for 73 household)	242,528	160,307	16,000	315,847	25,032,801
(3)-B=((3)-A)/73*346	Total NTFP Value for Yeak Loam Commune (per item)	1,149,517	759,810	75,836	1,497,027	118,648,619

Appendix 4.8 (Continued - 6) **Non-timber value of Forest Resources to Yeak Loam Commune**

		H. Medicine (basket)	Honey (Litre)	Rambutan (basket)	Mango (basket)	Phnieu (basket)	Malva Nuts (basket)
(1)	Sub-total (Value)	80,000	393,000	411,750	170,600	249,000	160,667
(2)	q(exclu. those without/p)	11	105	83	32	60	17
(3)=(1)/(2)	**Weighted Aver. Price** (per unit)	**7,273**	**3,743**	**4,961**	**5,416**	**4,150**	**9,451**
	Q (includ. those with & without price)	38	110	87	50	63	19
(3)-A = (3)*Q	Total NTFP Value (riels) (per item)(for 73 household)	272,727	411,714	431,593	268,086	261,450	176,418
(3)-B=((3)-A)/73*346	Total NTFP Value for Yeak Loam Commune (per item)	1,292,653	1,951,413	2,045,634	1,270,653	1,239,201	836,174

Appendix 4.8 (Continued - 7) **Non-timber value of Forest Resources to Yeak Loam Commune**

		Bamboo Shoots (basket)	Vegetables (basket)
(1)	Sub-total (Value)	3,010,167	4,431,500
(2)	q(exclu. those without/p)	806	2,006
(3)=(1)/(2)	**Weighted Aver. Price** (per unit)	**3,733**	**2,209**
	Q (includ. those with & without price)	853	2,213
(3)-A = (3)*Q	Total NTFP Value (riels) (per item)(for 73 household)	3,185,625	4,888,788
(3)-B=((3)-A)/73*346	Total NTFP Value for Yeak Loam Commune (per item)	15,098,989	23,171,518

Appendix 4.9 **Rice Production**

Rice-field Size (Hectare)	Total Production of Rice (kg) per year	Rice consumption (Family/Kg/Day)	Family Size
1.00	1,000.00	2.00	4
2.50	1,466.67	4.00	7
0.49	293.33	3.50	3
1.50	1,100.00		
2.00	1,466.67	2.00	5
0.41	513.33	4.50	8
1.00	1,100.00	2.50	5
1.00	750.00	1.00	2
1.28	440.00	1.25	4
2.00	2,669.33	2.00	4
1.00	440.00	3.50	7
2.50	1,466.67	7.50	8
2.00	953.33	3.75	7
1.00	264.00	1.88	4
1.00	330.00	2.50	6
1.00	476.67	3.00	4
1.50	792.00	2.25	8
2.00	2,200.00	2.00	3
1.50	1,173.33	2.00	4
2.00	1,540.00	4.00	7
2.00	2,200.00	2.00	6
2.00	1,466.67	3.75	7
1.00	440.00	2.00	5
2.00	1,056.00	3.75	5
0.64	410.67	1.50	2
1.00	330.00	2.50	4
1.60	1,936.00	5.25	9
0.80	440.00	2.50	4
2.00	1,056.00	3.75	5
0.50	440.00	2.50	4
1.40	806.67	3.75	9
1.00	704.00	3.75	5
0.88	1,870.00	2.50	7
2.50	673.75	3.75	7
0.64	880.00	3.00	7
Sub-total: 48.64	35,145.08	101.38	186.00
Average:	**722.56** (kg/ha./year)	**0.55** (kg/person/day)	5.31

1 Ha. of rice-field can produce 722.6 kg of rice.
Each person consumes 0.55 kg of rice per day.

The total quantity of rice required by Yeak Loam Commune per year = 385,456
(based on an average family size of 5.6 as per 73 interviewed samples) (kg/per yr.)

Rice-field size required to produce enough rice for Yeak Loam Commune = **533.46**
(if good season) (ha.)

A person should get 0.28 ha. Of rice-field to be self-sufficient. **0.28**
(if good season) (ha.)

An average household of 6 persons should have 1.7 ha. Of rice-fields **1.652**
to be sufficient (if good season)

APPENDIX 4.10 CHI-SQUARE TEST

Chi-Square Test: **The Association Between Fishing Activity and NTFP Income**

NTFP Income		Fishing Yes	No		
>	894,397	***21***	***4***	25	*Relative Risk = (C6/(C6+D6))/(C7/(C7+D7))*
<	894,397	***47***	***1***	48	*Relative Risk = 0.86 <1*
		68	5	73	

Assumption: The NTFP income level is significant if it is > 894,397 riels/yr.

$\rho =$ 0.025495 <0.05

		0.224730056	3.056329
Expected:		0.117046904	1.591838
23.3	1.7		
44.7	3.3	$\chi^2 =$	***4.99*** >3.84

Exposure	+	-	
+	21	4	25
-	47	1	48
	68	5	73

Analysis of Single Table
Odds ratio = 0.11 (0.00 <OR< 1.18*)
Cornfield 95% confidence limits for OR
*Cornfield not accurate. Exact limits preferred.
Relative risk = 0.86 (0.72 <RR< 1.02)
Taylor Series 95% confidence limits for RR
Ignore relative risk if case control study.

	Chi-Squares	P-values
Uncorrected :	4.99	0.0254950 ---
Mantel-Haenszel:	4.92	0.0265231 ---
Yates corrected:	3.05	0.0808825

Fisher exact: 1-tailed P-value: 0.0439624 --
2-tailed P-value: 0.0439624 --

An expected cell value is less than 5.
Fisher exact results recommended.

F2 More Strata; <Enter> No More Strata; F10 Quit

Chi-Square Test:

The Association Between Herbal Medicine Collection and Total Annual Income

			H. Medicine Yes	No		
Total Income	>	2,042,064	***10***	***16***	26	*Relative Risk = (C6/(C6+D6))/(C7/(C7+D7))*
	<	2,042,064	***8***	***39***	47	*Relative Risk = 2.26 >1*
			18	55	73	

Assumption: The total income level is significant if it is > 2,042,064 riels/yr.

$\rho =$ 0.0418296 <0.05

		2.009249502	0.657573
Expected:	6.4	19.6	1.111499725	0.363764
	11.6	35.4	$\chi^2 =$ ***4.14*** >3.84

Exposure	+	-	
+	10	16	26
-	8	39	47
	18	55	73

Odds ratio = 3.05 (0.90 <OR< 10.55)
Cornfield 95% confidence limits for OR
Relative risk = 2.26 (1.02 <RR< 5.01)
Taylor Series 95% confidence limits for RR
Ignore relative risk if case control study.

	Chi-Squares	P-values
Uncorrected :	4.14	0.0418296 ---
Mantel-Haenszel:	4.09	0.0432566 ---
Yates corrected:	3.07	0.0798288

F2 More Strata; <Enter> No More Strata; F10 Quit

Chi-Square Test: **The Association Between Occupation and Total Annual Income**

			Student Yes	No		
						Relative Risk = (C6/(C6+D6))/(C7/(C7+D7))
Total Income	>	2,042,064	***7***	***19***	26	*Relative Risk = 4.22 >1*
	<	2,042,064	***3***	***44***	47	
			10	63	73	

Assumption: The total income level is significant if it is > 2,042,064 riels/yr.

$\rho =$ 0.0145191 <0.05

		3.319336143	0.526879
Expected:	3.6	22.4	1.836228505	0.291465
	6.4	40.6	

$\chi^2 =$ ***5.97*** >3.84

Exposure	+	-	
+	7	19	26
-	3	44	47
	10	63	73

Odds ratio = 5.40 (1.08 <OR< 30.06*)
Cornfield 95% confidence limits for OR
*Cornfield not accurate. Exact limits preferred.
Relative risk = 4.22 (1.19 <RR< 14.94)
Taylor Series 95% confidence limits for RR
Ignore relative risk if case control study.

	Chi-Squares	P-values
Uncorrected :	5.97	0.0145191 ---
Mantel-Haenszel:	5.89	0.0152092 ---
Yates corrected:	4.36	0.0367318 ---
Fisher exact: 1-tailed P-value:		0.0201299 --
2-tailed P-value:		0.0284638 --

An expected cell value is less than 5.
Fisher exact results recommended.

F2 More Strata; <Enter> No More Strata; F10 Quit