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Local land use on Borneo: applications of indigenous knowledge systems and natural resource utilization among the Benuaq Dayak of Kalimantan, Indonesia

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LOCAL LAND USE ON BORNEO: APPLICATIONS OF INDIGENOUS KNOWLEDGE SYSTEMS AND NATURAL RESOURCE UTILIZATION AMONG THE BENUAQ DAYAK OF KALIMANTAN, INDONESIA

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ABSTRACT

Indonesia as a nation faces the formidable task of balancing sustainable economic activity, conservation goals, and continuation of traditional indigenous life ways. This research encompasses a broad but integrated system of human-land relationships among the Benuaq Dayak, an indigenous group who maintain their customary laws and land use systems. The study identifies and analyzes instances of community related land management and resource utilization in the interior of Borneo. As forest dwelling people, the environment has shaped the culture and life ways of the Dayak. They have developed a complex system of cultural aspects in relation to the forest that they depend on for survival. The Benuaq Dayak create a mosaic of land use systems practicing Swidden agriculture, managing mixed fruit orchards, rubber and rattan plots, and community forest reserves. Customary laws continue to shape the landscape and dictate extraction of forest resources in the community reserves. Because the Benuaq Dayak are subsistence farmers, small-varied land parcels are used to cultivate a high variety of resources. Village household surveys were conducted to identify the varying types of resources utilized and agricultural activities. Land surveys and biodiversity plots were used to analyze the land use patterns. This research through sample surveys, species diversity plots, and ethnographic research identifies differences in resource use, sustainability efforts, and economic utility of the various land use types of the Benuaq Dayak.

CHAPTER 1

INTRODUCTION

1.1 Introduction

Throughout the tropics there is a need to research and document local land use systems. Research needs to be available to decision makers and non-governmental organizations (NGOs) working with local communities on sustainable development and conservation issues. In Indonesia it is vital to understand the land use systems of the Benuaq Dayak, an indigenous group facing pressure on its cultural dynamics due to Indonesia's rapid development and the decentralization of the forestry sector. This study identifies and analyzes community related sustainable land management and resource utilization in the rainforests of East Kalimantan, Indonesia where the Benuaq Dayak of Kutai Barat strive to continue to practice traditional management practices in times of rapid change in Indonesia.

Indonesia has been blessed with the second most ecologically diverse rainforests in the world (Barber 1998). Covering only 1.3 percent of the earth's landmass, this nation holds 10 percent of the world's rainforests and 40 percent of Asia's rainforests (Figure 1.1). Some 19 different forest types have been identified in Indonesia, containing an overwhelming amount of biological diversity (Barber 1998). The forests, far from empty, are home to indigenous cultures and their great knowledge of the forest ecosystem, endangered flora and fauna, valuable medicinal plants, and hardwoods that hold an immeasurable wealth, which if destroyed can never be restored. In short, there is now an urgent need in Indonesia to conserve and manage forested areas and protect the people who live in them and depend on these resources for their livelihood. A balance in

Figure 1.1 **Map of Indonesia** (Maps.com 1999)

the ecosystem should be maintained while permitting sufficient production to meet the capital requirements of development. Conservation and sustainable land use practices, if implemented properly, will enable Indonesia to maintain healthy and productive forest ecosystems.

1.2 Deforestation in Indonesia

Deforestation is caused by human activities that critically alter the natural habitat of forest ecosystems (Nasendi 2000). In the tropics, 36 percent of the land remains covered by natural forests, roughly 1,715 million hectares (World Bank Statistics 1992). The low percentage of intact forest coverage indicates that the majority of tropical forests have been largely degraded. Developing countries have substantially higher rates of deforestation due to their heavy reliance on natural resources (Palo and Mery 1996). Many developing countries are dependent on the extraction and export of natural resources to generate income (Palo and Mery 1996). Often these countries exhaust resources in an attempt to make short-term gain. This has, in turn, caused large-scale removal of resources with little consideration of the future needs.

The Indonesian economy is largely based on primary industries associated with the use, processing, and sale of natural resource products (BPS Statistics, Indonesia 2001). Aggressive logging policies while raising much needed capital, overlooked or ignored the environmental impacts of deforestation and further, the social consequences of rapid resource depletion and related environmental problems. The steady depletion and uneven development of the country's natural resources including forest resources has led to long term problems such as a loss of biodiversity, wildlife, reduced vegetation cover in upper watersheds which will heighten the effects of erosion, flooding, and crop

loss. The Indonesian economy has been heavily dependent on extracting forest resources for many years. A discussion regarding the causes of deforestation is crucial to the understanding how this broad based issue affects many stakeholders. Deforestation caused by human activities alter the natural habitat of forest systems include the following:

- Timber harvesting at non-sustainable rates
- Large-scale agricultural and plantation expansion
- Mining
- Poverty, migration, local resource needs
- Shifting cultivation that is non-sustainable
- Multiplier effects such as drought, fire, crisis (Sunderland 1998, Nasendi 2000).

Timber harvesting at non-sustainable rates is the largest factor of deforestation (Barber, Johnson, and Hafild 1994). Agricultural and forest plantation expansion has contributed to the conversion of naturally forested land to other uses. Swidden[1] agriculture has been a contributor to deforestation, however the impact has been less than that of large-scale timber removal (Colfer 1997, Shulte and Schone 1996). Poverty, migration, and local resource needs have led to deforestation in lands that up until recently have been forested. Government sponsored transmigration programs in Indonesia relocate people to remote outer islands in order to resettle landless people from Java and to develop remote regions. Land allocated for these projects are often already claimed by indigenous people, which adds additional problems. New residents to these areas are not familiar with the ecosystems and often farm, using methods that are not sustainable and lead to deforestation (Dove 1985).

[1] Swidden Cultivation depends on the rotation of non-permanent fields with short periods of cropping and long fallow periods (Whitten et al. 1987). Land clearing in Swidden agriculture is associated with fire. Primary and other forest types are slashed and then burned to promote nutrient return to the soil.

1.2.1 Logging / Timber Harvesting

Poor management practices are the biggest problems in forest management (Bowyer 2001, Palo and Mery 1996, Shulte and Shone 1996). In addition, lack of enforcement by officials to prevent large-scale timber harvesting can often lead to forestry practices that are wasteful and lead to long-term environmental degradation (Barber, Johnson, and Hafild 1994) (Figure 1.2). Concessions are the contracts given to timber companies to allow extraction of forest resources; concessions are generally given for a 20-25 year period. However, often times logging will continue 24 hours a day until all commercial trees are removed from the forest. In Indonesia from the 1980s onward, deforestation is estimated at 1.6 million hectares annually (Toha 2000 in Cassan 2001). Timber harvesting by concessions has had devastated large tracts of land on Borneo (Dove 1985). Potter (1990) estimated that 40 percent of Indonesian log production originated in East Kalimantan during period of 1970-79 where the largest stands of commercial timber were found. The sustainable timber threshold for Indonesia (under the national forest policy) is 25 million cubic meters per year, through the mid-1990s. Sawnwood, plywood, and pulpwood industries were estimated to consume 60-80 million cubic meters per year, over double the sustainable threshold (Barr 2001, Scotland et al. 1998 in Cassan 2001). Forests where there is large-scale extraction are often left denuded with much damage caused by harvesting techniques such as clear cutting and logging roads. When sustainable harvesting is attempted the damage done to residual stands can be immense (Barber, Johnson, and Hafild 1994). An example of large-scale deforestation is the Philippines where 90 percent of the country's original land cover has been deforested. Without sustainable management practices this country has been left with a

Figure 1.2 **Logs Harvested from the Interior of Kalimantan, Carried Down the Makaham River to the Provincial Capital, Samarinda.**
Makaham River, East Kalimantan, Indonesia 2002

huge deficit of forest resources and the daunting challenge of attempting reforestation. This is only one example where exhaustion of resources leads to long-term devastation of the environment and renewable resources.

1.2.2 Plantation Forests

Plantation forests located on degraded landscapes are thought to aid in sustainable forestry by taking pressure off natural forests (Vittanen 1996). The exotic *Acacia mangium* and other fast growing species are used for pulpwood in plantations. Many forest plantations are exotic monocrops, which are susceptible to pathogens and other problems such as insect infestation (Bowyer 2001). The land used for monocrop plantation forests is only viable for shorter periods of time when compared to natural forests. Plantation forests often plant fast growing exotics that remove the already scarce

nutrients from the soil. Leaving the land unproductive after only a few rotations (Palo and Mery 1996). Plantation forestry practices in Indonesia are being revised and experimental intercropping with multiple species in plantations is in initial phases, which adds diversity to monocrops and mimics natural forests (Bowyer 2001).

Plantation forests are found throughout Indonesia, natural forest stands are often cleared in order to produce estate crops such as palm oil or banana trees. The highly valued palm oil has influenced the Indonesian government to convert forested land into plantations in many of the outer islands in Indonesia (NRM 2000). Large-scale agricultural expansion of palm oil and banana plantations are being promoted and developed through out Indonesia, including large tracts of land in East Kalimantan. A proposed palm oil plantation was to be developed within the boundaries of three Benuaq Dayak communities, the land that was to be converted included forest reserves and land actively managed by the communities (pers. comm. with local NGO SHK). Studies on economic valuation of Benuaq Dayak land management practices concluded that community forest practices provided greater returns than palm oil plantation (NRM 2000). The plantation was not developed in the area due to protests by the communities with the aid of local and national NGOs. The Benuaq Dayak were fortunate; many communities have suffered loss of traditional lands to logging and plantation forestry (King 1993, Peluso and Padoch 1996, Brookfield, Potter, and Byron 1995).

1.2.3 Mining

Mining is one of several causes of land degradation in Indonesia (DTE 1998). Coal, gold, and other mining cause environmental degradation in East Kalimantan, but it has also been the main source income for the government in the region (Cassan 2001). Significantly, PT Kelian Equatorial Mining (PT KEM) one of the largest gold mines in

the world is located in Kutai Barat, East Kalimantan. (The mine is 90 percent owned by Rio Tinto Foundation of Australia and 10 percent owned by PT Harita Jayaraya of Indonesia). The mine has been operating since 1992 and averages 450,000 ounces of gold and 400,000 ounces of silver per year (PT KEM 1999). The mine has one of the largest processing plants in the world (Cassan 2001). The ore mining process, involving gravity separation and cyanide leaching, causes significant environmental damage. For each ton of ore extracted, five tons of tailings are produced. Attention has been given to the mine from both national and international non-governmental organizations (NGOs) criticizing the environmental impacts in the region. PT KEM has been unable to rehabilitate most of the land that has been mined. This land, once forested, is now too degraded to reforest and will be converted into lakes and wetlands (Cassan 2001).

In Irian Jaya, Indonesia, (West Papua) Freeport-McMoran/ Rio Tinto Mining Company has caused much destruction by leveling mountaintops mining the rich mineral resources (O'Neill 1996). The mine is located less than 20 km from one of three ice glaciers in the world. In addition to environmental devastation, social problems with the local population are an ongoing occurrence, which in recent times has turned violent (DTE 2002). Many conflicts have occurred between the mine and the local population over the last several years, and continue to be a problem in the region. As indicated above destruction of forests is one of many types of land degradation in this region, mining also causes contamination of water supplies and irreversible damage to land (Cassan 2001).

1.2.4 Shifting Cultivation

Shifting cultivation by indigenous people has been noted as a main factor in deforestation. This is a stand that many governments in the tropics often take to redirect

deforestation caused from timber companies. Migrants to a new region and ecosystem can cause damage to the environment due to unfamiliar ecosystem constraints and lack of land tenure (Dove 1985, Peluso 1992). New migrants to the outer islands of Indonesia often practice temporary cultivation of various high yielding crops and with no interim fallow period which can leach the soils to the point that necessary nutrients can not be replaced in the ecosystem (Dove 1985).

1.2.5 Multiplier Effects

Multiplier effects include economic crisis, large-scale natural disasters, and resource limitation, these factors have contributed to deforestation in Indonesia. In recent years drought, fire, and economic crisis have exacerbated deforestation (Sunderland 1998). The causes and affects of deforestation encompass a large range of stakeholders from national governments to timber industries and local people reliant on forest resources. Population increase and economic stress in developing countries also contributes to deforestation due to fuel wood extraction and lack of other resources. A large number of developing countries experiencing deforestation are also facing shortages of industrial timber, and other forest products for local use. Although resource extraction is necessary for income generation, sustainable methods have not been followed, and as a result Indonesia has lost a great expanse of its natural land cover and faces general environmental degradation.

1.3 Sustainable Forestry and Indigenous Communities

Western ecological economists and development researchers have defined sustainability as the relationship between human economy and natural environment (Loomis 2000). For sustainable forestry to truly be successful it must have the support of local, national, and international organizations, agencies, and governments. Strategic

principles and policy-relevant information for sustainable forest use needs to be filtered through the entire forestry process from planting and extracting to exporting finished products. Technology, profit, expectations, and benefits also must flow in both directions. Top-down to bottom-up theories must mesh together for successful sustainable forestry practices. This study however, focuses on local forestry practices; issues of national sustainability of forest resources and management will not be reviewed.

Indigenous epistemologies, science, and ethics can contribute greatly to sustainable development (Colfer 1997, Loomis 2000). This study focuses on land use practices of the Benuaq Dayak, an indigenous ethnic group in the interior of Borneo whom through community management and heavily implemented customary laws are able to sustainably exploit their land. Sustainable development involves measuring and valuing stock resources and making trade off decisions about "balance investments" and consumption without depleting the resource to enable use for future generations. Sorenson (in Shultze and Shone 1996) has studied traditional Dipterocarp forest management and has found that subsistence exploitation is indeed sustainable. Indigenous extractions of timber resources are generally for subsistence purposes. Small-scale low impact forestry that is often practiced by indigenous groups causes very little damage to the ecosystem (Colfer 1997, Lawrence 1996). In some cases when indigenous groups fell trees it is in a directional manner to cause the least amount of damage to the surrounding vegetation (Lawrence 1996). The gaps caused by small scale tree felling by Dayak communities (the indigenous people of Borneo) are not much larger than a natural tree gap (Shulte and Shone 1996). If timber is removed from tribal land there is an effort to do as little damage as possible because trees will need to be extracted in the future (Colfer 1997).

Most if not all of the lands where indigenous people extract forest resources are communal; due to this system, indigenous groups practice customary laws and taboos to control resources. Indigenous societies are based on the community and reciprocity; these traits have allowed these cultures to survive and progress in modern times. Without the culture traits mentioned, many indigenous groups would have so many internal conflicts that it could not be possible to maintain community management of lands (Loomis 2000). Socioeconomic development depends on the existence of voluntary associations and networks, close-knit families and norms of cooperation and reciprocity that are more important than finance or other natural resources (Loomis 2000). The close ties in indigenous communities enable them to manage and maintain forestry systems and networks that are based on customary laws and taboo.

1.4 Justification and Rationale

Worldwide concern over deforestation of rainforests due to widespread logging has impressed upon the Indonesian government the importance of conserving and managing these natural resources. The question, however, remains of how best to effectuate conservation. Studies have shown that the ultimate success of vital conservation efforts depends on the inclusion of local groups as well as the government (Brookefield et al. 1995, Potter, and Byron 1995, Colfer 1997, Padoch and Peluso 1996). Community management by those who are familiar with the ecosystem and have a personal interest in the well-being of the forest appears to be the most effective approach for conservation in developing countries (Furze et al. 1996). Indonesia as a nation faces the formidable task of balancing sustainable economic activity, conservation goals, and continuation of traditional indigenous lifeways. Research in this area suggests that success in finding

such a balance will require that the Indonesian government reach a consensus on future direction and act in a transparent and inclusive manner.

The natural resources in East Kalimantan including forests, coal, natural gas, and gold have been intensively exploited since the 1960s. Migration both governmental sponsored and spontaneous has been continuous since the 1950s which has lead reallocation of land and varied land use practices by immigrants. As a result of marked increase in logging and agricultural lands, the frequency and areas, with which fire is used, have greatly increased because land preparation by fire is the most efficient in cost and labor and the ash supplies the needed nutrients for the soil (Fatawi and Mori 2000). Roughly 7 million hectares of undisturbed forests were estimated to have been lost from 1968 to 1990 (Ave and King 1986). All of these factors coupled with droughts caused by El Niño Southern Oscillation (ENSO) events have exacerbated wildfires in the region since the 1980s. Large-scale wildfires devastated East Kalimantan in 1982-83, 1987, 1994, 1997-98, 2000 and currently in 2002, the fires have resulted in significant losses both economically and environmentally (Figure 1.3). The forest area that burned in 1982-83 was one of the worst fires in the century; the estimated area affected by fire in East Kalimantan was 3.6 million hectares (Fatawi and Mori 2000). The fires in 1998 affected roughly the same amount of hectares (Mori 2000). The creations of the fire sources were closely connected with human activities, without these sources neither of the great fires would have existed (Mori 2000). The large tracts of land affected by the fires included primary, secondary, production, logged over, protected forests, bushlands, grasslands, and peat swamp biomass. These burned areas greatly affected the province

Figure 1.3 **Forest Stand After Large-scale Fires Devastated Kalimantan in 2000.** East Kalimantan, Indonesia 2002

environmentally from the coast to the interior. Many indigenous groups who reside in the interior of Borneo have deeply suffered the impact of forest and crop loss.

Over the last several years Indonesia has faced economic crises, ethnic turmoil, in addition to being plagued by natural disasters, primarily forest fires as explained above. Wildfires that have occurred on the island of Borneo have caused many environmental disasters and have affected the indigenous populations in the region. The foundation for this dissertation research is ecological disaster due to the huge impact it has on indigenous people who rely on forest resources and Swidden agriculture for subsistence farming.

The first objective of this study is to identify the differences in productivity of land use types in areas disturbed by natural disaster, and the second is to ascertain differences in productivity of land use types in villages not affected by natural disaster.

Three villages were chosen for this research. The first two villages, Tepulang and Benung, are in proximity to one another. There were no large-scale fires in this area in the last six years. This region did experience fires in 1997, but since then these villages have not been plagued by wild fires. Development agencies entered the area to assist in rubber tree cultivation on fire-damaged land. In the last six years, the third study village, Dingin, was plagued by fires in 1997,1998, and in 2000. Fruit gardens and the community forest reserve were heavily damaged. Dingin is located on the Pahu River, where the flooding of *Umaq*, the shifting cultivation plots, was also a problem in the last year. This area has been plagued with several ecological disasters over the last several years. Since small-scale farmers have very limited resources, it is important to identify the impact that these disasters have on subsistence economies in the region.

1.5 Overview of Chapters

This dissertation documents the land use practices of the Benuaq Dayak, an indigenous group who resides in the middle stretches of the Mahakam River Basin in East Kalimantan, Indonesia. In addition, this study analyzes the impact of natural disasters on the subsistence and economic welfare of one study village in relation to villages that have not been plagued by ecological catastrophes.

The second chapter discusses the theoretical foundation for this study and various methods applied to create a comprehensive documentation of the Benuaq Dayak land use practices. The theoretical base for this study is grounded in the concept of sustainable development. The Benuaq Dayak practice a multitude of land use practices in order to maintain their subsistence base. They are also linked to the market economy through the cultivation and sale of natural resources such as rattan, rubber, and various agricultural produce.

Chapter three describes Dayak indigenous land use practices and indigenous knowledge systems, primarily discussing the heavy reliance on natural resources. The Dayak are a forest dwelling people who have throughout history relied on a subsistence base of agricultural products cultivated in shifting cultivation plots and forest gardens. Indigenous knowledge as a theoretical foundation in development is discussed in detail. In the field of development there is now recognition that indigenous knowledge may be the key to sustainability. Concepts long used by indigenous groups have maintained populations for thousands of years and continue to due so successfully in times of rapid change in the world.

The fourth chapter is an overview of the study area. A brief description of Borneo is followed by an overview of East Kalimantan. Demographic information on the Benuaq Dayak gives a profile on the three study villages. These data include average household size, age, and education, income generation, and expenses. Primary income is derived from the sale of agricultural products, rattan, rubber, and livestock. Expenses are generally based on food items and travel expenses. This chapter gives a clear understanding of typical Benuaq Dayak subsistence economy.

Chapter five discusses the practice of shifting cultivation. This land use type provides the Benuaq Dayak as well as other indigenous groups of Borneo with the basic subsistence needs. Rice and cassava are the most important staple for the Benuaq Dayak which is grown in *Umaq*, shifting cultivation plots. This chapter describes in detail agricultural products cultivated in these plots as well as information on the management of fallow fields. For the Benuaq Dayak these are the most important agricultural plot, their daily life activities are based around their shifting cultivation plots. One of the study

villages was plagued by flooded *Umaq* plots which devastated the staple crops and drastically reduced the yields of staple crops

Chapter six focuses on a variety of forest gardens managed by the Benuaq Dayak. They maintain fruit, rattan, and rubber gardens, the products from these gardens are consumed for household use or are sold at the local market. This chapter also describes the ecological impacts of the forest fires of East Kalimantan and the effect it has had on the local communities. Large-scale fires in the region have repetitively plagued one village over the last several years. It has devastated the community's landscapes and also lowered the overall morale of the village. This chapter gives a good indication of the damage that is done to small indigenous communities who rely on forest resources for subsistence.

Chapter 7 describes various community forest reserves and the reliance on the extraction of forest products for forest dwelling peoples. The *Bengkar*, Benuaq Dayak community forest reserves contain very valuable tree species that have been heavily logged throughout Indonesia. At the time of this research in 2002 there was no commercial logging permitted in the reserves. Tree species extracted from the reserves are only removed for personal use, for example for building purposes. Non-timber forest products such as medicinals, rattan, and animals are extracted at very low rates. The Benuaq Dayak maintain reserves in order for future generations to have access to forest resources. This chapter also examines the opinions related to conservation issues on the *Bengkar*. The majority of residents would reduce their current extraction rates in order for future generations to have access to forest resources. This chapter identifies the importance of sustainable extraction rates and values placed on future generations.

Chapter 8 concludes this study and discusses the sustainability of Benuaq Dayak land use systems.

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CHAPTER 2

METHODOLOGY

2.1 Overview

This study was conducted in the Indonesian province of East Kalimantan, in the district of Kutai Barat. The locations of the study sites are up the Makaham River into in interior approximately 250 kilometers from the provincial capital of Samarinda. Three Benuaq Dayak villages located in the upper watershed of the Makaham catchment system were chosen for this research project. These villages were selected because they are composed of 100 percent Benuaq Dayak ethnicity. Benuaq Dayak villages have been established in this area for over 300 years. The Benuaq Dayak practice subsistence economy based on various land management units including Swidden agriculture of hill rice, fallow fields, fruit, rubber, and rattan gardens, and community forest reserves. The main income generation activities are agricultural based, however non-agriculture income is available in some areas but is somewhat limited.

The Benuaq Dayak are the research focus due to their mosaic of land use systems and community conservation practices. The Benuaq Dayak live in a communal setting that allows for reciprocity and close relationshipS with one another. In spite of Dutch colonialism, Christian missionaries, and other outside influences, there remains a very close relation between nature and the Dayak people. Their continuance of traditional lifeways meshed in times of rapid development in the region makes this a dynamic area for research.

This research was conducted in 2002 under the indirect supervision of Natural Resource Management, an NGO based in Samarinda, the provincial capital of East Kalimantan and by the head of the forestry sector in the district of Kutai Barat.

2.2 Objectives

This study's purpose is to identify natural resource use in subsistence economies and the economic utility of these resources in the villages of Tepulang, Benung, and Dingin. Geography and environmental factors were hypothesized to play a role in variation of resource utilization among the Benuaq Dayak villages. The reliance of natural resource use for subsistence and income generation is a significant aspect of the livelihood of this ethnic group but differ in degree between villages. In addition, the land management system for the Benuaq Dayak at its current condition appears to be sustainable but again this may vary between villages.

Specifically, the objectives of the study are:

1.Study indigenous knowledge systems in relation to land use practices.

2. Describe land use systems of the Benuaq Dayak.

3. Describe agricultural practices.

4. Describe economic utility of agricultural activities.

5. Identify forest resources extracted and yields of these resources.

6. Analyze land use systems sustainability.

7. Identify variation among resource use in the three study sites, taking into account ecological disaster caused by fires and flooding.

This study also aims to identify the willingness to conserve and maintain community forest reserves among the three study sites. In addition to the decentralization of the forestry sector, this region is also going through rapid changes in the government due to regional autonomy. This area and the local communities are being developed and have

more opportunities than ever before. Critical to this change is the understanding that continued sustainable extraction and forestry practices among the Benuaq Dayak are maintained.

2.3 Methodology

Social scientists have historically relied on qualitative data to describe, analyze, and understand the meanings that people ascribe to their social settings and activities. This data has a holistic view that incorporates all or many cultural and natural aspects of the group studied. While collecting data in interviews with local people, additional information in casual conservation can add important relevance to research. Historical and traditional explanations of land use, social formation, and customs are invaluable to the researcher. Further, the context and setting of a study site may be enhanced through qualitative data methods.

Social anthropology is the most prominent field applied in social sciences to conduct research with indigenous people. This section will focus on ethnography and its methodologies due to its relevance in this research. Ethnographers seek to document knowledge and belief systems that contribute to the coherence of the group (Potter 1996). Ethnography as defined by Atkinson and Hammersley in Denzin and Lincoln (1994) includes forms of social science having a substantial number of the following features:

- A strong emphasis in exploring the nature of a particular phenomenon, rather than setting out to test a hypothesis.
- A tendency to work with "unstructured" data...
- Analysis of data that involves explicit interpretation of the meanings and functions of human behaviors…

According to this definition, ethnography is applicable to a number of social sciences. This research incorporates many of the aspects of working with indigenous

groups in remote areas. There are three theories that I will include that are relevant in the analysis of data when working with indigenous groups. All three derive from the theory of Construction: Induction. The first is the Grounded Theory where researchers look for patterns in data in order to make general statements about the phenomenon examined (Potter 1996). It focuses on the interplay between data collection and analysis. The process follows inductive reasoning- identifying patterns across individual observations to make general inferences from the formed patterns. Within grounded theory researchers do not begin with a theory and deduce hypothesis to be tested; researchers begin with a study area and then make observations (Potter 1996). The researcher then identifies patterns and makes conclusions based on observations. Data collection, analysis, and theory have reciprocal relations (Strauss and Corbin 1990). The quantitative data in this research is analyzed through statistical methods such as the ANOVA test, used to identify similarities and differences related to yields of agricultural produce cultivated by three Benuaq Dayak villages. By looking at levels and yields of productivity in various land use types, it will enable the researcher to understand the impacts of ecological disaster of subsistence economies.

The second theory is Triangulation, where conclusions are derived from many different sources and people building on many dimensions as opposed to one. When adopting this theory, researchers add dimensions to data by increasing sources of data using a variety of methods to collect information. Data were collected using multiple research methods in the form of interviews and field surveys of various land use systems. Information was collected in three different villages and from 95 different households to understand and identify multiple perspectives on land management within the same ethnic group. Species diversity sample plots were conducted in three different land use

systems to understand the diversity of plots and compare them to data collected in the household surveys.

The last theory is regarded as Theory Construction. In this theory the process of analysis begins at the beginning of the research project and continues through the writing process. There is an ongoing dialogue between the researcher's understanding of the social actions studied. In this research statistical tests were run to give meaning to the data and support conclusions. The diversity of data collection methods I used enriched the research itself and analysis techniques drawn from a variety of fields gives the study more depth than if only one technique were used.

This research encompassed a broad but integrated system of human-land relationships among the indigenous group the Benuaq Dayak of East Kalimantan, Indonesia. The Benuaq Dayak make up the main population in the district of Kutai Barat where this research was conducted. Data were collected through qualitative and quantitative methods to determine current land use and forest management practices among the Benuaq Dayak in the three chosen study sites.

First, in-depth interviews were conducted to understand traditional belief systems as they pertain to land management and *Adat* (customary) law. Interviews also provided data on land management activities in these communities. Second, sampling households and conducting land use surveys accomplished data collection. I conducted the interviews and household surveys myself in Indonesian with the assistance of a local research assistant. Having a local assistant helped the villagers become comfortable with my presence in the villages as well as in their homes. Although impossible to quantify, I believe the villagers were comfortable with and enjoyed the interview process which lead to high response rates and overall quality of the interviews.

Individual households were surveyed randomly in each of the three villages. In each of the villages approximately 50 percent of households were surveyed. Interview sessions were scheduled in the evening after the villagers had returned from their cultivated fields. Whenever possible interviews were conducted with all adult members of the household present, for the most part both men and women gave equal responses, although one gender may have been more informed about certain information. Those interviewed were generally interested in the survey and answered the questions to the best of their ability. Questions were repeated, explained, and followed up to ensure that all pertinent information was gathered. In general, data were collected in local units and then converted to international standardized units. The units were generally consistent and accurate. The information used in this section of this dissertation include household information, demographic information, expenditures, income generation activities; non-agriculture and agriculture related activities; land ownership agriculture; cropping intensity; resource extraction of flora and fauna in the communities forests and rivers; livestock ownership; and opinions concerning conservation activities. The surveys were also intended to identify the varying types of forest resources used, to catalogue the frequency and volume of use, as well as to determine the demographic apportionment of use.

Surveys were supplemented with objective field observations. I became involved in some of the daily activities associated with agricultural activities as an active observer. I studied the methods of extracting and processing resources such as rubber and rattan. I assisted some of the villagers in extracting forest products and harvesting agricultural products. In addition, I also learned techniques in weeding agricultural plots, husking rice, as well as daily animal husbandry tasks.

The third phase of research entailed setting up land use plots to sample for species diversity of trees and agricultural foodstuffs. With the aid of two local plant experts in each of the three study sites, species diversity plots were sampled on three of the various land management units. Sites were chosen randomly. These plots determined density, abundance, and stature (tree size) of forest resources. When Indonesian names of trees were unknown the local name was used and later an attempt was made to identify the Indonesian or Latin name. Three 20X20 meter plots were sampled in each village for the chosen land use types to identify species diversity. The plots included; 1) *Umaq* – rice cultivation and agricultural plots, 2) *Simpukng* - fruit gardens, 3) *Bengkar* - community forest reserves. In the 20X20-meter plots diversity and abundance data were collected. Two additional samples were set up in all the *Bengkar* plots; the smaller plots identified smaller trees and seedlings. The 20X20-meter plots in the *Bengkar* measured the diversity of trees over 20 cm diameter at breast height (dbh). The 10X10-meter plots measured trees between 10-20 cm dbh. The last survey plots were 2X2 meters in which seedlings were identified with their common names. The number of species and abundance were calculated for each plot. The species diversity plots were used to compare the natural resource availability among the different land use types.

2.4 Variables and Tables

Demographic Information

Household Size
Number of Children
Total Family size
Age and Education of Household Head and Spouse
Land Parcels
Number of Hectares and Production
Income Generation
Annual Average Income
Annual Expense to Income
Expenses:

Total expenses
Food
Clothing
Medicine and Health Care
Educational
Travel
Ritual – Ceremonial
Other
Average Income and Expenses

Umaq

Hectares
Rice (kg)
Cassava (kg)
Corn (kg)
Umaq Income Generation (Rupiah)

Uratn

Hectares
Construction Wood (trees)
Bamboo (poles)
Edible Rattan (shoots)
Edible Bamboo (plants)

Firewood

Umaq (ikat)
Uratn (ikat)
Bengkar (ikat)
Total Firewood Consumption

Simpukng

Hectares
Jackfruit (number of fruits)
Rambutan (kg)
Langsat (kg)
Durian (number of fruits)
Mangos (kg)
Simpukng Income Generation (Rupiah)

Kebotn

Hectares
Rubber (kg)
Rattan (kg)
Kebotn Income Generation (Rupiah)

Bengkar

Timber

Meranti Wood (m^3)
Benkirei Wood (m^3)
Borneo Ironwood (m^3)
Other Wood (m^3)
Bengkar Fauna
Wild Boar
Deer
Mouse Deer
Birds
Honey (liters)

Riverine Resources
Fish (kg)
Roof Thatch (branches)
Fern (kg)

Opinions Regarding the Reduction of Natural Resource Extraction
Percentage of Extraction Households are Willing to Reduce if Necessary
Rupiah Villagers Willing to Pay for Natural Resource Access

Animal Husbandry (See Appendix D.)
Pigs Owned
Pigs Consumed
Pigs Sold
Chickens Owned
Chickens Consumed
Chickens Sold

2.5 Statistical Tests

My focus is to determine the relative conditions and economic use of forest resources, as well as the lifeways of the people living within three Benuaq Dayak villages. The rationale was to identify the differences in areas disturbed by a natural disaster and ascertain differences in villages not affected by a natural disaster. Descriptive statistics were calculated to provide a summary of characteristics of the data set. The mean for all variables in each data set were calculated to identify measures of central tendency for each village. The ranges of variables were calculated to analyze variability among the largest and smallest values for each village. Standard deviations

provided measures of variability in the data set among the three villages. The most appropriate statistical test is the Analysis of Variance test that can be used to compare a range of variables between villages. The Scheffe Post Hoc Analysis of Variance Test was used to identify significant differences between individual villages.

1) Analysis of Variance (ANOVA -one way) tests are used to determine differences and similarities between and within groups in the three study areas of natural resource extraction and use levels. The ANOVA comparison of means test will indicate if there are differences in the extraction of natural resources, levels of household expenses, livestock ownership, and other related variables between households living in the three villages.

As defined by McGrew and Monroe in Statistical Problems in Geography, Analysis of Variance is defined as follows:

> The Analysis of Variance or ANOVA is defined as a descriptive statistic measuring variability about the mean. The Analysis of Variance involves separation of the total variation found between nominal groupings or samples into meaningful components: (1) Variability *between* the groups or categories; and (2) variability *within* the groups or categories. ANOVA determines which is more dominant or pronounced and accounts for a greater portion of the total variation (McGrew and Monroe 1993).

The ANOVA test statistic (F) is:

$$F = \frac{MS_B}{MS_W}$$

where: MS_B = between group mean squares
MS_W = within group mean squares

Formula 5.1 Source: McGrew and Monroe 1993:173

2.6 Survey Information

Surveys were conducted in the villages of Tepulang, Benung, and Dingin in the Kutai Barat district, East Kalimantan, Indonesia sampling roughly 50 percent of households in each village. In this survey there were 95 household units sampled.

Table 2.1 **Number of Households in Villages and Number Sampled**

Village	**Approximate Number of Households**	**Number sampled**
Tepulang	57	25
Benung	52	25
Dingin	92	45

Households are approximate for each village because some villagers have residences or reside part time with their adult children in other villages or in the provincial capital of Samarinda, thus they are not residing in the study site villages on a continual basis. The villages are considerably small which is the reason for the small sample size. Due to the great amount of variance and large numbers of zeros within the dataset the mean as opposed to the median value was used in data analysis.

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CHAPTER 3

DAYAK LAND USE SYSTEMS AND INDIGENOUS KNOWLEDGE

3.1 Indigenous Dayak Land Use Systems

Indigenous knowledge and tradition is often seen as static and unchanging, when in fact it is a fluid and transforming agent (Ellen, Parks, and Bicker 2000). It is therefore adaptable and influential. The Dayak and other indigenous groups who use traditional knowledge in their land use and cultural evolution also have adapted strategies in which to develop new techniques and ideologies in time of need. However, the value of indigenous knowledge of Dayak cultures remains laden in every aspect of their lives.

Throughout history the Dayak have had a reliance on forest resources. As forest dwelling people, the environment has thus shaped their culture and lifeways. The Dayak are interwoven with their surroundings and have developed a complex system of cultural aspects in relation to the forest that they depend on for survival. The Dayak have historically and currently practice shifting cultivation[1] for hill rice farming with long fallow periods, intensive agroforestry, and natural resource extraction. Shifting cultivation is a complex agricultural system dedicated to non-permanent shifting field use that is associated with fire for clearing land (Dove 1985, Geertz 1963, Whitten et al. 1987). This process accelerates the process of decomposing organic material allowing nutrients to return to the soil. After 3-5 years of crop rotation fields are left to regenerate. Resources from fallow fields remain important to Dayak communities. In fallow rice fields, intensive agroforests are often maintained to supply needed wood and food

[1] Shifting cultivation and Swidden agriculture are used interchangeably in this chapter.

products. In many scenarios hill rice fallows are converted to agroforests permanently (Colfer 1997).

Forests in close proximity to indigenous communities are often heavily managed and productive. Researchers who have conducted extensive studies in Kalimantan, Indonesian Borneo have found that there are several different forest management schemes that are sustainable and involve minimal clearing of primary forest. Lawrence (1995) found that it was more beneficial to extract resources in managed agroforests than primary forest due to higher yields in managed forests. The Dayak use several types of managed forest gardens to produce marketable products such as durian fruits, rubber, medicinals, and timber. Agroforests are found to be very high in diversity and within 30 years are distinguishable from other secondary and primary forest only by the high density of fruit trees along with other valuable tree species (Lawrence 1995).

In opposition to Colfer (1997), Lawrence (1995), and many others conducting research in Indonesia (Padoch and Peluso 1996, Dove 1985, King 1993), indigenous groups, in particular the Dayak, are accused of fostering deforestation due to unsustainable forestry practices. National governments in Southeast Asia tend to blame ethnic minorities for loss of forests due to large-scale forest fires caused by Swidden agriculture, primary forest clearance, etc. (Dove 1984, Le Trong Cuc 1996, Rambo 1996). However, the main perpetrator in deforestation and wasteful use of forest resources are timber concessions and mining companies, not indigenous people. Indigenous people throughout the world are in fact defending larger areas of tropical forests from large-scale deforestation and logging than national parks, thereby conserving the ecological services provided by these forests and the majority of their plant and animal component (Schartzman, Meira, and Nepstad 2001).

The Benuaq Dayak manage several different types of land units; *Umaq* are rice cultivation plots, *Uratn* is an *Umaq* fallow where resources continue to be extracted, the *Simpukng* is a fruit garden, *Kebotn* is a plot of land where resources such as rattan and rubber are cultivated. Although most of the land in Benuaq Dayak communities is communal, these land use mosaics are inherited through families. Land is usually divided equally among siblings in a family. If one does not choose to farm the land or extract resources, other siblings have the option of using this land. The community will lend land to people who move in to the village in order for them to produce crops for subsistence. The most common land use type that is "borrowed" is the *Umaq*, where the staple of rice and cassava are cultivated. The Benuaq Dayak along with other indigenous groups practice communal systems that sanction sharing of land and resources, this allows for a great amount of reciprocity between individuals in a community.

The Benuaq Dayak also maintain reserves that contain a surplus of natural resources. The *Bengkar* is the community forest reserve that provides wild game and forest resources such as rattan, wood, and medicinals. The communities' reserves have had minimal timber extraction and are primarily used for hunting and small-scale extraction. The *Kapala Desa* (village head) grants permission for resource extraction by community members. Fees are associated with extraction of timber; non-timber forest products including flora and fauna are extracted at the discretion of community members. Many indigenous groups throughout the tropics practice a mosaic of land use patterns in which conservation and sustainability ensures resources for the future.

3.2 Indigenous Knowledge as a Theoretical Approach in Development

Over the past decade there has been an insurgence of indigenous knowledge as an applied theoretical approach in relation to socioeconomic methodologies. The theory of Cultural Ecology and Neo-Evolutionism ideologies stem from the influence of environment on cultural development. The basic features include the impact of environment on culture, focus on adaptation, and reciprocal links between culture and ecology as is seen by indigenous groups who rely forest on resources for survival (Barrett 1996). Indigenous conservationism is now a widely accepted ideology that is culturally expressed in conservation ethics, and in natural resource and animistic religious beliefs. For example, the Mentawai of Siberut Island, Indonesia, who through their traditional religion believe that all elements of the earth have a soul, believe that proper offerings must be given in order to maintain cosmic harmony (Crevello 1998). Benuaq Dayak shamans heavily rely on spirits from the natural world for healing ceremonies (Figure 3.1). Aspects of indigenous conservationism have been identified for many indigenous groups who continue to rely heavily on natural resources for subsistence economies.

The indigenous knowledge perspective has been studied at great length in academia and development although have remained largely independent of one another (Sillitoe 1998). The structure of development has transformed moving drastically towards grass-roots focused paradigms. In the past, the focus was on modernism, with the classic transfer-of-technology model and top-down approaches (Sillitoe 1998). With a more grass-roots approach being implemented in the past decade, indigenous knowledge is often incorporated into agricultural systems and participatory development when non-

Figure 3.1 **Pak Sarani, Benuaq Dayak Medicine Man. Healing Ceremony for a Sick Child.** Benuaq Dayak, East Kalimantan, Indonesia 2002

governmental organizations (NGOs) and outside agencies are implementing development projects. Often times when government involvement or stakeholders in highly valued natural resources are involved indigenous knowledge is often overlooked and ignored.

In the name of development, many countries have attempted to force or employ indigenous groups to abandon their traditional livelihoods in order to "save the forests" and assimilate them into modern society. (In many countries indigenous groups are seen as backward and a sign that the country is not developing). Many development and conservation related projects have failed due the lack of involvement and knowledge of local people and the ecosystems. In the past, top-down approaches were initiated by outside agencies attempting to develop natural resource management or extraction techniques which were also unsuccessful due to local ecosystem constraints (Gegeo 1998) and lack of interest in local perspectives or involvement. The influx of indigenous knowledge approaches has led to a locally informed perspective into development (Sillitoe 1998). The most relevant approach to working with indigenous groups is the neopopulist, as it advocates participation and empowerment. The neopopulist focus is to contribute long-term positive change, promoting culturally appropriate and environmentally sustainable adaptations as increasing resources are commercially exploited (Sillitoe 1998). Indigenous participation is used as a process of empowerment to amplify traditionally unacknowledged voices (Slocum et al. 1995). Participation focuses on ways to mobilize local resources, engage in diverse social groups in decision-making, and identify patterns to eliminate poverty (Feldstein and Jiggins 1994, Slocum et al. 1995). Active and meaningful involvement of indigenous people and the researcher or outside agency involved in the processes regarding issues related to land tenure and social-cultural development, and in decisions related to it, creates a partnership of equals

while linking ecological and social justice concerns. It is important that researchers or agencies link management practices to social, temporal, and environmental circumstances to particular communities where such practices are present (Eghenter 2000).

3.3 Indigenous Knowledge as a System

Indigenous knowledge is characteristically holistic, integrative, and situated within broader cultural traditions (Ellen, Parks, and Bicker 2000). Indigenous people in many societies see themselves as a part of the natural world as opposed to detached from nature, as in much of western ideology where man conquers nature. Many indigenous people have a respect and knowledge for the environment as their lifeways are intermingled with nature. Some scholars now recognize indigenous people as shapers of environmental history (Smith and Wishnie 2000). This is not to say that indigenous people are in constant harmony with nature, there has also been destruction of forests due to their presence. Evidence of non-conservationists activities have been found in archaeological sites, there is also evidence based on research by contemporary biologists and ethnographers, such as anthropogenic faunal extinction and habitat degradation. Indigenous societies have however maintained lands and resources better than other societies, due to low population densities with less environmental degradation. In general, however the damage caused by indigenous groups has had less impact on the ecosystem than large scale timber harvesting, mining, and migrants from other regions who are not familiar with the ecosystem (Schartzman, Meira, and Nepstad 2001, Redford and Sanderson 2001).

Since the 1980s there has been a radical shift in the thinking towards the rights of indigenous people and access to natural resources. The acknowledgment that local people have their own effective science and resource use practices is now recognized more than

ever before (Sillitoe 1998). Indigenous groups are quite capable and have developed their own methods of conservation and sustainable management practices (Colfer 1997, Gegeo 1998). Herlihly (1990) has been an active participant in the implementation of regional natural reserves inhabited by indigenous people in Central America. His research has shown that in Central America a lack of land tenure and deforestation are closely related. Providing land users with secure access to property rights will result in more sustainable land use, protection of biodiversity, and less deforestation (Nelson, Harris, and Stone 2001). Indigenous people, conservation organizations, and development agencies have come to be perceived as allies in the quest to conserve the last remaining parcels of land that contain great biodiversity (Eghenter 2000).

Local management by those who are familiar with the ecosystem and have a personal interest in the well being of the forest appears to be the most effective procedure for conservation and sustainable development in developing countries (Colfer 1997, Furze et al. 1996). Indigenous people have a wealth of knowledge on plant usage, function, efficient growth methods, and medicinal properties, to name a few. Indigenous knowledge and involvement is crucial to the development of conservation and sustainable forestry related projects. The main issues that need to be addressed are the needs of the local people as far as resources and incentives. It is in the best interest for local people to conserve their natural resources for future generations. In many cases indigenous groups have put limits on harvesting and hunting through customary laws and have developed reserves to protect their lands from new migrants in the region (Furze et al. 1996).

When a voice is given to indigenous people and importance is paid to the immeasurable knowledge of their lands, there is a sense of pride given when involved in management and conservation projects (Furze et al. 1996). The benefits for local people

would be three-fold if involved in conservation and management issues. They could then be assured of future resources; possible employment through conservation projects, and the land would be protected from outside encroachment.

With the future needs of natural resources and land in constant competition with timber concessions and other constraints it is vital for indigenous people and conservation groups to work together to protect the future of the forests and the people who depend on them. Forest dwellers hold a wealth of knowledge about the environment. Conservation agencies have used this knowledge to develop and implement plans for both conservation of biodiversity and the development of economics, social and cultural interests of marginal peoples (Eghenter 2000).

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CHAPTER 4

OVERVIEW OF BORNEO AND THE BENUAQ DAYAK

4.1 Introduction

Indonesia is the world's largest and most diverse archipelago, extending across three thousand miles of the Indian and Pacific oceans (Figure 4.1). The surrounding archipelago contains five main islands and thirty smaller clusters of islands giving Indonesia a total of 17,000 islands. Of these islands, an estimated six thousand are inhabited. The physical geography of Indonesia is remarkably diverse, extending from the great volcanic mountains of Java to the extensive mangrove swamps and coral reefs of Bunakan, a natural island reserve off the shore of northern Sulawesi.

There are over three hundred distinct ethnic groups, with 365 local languages, living within the country. The ethnic groups vary from the Muslim Acheness to the indigenous tribes of New Guinea. The estimated population in Indonesia is 210 million, (World Bank 2001) which ranks as the world's fourth most populous nation. Indonesia's estimated 10 million indigenous peoples continue to live mostly within the forested areas of Kalimantan (Indonesian Borneo), Sumatra, Irian Jaya, and several other smaller islands.

4.2 Borneo

Borneo compromises a land area of 54,000 km^2, making it the third largest island in the world. The territory is divided among three countries; Brunei Darussalam in the northwest, two Malaysian states, Sabah and Sarawak, and the remaining southern two-thirds Kalimantan, Indonesia. Lowland rainforests and mountainous forests are historically the dominant vegetation type on Borneo. Lowland rainforests

Figure 4.1 **Map of Indonesia**

are characterized by highly diverse plant species that have a complex horizontal structure with three to five canopies of vegetation. There are over 100 species of *Dipterocarpaceae* in Indonesia. Within the top canopies, the most dominant trees are *Diptocarp T. Shorea, Dipterocarpus, Caeasal pineceae,* and *Dryobanalops* (Whitmore 1984). Diptercarp trees are highly valued hardwoods that have been heavily exploited throughout Borneo. The smaller trees found in the lower canopies are *Burseraceae, Saptaceae, Eurphorbiaceae, Rubiac, Annonaceae, Lauraceae*, and *Myristicaceae* (Whitmore 1984). *Lianas* are also a dominant vegetation type that relies on large tropical trees for physical support. The soil of lowland rainforests is often leeched by rainfall and is poor in nutrients. The nutrients are stored in the biomass; nutrients from decomposing matter are quickly reabsorbed by the trees and other vegetation. Although soils are poor in nutrients, the hot and humid climate of lowland rainforests permits for a biodiversity that is richer that any other forest type.

4.3 East Kalimantan, Indonesian Borneo

Due to the rich natural resources of East Kalimantan, it is the most prosperous province in Indonesia. This province has played a key role in the development of Indonesia. The main income is generated by forestry and mining activities. East Kalimantan also has one of the largest oil and natural gas deposits in the world. All of these resources are heavily exploited. The province is located 113° 44' – 119° 00' East (longitude) and 4° 24' North – 2° 25' South (latitude) along the equator on the island of Borneo. It covers a land area of 21,193,000 hectares[1], of which 94.6 percent is land mass and 5.2 percent water territory (Solichin 1999). The province of East Kalimantan occupies 11 percent of the entire country; despite such a large land area the population is

[1] All land areas are presented in hectares (1 Hectare = 2.5 Acres).

only 2.3 million, which is 1 percent of the countries population[2] (Fatawi and Mori 2000) (Figure 4.2). The topography of the region varies from lowland forests to mountainous areas in the north. East Kalimantan occupies the southeastern central mountains of the island. The climate ranges from 16.4°C to 35.4°C, with diurnal temperatures fluctuating more than annual temperature change. The rainfall ranges from 1,500 mm to 4,500 mm annually, increasing in the mountainous regions. Due to the location on the equator the climate is affected by monsoons, there is a distinct rainy season from November to April and a dry season from May through October. In recent years due to the El Niño effect the climate has become somewhat unpredictable, large land and forest fires dominated the region in 1982-83 and 1997-98. In October of 2002 fires have again plagued East Kalimantan which is possibly linked to El Niño events.

Soils in East Kalimantan are very poor in nutrient levels and are intensively leached due to high rainfall and subsequent run off. This, coupled with slope (of which 60 percent of the area has a slope class over 20 percent) and physical conditions (texture, drainage, etc.) allows for approximately 13 percent of the land to be suitable for agricultural crops with annual cropping (Solichin 1999). Other land types are only suitable for perennial cropping or no agricultural activities. Much of the land in this region has been converted to plantation forests or agriculture; the three main agro-industrial crops are rubber, coconut, and oil palm. Palm oil plantations have been developed in the last 5-10 years, this is an industry that has been heavily promoted by the central government. Wood is mainly being extracted from natural forests due to the expansion of oil palm, agro-industrial plantations and a decline in the commercial forestry concessions (Solichin 1999). Large-scale logging continues in the region which

[2] East Kalimantan has a density of 11 people per km^2 as compared to Java with more than 800 people km^2.

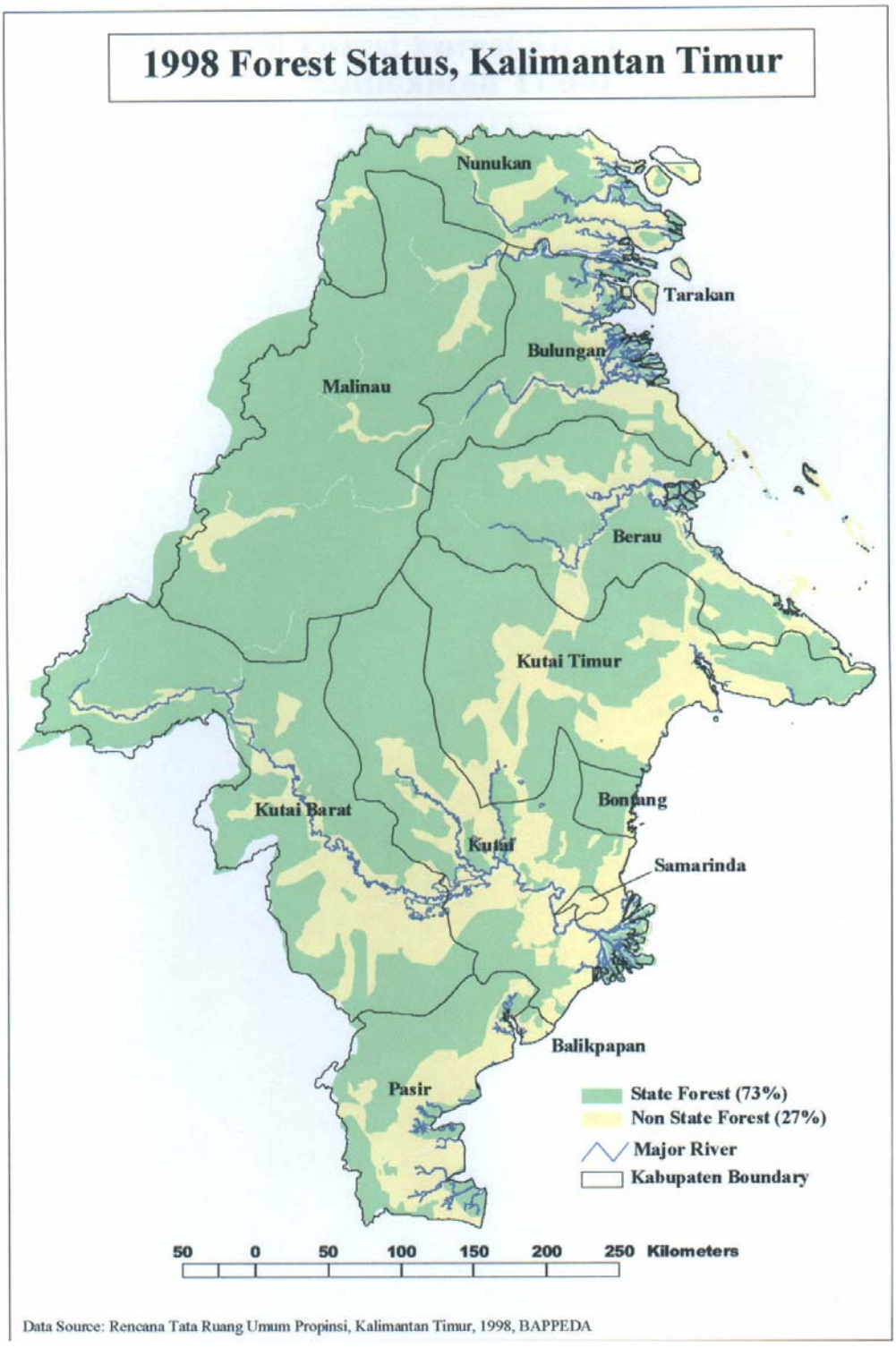

Figure 4.2 **East Kalimantan Forest Cover** (BAPPEDA, 1998 in NRM 2000).

has led to environmental problems. The steady natural resource depletion, including forest resources, will lead to long term problems such as a loss of biodiversity and wildlife, and reduced vegetation cover in upper watersheds that will heighten the effects of erosion, flooding, and crop loss (Barber 1998, Furze et al. 1996, Golammer 1992).

Highly valued mixed dipterocarp hardwoods dominate the forests of Borneo. Exploitation of these species found in the lowland rainforests in East Kalimantan, began in the late 1960s. At that time there were several hundred logging companies operating in the region. More recently, in 1999, only 72 concessions remain in the area (Solichin 1999). Commercial logging companies are either private or state owned and generally hold a 20-year concession for rights to harvest timber resources. Illegal logging activities by timber companies and small-scale loggers is a continual problem in the area (Colfer 1997, Lawrence et al. 1995). Potter (1990) estimated that 40 percent of Indonesian log production originated in East Kalimantan during period of 1970-79 where the largest stands of commercial timber were found.

The Mahakam River has historically and continues to be the main method of transportation for all commerce in the region. Due to its wide channels, ships are able to transport natural resources of timber, coal, gold, and other resources down river to the provincial capital, Samarinda. Supplies are easily transported up river to provide communities with products from the coast. This main thoroughfare has allowed exploitation of natural resources that would otherwise be very difficult to access. The highest quality and largest logs have been depleted from the lower Mahakam. Logging continues but the size and quality of trees originally found in the region have declined. In

the upper stretches of the more remote Mahakam River, large high quality timber is still logged. These forests are in danger of being depleted if large-scale logging continues.

Traveling up river from Samarinda, the provincial capital and port town, there are no primary forest stands remaining; this area has been almost completely denuded, what remains are small-scale banana plantations and stands of young trees. Sawmills along the lower reaches of the river remain active supplied by logs from upper remote areas of the Mahakam River. Traveling into the interior by land less is common, there is one main hazardous road from the coast into the interior that has river access at various sites. This road provides access and resupply of resources from the coast for communities that live in the interior. Along this main road forest land has been converted into newly developed oil palm and banana plantations. *Alang-alang* or *Imperata cylindrica* grasslands are also common in the areas. This is an exotic evasive grass that will inhibit natural regeneration of forestlands, it has become an extensive problem in Kalimantan. Deforestation and other natural resource extraction has lead to changes in the ecosystem and the environment in this region.

Coal, gold, and other mining also cause environmental degradation in the region, but it has also been the main source income for the government. Significantly, Kelian Equatorial Mining (PT KEM), one of the largest gold mines in the world is also located in the area. The mine has been operating since 1992 and averages 450,000 ounces of gold and 400,000 ounces of silver per year (PT KEM 1999). The ore mining process, involving gravity separation and cyanide leaching, causes significant environmental damage. For each ton of ore extracted, five tons of tailings are produced. Attention has been given to the mine from both national and international non-governmental organizations (NGOs) criticizing the environmental impacts in the region. PT KEM has

been unable to rehabilitate most of the land that has been mined. This land, once forested, is now too degraded to reforest and will be converted into lakes and wetlands (Cassan 2001).

Over the past five years PT KEM has paid a total of US$ 8.5 million to the central government and US$ 14.4 million to the East Kalimantan provincial government (Cassan 2001). The majority of revenue was generated by corporate income tax and land rent tax (Cassan 2001). The mine is planning to shut down operation in the year 2004. When the mine closes in 2004 the regional government will lose income as well as the problem of residual environmental damage caused by the mining. Although resource extraction is necessary for income generation, sustainable methods have not been followed, and as a result much of this region has lost a great expanse of its natural land cover and faces general environmental degradation.

4.4 Study Area

This research took place in the district of Kutai Barat, East Kalimantan, Indonesia approximately 250 kilometers from the provincial capital of Samarinda. In 1999, the district of Kutai Negera in East Kalimantan was divided into three new districts. One of which formed Kutai Barat, where research was conducted for this project (Figure 4.3). Three Benuaq Dayak villages located in the upper watershed of the Makaham catchment system were chosen for this research project. These villages were selected because they are composed of 100 percent Benuaq Dayak ethnicity. Benuaq Dayak villages have been established in this area for over 300 years, prior to this time period they resided further in the interior of Borneo. The area ranges in altitude from 80-120 meters above sea level

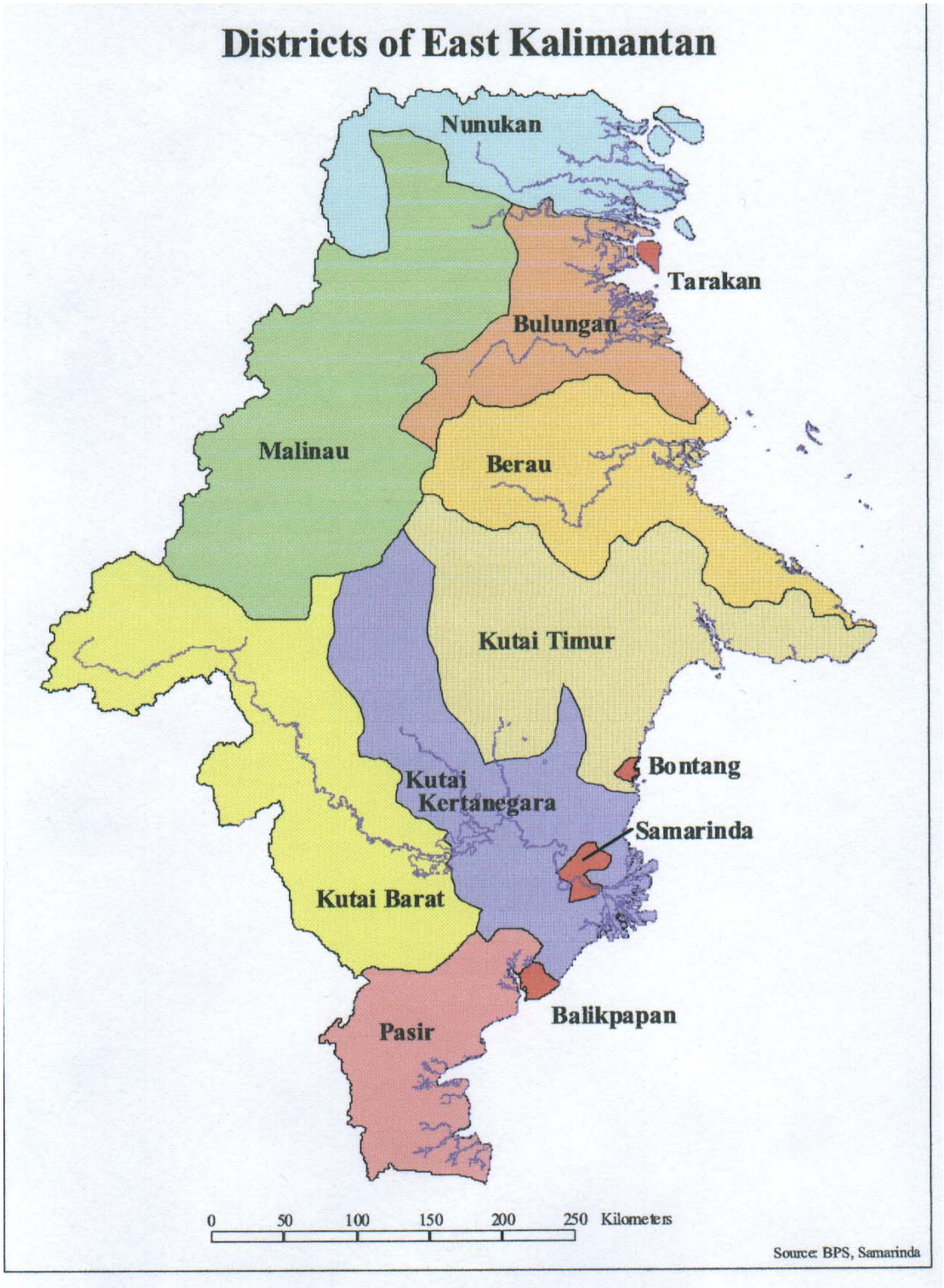

Figure 4.3 **Districts of East Kalimantan, Indonesia** (BAPPEDA, 1998 in NRM 2000).

with an annual precipitation of 3000 mm.

Prior to the division of the district, the costs and length of time associated with travel to the district capital were prohibitive for local people. Thus the government rarely acknowledged the needs of the villagers in outlying regions. The district capital is now located 1-2 hours from the villages, which provides much easier access. During the past two years there has been an influx of money and projects to develop the region. The government decentralization and the forestry sector are also having an impact on Kutai Barat (Figure 4.4), monies earned from exploitation of resources are in the process of being directed to local governments.

Projects such as electricity lines and road development have begun to filter into the newly formed district. Currently there is a reforestation program in which the local population is able to reforest disturbed land. This is a government-sponsored project where timber companies must pay a tax for replanting after harvesting. Reforestation can take place at any location of disturbed forests, not necessarily where the timber concession is located. Local people can apply to the local government to reforest their own land in which case they are provided with seedlings and are paid a daily wage for replanting. The Benuaq Dayak communities have been very successful in recent efforts to reforest degraded land near the community forest reserves. Seedlings provided by the government are mixed dipterocarp and native fruit trees. In addition, Asian Development Bank also sponsored a project after the devastating forest fires of 1997-98, where villagers received rubber tree seedlings and were given loans for pesticides. The loans are to be repaid when the rubber trees reach productive age. Because there is much

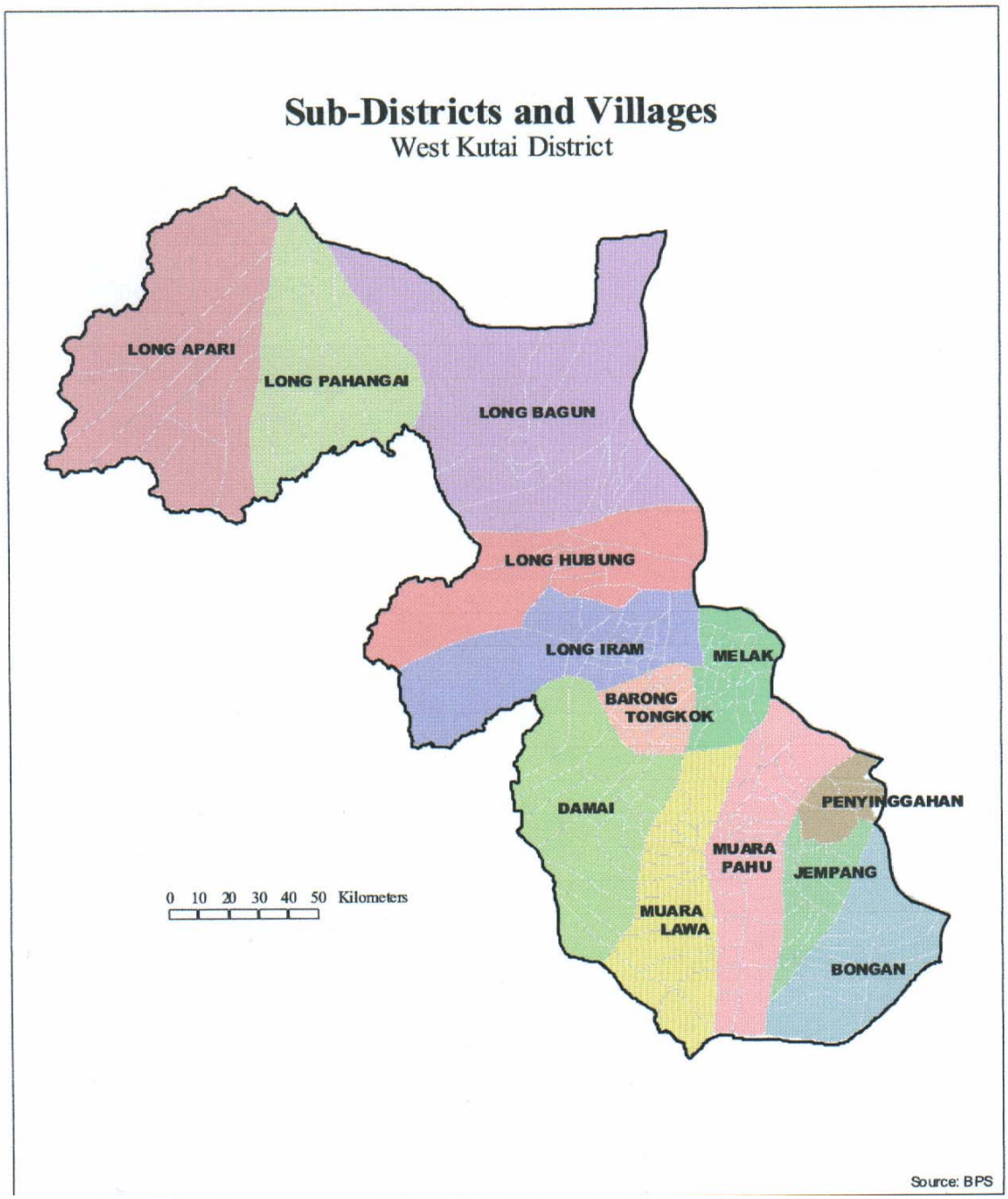

Figure 4.4 **Sub-Districts of Kutai Barat. East Kalimantan, Indonesia** (BAPPEDA, 1998 in NRM 2000).

development in this region, there are new opportunities and changes in lifestyles among this indigenous group. Although access is now much easier than prior to the new district being formed, the Benuaq Dayak are continuing their traditional land use systems, while taking advantage of new opportunities.

This research was conducted in 2002 under the indirect supervision of Natural Resource Management, an NGO based in Samarinda, the provincial capital of East Kalimantan and by the head of the forestry sector in the district of Kutai Barat.

4.5 Study Group: The Dayak of Borneo

The term Dayak is a generic term for the non-Malay indigenous people of Borneo, living in Kalimantan (Indonesian Borneo) and Sabah and Sarawak (Malaysian Borneo or East Malaysia). This distinction is primarily to distinguish them from Muslim coastal Malays. There are several distinct ethnic groups and languages among the Dayak, however, there are common traits that link these ethnic groups together. There are several similarities among Dayak groups such as worldview, cosmology, and symbolism, funeral practices and fertility cults, in material culture, and in social organization (King 1993). The social organization historically was based around longhouse communities and subsistence Swidden agriculture. Many Dayak communities practice hill rice farming as opposed to the wet rice (paddy) cultivation that is most common throughout Southeast Asia. A further description of land use systems is provided in the following section.

The original political and social structure for the Dayak was based on the longhouse. Historically this method of housing provided protection against warring ethnic groups. The longhouse is the traditional Dayak communal home where several

Figure 4.5 **Longhouse (Laming) in Benuaq Dayak Village**
Benuaq Dayak, East Kalimantan, Indonesia 2002

families live in one large housing unit sharing a common roof (Figure 4.5). Many traditional longhouses have housed 200 or more families. The houses are elevated off the ground and are built with a large communal veranda with individual and multiple family homes sharing common walls. There are multiple families that will live within one "unit" within the longhouse. If an additional "home" is needed then it is built on to the end of the long house. Some longhouses can extend in many directions and develop into a maze, expanding to accommodate the growing community. Over the past several decades many communities have split into smaller units or become divided due to political or personal reasons. In the village of Tepulang where research was conducted, there is only one relatively small longhouse housing 10 families. In the 1980s the large longhouse was destroyed by fire. The Indonesian government discourages indigenous people from living

in longhouse communal settings. The government initiated and funded the building of single-family houses in the village. The longhouse no longer serves as a political unit as it did so in the past. The villages are now governed by the *Kepala Desa* (village head), his staff and the *Kepala Adat* (head of customary law). Established laws continue to govern land ownership and use. However, the village staff for the most part generally acts in settling various disputes. Although the longhouse is no longer the main political unit there continues to be a close-knit relationship and community land.

The Benuaq Dayak practice subsistence economy based on various land management units including shifting cultivation of hill rice, fruit gardens, rubber, and rattan fields, rice fallows, and community forest reserves. The main income generation activities are agricultural based, however non-agriculture income is available in some areas but is somewhat limited.

Labor division among the Benuaq Dayak in general is not gender oriented. Men women, and children all work in the *ladang* (agricultural plots) and participate in other activities. During harvest or planting periods all capable members of the household work six to seven days a week. Adult household members generally work in the fields seven to eight hours per day subdivided into a morning (07:00-11:30) and an afternoon (14:00-17:30). Labor inputs vary at different times throughout the year. After the rice has been planted there is a long period of maintenance and weeding of the plots, which does not require large labor inputs. Very young children who are not in school stay at home with an elder member of the family or go with their parents to the cultivation plots. Older children will often work in the fields after finishing school in the afternoon. Children learn at a young age various tasks to assist their parents in household as well as

agricultural duties. All members of a household contribute in some manner to help sustain the household.

The Benuaq Dayak are the research focus due to their mosaic of land use systems and community conservation practices. The Benuaq Dayak live in a communal setting that allows for reciprocity and close relationship with one another. In spite of Dutch colonialism, Christian missionaries, and other outside influences, there remains a very close relation between nature and the Dayak people. Their continuance of traditional lifeways meshed in times of rapid development in the region makes this a dynamic area for research.

4.6 Objectives

This study's purpose is to identify natural resource use in subsistence economies and the economic utility of these resources in the villages of Tepulang, Benung, and Dingin. Geography and environmental factors were hypothesized to play a role in variation of resource utilization among the Benuaq Dayak villages. The reliance of natural resource use for subsistence and income generation is a significant aspect of the livelihood of this ethnic group but differ in degree between villages. In addition, the land management system for the Benuaq Dayak at its current condition appears to be sustainable but again this may vary between villages.

Specifically, the objectives of the study are:

1.Study indigenous knowledge systems in relation to land use practices.

2. Describe land use systems of the Benuaq Dayak.

3. Describe agricultural practices.

4. Describe economic utility of agricultural activities.

5. Identify forest resources extracted and yields of these resources.

6. Analyze land use systems sustainability.

7. Identify variation among resource use in the three study sites, taking into account ecological disaster caused by fires and flooding.

This study also aims to identify the willingness to conserve and maintain community forest reserves among the three study sites. In addition to the decentralization of the forestry sector, this region is also going through rapid changes in the government due to regional autonomy. This area including local communities are being developed and have more opportunities than ever before. Critical to this change is the understanding that continued sustainable extraction and forestry practices among the Benuaq Dayak should be maintained.

Variables used from survey are as follows:

Demographic Information

Household Size
Number of Children
Total Family size
Age and Education of Household Head and Spouse
Land Parcels
Number of Hectares and Production

Income Generation

Annual Average Income
Annual Expense to Income

Expenses

Total Expenses
Food
Clothing
Medicine and Health Care
Educational
Travel
Ritual – Ceremonial
Other

4.7 Methods

This research encompassed a broad but integrated system of human-land relationships among the indigenous group the Benuaq Dayak of East Kalimantan, Indonesia. The Benuaq Dayak make up the main population in the district of Kutai Barat where this research was conducted. Data were collected through qualitative and quantitative methods to determine current land use and forest management practices among the Benuaq Dayak in the three chosen study sites.

First, In-depth interviews were conducted to understand traditional belief systems as they pertain to land management and *Adat* (customary) law. Interviews also provided biographical data on land management activities in these communities. Second, sampling households and conducting land use surveys accomplished data collection. I conducted the interviews and household surveys myself in Indonesian with the assistance of a local research assistant. Having a local assistant helped the villagers become comfortable with my presence in the villages as well as in their homes. Although impossible to quantify, I believe the villagers were comfortable with and enjoyed the interview process which lead to high response rates and overall quality of the interviews.

The households surveyed were randomly selected in each of the three villages. In each village approximately 50 percent of households were surveyed. Interview sessions were scheduled in the evening after the villagers had returned from working in their cultivated fields. Whenever possible interviews were conducted with all adult members of the household present, for the most part both men and women gave equal responses, although one gender may have been more informed about certain information. Those interviewed were generally interested in the survey and answered the questions to the

best of their ability. Questions were repeated, explained, and followed up to ensure that all pertinent information was gathered. In general, data were collected in local units and then converted to international standardized units. The units were generally consistent and accurate.

The information used in this section of this dissertation include household information, demographic information, expenditures, income generation activities; non-agriculture and agriculture related activities; land ownership agriculture; cropping intensity; resource extraction of flora and fauna in the communities forests and rivers; livestock ownership; and opinions concerning conservation activities. The surveys were also intended to identify the varying types of forest resources used, to catalogue the frequency and volume of use, as well as to determine the demographic apportionment of use.

Surveys were supplemented with objective field observations. I became involved in some of the daily activities associated with agricultural activities as an active observer. I studied the methods of extracting and processing resources such as rubber and rattan. I assisted some of the villagers in extracting forest products and harvesting agricultural products. In addition, I also learned techniques in weeding agricultural plots, husking rice, as well as daily animal husbandry tasks.

The third phase of research entailed setting up land use plots to sample for species diversity of trees and agricultural foodstuffs. With the aid of two local plant experts in each of the three study sites, species diversity plots were sampled on three of the various land management units. Sites were chosen randomly. These plots determined density, abundance, and stature (tree size) of forest resources. When Indonesian names of trees were unknown the local name was used and later an attempt was made to identify the

Indonesian or Latin name. Three 20X20 meter plots were sampled in each village for the chosen land use types to identify species diversity. The plots included; 1) *Umaq* – rice cultivation and agricultural plots, 2) *Simpukng* - fruit gardens, 3) *Bengkar* - community forest reserves. In the 20X20-meter plots diversity and abundance data were collected. Two additional samples were set up in all the *Bengkar* plots; the smaller plots identified smaller trees and seedlings. The 20X20-meter plots in the *Bengkar* measured the diversity of trees over 20 cm diameter at breast height (dbh). The 10X10-meter plots measured trees between 10-20 cm dbh. The last survey plots were 2X2 meters in which seedlings were identified with their common names. The number of species and abundance were calculated for each plot. The species diversity plots were used to compare the natural resource availability among the different land use types.

4.7.1 Statistical Tests

My dissertation's focus is to determine the relative conditions and economic use of forest resources, as well as the lifeways of the people living within three Benuaq Dayak villages. The rationale was to identify the differences in areas disturbed by a natural disaster and ascertain differences in villages not affected by a natural disaster. Descriptive statistics were calculated to provide a summary of characteristics of the data set. The mean for all variables in each data set was calculated to identify measures of central tendency for each village. The ranges of variables were calculated to analyze variability among the largest and smallest values for each village. Standard deviations provided measures of variability in the data set among the three villages. The most appropriate statistical test is the Analysis of Variance test that can be used to compare a range of variables between villages. The Scheffe Post Hoc Analysis of Variance Test was used to identify significant differences between individual villages.

1) Analysis of Variance (ANOVA -one way) tests are used to determine differences and similarities between and within groups in the three study areas of natural resource extraction and use levels. The ANOVA comparison of means test will indicate if there are differences in the extraction of natural resources, levels of household expenses, livestock ownership, and other related variables between households living in the three villages.
2) As defined by McGrew and Monroe in Statistical Problems in Geography,

Analysis of Variance is defined as follows:

> The Analysis of Variance or ANOVA is defined as a descriptive statistic measuring variability about the mean. The Analysis of Variance involves separation of the total variation found between nominal groupings or samples into meaningful components: (1) Variability *between* the groups or categories; and (2) variability *within* the groups or categories. ANOVA determines which is more dominant or pronounced and accounts for a greater portion of the total variation (McGrew and Monroe 1993).

The ANOVA test statistic (F) is:

$$F = \frac{MS_B}{MS_W}$$

where: MS_B = between group mean squares
MS_W = within group mean squares

Formula 5.1 Source: McGrew and Monroe 1993:173

4.8 Survey Information

Surveys were conducted in the villages of Tepulang, Benung, and Dingin in the Kutai Barat district, East Kalimantan, Indonesia sampling roughly 50 percent of

households in each village (Table 4.1). In this survey there were 95 household units sampled.

Table 4.1 **Number of Households in Villages and Number Sampled**
Benuaq Dayak, East Kalimantan, Indonesia 2001

Village	**Approximate Number of Households**	**Number Sampled**
Tepulang	57	25
Benung	52	25
Dingin	92	45

Households are approximated for each village because some villagers have residences or reside part time with their adult children in other villages or in the provincial capital of Samarinda, thus they are not residing in the study site villages on a continual basis. The villages are considerably small which is the reason for the small sample size. Due to the great amount of variance and large numbers of zeros within the dataset the mean as opposed to the median value was used in data analysis.

4.9 Demographics

The data for this research were collected at the household unit. Household data were collected to determine if there are differences in family size, education levels, and income among the three villages. Data were collected for family members living inside the home or still relying on family financial resources. For example, there are no high schools in the villages, if a child goes to high school they generally rent a room in a boarding house or live with relatives. They usually go to school in one of three different cities, Melak; the new district center, which is the closest city about 1-2 hours or 50-60 kilometers by vehicle from the villages; Samarinda, the provincial capital of East Kalimantan or Tengarong, the old district center. Both Tengarong and Samarinda are a 20-22 hour waterbus ride or 250 kilometers down the Mahakam River to the coast.

As indicated in Table 4.2, the mean family size for those who still had children living in the home was 3.38 children. Adult children not living in the household or having their own families but residing in the home were not concluded. All three villages have relatively the same number of people relying on family resources. The average household size for the village of Benung was 3.04, Tepulang had an average of 3.28 people within each household, and Dingin was slightly higher than average family size of 3.62. Of those households surveyed, 71 percent reported having children living in the home, the overall mean was 2.19 children. *Desa* (village) Dingin had a slightly higher number of children (2.31) in each family, as opposed to Tepulang having 2.00 children per household, and Benung had an average of 2.12 children relying on household resources. The component of all families surveyed varied greatly from single fathers with children to older couples with no children relying on parental resources. Again this was the household size for individual families, it is not uncommon for multiple households to live under the same roof. In the villages of Tepulang and Benung, several families continue to live in longhouses. In Tepulang there is one relatively small longhouse that is not divided up by common walls. It is one large room where 8-10 families reside. The traditional longhouse that originally housed most of the village burned down in the early 1980s, the government then assisted in building individual family homes that accommodate 2-3 families. Although the government has historically and continues to discourage communal living in many parts of Indonesia, the village of Benung has a very large longhouse accommodating almost the entire population of the village; possibly 35 families are housed there. In the sub-village of Pintuq, which is considered to be part of the village of Benung, has a longhouse located ½ kilometer or 5 minutes walking time from Benung, where an additional 10 families reside. This relatively small longhouse has

one large communal room with two extensions. One unit is used to house an extended family and the other as a cooking facility. There are many close family relations among the Benuaq Dayak in the area, especially in Tepulang and Benung as they are in proximity to each other. Dingin is considerably farther from the first two study sites and generally has no relationship with the two other villages; this is most likely due to difficulty of transportation. Other Benuaq Dayak villages in proximity to one another generally have more family ties.

Table 4.2 **Benuaq Dayak Family Size**
Benuaq Dayak, East Kalimantan, Indonesia 2001

Family Size	**Total Size**	**% Reported**	**No. of Children**
Range	7		5
s.d.	1.63		1.84
Tepulang	3.28	60%	2.00
Benung	3.04	64%	2.12
Dingin	3.62	80%	2.31
Mean total	3.38	71%	2.19

The average age and education level was measured for all villages in Table 4.3. The education was based on a scale of one to seven, one being no education and seven the highest with additional education beyond high school. Among the families surveyed the mean age for the head of the household was 38 years with an average education (3.23) completing primary school plus some additional schooling. Benung had the oldest average age of about 40 years, Dingin had an average age for household head of 38 and Tepulang an average of 37 years old.

Education levels are scaled from 1-7, the lowest being (1) no schooling and 7 being the highest with some form of training or additional education. Primarily education is now generally available the in village or within 1-2 kilometers from the villages. Most of the respondents did have some education in completing primary school (code 3) (Table

4.3). Benung ranked highest in education levels (3.44), which equates to finishing primary school plus additional secondary schooling. Tepulang had the lowest level of education (3.04) with most household heads finishing primary school. Dingin falls within the overall average with a mean of 3.23 which is a completion of primary schooling plus some additional schooling. Spouses of the household heads for Benung and Tepulang were generally younger between 30-32 years of age; in Dingin the average age for a spouse was 35. Spouses in Tepulang and Dingin were less educated not having completed primary school. Only in Benung did women finish primary school. The overall education in the region is fairly low when compared to national standards, however for rural communities it is higher than average.

Table 4.3 **Age and Education**
Benuaq Dayak, East Kalimantan, Indonesia 2001

Age and Education	**HH Age**	**HH Education**	**Age / Spouse**	**Edu. /Spouse**
Tepulang	37	3.04	32	2.82
Benung	40	3.44	30	3.00
Dingin	38	3.23	35	2.89
Mean total	38	3.23	32	2.89
F Statistics	F=. 33 p=. 72		F=1.15 p= .32	

4.10 Land Parcels, Yields, and Agricultural Income Generation.

The Benuaq Dayak have several different types of managed land units; *Umaq* are cultivation plots containing staples such as rice and casssava, *Uratn* is an *Umaq* fallow where resources continue to be extracted, a *Simpukng* is a fruit garden, *Kebotn* is a plot of land where resources such as rattan and rubber are cultivated (Table 4.4). The *Bengkar* is the Benuaq Dayak community for reserve that provides wild game and forest resources

such as rattan, wood, and medicinals. Livestock are kept including pigs, chickens, cows, and in one village goats and water buffalo are raised. Riverine resources provide fish and vegetation. The majority of people derive the bulk of their income by selling natural resources.

Table 4.4 **Major Benuaq Dayak Subsistence Activities**
Benuaq Dayak, East Kalimantan, Indonesia 2001
Values are % of n interviews households.

Activity	**Village** **Tepulang** n= 25	**Benung** n=25	**Dingin** n=45	**Total** n= 95
Agriculture				
Rice Cultivation	80%	80%	44%	65%
Cassava Cultivation	80%	88%	60%	73%
Forest Gardens				
Own Fruit Garden	80%	88%	71%	80%
Own Rubber and Rattan Gardens	76%	88%	64%	74%
Livestock				
Own Pigs	88%	88%	60%	75%
Own Chickens	80%	92%	53%	71%
Non-Agricultural Activities	48%	68%	60%	59%

The Benuaq Dayak maintain large land parcels in which they cultivate a variety of crops. The mean total number of hectares for the entire survey was 8.33 ha per household. The highest reported average for total hectares was from the village of Benung with 9.48 ha per household. The village of Dingin had the second highest average at 9.56 ha per household Tepulang had the lowest average with 4.95 ha per household. The ANOVA test at a significance level of sig = .05 indicated that there is no significant difference between villages for the total number of hectares per household. Income generation is primarily based on agriculture related activities including selling a variety of fruit, rubber, rattan, and livestock. At the time of this research (2002) the

Indonesian Rupiah had an exchange of 10,000 Rupiah to 1US$. Table 4.5 summarizes variables for the entire study. Relevant information on Benuaq Dayak demographics for each of the three study sites is included such as annual household income, expenses, education, and number of hectares actively farmed for each land use type. Yields of agricultural products, livestock ownership, and natural resource extraction rates of flora, fauna, and riverine resources are summarized. These data are described individually in detail according to each land use type.

Table 4.5 **Summary Data**
Benuaq Dayak, East Kalimantan, Indonesia 2001

Variable (Mean data per village/yr)	**Tepulang** n=25	**Benung** n=25	**Dingin** n=45	**Mean Total** n=95
Demographic Information				
Number of Children	2.00	2.12	2.31	2.19
Total Family Size	3.28	3.04	3.62	3.38
HH Age	37	40	38	38
HH Education (1-7)	3.04	3.44	3.23	3.24
Spouse Age	32	30	35	32
Spouse Education (1-7)	2.82	3.00	2.89	2.90
Agricultural Income (Rupiah)	6,912,652	4,743,860	4,715,411	5,031,118
Non-Ag Income (Rupiah)	4,158,400	6,500,600	3,524,622	4,727,874
Total Income (Rupiah)	11,071,052	11,244,460	8,240,033	9,775,676
Total Expenses (Rupiah)	5,735,980	5,270,480	4,125,000	4,850,752
Total Hectares	4.95	9.48	9.56	8.33
Umaq (ha)	1.43	1.40	1.24	1.34
Rice (kg)	293	581	285	393
Cassava (kg)	2,367	3,357	1,892	2,497
				Table continued on next page.

Variable	Tepulang n=25	Benung n=25	Dingin n=45	Mean Total n=95
Uratn (ha)	3.3	5.2	5.9	5.43
Con. Wood (trees)	72	95	90	88
Bamboo (poles)	50	111	187	130
Edible Rattan	0	149	1,334	1,102
Edible Bamboo	267	187	171	181
Firewood (total)	408	567	412	534
Simpukng (ha)	1.21	2.32	1.83	1.84
Rambutan (kg)	248	232	135	200
Langsat (kg)	750	258	203	357
Mango (kg)	100	167	117	135
Durian (# fruit)	471	154	96	204
Jackfruit (# fruit)	825	694	160	557
Kebotn (ha)	1.92	3.68	2.44	2.69
Rubber (kg)	229	741	1,142	807
Rattan (kg)	3,418	1,911	1,113	1,966
Bengkar Resources				
Meranti Wood (m^3)	2.64	3.86	2.45	2.89
Benkerei Wood(m^3)	4.13	3.83	1.33	3.44
Ironwood (m^3)	0	2.00	1.00	1.25
Wild Boar (animals)	3.43	10.67	4.53	10.11
Deer (animals)	3.67	2.50	3.58	3.50
Mouse deer (animals)	3.00	2.50	3.00	2.78
Birds (number)	14.33	0	0	14.33
Honey (liters)	83.60	7.50	5.33	44.90
Riverine Resources				
Fish (kg)	341	165	431	312
Roof Thatch (branches)	165	156	100	132
Fern (kg)	77	56	71	68
				Table continued on next page.

Variable	Tepulang n=25	Benung n=25	Dingin n=45	Mean Total n=95
Livestock				
Pigs Owned	8.64	5.41	2.74	5.39
Pigs Sold	3.67	2.23	1.29	2.21
Pigs Consumed	2.50	2.67	1.74	2.21
Chickens Owned	3.95	17.00	8.63	11.00
Chicken Sold	11.00	22.67	6.79	12.53
Chickens Consumed	15.73	4.63	7.80	8.50

4.11 Income Generation

Various forms of non-agriculture income include, *belian* (traditional healer) (Figure 4.6), teachers, working in a government capacity such as village head, with additional staff, such as the secretary and the *kepala adat* (head of customary law). A few families own a *warung* (small store), selling gasoline and dry foodstuff such as instant noodles, sugar, and crackers. Others hire out as laborers, for example, for forest rehabilitation projects where the pay is 25,000 rp. per day, but this is part time work. At the time of this research (2002) the Indonesian Rupiah had an exchange of 10,000 Rupiah to 1US$. Some villagers will work to harvest rubber on other people's land to earn a percentage of the total harvest. There are villagers who own chainsaws and hire out to cut wood for others. Two men from Dingin are *ojek* drivers, they work in the larger town in Lambing hiring out their mini vans to take people to other villages or to market days. Parents of adult children often receive a monthly stipend from their children who are working in cities or Samarinda, the provincial capital. The opportunity for income generation outside of agriculture is somewhat limited and 59 percent of those surveyed reported non-agriculture income. Benung led in non-agricultural income generation with a mean of 6,500,600 Rupiah per year. This may be due to the fact that the residents of Benung have a relatively higher education and thus have more opportunities to work in

Figure 4.6 **Benuaq Dayak Traditional Healer**
Benuaq Dayak, East Kalimantan, Indonesia 2002

the cities for higher wages. Residents of Tepulang reported an average of 4,158,400 rp./yr, and Dingin had the lowest average with 3,524,622 rp./yr. Although Dingin is only a 15 minute boat ride or 4 kilometers from the *Ibu Kota* (mother city, which can be described here as a small but one of the few towns in the area) and a 45 minute or 12-15 kilometer boat ride from the larger town of Damai which is the district center, the income is moderately low compared to the other villages that are a greater distance from towns in the region. Although ANOVA tests were run on these variables there were no significant differences found in non-agriculture income generation. The difference in 3,000,000 rp./yr between Benung and Dingin is important when the total mean income for the data set is only 9,775,676 rp./yr. That amounts to a difference of approximately 300US$ annually, which is an enormous amount of money to these communities as well as for other rural peoples of Indonesia.

The largest reported average income generation from agricultural activities is from the village of Tepulang with an average of 6,912,652 Rupiah in 2001. Benung reported the second highest average with 4,743,680 Rupiah annually. Dingin reported the lowest average income for agriculture activities at 4,715,411 rp./yr, average however this is only slightly less than the reported income generation by the village of Benung. The overall mean for agricultural income generation was 5,031,118 rp./yr. More detailed descriptions of agricultural income generation activities is provided in the following sections.

As indicated in Figure 4.7 for the year calendar year 2001, the total mean income was 9,775,676 rp./yr (range 158,550,000, s 18,265,087), the range for income generation was extremely high, this may be due to the fact that there was so much variation in levels of income among villagers and between villages. The village of Benung had the highest

average income at 11,244,460 rp./yr (range 35,617,000, s 9,261,432). Tepulang followed in income generation with a total of 11,071,052 rp./yr (range 51,559,500, s 12,900,399). Dingin had the lowest with 8,240,033 rp./yr (range 158,550,000, s 23,886,566). Although the village of Dingin had the least amount of resources and income generation overall, it had the highest range (158,550,000 Rupiah) in income generation. Income generation in remote areas is often extremely difficult so the Benuaq Dayak are fortunate that they are able to gain income from both agricultural and non-agriculture activities. Development in this region will give villagers the opportunity for further income generation activities.

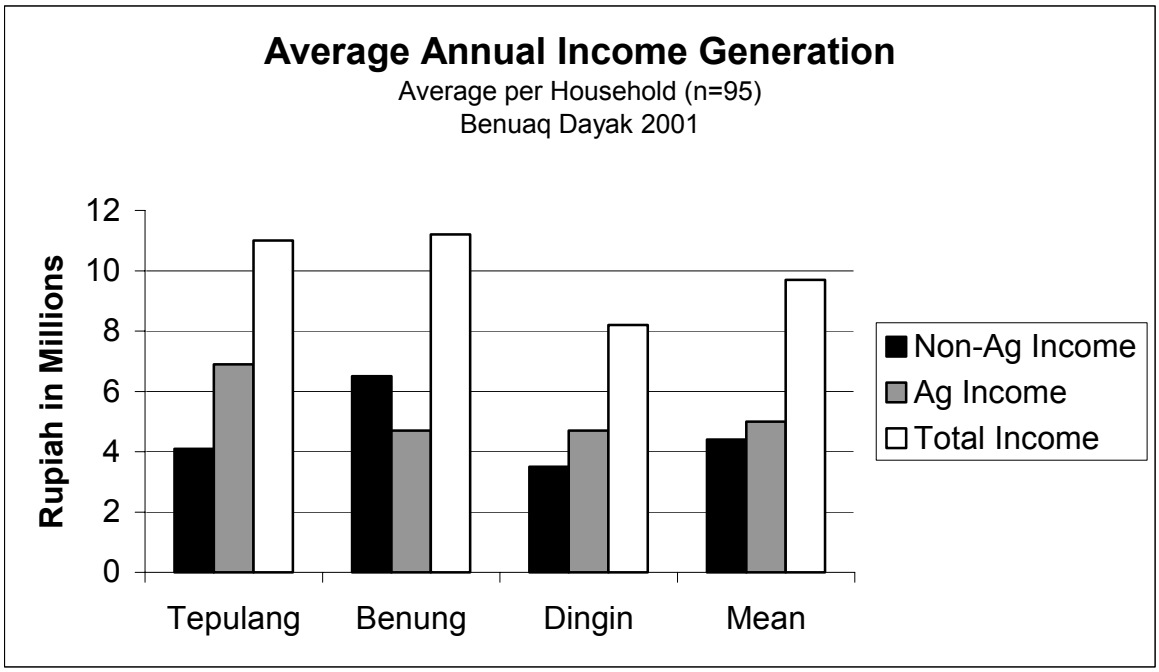

Figure 4.7 **Average Annual Income Generation**
Benuaq Dayak, East Kalimantan, Indonesia 2002

4.12 Expenses

At the time of this research (2002) the Indonesian Rupiah was valued at 10,000 Rupiah for $1 U.S. This is due to the economic crisis that Indonesia has been experiencing since 1997, the Rupiah was relatively stable at the time of this research but

the huge inflation and low value of the Rupiah has led to a national crisis. This also affects subsistence economies such as the Benuaq Dayak even though they are agriculturally more self-sufficient. Expense variables for all villages are indicated in Figure 4.8, food and transportation account for the highest expenses in each of the villages. Food purchased includes staples such as salt, sugar, tea, instant noodles, and rice. Travel costs can be expensive due to high fuel costs and minimal access to transportation vehicles. Most villagers do not have their own transportation. There are some, however, who own motorcycles and those in Dingin have small boats with outboard motors or canoes. There are two men in Dingin who own minivans, which is extremely rare. Those who do own some type of transportation will for a sum take people on various errands. For example, one couple in Tepulang will take other villagers to town or to the doctor when needed, however there is always a charge. One young man in Dingin will take villagers to market days for a round trip fee and he will wait until they have made their purchases and before taking them back in the afternoon. Transportation can become costly with the price of gas at 2,500 rp. per liter. Some villagers tend to leave the village at least once a month, most need to leave more frequently.

Ceremonial costs can also be high depending on the number of ceremonies that must be performed throughout the year. The village of Benung (n=13, mean 1,610,000 rp./yr) averages more costs related to ceremonial and *belian* (traditional healer) expenses than Tepulang (n= 10, mean 731,050 rp./yr) and Dingin (n=11, mean 537,272 rp./yr). Ceremonial costs include paying for the services of traditional medicinal practices, ceremonies for the death of family members and ancestors, childbirth ceremonies, etc. Expenditures include sacrificing pigs and chickens, providing rice and other staples for those conducting and participating in the ceremony. During my stay in Tepulang,

Upacara (ceremonies) were held several times a week and on many occasions there would be concurrent ceremonies on the same night. Ceremonies may also last up to nine days for a severe illness or for an important ceremony, thus creating high expenses for the family. While I was conducting research in Benung, there were ceremonies for the two people who died that lasted nine days each. Although it is a communal effort, the expense that the family accrues in this time period is immense. Visitors will stay for extended periods and the family must provide for them entirely. In the case of someone's death, visitors and the members of the community will give the family rice, sugar, coffee, and other staples to assist in the ceremony.

Medicinal costs include doctor's visits and medication, not traditional remedies, this is included in ceremonial costs. Although the Benuaq Dayak practice traditional healing, they go to health care facilities when necessary. Often times traditional and modern medicine are practiced concurrently. Benung residents report the highest costs for health care with an annual mean of 412,857 rp./yr (n=21), with Tepulang following with an average of 335,739 rp./yr (n=23) and Dingin with the lowest average (n=42, mean 222,904 rp./yr).

Schooling in Indonesia is not free, there are fees that parents must pay for children to attend school. There is a monthly payment at least in this area of 1,000 rp. per month coupled with added fees and costs for uniforms, it can become quite expensive for parents to send their children to school. In the villages of Tepulang and Benung the nearest high school is 2 hours away by vehicle or 50-60 kilometers. The cost for children to attend high school is extremely high when room and board must be added to monthly expenses. The village of Dingin is fortunate that there is a high school in the town of Lambing only 15 minutes or 4 kilometers away by boat. Boats make regular trips back

and forth along the river so it is not necessary for students to board in Lambing. This commute is expensive but not as high and having a child board there. Round trip from Dingin to Lambing averages 10,000 Rupiah. The highest average school expense is found in the village of Dingin (n=23 mean 852,608 rp./yr), several people interviewed have children attending school outside of the village. Benung residents reported the second highest average at 783,416 rp./yr (n=12). Several children from this village attended school in Samarinda, the provincial capital. Tepulang had the lowest mean for school expenses at 483,111 rp./yr (n=9). Most of the people interviewed only receive a primary school education with an additional year or two of junior high school. Children in these villages currently have more opportunity than their parents did as children. Parents are willing to send their children to schools in the larger towns and cities that will allow them to excel. Another expense includes clothing, which is generally not a very high expense. The majority of people interviewed purchase clothing once or twice a year, but a few villagers did not report purchasing any clothing last year.

Tepulang had the highest number of total expenses (5,735,980 rp./yr), with the other villages following Benung with an annual average of 5,270,480 rp./yr and Dingin with the lowest at 4,125,000 rp./yr (Figure 4.8). These averages are roughly half the amount of income reported every year in each village (Figure 4.9). Because the Benuaq Dayak are subsistence farmers, low cost is associated with purchased foodstuffs. Costs would be much higher if they needed to purchase staple foodstuffs. Fifty percent of all expenses are for the basic subsistence needs of food, clothing, and shelter. Additional expenses include non-subsistence household needs.

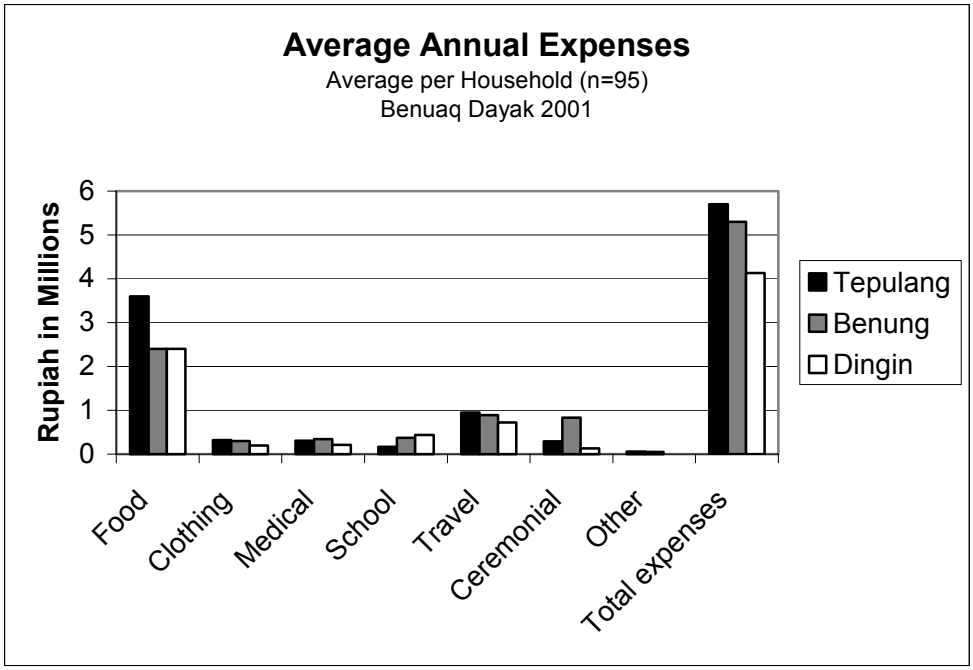

Figure 4.8 **Average Annual Household Expenses**
Benuaq Dayak, East Kalimantan, Indonesia 2001

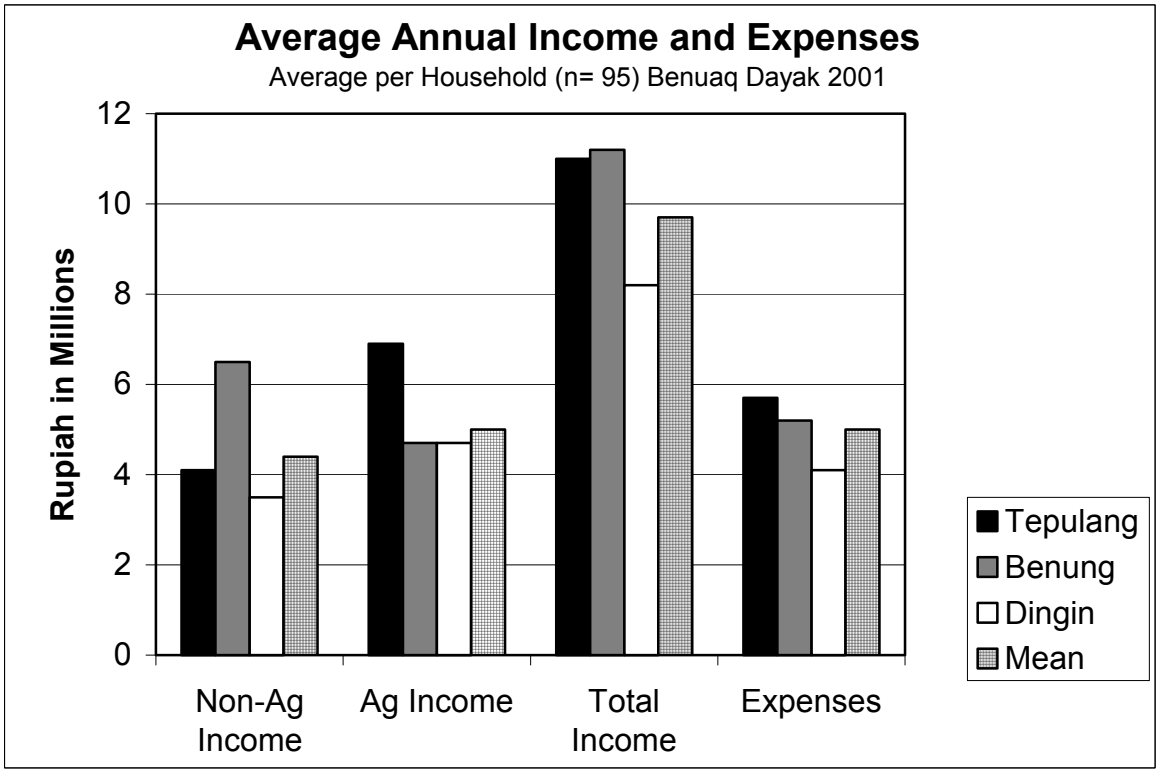

Figure 4.9 **Average Annual Income and Expenses**
Benuaq Dayak, East Kalimantan, Indonesia 2001

4.13 Summary

This chapter gives an overview of Indonesia as a nation and then narrows to focus on the region and ethnic group for this study. The Benuaq Dayak of Borneo are a distinct ethnic group with customs and land use practices worthy of study. The mosaic of land use systems that are continued in a time of great change in Indonesia need to be documented and studied to identify their sustainable land use practices. Demographics of the Benuaq Dayak provide information relative to their land use systems, such as reliance on natural resources, size of the family units, and income generation. The three study areas generally follow the same pattern with regards to household size as far as people in the family unit who continue to rely on parental income. Education for the Benuaq Dayak in this region is high for rural areas with household heads receiving a primary school education plus additional schooling. Spouses have a slightly lower education; the sample mean indicated that spouses did not finish primary school. These factors could be indicative that higher education leads to opportunities for non-agriculture income. For example, the village of Benung has the overall highest education and highest non-agricultural income. Agricultural income generation surprisingly is not related to average size of total land parcels, Tepulang has the lowest reported total hectares and has the overall highest reported income by agricultural activities. Income generation from both agriculture and non-agriculture in remote areas is often extremely difficult, the Benuaq Dayak are fortunate in that they have access to market economies. Expenses are relative to incomes of each village, expenses constitute roughly half of total household income. Because the Benuaq Dayak are subsistence farmers cost for food is minimal when compared to non-farming communities.

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CHAPTER 5

SHIFTING CULTIVATION AMONG THE BENUAQ DAYAK OF BORNEO: DIVERSITY AND UTILITY

5.1 Overview

This research took place in East Kalimantan, Indonesia approximately 250 kilometers from the provincial capital of Samarinda. In 1999, the district of Kutai Negera in East Kalimantan was divided into three new districts. One of which formed Kutai Barat, where research was conducted for this project. Three Benuaq Dayak villages located in the upper watershed of the Makaham catchment system were chosen for this research project. These villages were selected because they are composed of 100 percent Benuaq Dayak ethnicity. Benuaq Dayak villages have been established in this area for over 300 years. The area ranges in altitude from 80-120 meters above sea level with an annual precipitation of 3,000 mm.

Prior to the division of the district, the costs and length of time associated with travel to the district capital were prohibitive for local people. Thus the government rarely acknowledged the needs of the villagers in outlying regions. The district capital is now located 1-2 hours from the villages, which provides much easier access. During the past two years there has been an influx of money and projects to develop the region. The government decentralization and the forestry sector are also having an impact on Kutai Barat, monies earned from exploitation of resources are in the process of being directed to local governments.

Projects such as electricity lines and road development have begun to filter into the newly formed district. Currently there is a reforestation program in which the local population is able to reforest disturbed land. This is a government-sponsored project where timber companies must pay a tax for replanting after harvesting. Reforestation can

take place at any location of disturbed forests, not necessarily where the timber concession is located. Local people can apply to the local government to reforest their own land in which case they are provided with seedlings and are paid a daily wage for replanting. The Benuaq Dayak communities have been very successful in recent efforts to reforest degraded land near the community forest reserves. Seedlings provided by the government are mixed dipterocarp and native fruit trees. In addition, Asian Development Bank also sponsored a project after the devastating forest fires of 1997-98, where villagers received rubber tree seedlings and were given loans for pesticides. The loans are to be repaid when the rubber trees reach productive age. Because there is much development in this region, there are new opportunities and changes in lifestyles among this indigenous group. Although access is now much easier than prior to the new district being formed, the Benuaq Dayak are continuing their traditional land use systems, while taking advantage of new opportunities.

This research was conducted in 2002 under the indirect supervision of Natural Resource Management, an NGO based in Samarinda, the provincial capital of East Kalimantan and by the head of the forestry sector in the district of Kutai Barat.

5.2 Objectives

This study's purpose is to identify natural resource use in subsistence economies and the economic utility of these resources in the villages of Tepulang, Benung, and Dingin. Geography and environmental factors were hypothesized to play a role in variation of resource utilization among the Benuaq Dayak villages. The reliance of natural resource use for subsistence and income generation is a significant aspect of the livelihood of this ethnic group but differ in degree between villages. In addition, the land

management system for the Benuaq Dayak at its current condition appears to be sustainable but again this may vary between villages.

Specifically, the objectives of the study are:

1.Study indigenous knowledge systems in relation to land use practices.

2. Describe land use systems of the Benuaq Dayak.

3. Describe agricultural practices.

4. Describe economic utility of agricultural activities.

5. Identify forest resources extracted and yields of these resources.

6. Analyze land use systems sustainability.

7. Identify variation among resource use in the three study sites, taking into account ecological disaster caused by fires and flooding.

This study also aims to identify the willingness to conserve and maintain community forest reserves among the three study sites. In addition to the decentralization of the forestry sector, this region is also going through rapid changes in the government due to regional autonomy. This area including local communities are being developed and have more opportunities than ever before. Critical to this change is the understanding that continued sustainable extraction and forestry practices among the Benuaq Dayak should be maintained.

Variables used from survey are as follows:

Umaq

Hectares
Rice (kg)
Cassava (kg)
Corn (kg)
Umaq Income Generation (Rupiah)

Uratn

Hectares
Construction Wood (trees)
Bamboo (poles)
Edible Rattan (shoots)
Edible Bamboo (plants)

Firewood

Umaq (ikat)
Uratn (ikat)
Bengkar (ikat)
Total Firewood Consumption

5.3 Methods

This research encompassed a broad but integrated system of human-land relationships among the indigenous group the Benuaq Dayak of East Kalimantan, Indonesia. The Benuaq Dayak make up the main population in the district of Kutai Barat where this research was conducted. Data were collected through qualitative and quantitative methods to determine current land use and forest management practices among the Benuaq Dayak in the three chosen study sites.

First, In-depth interviews were conducted to understand traditional belief systems as they pertain to land management and *Adat* (customary) law. Interviews also provided biographical data on land management activities in these communities. Second, sampling households and conducting land use surveys accomplished data collection. I conducted the interviews and household surveys myself in Indonesian with the assistance of a local research assistant. Having a local assistant helped the villagers become comfortable with my presence in the villages as well as in their homes. Although impossible to quantify, I believe the villagers were comfortable with and enjoyed the interview process which lead to high response rates and overall quality of the interviews.

The households surveyed were randomly selected in each of the three villages. In each village approximately 50 percent of households were surveyed. Interview sessions were scheduled in the evening after the villagers had returned from working in their cultivated fields. Whenever possible interviews were conducted with all adult members of the household present, for the most part both men and women gave equal responses, although one gender may have been more informed about certain information. Those interviewed were generally interested in the survey and answered the questions to the best of their ability. Questions were repeated, explained, and followed up to ensure that all pertinent information was gathered. In general, data were collected in local units and then converted to international standardized units. The units were generally consistent and accurate.

The information used in this section of this dissertation include household information, demographic information, expenditures, income generation activities; non-agriculture and agriculture related activities; land ownership agriculture; cropping intensity; resource extraction of flora and fauna in the communities forests and rivers; livestock ownership; and opinions concerning conservation activities. The surveys were also intended to identify the varying types of forest resources used, to catalogue the frequency and volume of use, as well as to determine the demographic apportionment of use.

Surveys were supplemented with objective field observations. I became involved in some of the daily activities associated with agricultural activities as an active observer. I studied the methods of extracting and processing resources such as rubber and rattan. I assisted some of the villagers in extracting forest products and harvesting agricultural

products. In addition, I also learned techniques in weeding agricultural plots, husking rice, as well as daily animal husbandry tasks.

The third phase of research entailed setting up land use plots to sample for species diversity of trees and agricultural foodstuffs. With the aid of two local plant experts in each of the three study sites, species diversity plots were sampled on three of the various land management units. Sites were chosen randomly. These plots determined density, abundance, and stature (tree size) of forest resources. When Indonesian names of trees were unknown the local name was used and later an attempt was made to identify the Indonesian or Latin name. Three 20X20 meter plots were sampled in each village for the chosen land use types to identify species diversity. The plots included; 1) *Umaq* – rice cultivation and agricultural plots, 2) *Simpunkg* - fruit gardens, 3) *Bengkar* - community forest reserves. In the 20X20-meter plots diversity and abundance data were collected. Two additional samples were set up in all the *Bengkar* plots; the smaller plots identified smaller trees and seedlings. The 20X20-meter plots in the *Bengkar* measured the diversity of trees over 20 cm diameter at breast height (dbh). The 10X10-meter plots measured trees between 10-20 cm dbh. The last survey plots were 2X2 meters in which seedlings were identified with their common names. The number of species and abundance were calculated for each plot. The species diversity plots were used to compare the natural resource availability among the different land use types.

5.3.1 Statistical Tests

My dissertation's focus is to determine the relative conditions and economic use of forest resources, as well as the lifeways of the people living within three Benuaq Dayak villages. The rationale was to identify the differences in areas disturbed by a natural disaster and ascertain differences in villages not affected by a natural disaster.

Descriptive statistics were calculated to provide a summary of characteristics of the data set. The mean for all variables in each data set was calculated to identify measures of central tendency for each village. The ranges of variables were calculated to analyze variability among the largest and smallest values for each village. Standard deviations provided measures of variability in the data set among the three villages. The most appropriate statistical test is the Analysis of Variance test that can be used to compare a range of variables between villages. The Scheffe Post Hoc Analysis of Variance Test was used to identify significant differences between individual villages.

1) Analysis of Variance (ANOVA -one way) tests are used to determine differences and similarities between and within groups in the three study areas of natural resource extraction and use levels. The ANOVA comparison of means test will indicate if there are differences in the extraction of natural resources, levels of household expenses, livestock ownership, and other related variables between households living in the three villages.

As defined by McGrew and Monroe in Statistical Problems in Geography, Analysis of Variance is defined as follows:

The Analysis of Variance or ANOVA is defined as a descriptive statistic measuring variability about the mean. The Analysis of Variance involves separation of the total variation found between nominal groupings or samples into meaningful components: (1) Variability *between* the groups or categories; and (2) variability *within* the groups or categories. ANOVA determines which is more dominant or pronounced and accounts for a greater portion of the total variation (McGrew and Monroe 1993). The ANOVA test statistic (F) is:

$$F = \frac{MS_B}{MS_W}$$

where: MS_B = between group mean squares
MS_W = within group mean squares
Formula 5.1 Source: McGrew and Monroe 1993:173

5.4 Survey Information

Surveys were conducted in the villages of Tepulang, Benung, and Dingin in the Kutai Barat district, East Kalimantan, Indonesia sampling roughly 50 percent of households in each village (Table 5.1). In this survey there were 95 household units sampled.

Table 5.1 **Number of Households in Villages and Number Sampled**
Benuaq Dayak, East Kalimantan, Indonesia 2001

Village	**Approximate Number of Households**	**Number Sampled**
Tepulang	57	25
Benung	52	25
Dingin	92	45

Households are approximated for each village because some villagers have residences or reside part time with their adult children in other villages or in the provincial capital of Samarinda, thus they are not residing in the study site villages on a continual basis. The villages are considerably small which is the reason for the small sample size. Due to the great amount of variance and large numbers of zeros within the dataset the mean as opposed to the median value was used in data analysis.

5.5 Land Parcels, Yields, and Agricultural Income Generation.

The Benuaq Dayak have several different types of managed land units; *Umaq* are cultivation plots containing staples such as rice and cassava, *Uratn* is an *Umaq* fallow where resources continue to be extracted, a *Simpukng* is a fruit garden, *Kebotn* is a plot of land where resources such as rattan and rubber are cultivated (Table 5.2). The *Bengkar* is the Benuaq Dayak community for reserve that provides wild game and forest resources such as rattan, wood, and medicinals. Livestock are kept including pigs, chickens, cows,

Table 5.2 **Major Benuaq Dayak Subsistence Activities**
Benuaq Dayak, East Kalimantan, Indonesia 2001
Values are % of n interviews households.

Activity	Village **Tepulang** n= 25	**Benung** n=25	**Dingin** n=45	**Total** n= 95
Agriculture				
Rice Cultivation	80%	80%	44%	65%
Cassava Cultivation	80%	88%	60%	73%
Forest Gardens				
Own Fruit Garden	80%	88%	71%	80%
Own Rubber and Rattan Gardens	76%	88%	64%	74%
Livestock				
Own Pigs	88%	88%	60%	75%
Own Chickens	80%	92%	53%	71%
Non-Agricultural Activities	48%	68%	60%	59%

and in one village goats and water buffalo are raised. Riverine resources provide fish and vegetation. The majority of people derive the bulk of their income by selling natural resources.

The Benuaq Dayak maintain large land parcels in which they cultivate a variety of crops. The mean total number of hectares for the entire survey was 8.33 ha per household. The highest reported average for total hectares was from the village of Benung with 9.48 ha per household. The village of Dingin had the second highest average at 9.56 ha per household. Tepulang had the lowest average with 4.95 ha per household. The ANOVA test at a significance level of sig = .05 indicated that there is no significant difference between villages for the total number of hectares per household. Additional activities are practiced to supplement resources for the communities. Income generation is primarily based on agriculture related activities including selling a variety of fruit, rubber, rattan, and livestock. At the time of this research (2002) the Indonesian

Rupiah had an exchange of 10,000 Rupiah to 1US$. Table 5.3 summarizes variables for the entire study. Relevant information on Benuaq Dayak demographics for each of the three study sites is included such as annual household income, expenses, education, and number of hectares actively farmed for each land use type. Yields of agricultural products, livestock ownership, and natural resource extraction rates of flora, fauna, and riverine resources are summarized. These data are described individually in detail according to each land use type.

Table 5.3 **Summary Data**
Benuaq Dayak, East Kalimantan, Indonesia 2001

Variable (Mean data per village/ yr)	**Tepulang** n=25	**Benung** n=25	**Dingin** n=45	**Mean Total** n=95
Demographic Information				
Number of Children	2.00	2.12	2.31	2.19
Total Family Size	3.28	3.04	3.62	3.38
HH Age	37	40	38	38
HH Education (1-7)	3.04	3.44	3.23	3.24
Spouse Age	32	30	35	32
Spouse Education (1-7)	2.82	3.00	2.89	2.90
Agricultural Income (Rupiah)	6,912,652	4,743,860	4,715,411	5,031,118
Non-Ag Income (Rupiah)	4,158,400	6,500,600	3,524,622	4,727,874
Total Income (Rupiah)	11,071,052	11,244,460	8,240,033	9,775,676
Total Expenses (Rupiah)	5,735,980	5,270,480	4,125,000	4,850,752
Total Hectares	4.95	9.48	9.56	8.33
Umaq (ha)	1.43	1.40	1.24	1.34
Rice (kg)	293	581	285	393
Cassava (kg)	2,367	3,357	1,892	2,497
				Table continued on next page.

Variable	Tepulang n=25	Benung n=25	Dingin n=45	Mean Total n=95
Uratn (ha)	3.3	5.2	5.9	5.43
Con. Wood (trees)	72	95	90	88
Bamboo (poles)	50	111	187	130
Edible Rattan	0	149	1,334	1,102
Edible Bamboo	267	187	171	181
Firewood (total)	408	567	412	534
Simpukng (ha)	1.21	2.32	1.83	1.84
Rambutan (kg)	248	232	135	200
Langsat (kg)	750	258	203	357
Mango (kg)	100	167	117	135
Durian (# fruit)	471	154	96	204
Jackfruit (# fruit)	825	694	160	557
Kebotn (ha)	1.92	3.68	2.44	2.69
Rubber (kg)	229	741	1,142	807
Rattan (kg)	3,418	1,911	1,113	1,966
Bengkar Resources				
Meranti Wood (m^3)	2.64	3.86	2.45	2.89
Ironwood (m^3)	0	2.00	1.00	1.25
Other Wood (m^3)	4.20	3.00	4.00	3.70
Wild Boar (animals)	3.43	10.67	4.53	10.11
Deer (animals)	3.67	2.50	3.58	3.50
Mouse deer (animals)	3.00	2.50	3.00	2.78
Birds (number)	14.33	0	0	14.33
Honey (liters)	83.60	7.50	5.33	44.90
Riverine Resources				
Fish (kg)	341	165	431	312
Roof Thatch (branches)	165	156	100	132
Fern (kg)	77	56	71	68
Livestock				
Pigs Owned	8.64	5.41	2.74	5.39
Pigs Sold	3.67	2.23	1.29	2.21
Pigs Consumed	2.50	2.67	1.74	2.21
Chickens Owned	3.95	17.00	8.63	11.00
Chicken Sold	11.00	22.67	6.79	12.53
Chickens Consumed	15.73	4.63	7.80	8.50

Figure 5.1 **Benuaq Dayak Shifting Cultivation Plot** (after rice harvest).
Benuaq Dayak, East Kalimantan, Indonesia 2002

5.6 Shifting Cultivation by Indigenous Communities in the Tropics

Many indigenous groups throughout the tropics practice shifting cultivation[1] also known as Swidden agriculture or slash and burn agriculture. Conklin states that since Neolithic times extensive areas of forestland have been farmed under conditions of shifting cultivation (Conklin 1961). Shifting cultivation is one of the earliest systems of crop growing for people living in the tropics (Yuksel 1999) (Figure 5.1). There is evidence of shifting cultivation on Borneo as far back as 2500 B.P. (Maloney 1985). Today it remains the major source of livelihood for indigenous groups residing in the interior of Borneo (Mackinnon et al. 1996). Shifting cultivation is a complex agricultural system dedicated to non-permanent field use. This practice of agriculture has become synonymous with deforestation of tropical rainforests. Governments in many countries

[1] Shifting cultivation and Swidden agriculture are used interchangeably in this chapter.

have tried to discourage Swidden agriculture by claiming instead that it is "wasteful and destructive" and promote more permanent agriculture (Angleson 1995). Swidden agriculture, if the under sustainble conditions, is suitable to various tropical areas. In comparison to other methods of agriculture in the tropics, the system of shifting cultivation under the ideal conditions may minimize long-term environmental degradation (Seubert et al. 1977). This method of agriculture is a sustainable land use practice if the forest is allowed to regenerate (Morisada et al. 2000). According to Geertz, in ecological terms Swidden agriculture is integrated into, and when genuinely adaptive, maintains the general structure of pre-existing natural ecosystem into which it is projected (Geertz 1963).

This practice depends on the rotation of non-permanent fields with short periods of cropping and long fallow periods (Whitten et al. 1987). Land clearing in Swidden agriculture is associated with fire. Primary and other forest types are slashed and then burned to promote nutrient return to the soil, because the soils found in most tropical rainforests are very poor. Because nutrients are stored in the biomass and not the soil, the fastest way to return the nutrients to the soil is by fire. However, too frequent burning can also prolong soil exposure and increase the potential for both long and short-term erosion (Yuksel 1999). Cultivation periods generally are from 4-5 years; fallow periods are longer from 20-30 years (Dove 1985). At the beginning of the fallow period, nutrients start to accumulate in the topsoil. Nutrients are returned to the soil through leaf litter timber fall, root decomposition and rainfall, thus the soil slowly regains productivity. It is an erroneous belief that shifting cultivation fields are simply "abandoned" (Angelson 1995, Colfer 1997, Dove 1985). Many fallow fields are managed and converted to permanent agroforests (Colfer 1997). In addition, resources from fallows including food

and other materials often remain essential to shifting cultivators. In the case of the Benuaq Dayak and other indigenous groups, fallow fields are continually managed to promote growth of useful tree species.

By using local technological knowledge and natural resource management, indigenous groups have successfully cleared the land by burning, planting and harvesting their crops, and in addition the forests have regenerated. The main factors in the success of shifting cultivation are land availability and low population densities (Conklin 1961, Dove 1985, Geertz 1963, King 1993). The specific forms of Swidden agriculture used in different geographical areas also depends on a number of factors including available land, and capital; local settlement patterns; principle crops raised; crop fallow ratios; the dispersal of Swidden plots; vegetation cover of cleared land, climate, soil conditions and topography (Conklin 1963). Negative factors that can have an immense impact on shifting cultivators include economic conditions, population pressures, migration, and unequal distribution of resources. If economic and population factors remain stable then in ecological terms this form of agriculture maintains the general structure of the pre-existing natural ecosystem (Geertz 1963). In Indonesia however, problems regarding the above factors arise due to spontaneous and governmental sponsored migration programs. Displaced groups will practice Swidden agriculture for short-term gain, but not as a complete system. For Swidden agriculture to truly be successful, the fallow period must have the appropriate time period for forest regeneration.

Environmental degradation can occur when proper rotational cycles are not complete, if land is scarce or if fallow periods are often shortened, some as short as 5-7 years, the nutrients are further depleted from the soil. If the cycle of shifting cultivation can be completed then it is possible to restore lost nutrients and forest cover to these

areas. The swiddener plays an important role in the regeneration of these shifting cultivation fields. Diversity may be added to the forest cover by active management and manipulation of tree species by the swiddener, thus once natural forest cover is transformed or converted to a harvestable forest providing useful forest resources. Swidden agriculture is not one but many hundreds of different land use systems that can evolve into permanent and complex agroforestry systems (Angelson 1995). Several indigenous groups in Kalimantan such as the Tae, Dayak Kenyah (Figure 5.2A and 5.2B), and Bagak villagers cultivate the same produce as the Benuaq Dayak including *beras gunung* (dry hill rice) cassava, corn, and other vegetables. In addition, they cultivate fruit and rubber gardens, which provide supplemental income. Several Dayak groups throughout Borneo tend to practice similar land use systems and cultivate similar crops. On other islands in Indonesia, indigenous people also manage a combination of land use types. For example, the Nuaulu, an indigenous group on Seram, one of the largest of the Moluccan Islands, or the Spice Islands practice Swidden agriculture and forest resource extraction. They clear land from secondary forests (typically bamboo shrub) to cultivate various annual crops. Of course many rural groups throughout the world practice multiple land use systems. This research focuses on the various land management systems of the Benuaq Dayak of East Kalimantan.

5.7 The Benuaq Dayak Cycle of Rice Cultivation

Benuaq Dayak practice hill rice farming, in which dry land is used to grow one crop of local upland rice annually and is intercropped with a variety of other food staples. The farming season begins in August or September at the end of the dry season with a cultivation season of six months. To prepare the site for rice cultivation the farmers burn the grass and weeds on their existing plots or open new plots from forested areas. If a

new plot is opened, the Benuaq Dayak remove trees that are larger than 15 cm diameter at breast height (dbh) to use as fuelwood for cooking. The ground is hand tilled to remove remaining roots and to loosen the soil.

The rice is hand planted at the end of September. The plots are weeded continually throughout the entire year due to intercropping of other crops throughout the year. The intercropping of cassava, bananas, chili peppers, sweet potatoes and other perennial crops are planted when the rice is roughly knee height. The Benuaq Dayak use this form of measurement to indicate appropriate time for intercropping, depending on if it is a drought year or not the rice crop is generally 3-4 months when other crops are to be planted in the *Umaq*. The rice is usually harvested in March, leaving the other crops to grow to maturity. Harvesting of the rice is done with small scythes, the grain is collected and sun dried. The rice (*beras*) is stored and later milled either by hand or machine. The other important food crops are harvested on an as needed basis. In August the annual cycle begins again with burning the fields.

5.8 Labor Inputs

Swidden agriculture has variable and seasonal labor inputs. The greatest demands on labor in the Swidden cycle occur during land clearing, planting, weeding, and harvesting. In other stages the labor is less demanding and attention is placed on other land use types such as fruit and rubber gardens. Labor division among the Benuaq Dayak in general is not gender oriented with men, women, and children all work in the *ladang* (agricultural plots) as well as participating in other activities. Very young children who are not in school stay at home with an elder member of the family or go with their parents to the cultivation plots. Older children will often work in the fields after finishing school in the afternoon. Children learn at a young age various tasks to assist their parents in

household as well as agricultural duties. All members of a household contribute in some manner to help sustain the household.

During harvest or planting periods of the Swidden agricultural cycle all capable adult members of the household work six to seven days a week. Adult household members generally work in the fields seven to eight hours per day subdivided into a morning (07:00-11:30) and an afternoon (14:00-17:30). At other times of the year labor input is less. The maintenance of the *Umaq* entails continual weeding of the plots. Other land use types such as the fruit, rattan or rubber gardens are focused on when there is not a high demand for labor in the *Umaq*. Other land use types such as rattan gardens must also be weeded somewhat regularly in the initial stages after planting. Labor inputs in agricultural societies such as the Benuaq Dayak require time management and efficiency due to the effort involved in maintaining several different land use types.

5.9 Results

5.9.1 Species Diversity of Shifting Cultivation Plots

The species diversity plots were taken in April and May of 2002, Rice is generally harvested in March. This is the reason that rice is not found in any of the sample plots. Annual yields of rice are documented in the following section. As indicated by Figure 5.3, there are a variety of non-rice crops grown in the shifting cultivation plots. The Benuaq Dayak as well as many other indigenous groups such as the Dayak Kenyah and Kantu' consider rice the most important crop (Colfer 1997, Dove 1985, Padoch, Harwell, and Susanto 1998), however other staple crops cultivated in *Umaq* plots are also significant in their diet. The species documented in the chart are crops where there were three or more individuals found in all the combined plots. The subsistence based Benuaq

Figure 5.2A **Procession in Dayak Kenyah Rice Harvest Ceremony**
Dayak Kenyah, East Kalimantan Indonesia, 2002

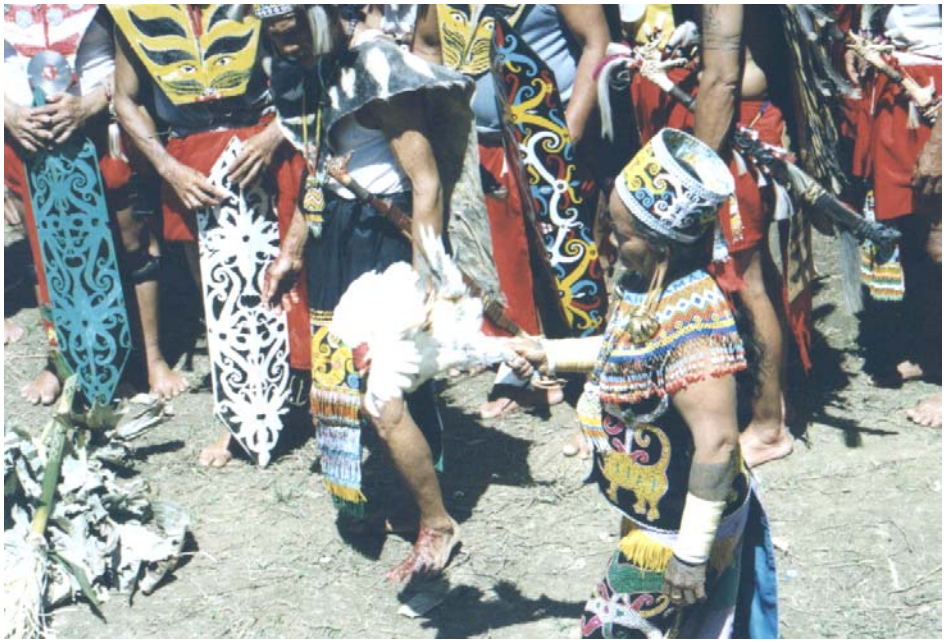

Figure 5.2B **Female Shaman in Dayak Kenyah Rice Harvest Ceremony**
Dayak Kenyah, East Kalimantan Indonesia, 2002

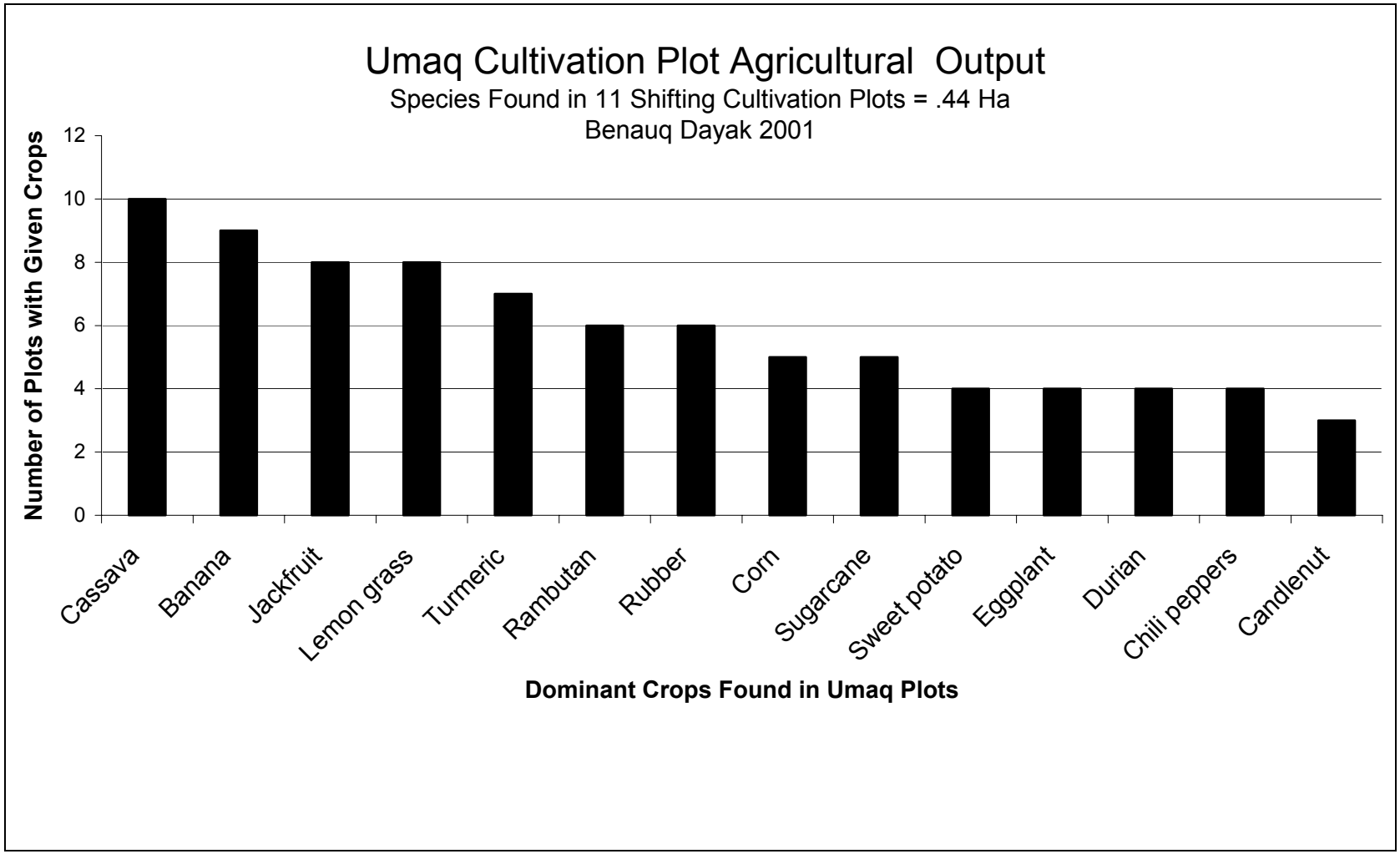

Figure 5.3 ***Umaq*** **Cultivation Plot Agricultural Output**
Benuaq Dayak, East Kalimantan, Indonesia 2001

Dayak consider the *Umaq* as the most important land use type. Shifting cultivation plots provide the communities with the annual surplus of rice, cassava, bananas, and vegetables. In all the sample plots fruit and rubber trees were five years of age or younger, thus not yet producing yields. The dominant vegetation type in most of the sample plots was cassava; this is a very important staple to the Benuaq Dayak. Cassava leaves provide majority of the green vegetables in the diet, candlenut (*kemiri*) is often cooked with cassava leaves and garlic in a stir-fry. The tubers of the cassava plant are often consumed when the annual supply of rice is limited. Corn and other vegetables provide variety to the diet and occasionally income generation. Although there were not a large variety of vegetables found in the sample plots, in the household surveys villager reported crops such as green beans, cucumbers, and peanuts. These products are often sold in the local market. Spices such as lemongrass, turmeric, and candlenut are used daily in cooking. As a part of ceremonies associated with the cultivation of a new rice plot (*buka ladang* or opened), lemongrass and turmeric are planted. This is to ensure successful yields while the plots are in cultivation.

The *Umaq* shifting cultivation plots thus provide Benuaq Dayak staple of rice and essential non-rice food items such as cassava, and fresh vegetables. Other land use types such as the *Simpukng*, only provide season fruit, *Uratn* (*Umaq* fallows) provide limited food resources including edible bamboo and rattan shoots. Protein resources are obtained by fishing, hunting, and the rare consumption of livestock. (Livestock is used more as income generation as opposed to direct consumption). Shifting cultivation plots are the most common land use type that can be "borrowed" by new inhabitants to the village, it

is understood among the Benuaq Dayak that without this land use type subsistence needs cannot be met (field notes 2002).

5.9.2 *Umaq* -Benuaq Dayak Shifting Cultivation Plots

Shifting cultivation plots (called *Umaq*) are used to cultivate dry hill rice intercropping mainly with cassava, including various fruits and vegetables for subsistence (Figure 5.3). Usually households maintain 1 to 1.5 hectares if rice cultivation plots annually. The average size for *Umaq* for all three study villages was 1.34 hectares; there was very little difference in the amount of *Umaq* land parcels between villages (Table 5.4A). Tepulang had the highest mean of 1.43 Umaq hectares, Benung with 1.40 ha, and Dingin had the lowest with 1.24 ha.

Paddy rice is generally cultivated in Indonesia in wet rice fields, unlike the dry hill rice farming that is practiced amongst the many Dayak communities. The hill rice (*beras gunung*) is a highly prized commodity and most villagers are unwilling to sell even at high prices. The yield of *Beras gunung* is always kept for the annual supply of rice. The ANOVA test on this yield confirmed that there was significant difference in the annual rice yield for the three study groups (F= 4.32 p=. 018). The Scheffe Post Hoc test indicated that the significant difference in the annual rice yield is between the villages of Benung and Dingin but not the village of Tepulang. The total average rice yield for last year was 393 kilos (n=62, range 2,480, s 394). The mean yield for rice in Benung was almost double than in other villages at 581 kilograms (range 2,450, s 519). Tepulang had the second highest yield with a mean of 293 kilos (range 980, s 252). The annual average yield of rice for Dingin was 285 kilos (range 780, s 272). Only 44 percent of those households sampled in Dingin reported a rice yield and 33 percent reported flooded plots, this explains the significant difference. Although the average household for Tepulang

had a slightly higher mean of 293 kilos, 80 percent of the households reported yields as opposed to the low number of those in the village of Dingin. (See Table 5.4A).

Although rice is the most important crop for the Benuaq Dayak, the most dominant crop grown is the root crop cassava (*Manihot esculenta sp*.). Cassava or *Singkong* (Figure 5.4) had a reported yield much higher than that of rice (Table 5.4B). It was also a staple for the communities studied. The leaves of *singkong* are cooked as a vegetable and the tuberous root cooked in a variety of ways. It also provides the food supply for livestock including pigs and chickens. The results of the ANOVA test indicate that there is a significant difference in cassava yield between villages (F=4.12 p=. 021).

Table 5.4A ***Umaq* Resources**
Benuaq Dayak, East Kalimantan, Indonesia 2001

Umaq	**Number of Hectares**	**n=**	**%**	**Rice** (kg) **	**n=**	**%**
Ranges	7 0.98			2,480 394		
Tepulang	1.43	21	84%	293	20	80%
Benung	1.40	23	92%	581	20	80%
Dingin	1.24	33	73%	285	20	44%
Mean sample	1.34	77	81%	393	62	65%
F Statistics	F=0.29 p=. 75			F= 4.32 p=. 018		

**** Sig. @ p=<. 05**

Figure 5.4 **Cassava and Leaves Used for Benuaq Dayak Household Consumption**
Benuaq Dayak, East Kalimantan, Indonesia 2002

The ANOVA Scheffe Post Hoc test identified the significant difference between villages for cassava yield is again between the villages of Benung and Dingin, but not between Tepulang. This crop is essential to the subsistence farming of the Benuaq Dayak; the overall mean was 2,497 kilos annually (range 9,105, s 1,875). The highest mean annual yield for *Singkong* was in the village of Benung with 3,357 kilos (range 8,345, s 2,214)(Table 5.3B). Tepulang had the second highest yield at 2,367 kilos (range 6,170, s 1,832). Dingin again had the lowest yield at 1,892 kilos (range 5,440, s 1,324) annually, again this may have been due to the flooding of so many *Umaq* in 2002 (Figure 5.5). Firewood (small trees 10-15 cm diameter at breast height (dbh)) is often gathered in the *Umaq*. Various other crops such as corn, eggplant, bananas, cucumbers, chili peppers, and sweet potatoes are cultivated after the rice is harvested (See Figure 5.3). These crops add additional variety to the diet and in rare cases also generate income. There were nine

Table 5.4B ***Umaq* Resources**
Benuaq Dayak, East Kalimantan, Indonesia 2001

Umaq	**Cassava** (kg)**	**n=**	**%**	**Corn** (kg)	**n=**	**%**	***Umaq* Income Generation ** ** (Rupiah)	**n=**	**%**
Range s	9,105 1,875			1,920 346			10,300,000 3,854,759		
Tepulang	2,367	20	80%	287	20	80%	2,705,714	7	28%
Benung	3,357	22	88%	50	20	80%	10,500,000	1	4%
Dingin	1,892	27	60%	61	20	44%	200,000	1	2%
Mean sample	2,497	69		125	62	65%	3,293,333	9	9%
F Statistics	F=4.12 p=. 021			F=1.64 p=.212			F=3.75 p=. 090		

**** Sig. @ p=<. 05**

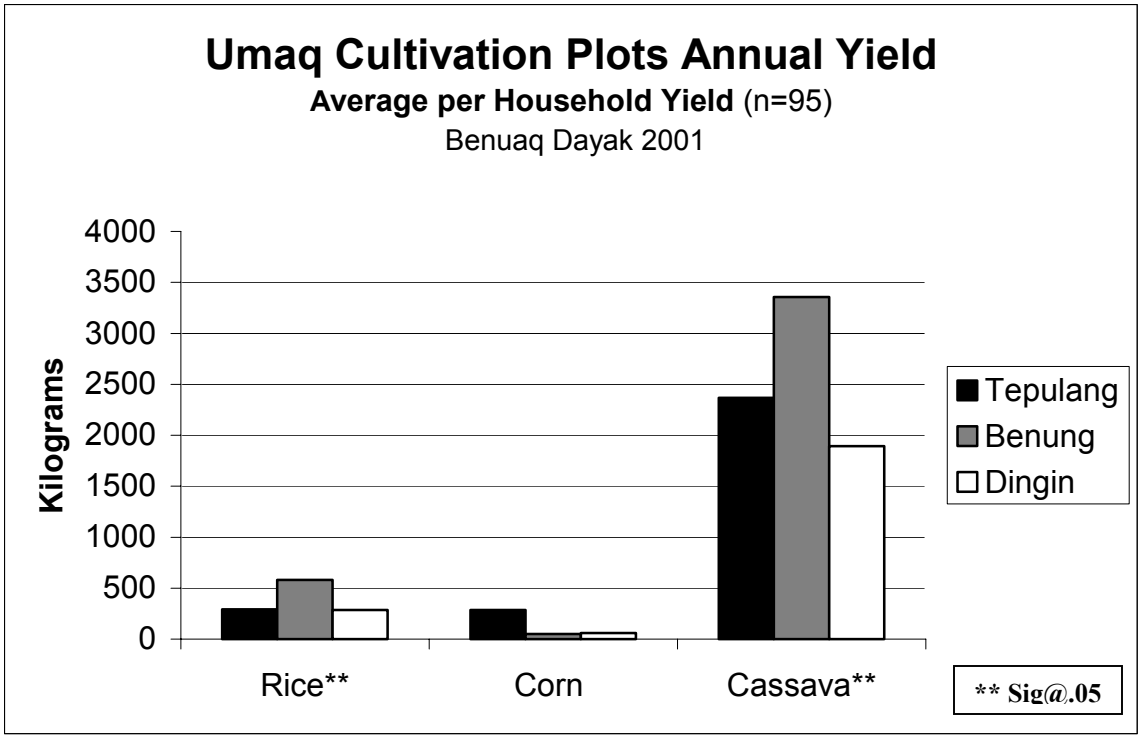

Figure 5.5 ***Umaq* Average Annual Yield**
Benuaq Dayak, East Kalimantan, Indonesia 2001

villagers in the sample who reported income generation from the *Umaq*, those villagers either sold corn or dried cassava that is used for livestock feed. Because resources from the *Umaq* are staples it is expected that the majority in the sample would not sell produce grown in this land use type.

5.9.3 *Uratn* (*Umaq* Fallow Fields)

When an *Umaq* is no longer used for rice cultivation it becomes a fallow field that is called an *Uratn*. *Uratn* provide much needed resources for the communities including wood for construction of *rumah ladang* (field houses) and firewood usually using small trees approximately 10-15 cm diameter at breast height (dbh). Edible and other species of bamboo and rattan shoots are often found in *Uratn* along with residual fruit trees. After the shifting cycle has been completed some of these fallows will once again be converted to rice cultivation or left to regenerate into secondary forest. If families were well

established, they generally had the most hectares in this land use type because it is a fallow rice field in a shifting cultivation society. The villagers who reported owning *Uratn* were fairly high (n=67), the 71 percent of those who reported owning *Uratn* had an average of 5.43 hectares with a range of 20 ha. Dingin residents had the most amount of *Uratn* hectares with a mean of 5.9 ha, Benung residents had the second highest average with 5.2 ha. Of those surveyed in Tepulang, the mean number of hectares was only 3.3, in Tepulang *Uratn* plots tend to be more communal, this is possibly the reason for the low number of respondents and reported hectares.

Different varieties of wood are often collected from the *Uratn*, the wood removed is usually taken to construct field houses (Table 5.5A). Field houses generally need to be repaired annually or rebuilt if the family has opened up a new *Umaq* (rice plot). Long periods of time are spent in the *Umaq*, the plots need to be tended to on a regular basis. Some villagers prefer to spend months at a time in their field houses instead of staying in the villages. Every family who has an *Umaq*, has a field house, thus wood is removed on a regular basis from the *Uratn.* Of the villagers in the survey, 51 percent reported extracting construction wood from the *Uratn*, collecting a mean of 88 trees annually. The average number of trees collected for the village of Benung was 95 trees, Dingin residents reported the second highest with an average of 90 trees, and Tepulang reported the least amount with a mean of 70 trees. As noted above the trees used for building field houses are small trees only 10-15 cm dbh. Removing small numbers of trees from these plots has little impact on these regenerating fallows.

Bamboo is another resource that is found in the *Uratn,* Bamboo is used for several purposes such as to build pens for livestock, floors for field houses, and altars for ceremonial purposes. The mean sample of bamboo extraction was 130 poles annually

with a range to 1,196 poles. As indicated by the range some villagers extract large amounts of bamboo (Table 5.5A). The average amount of bamboo poles extracted from Dingin was the highest with 187 poles, Benung rates second with 111 poles and a larger percentage of Tepulang residents reported extracting bamboo but at a lower average (50 poles). Edible bamboo is another resource that is found in the *Uratn*, large stalks and the base are harvested. The sample mean of edible bamboo removal was 181 plants annually. In Dingin this resource had the most number of respondents, with a mean extraction of 171 bamboo plants annually. In the village of Dingin some of the residents reported feeding the edible bamboo to their livestock if they were in short supply of cassava. Benung ranked second with an average of 187 plants annually. Only two people in Tepulang extracted edible bamboo with a mean of 267 plants per year. Statistical tests run on this variable indicate that there is no significant difference between villages, most likely because only 38 percent of the sample survey reported collecting the edible bamboo.

Table 5.5A ***Uratn* Resources**
Benuaq Dayak, East Kalimantan, Indonesia 2001

Uratn	**Hectares**	**n=**	**%**	**Con. Wood** (trees)	**n=**	**%**	**Bamboo Poles**	**n=**	**%**
Range s	20 5.03			180 39.5			1,196 225		
Tepulang	3.3	10	40%	72	11	44%	50	15	60%
Benung	5.2	13	52%	95	18	72%	111	13	52%
Dingin	5.9	44	98%	90	19	76%	187	26	57%
Mean sample	5.43	67	71%	88	48	51%	130	54	57%
F Statistics	F=1.12 p=. 319			F=1.91 p=. 313			F= 1.87 p=. 163		

Edible rattan shoots are another food source that is harvested from the *Uratn*. This resource is collected more often than edible bamboo. The rattan shoots are extremely bitter and are often cooked in a stir-fry. The mean sample for collection was 1,102 shoots annually. The majority of residents of Dingin collecting the product average 1,334 rattan shoots. Benung residents also collected this resource but with a much lower mean of 149 shoots annually. No residents in the sample survey in Tepulang reported eating edible rattan. Edible rattan and bamboo are not staples for the Benuaq Dayak, however are added as relishes to their meals. Non-edible rattan is also collected from the *Uratn,* however total yields are combined in the *Kebotn* section, the sample mean for collection of rattan in the *Uratn* was 13,600 kilos and only 3 percent of villagers (range 38,200, s 21,997) reported extracting rattan from this land use plot. Firewood (mean 136 *ikat*, range 600, s 147) is a resource that is also commonly removed from the *Uratn*, because this is such an important resource a more detailed explanation will be given toward the end of this section.

Table 5.5B. ***Uratn* Resources**
Benuaq Dayak, East Kalimantan, Indonesia 2001

Uratn	**Edible rattan shoots**	**n=**	**%**	**Edible bamboo plants**	**n=**	**%**
Range s	25,990 3,892			1,295 253		
Tepulang	0	0	0	267	2	8%
Benung	149	6	36%	187	11	44%
Dingin	1334	37	82%	171	23	51%
Mean sample	1102	43	45%	181	36	38%
F Statistics	F=. 666 p=. 419			F=. 129 p=. 880		

5.9.4 Firewood

The firewood is a resource that is crucial to the every day lives of the Benuaq Dayak with 79 percent of respondents collecting firewood on a regular basis. Those who did not report collecting firewood lived in a multiple family home and it was not their duty to collect firewood. There was only one family in the survey that used a gas burner for cooking. The *ikat* is the unit in which firewood is measured, it is a bundle of firewood that would be equivalent to a bundle of wood that is sold in the U.S., however the wood is cut from smaller trees. Most trees that are cut for firewood are commonly 10-20 cm around. As seen in Table 5.6 firewood is collected from various land use types. Villagers collected firewood more commonly from the *Uratn*, but at a lower yield (118 *ikat*). The greatest mean extraction rates of firewood were from the *Umaq* (246 *ikat*), however less villagers collected from the *Umaq*. There is a significant difference between villages in the amount of *ikat* collected in the *Bengkar* ($F= 4.12$ $p= .030$). Dingin residents collected firewood from the *Bengkar* far more regularly than in the other villages and at higher rates (mean 202). The *Bengkar* for Dingin is located the farthest from the village several kilometers away, *Bengkar* for Benung and Tepulang are only 1-2 hours walking distance from the villages. It is possible that due to the fires that plagued the region over the past several years, wood that is normally available from the *Uratn* and *Umaq* have not regenerated sufficiently to collect sufficient firewood from these land use types. Wood that is collected from the *Umaq* and *Uratn* is generally a renewable resource. Trees that are normally cut when opening a new *Umaq* are used as firewood and not just burned in the process of creating new rice plots. Trees cut from the *Uratn* also have the ability to regenerate easily as they are located in fallow fields. Firewood is a resource that if collected sparingly from various land use types and at low rates, then

Table 5.6 **Firewood Resources**
Benuaq Dayak, East Kalimantan, Indonesia 2001

Firewood *Ikat*	***Umaq*** *Ikat*	**n=**	**%**	***Uratn*** *Ikat*	**n=**	**%**	***Bengkar*** *Ikat*	**n=**	**%**	**Total Firewood**
Ranges	1,156 372			619 120			404 107			1,579 253
Tepulang	239	5	20%	102	13	52%	67	5	20%	408
Benung	336	10	40%	105	14	56%	126	2	8%	567
Dingin	73	2	4%	137	21	47%	202	19	42%	412
Mean sample	246	17	18%	118	48	51%	170	26	27%	534
F Statistics	F=.821 p=.457			F=.457 p=.636			F=4.12 p=. 030			F=. 495 p=. 612

resources for the future will be abundant. In contrast, firewood collection in many African countries has lead to high rates of deforestation (Seeland 1997). The Benuaq Dayak continue to maintain low population densities and hold large parcels of heavily forested land, thus firewood extraction at the time of this research was not a resource that was in any danger of growing scarce.

5.10 Conclusions

This research documented shifting cultivation practices among the Benuaq Dayak of East Kalimantan. This study identified the diversity of crops within Benuaq Dayak shifting cultivation plots. It also documented the yields of the dominant subsistence crops and analyzed the differences among villages. In identifying the yields of staple crops such as rice and cassava reported by the three villages, it was possible to recognize the differences in villages affected by flooding and those unaffected. The disturbances caused by flooded *Umaq* plots in the village of Dingin were very apparent when looking at the

low yields produced in the last year. Flooding and fires have plagued the village of Dingin over the last several years; this has devastated the subsistence base and the village economy. There is a general low morale in the community due to the reoccurring natural disasters plaguing this area. Many of the community members were not optimistic about the future of their subsistence resources. Some villagers did not plan cultivate *Umaq* plots for the following year already anticipating crop loss. In 2001, only 44 percent of the villagers in Dingin reported a rice yield and 60 percent reported yields for cassava. (For information on the affects of fire damage on fruit gardens see this volume chapter 6). If subsistence crops are not available they must be purchased. Average annual income for Dingin was substantially lower (8.2 million rp./yr.) than that of the other villages (Tepulang 11.2 million rp./yr. and Benung 11.1 million rp./yr.). There is some opportunity for non-agricultural employment, however it is somewhat limited. Without staple crops and low potential for income generating activities, the village of Dingin is currently in crisis. This community needs the support of the local government and NGOs to assist recovery of subsistence goods and other associated losses.

Shifting cultivation practices by the Benuaq Dayak and other Dayak groups in Borneo have historically been under scrutiny from the Indonesian government (Dove 1984, King 1993, Colfer 1997). The practice of shifting cultivation has been blamed for destroying much of the forested land on Borneo. Fallow rice fields are heavily managed and cultivated to become productive forests when regenerated. This often enhances the biodiversity of original forests. This practice has flourished and maintained populations for thousands of years without the large-scale damage caused by logging and other natural resource extractions activities on Borneo. The Benuaq Dayak maintain several land use practices, they uphold traditional laws pertaining land tenure, and they have

immersed themselves in the market economy by collecting and cultivating rattan and rubber. Although their traditional culture and practices remain strong they have incorporated themselves into mainstream Indonesia in times of change in the region.

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CHAPTER 6

ECOLOGICAL DISASTER AND THE IMPACTS ON BENUAQ DAYAK FOREST GARDENS IN EAST KALIMANTAN, INDONESIAN BORNEO

6.1 Overview

This research took place in East Kalimantan, Indonesia approximately 250 kilometers from the provincial capital of Samarinda. In 1999, the district of Kutai Negera in East Kalimantan was divided into three new districts. One of which formed Kutai Barat, where research was conducted for this project. Three Benuaq Dayak villages located in the upper watershed of the Makaham catchment system were chosen for this research project. These villages were selected because they are composed of 100 percent Benuaq Dayak ethnicity. Benuaq Dayak villages have been established in this area for over 300 years. The area ranges in altitude from 80-120 meters above sea level with an annual precipitation of 3,000 mm.

Prior to the division of the district, the costs and length of time associated with travel to the district capital were prohibitive for local people. Thus the government rarely acknowledged the needs of the villagers in outlying regions. The district capital is now located 1-2 hours from the villages, which provides much easier access. During the past two years there has been an influx of money and projects to develop the region. The government decentralization and the forestry sector are also having an impact on Kutai Barat, monies earned from exploitation of resources are in the process of being directed to local governments.

Projects such as electricity lines and road development have begun to filter into the newly formed district. Currently there is a reforestation program in which the local population is able to reforest disturbed land. This is a government-sponsored project

where timber companies must pay a tax for replanting after harvesting. Reforestation can take place at any location of disturbed forests, not necessarily where the timber concession is located. Local people can apply to the local government to reforest their own land in which case they are provided with seedlings and are paid a daily wage for replanting. The Benuaq Dayak communities have been very successful in recent efforts to reforest degraded land near the community forest reserves. Seedlings provided by the government are mixed dipterocarp and native fruit trees. In addition, Asian Development Bank also sponsored a project after the devastating forest fires of 1997-98, where villagers received rubber tree seedlings and were given loans for pesticides. The loans are to be repaid when the rubber trees reach productive age. Because there is much development in this region, there are new opportunities and changes in lifestyles among this indigenous group. Although access is now much easier than prior to the new district being formed, the Benuaq Dayak are continuing their traditional land use systems, while taking advantage of new opportunities.

This research was conducted in 2002 under the indirect supervision of Natural Resource Management, an NGO based in Samarinda, the provincial capital of East Kalimantan and by the head of the forestry sector in the district of Kutai Barat.

6.2 Objectives

This study's purpose is to identify natural resource use in subsistence economies and the economic utility of these resources in the villages of Tepulang, Benung, and Dingin. Geography and environmental factors were hypothesized to play a role in variation of resource utilization among the Benuaq Dayak villages. The reliance of natural resource use for subsistence and income generation is a significant aspect of the livelihood of this ethnic group but differ in degree between villages. In addition, the land

management system for the Benuaq Dayak at its current condition appears to be sustainable but again this may vary between villages.

Specifically, the objectives of the study are:

1.Study indigenous knowledge systems in relation to land use practices.

2. Describe land use systems of the Benuaq Dayak.

3. Describe agricultural practices.

4. Describe economic utility of agricultural activities.

5. Identify forest resources extracted and yields of these resources.

6. Analyze land use systems sustainability.

7. Identify variation among resource use in the three study sites, taking into account ecological disaster caused by fires and flooding.

This study also aims to identify the willingness to conserve and maintain community forest reserves among the three study sites. In addition to the decentralization of the forestry sector, this region is also going through rapid changes in the government due to regional autonomy. This area including local communities are being developed and have more opportunities than ever before. Critical to this change is the understanding that continued sustainable extraction and forestry practices among the Benuaq Dayak should be maintained.

Variables used from survey are as follows:

Simpukng

Hectares
Rambutan (kg)
Langsat (kg)
Mangos (kg)
Jackfruit (number of fruits)
Durian (number of fruits)
Simpukng Income Generation (Rupiah)

Kebotn

Hectares
Rubber (kg)
Rattan (kg)
Kebotn Income Generation (Rupiah)

6.3 Methods

This research encompassed a broad but integrated system of human-land relationships among the indigenous group the Benuaq Dayak of East Kalimantan, Indonesia. The Benuaq Dayak make up the main population in the district of Kutai Barat where this research was conducted. Data were collected through qualitative and quantitative methods to determine current land use and forest management practices among the Benuaq Dayak in the three chosen study sites.

First, In-depth interviews were conducted to understand traditional belief systems as they pertain to land management and *Adat* (customary) law. Interviews also provided biographical data on land management activities in these communities. Second, sampling households and conducting land use surveys accomplished data collection. I conducted the interviews and household surveys myself in Indonesian with the assistance of a local research assistant. Having a local assistant helped the villagers become comfortable with my presence in the villages as well as in their homes. Although impossible to quantify, I believe the villagers were comfortable with and enjoyed the interview process which lead to high response rates and overall quality of the interviews.

The households surveyed were randomly selected in each of the three villages. In each village approximately 50 percent of households were surveyed. Interview sessions were scheduled in the evening after the villagers had returned from working in their cultivated fields. Whenever possible interviews were conducted with all adult members of the household present, for the most part both men and women gave equal responses,

although one gender may have been more informed about certain information. Those interviewed were generally interested in the survey and answered the questions to the best of their ability. Questions were repeated, explained, and followed up to ensure that all pertinent information was gathered. In general, data were collected in local units and then converted to international standardized units. The units were generally consistent and accurate.

The information used in this section of this dissertation include household information, demographic information, expenditures, income generation activities; non-agriculture and agriculture related activities; land ownership agriculture; cropping intensity; resource extraction of flora and fauna in the communities forests and rivers; livestock ownership; and opinions concerning conservation activities. The surveys were also intended to identify the varying types of forest resources used, to catalogue the frequency and volume of use, as well as to determine the demographic apportionment of use.

Surveys were supplemented with objective field observations. I became involved in some of the daily activities associated with agricultural activities as an active observer. I studied the methods of extracting and processing resources such as rubber and rattan. I assisted some of the villagers in extracting forest products and harvesting agricultural products. In addition, I also learned techniques in weeding agricultural plots, husking rice, as well as daily animal husbandry tasks.

The third phase of research entailed setting up land use plots to sample for species diversity of trees and agricultural foodstuffs. With the aid of two local plant experts in each of the three study sites, species diversity plots were sampled on three of the various land management units. Sites were chosen randomly. These plots determined density,

abundance, and stature (tree size) of forest resources. When Indonesian names of trees were unknown the local name was used and later an attempt was made to identify the Indonesian or Latin name. Three 20X20 meter plots were sampled in each village for the chosen land use types to identify species diversity. The plots included; 1) *Umaq* – rice cultivation and agricultural plots, 2) *Simpukng* - fruit gardens, 3) *Bengkar* - community forest reserves. In the 20X20-meter plots diversity and abundance data were collected. Two additional samples were set up in all the *Bengkar* plots; the smaller plots identified smaller trees and seedlings. The 20X20-meter plots in the *Bengkar* measured the diversity of trees over 20 cm diameter at breast height (dbh). The 10X10-meter plots measured trees between 10-20 cm dbh. The last survey plots were 2X2 meters in which seedlings were identified with their common names. The number of species and abundance were calculated for each plot. The species diversity plots were used to compare the natural resource availability among the different land use types.

6.3.1 Statistical Tests

My dissertation's focus is to determine the relative conditions and economic use of forest resources, as well as the lifeways of the people living within three Benuaq Dayak villages. The rationale was to identify the differences in areas disturbed by a natural disaster and ascertain differences in villages not affected by a natural disaster. Descriptive statistics were calculated to provide a summary of characteristics of the data set. The mean for all variables in each data set was calculated to identify measures of central tendency for each village. The ranges of variables were calculated to analyze variability among the largest and smallest values for each village. Standard deviations provided measures of variability in the data set among the three villages. The most appropriate statistical test is the Analysis of Variance test that can be used to compare a

range of variables between villages. The Scheffe Post Hoc Analysis of Variance Test was used to identify significant differences between individual villages.

1) Analysis of Variance (ANOVA -one way) tests are used to determine differences and similarities between and within groups in the three study areas of natural resource extraction and use levels. The ANOVA comparison of means test will indicate if there are differences in the extraction of natural resources, levels of household expenses, livestock ownership, and other related variables between households living in the three villages.

As defined by McGrew and Monroe in Statistical Problems in Geography, Analysis of Variance is defined as follows:

> The Analysis of Variance or ANOVA is defined as a descriptive statistic measuring variability about the mean. The Analysis of Variance involves separation of the total variation found between nominal groupings or samples into meaningful components: (1) Variability *between* the groups or categories; and (2) variability *within* the groups or categories. ANOVA determines which is more dominant or pronounced and accounts for a greater portion of the total variation (McGrew and Monroe 1993).

The ANOVA test statistic (F) is:

$$F = \frac{MS_B}{MS_W}$$

where: MS_B = between group mean squares
MS_W = within group mean squares

Formula 5.1 Source: McGrew and Monroe 1993:173

6.4 Survey Information

Surveys were conducted in the villages of Tepulang, Benung, and Dingin in the Kutai Barat district, East Kalimantan, Indonesia sampling roughly 50 percent of

Table 6.1 **Number of Households in Villages and Number Sampled**
Benuaq Dayak, East Kalimantan, Indonesia 2001

Village	Approximate Number of Households	Number Sampled
Tepulang	57	25
Benung	52	25
Dingin	92	45

households in each village (Table 6.1). In this survey there were 95 household units sampled. Households are approximated for each village because some villagers have residences or reside part time with their adult children in other villages or in the provincial capital of Samarinda, thus they are not residing in the study site villages on a continual basis. The villages are considerably small which is the reason for the small sample size. Due to the great amount of variance and large numbers of zeros within the dataset the mean as opposed to the median value was used in data analysis.

6.5 Land Parcels, Yields, and Agricultural Income Generation.

The Benuaq Dayak have several different types of managed land units; *Umaq* are cultivation plots containing staples such as rice and cassava, *Uratn* is an *Umaq* fallow where resources continue to be extracted, a *Simpukng* is a fruit garden, *Kebotn* is a plot of land where resources such as rattan and rubber are cultivated. (Table 6.2) The *Bengkar* is the Benuaq Dayak community for reserve that provides wild game and forest resources such as rattan, wood, and medicinals. Livestock are kept including pigs, chickens, cows, and in one village goats and water buffalo are raised. Riverine resources provide fish and vegetation. The majority of people derive the bulk of their income by selling natural resources.

Table 6.2 **Major Benuaq Dayak Subsistence Activities**
Benuaq Dayak, East Kalimantan, Indonesia 2001
Values are % of n interviews households.

Activity	**Village** **Tepulang** n= 25	**Benung** n=25	**Dingin** n=45	**Total** n= 95
Agriculture				
Rice Cultivation	80%	80%	44%	65%
Cassava Cultivation	80%	88%	60%	73%
Forest Gardens				
Own Fruit Garden	80%	88%	71%	80%
Own Rubber and Rattan Gardens	76%	88%	64%	74%
Livestock				
Own Pigs	88%	88%	60%	75%
Own Chickens	80%	92%	53%	71%
Non-Agricultural Activities	48%	68%	60%	59%

The Benuaq Dayak maintain large land parcels in which they cultivate a variety of crops. The mean total number of hectares for the entire survey was 8.33 ha per household. The highest reported average for total hectares was from the village of Benung with 9.48 ha per household. The village of Dingin had the second highest average at 9.56 ha per household. Tepulang had the lowest average with 4.95 ha per household. The ANOVA test at a significance level of sig = .05 indicated that there is no significant difference between villages for the total number of hectares per household. Additional activities are practiced to supplement resources for the communities. Income generation is primarily based on agriculture related activities including selling a variety of fruit, rubber, rattan, and livestock. At the time of this research (2002) the Indonesian Rupiah had an exchange of 10,000 Rupiah to 1US$. Table 6.3 summarizes variables for the entire study. Relevant information on Benuaq Dayak demographics for each of the three study sites is included such as annual household income, expenses, education, and

number of hectares actively farmed for each land use type. Yields of agricultural products, livestock ownership, and natural resource extraction rates of flora, fauna, and riverine resources are summarized. These data are described individually in detail according to each land use type.

Table 6.3 **Summary Data**
Benuaq Dayak, East Kalimantan, Indonesia 2001

Variable (mean per village/yr)	**Tepulang** n=25	**Benung** n=25	**Dingin** n=45	**Mean Total** n=95
Demographic Information				
Number of Children	2.00	2.12	2.31	2.19
Total Family Size	3.28	3.04	3.62	3.38
HH Age	37	40	38	38
HH Education (1-7)	3.04	3.44	3.23	3.24
Spouse Age	32	30	35	32
Spouse Education (1-7)	2.82	3.00	2.89	2.90
Agricultural Income (Rupiah)	6,912,652	4,743,860	4,715,411	5,031,118
Non-Ag Income (Rupiah)	4,158,400	6,500,600	3,524,622	4,727,874
Total Income (Rupiah)	11,071,052	11,244,460	8,240,033	9,775,676
Total Expenses (Rupiah)	5,735,980	5,270,480	4,125,000	4,850,752
Total Hectares	4.95	9.48	9.56	8.33
Umaq (ha)	1.43	1.40	1.24	1.34
Rice (kg)	293	581	285	393
Cassava (kg)	2,367	3,357	1,892	2,497
Uratn (ha)	3.3	5.2	5.9	5.43
Con. Wood (trees)	72	95	90	88
Bamboo (poles)	50	111	187	130
Edible Rattan	0	149	1,334	1,102
Edible Bamboo	267	187	171	181
Firewood (total)	408	567	412	534
				Table continued on next page.

Variable	Tepulang n=25	Benung n=25	Dingin n=45	Mean Total n=95
Simpukng (ha)	1.21	2.32	1.83	1.84
Rambutan (kg)	248	232	135	200
Langsat (kg)	750	258	203	357
Mango (kg)	100	167	117	135
Durian (# fruit)	471	154	96	204
Jackfruit (# fruit)	825	694	160	557
Kebotn (ha)	1.92	3.68	2.44	2.69
Rubber (kg)	229	741	1,142	807
Rattan (kg)	3,418	1,911	1,113	1,966
Bengkar **Resources**				
Meranti Wood (m^3)	2.64	3.86	2.45	2.89
Benkerei Wood(m^3)	4.13	3.83	1.33	3.44
Ironwood (m^3)	0	2.00	1.00	1.25
Other Wood (m^3)	4.20	3.00	4.00	3.70
Wild Boar (animals)	3.43	10.67	4.53	10.11
Deer (animals)	3.67	2.50	3.58	3.50
Mouse deer (animals)	3.00	2.50	3.00	2.78
Birds (number)	14.33	0	0	14.33
Honey (liters)	83.60	7.50	5.33	44.90
Riverine Resources				
Fish (kg)	341	165	431	312
Roof Thatch (branches)	165	156	100	132
Fern (kg)	77	56	71	68
Livestock				
Pigs Owned	8.64	5.41	2.74	5.39
Pigs Sold	3.67	2.23	1.29	2.21
Pigs Consumed	2.50	2.67	1.74	2.21
Chickens Owned	3.95	17.00	8.63	11.00
Chicken Sold	11.00	22.67	6.79	12.53
Chickens Consumed	15.73	4.63	7.80	8.50

6.6 Forest Gardens

Anthropogenic forests are created and adapted to fit the needs of forest dwelling people. Forest dependent people deforest and reforest through intensive management, thus often enhancing biodiversity (Peluso 1996). Many rural communities construct forest gardens to fill subsistence and economic needs. The indigenous people of Borneo have created a mosaic of anthropogenic forests over thousands of years (King 1993). These forest gardens as they have developed, have become a very important resource to indigenous groups as they provide subsistence farmers with food resources and income generation. Land tenure regarding managed forests is often complex and follows strict taboos on access to resources.

There is a great complexity to land tenure systems of agrarian societies and the roles of property and the political economy in shaping the landscape (Colfer 1997, Dove 1985, Peluso 1996). Political economic institutions heavily influence access to resources and market that in turn affects the way in which resources are managed (Peluso 1996). Spatial and temporal variation of resources within various land use types such as areas for crop cultivation, fallow fields, forest reserves, fruit, and rubber gardens develop zoning of resources. The Benuaq Dayak manage several land use systems in which tenure rights are usually inherited through family ties. Indigenous groups often have systems so complex that individual species of trees and their fruits have tenure systems that are taken into account individually. Property relations are in constant flux due to multiple influences and negotiations (Moore 1986 in Peluso 1996). Customary laws often evolve and adapt according to the political climate and the availability of resources. Land tenure and tree tenure and access to different parts of a tree may be allocated to different individuals (King 1993, Peluso 1996). The Penan, a hunter gather group in the interior of Borneo

have claim to individual trees, this is indicated by carved symbols scarring the bark of the tree. There are complex rules associated with the use and "borrowing" of resources. For example, the Penan being hunter gathers, travel long distances often times not returning to the same area for several years. Thus other Penan groups often use resources from trees, although ownership by another has long been established (Davis 1999). Other indigenous groups such as the Dayak of Borneo have a complex system of land tenure sharing common property rights to land, ownership or access to resources depends on *Adat* or customary laws and resource management.

Depending on the length of fruiting seasons of a species, there are also customary laws developed to maintain ownership rights to future generations. Many fruit trees will produce fruit yields for three to five human generations; durian may produce through seven generations (Peluso 1996). Durian is a highly valued fruit and commodity throughout Southeast Asia. Durian is an important component of both the social fabric and physical landscape of Borneo (Peluso 1996 p.513). Because durian is such a highly valued tree species, rights to the tree and access to its yield can be very intricate. In the case of the Salako of West Kalimantan, the planter of the tree has exclusive rights through out his/her lifetime. If the planter dies the surviving spouse will allocate the durian yield. Durian trees are passed down from parent to child to grandchild, with each generation planting trees for themselves as well as for future generations (Peluso 1996). Tenure rights for Benuaq Dayak *Simpukng* are passed on from one generation to the next. Thus far the fruit gardens have been large enough to divide among siblings. Most garden owners have very precise knowledge regarding their land holdings and the species diversity of trees in their fruit gardens. Yields are also known for the variety of fruit harvested annually. Many resources including various foodstuffs such as fruit,

vegetables, and rice are shared commodities within the immediate family. The younger generations are interested in non-agriculture activities, rubber, and rattan cultivation. Because many young couples live with their parents or are in proximity they are still able to reap to benefits of their parents large fruit gardens. Other activities that bring in monetary income are also pooled within the household, thus parents also benefiting from their children's activities whether agriculture or non-agriculture related. This reciprocal relationship among families and indigenous communities allows equal distribution of food and non-food resources.

Land availability for forest gardens are often created in fallows that are intensively managed in the period of forest regeneration. Many fruit, rattan, and rubber gardens are developed on rice fallows. In many instances fallow swiddens are converted to permanent fruit and rubber gardens (Colfer 1997). The Tae of West Kalimantan manage their woodland areas as forest gardens or agroforests with a multitude of products some of which include construction materials, fruit, rubber, and medicinals (Padoch and Peters 1993, Peluso and Padoch 1996). The Tai have also converted many of their fallows into rubber and mixed rubber fruit gardens. The Salako Dayak of West Kalimantan also tend to convert their fallows to mixed fruit and rubber gardens, they too cultivate rice, cassava, and corn, often planting peanuts for one to two season prior to the fallow period (Peluso 1996). Salako Dayak allow some fallows to regenerate to natural forests that will eventually be converted for crop cultivation after the Swidden cycle has been completed, other fallows become intensively managed for fruit, rubber, and medicinals (Peluso 1996).

In the case of the Benuaq Dayak, the *Simpukng* (fruit garden) is not a conversion from a fallow field but a mixed fruit garden where fruiting trees are cultivated. In many

Umaq and *Uratn* (fallow rice plots), fruiting trees are cultivated, however they are not considered *Simpukng*. When inventories of cultivation plots were conducted most of the *Simpukng* were old well-established plots, one in particular was over 100 years old. The decision of when an *Uratn* may eventually be termed a *Simpukng* is related to temporal scales. However, at the time of this research in 2002 the regeneration and management of *Uratn*, though containing fruiting trees were still regenerating forests and not considered *Simpukng*. Most of the trees found in the *Uratn*, were trees five years and younger. A large percentage of *Uratn* are heavily managed and some fallows are converted to rattan gardens.

There is a great variety management of forest gardens and fallows. Depending on the ethnic group these resources will be managed distinctively for desired species. The Benuaq Dayak manage forest gardens for fruit, rubber, and rattan and also extract resources found in fallows (See Figure 6.1 for *Simpukng* Species Diversity). The species chart identifies all species found in 10 sample plots equaling .40 ha. The species documented are those that were identified by the researcher and two local assistants. The are few remaining species that were only identified to local name, however it was important to note these species due to their abundance in the *Simpukng*. There were 463 individual stems found in all sample plots combined. The amount of diversity in these plots is significant, Jackfruit, *Langsat*, and *Kapor* being the dominant species. Annual yields of dominant crops are found in the following section.

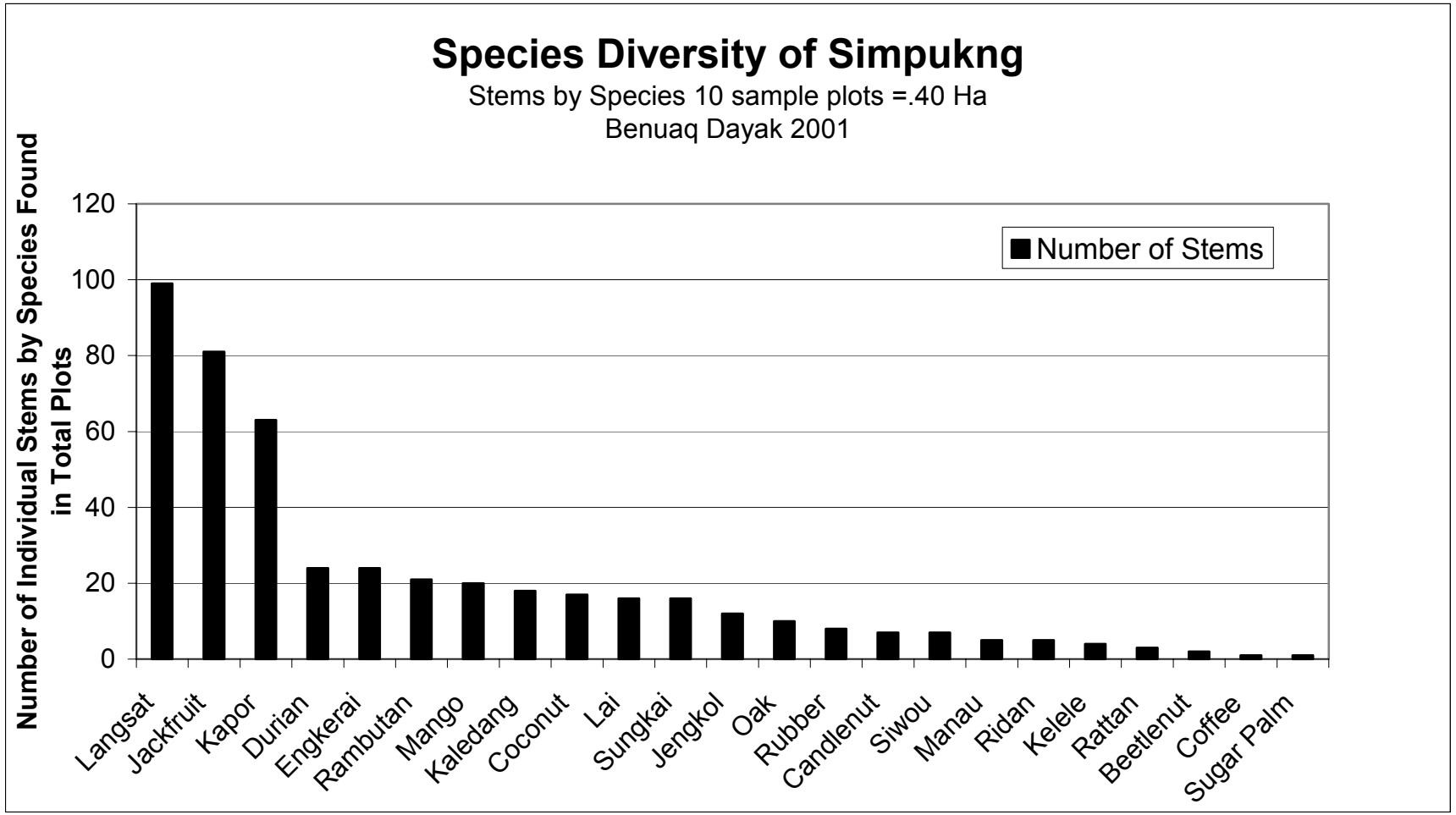

Figure 6.1 ***Simpukng*** **Species Diversity Plots**
Benuaq Dayak, East Kalimantan, Indonesia 2001

6.7 *Simpukng* (Fruit Orchards)

6.7.1 Results

The Benuaq Dayak cultivate fruit gardens called *Simpukng* that provide a variety of fresh fruit during the fruiting season from November through February. The fruit is consumed and divided among families, and is often sold at the local market. Several young adults have not yet inherited or cultivated their own *Simpukng* and thus rely on their parents' generosity. Many of the older people surveyed give much of the fruit to their children as opposed to selling it in the local market. One woman even sends her son fruit in Samarinda, she places it on the waterbuses that travel down the Mahakam river to the coast. The *Simpukng* is a very important land management unit in Benuaq Dayak communities as it provides food for families and income generation. The total mean sample of hectares of *Simpukng* was 1.84 ha with a range of 10 ha (See Table 6.4A). The residents of Benung had the most number of respondents to this question and reported owning the most hectares (2.84). This could be due to the fact that residents of Benung are relatively older than those of other villages and thus have well established older *Simpukng*. Within the village of Tepulang, 80 percent of villagers reported having *Simpukng*, however the mean hectare was only 1.21 ha. In the village of Dingin the mean size was 1.83 ha. Many of these hectares are newly cultivated gardens and have not produced substantial yields; many of the residents lost their *Simpukng* due to fires in the region in 1997, 1999, and 2000.

A variety of fruits are grown in the *Simpukng*, many of which include *Nangka* (Jackfruit*), Langsat, Rambutan*, Durian, *Kapur, Mangga* (Mango), *Kelapa* (Coconut), *Kemiri* (candlenut, a commonly used spice), and Coffee. The most prevalent fruits with

the highest yields are found in the Table 6.4A and Table 6.4B[1]. *Rambutan* (*Nephelium lappaceum*) is a highly prized fruit that is found in *Simpukng*, this fruit is very popular in all of Southeast Asia. The fruit inherits its name from the Malay word meaning "hair" due to the soft hair like spines found on the skin of the small ovoid fruit (Comstock 1992). The flesh of the fruit is a soft sweet jelly type substance with the seed attached firmly to the interior of the flesh. The overall mean for the survey sample for *Rambutan* was 200 kilograms. As indicated in Table 6.4A, *Rambutan* had the highest yield in the village of Tepulang with a mean of 248 kilograms. Benung reported the second highest yield of 232 kilos. Dingin had the lowest yield with 135 kilograms.

Langsat (*Lansium domesticum*) is another common fruit that is cultivated in the *Simpukng*. It is similar to *Rambutan* but is smaller and has a smooth outer skin. The mean sample for *Langsat* is 357 kilograms, which has a much higher yield than *Rambutan*. The ANOVA test run on this variable proves that there is a significant difference in the yield of *Langsat* extraction ($F= 9.72$ $p= .000$). The Scheffe Post Hoc test identified that the significant difference for *Langsat* yield in the villages is between Tepulang and Dingin and between Tepulang and Benung, but not between Dingin and Benung. Tepulang again had the highest mean of *Langsat* collection with 750 kilos. The residents of Benung had the largest percentage of people extracting *Langsat* but had a lower annual average yield of 258 kilos. Dingin had the lowest annual mean extraction rate of 203 kilograms.

[1] In Southeast Asia trees have synchronized or masting fruiting events that are characterized by very high yields, much larger than that of other years (Whitmore 1984, Salafsky 1993). Masting events occur every few years and are associated with El Niño Southern Oscillation (ENSO) events (Dove and Kammen 1997, Salafasky 1993). The periods of drier weather appear to influence flowering (Salafasky 1993). In normal years the crops are variable and but tend to yield a fair amount of fruit. This research was conducted in 2002, this was a normal fruiting season not a mast fruiting season. Over a period of ten years every fruiting season is variable averaging two to three masting years, six to seven average years, and one-two years of low productivity or no harvest at all (Salafasky 1993).

Mangos (*Magnifera indica*) are less commonly cultivated by the Benuaq Dayak. The overall mean for extraction of mangos is 135 kilos with only 18 percent of the sample survey collecting mangos. Benung residents had the highest yield of mangos averaging 167 kilograms annually. Dingin had the second highest yield reporting 117 mean kilos. In the village Tepulang there were only 8 percent of those surveyed who harvested mangos and had the lowest average mean of 100 kilos annually. This is the only fruit variable where Tepulang had the lowest average (Figure 6.2).

Table 6.4A ***Simpukng* Resources** (Average per Household)
Benuaq Dayak, East Kalimantan, Indonesia 2001

Simpukng	**Hectares**	**n=**	**%**	***Rambutan*** (kg)	**n=**	**%**	***Langsat*** (kg) **	**n=**	**%**	**Mango** (kg)	**n=**	**%**
Ranges	10 1.77			1,482 222			1,785 415			260 73		
Tepulang	1.21	20	80 %	248	17	68 %	750	12	48 %	100	2	8 %
Benung	2.32	24	96 %	232	22	88 %	258	20	80 %	167	7	28 %
Dingin	1.83	32	71 %	135	23	51 %	203	18	40 %	117	8	18 %
Mean sample	1.84	76	80 %	200	62	65 %	357	50	53 %	135	17	18 %
F Statistics	F=2.25 p=. 112			F=1.62 p=. 208			F=9.72 p=. 000			F=1.14 p=.345		

****Sig. @ p=<. 05**

Durian (*Durio zibethinus*) is another highly prized fruit in Southeast Asia that is cultivated by the Benuaq Dayak. Durian are cannonball sized fruit with a spiked tough outer layer and a creamy rich pungent flesh (Comstock 1992) (Figure 6.3). Of all those in the sample survey, 36 percent reported harvesting Durian with an average of 204 fruits annually. The ANOVA test for collecting Durian revealed that there is a significant difference between villages in the yield of Durian (F= 12.9 p=. 000). (See Table 6.4B) The ANOVA Scheffe Post Hoc test indicates that significant differences are found in

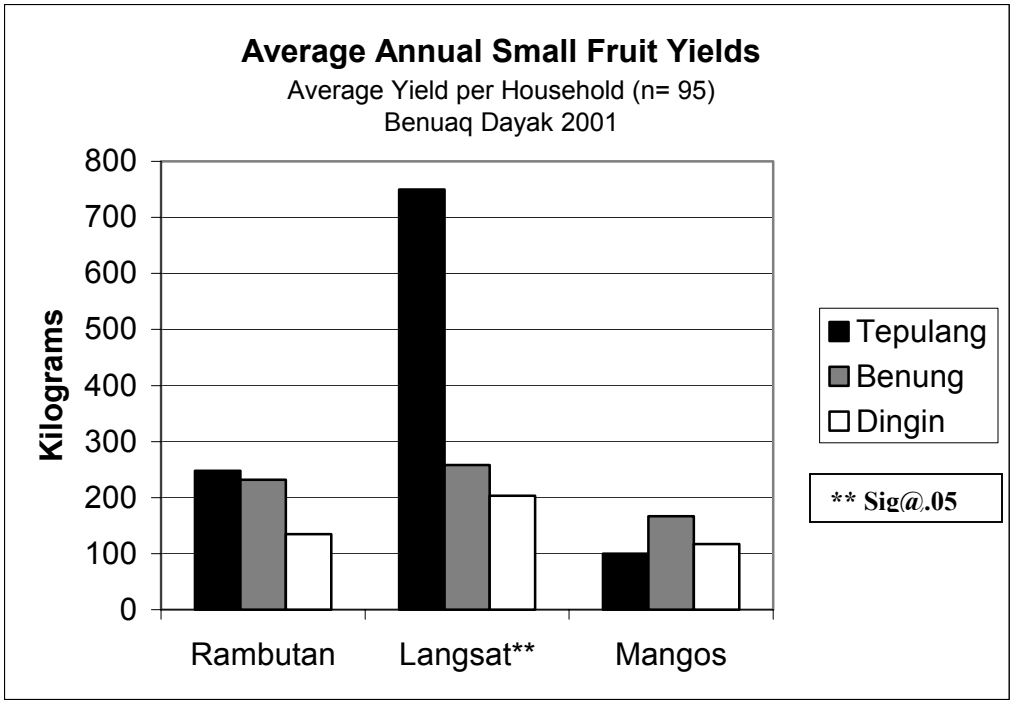

Figure 6.2 **Average Annual Small Fruit Yields**
Benuaq Dayak, East Kalimantan, Indonesia 2001

between the villages of Tepulang and Dingin and between Benung and Tepulang in annual Durian yields, but not between Dingin and Benung. Tepulang again had the highest yield of Durian fruit harvested from the *Simpukng* with a mean of 471 fruits, however only 28 percent of villagers collected Durian. Benung had a higher sample size of those harvesting Durian but the mean (154 fruit) was much lower than that of Tepulang. Dingin respondents harvested Durian in the past year, however the average number of fruits (96 fruits) was considerably lower than in the other villages. This was to be expected since most of the fruit trees are not mature enough to produce yields. *Nangka* or Jackfruit (*Artocarpus heterophyllus*) is a large fruit that is produced from the trunk of the tree (Figure 6.4). The fruit can grow up to a meter in length and weigh up to 20 kilograms. The flesh of the fruit is formed in a cylindrical shape with seeds dispersed within the yellow sticky flesh. The total mean sample for all villages for Jackfruit

Figure 6.3 **Highly Prized Durian Fruits**
Maluku Spice Islands, Indonesia 1995

was 557 fruits with a range to 2,999 fruits. The ANOVA test indicates that there is significant difference among villages for Jackfruit yield (F= 8.01 p=. 001). The analysis of the Post Hoc Scheffe test indicates that there are significant differences in Jackfruit yield between Tepulang and Dingin. The village of Tepulang had the highest mean yield for Jackfruit with 825 fruits (Figure 6.5). Benung reported the second highest mean with 694 Jackfruit. The lowest mean for Jackfruit harvested were 160 fruits, in the village of

Figure 6.4 ***Nangka* (Jackfruit) Sold in Local Market**
West Java, Indonesia, 2002

Dingin, this was to be expected because the gardens are newly established.

Additional fruits found in the *Simpukng* include *Kemiri* (candle nut), *Pinang* (*Areca catetchu* or Beetle nut), Coconut (*Cocos nucifera*) and *Aren*. These crops are harvested year round as needed basis. For example, candlenut is a spice that is used in many dishes of the Benuaq Dayak diet. It is commonly cooked with cassava leaves in stir-fry. Coconuts are also used in a variety of dishes and the milk of the young coconut is

a refreshing treat in the late afternoon. Beetle nut is chewed by many of the elders in the village. *Aren* is a palm that wine is extracted from the top of the tree trunk, it is usually extracted in the early mornings. In many areas palm wine is consumed on a regular basis, however in this region it is less common. Papaya (*Carica papaya*) is also harvested year round, the fruits are eaten ripe or if immature are cooked in stir-fry, the young leaves are said to have medicinal properties and are cooked as a stir-fry as well. Coffee (*Coffea sp*.) is not widely cultivated and generally has a very low yield. Rattan and Bamboo are also harvested from the *Simpukng* but are found in relatively low quantities. Three respondents collected an average of 40 liters of honey from the *Simpukng*, this is a resource that is difficult and dangerous to harvest, thus it is not commonly collected.

6.7.2 *Simpukng* Summary

With the large variety of fruits available during fruiting season from November through February, the Benuaq Dayak have a great assortment of food in their diet. During the time of this research there was virtually no fruit available even during market days. In other times of the year only the staples of rice, cassava, and a small variety of vegetables from the *Umaq* are available. *Simpukng* also provide income generations for families, large quantities of fruit are collected each year from the *Simpukng* (Table 6.4B). Several villagers who were interviewed did not collect their entire yield, some stated that there was too much to collect and much of the yield was left on the trees. If an outside market could be created then it would be possible for the villagers to sell their products. As indicated in Table 6.4B, of the villagers surveyed, 41 percent sold fruit from the *Simpukng*, the total mean sample for income generation was 938,135 rp./yr. Benung residents sold an average of 1,658,333 rp./yr. Tepulang villagers reported an average income generation of 842,323 rp./yr. Only four people from Dingin generated income

from selling fruit, with an average of 313,750 rp./yr. The reason for the low number of people selling fruit could also be due to the fact that Dingin residents have the lowest reported fruit yield in all categories except for Mango yield, again many young fruit gardens had not yet produced a yield. Average income generation from selling fruit for the villages of Tepulang and Benung is relatively high when considering that family's usually only sell surplus produce. At the time of this research (2002) the Indonesian Rupiah had an exchange of 10,000 Rupiah to 1US$. Families also share their resources with those whose gardens did not produce yields in particular seasons; this is a form of reciprocity that is extended to all villagers. It has been the researchers experience that Benuaq Dayak communities share all food resources; in these communities there is never a family that is lacking basic subsistence needs.

Table 6.4B ***Simpukng* Resources** (Average per Household)
Benuaq Dayak, East Kalimantan, Indonesia 2001

Simpukng	**Durian # of fruit ****	**n=**	**%**	**Jackfruit # of fruit ****	**n=**	**%**	**Income Generation** (Rupiah)	**n=**	**%**
Range s	990 207			2,999 613			23,790,000 3,879,636		
Tepulang	471	7	28%	825	18	72%	842,323	17	68%
Benung	154	19	76%	694	23	92%	1,658,333	18	72%
Dingin	96	9	20%	160	20	44%	313,750	4	9%
Mean sample	204	34	36%	557	61	64%	938,135	39	41%
F Statistics	F=12.9 p=. 000			F=8.01 p=. 001			F=. 289 p=. 750		

**Sig. @ p=<. 05

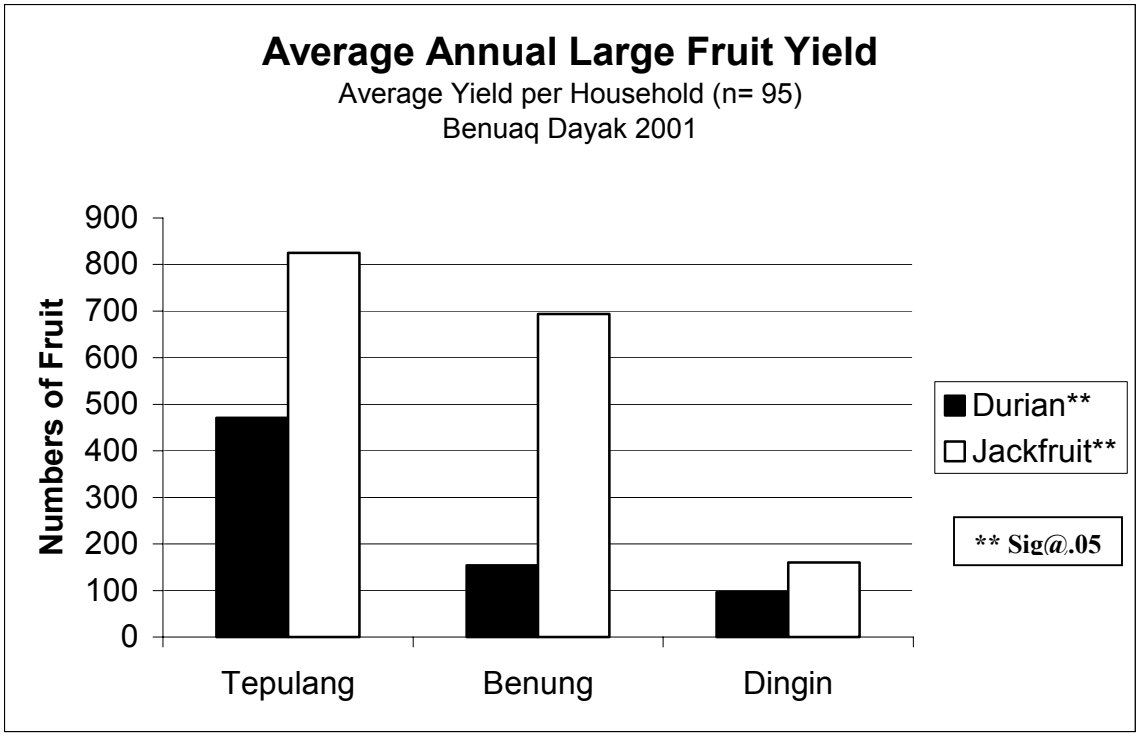

Figure 6.5 **Average Annual Large Fruit Yield**
Benuaq Dayak, East Kalimantan, Indonesia 2001

6.8 Rubber and Rattan

Rubber (*Hevea brasiliensis*), native to Brazil was introduced by the British into Southeast Asia in 1877 (Davis 1999). By introducing rubber into Southeast Asia, it having a similar climate to that of Brazil, it was anticipated that the rubber industry would flourish. Natural rubber tree stands in Brazil are found at low densities, this is due to the trees susceptibility to leaf blight that can devastate entire populations of trees. In the 1930s entire plantations of rubber trees in Brazil were killed due to the disease (Davis 1999). The rubber leaf blight of Brazil has not yet infected trees in Southeast Asia. This has allowed rubber cultivation in Indonesia and Malaysia to become a major industry. Today rubber is one of Indonesia's main exports (Dove 1993, BPS Statistics, Indonesia 2001). There are relatively small numbers of large-scale plantations with large labor forces and heavy capital investment. The main supply of unprocessed rubber is grown

and tapped by smallholders in areas of one hectare or less (Dove 1985). Local communities on Borneo have been tapping rubber since 1930.

Shifting cultivators are often associated with rubber cultivation as with many Dayak groups in Kalimantan (Colfer, Gill, and Fahmuddin 1988, Davis 1999, Dove 1993, King 1993, Lawrence 1996). A swidden-rubber cultivation combination not only achieves minimal competition for resources, it enhances resource use. Swidden farmers use their surplus of fallow land and labor resources within the swidden system to cultivate rubber gardens (Dove1993). This allows marginal other wise subsistence farmers to participate in market economies without completely relying on it. Rubber and rattan cultivation complements the swidden systems by cultivating and managing fallows to become extremely productive without compromising the swidden system.

Rubber and rattan cultivation links shifting cultivators with national and international markets that they otherwise would not be associated in a subsistence economy. Rubber cultivation is not an alternative to rice cultivation as rice is the staple crop. However, due to labor input variation in Swidden agriculture, rubber and rattan cultivation and extraction can coexist with rice cultivation. Rubber is usually tapped in the dry season, when there is less labor demand in shifting cultivation plots. The bark of the tree is slashed in a downward spiral and the latex runs down the bole into a collecting vessel. The rubber is gathered and then processed with acid and pressed into .5 X.5 meter sheets. Often the processed rubber is reserved until cash income is needed. Rubber and rattan cultivation allows for cash income as rice is generally not sold and is consumed for the annual household supply. Rubber and rattan income generation provides money for purchased trade goods and to pay household expenses such as school fees and boarding if the child is in school in another village or town; there are very few high schools in the

interior of Borneo. Rattan and rubber are used as income stock. When families are in need or the market price rises they sell these items (Colfer, Gill, and Fahmuddin 1988, Dove 1993). One family in the village of Tepulang sold more than 20 kilograms of rubber in order for a family member to take a high school proficiency test, this transaction took place only after all other options for resources were exhausted. The Kantu' of West Kalimantan use similar practices as the Benuaq Dayak, growing hill rice and cassava, and cultivate small-scale rubber plots, rubber being their main source of tradable income (Dove 1993). A surplus of market goods allows families to obtain cash in time of crisis. In the case of crop failure, rice and other necessary food items can be purchased.

6.8.1 Rattan

Many villagers find it more beneficial to plant and manage resources than to collect in forests (Lawrence, Lieghton, and Peart, 1995). Rattan can be collected from natural forest stands, however managed stands of cultivated rattan are also common. There are a large variety of rattan species found in Indonesia. Rattan are the tropical climbing palms of Southeast Asia, they use other trees for support and can grow several hundred meters in length. The stems are of great strength and are used in a multitude of industries but primarily to build furniture. Time spent searching for resources is often very time consuming due to resource dispersal in natural forest stands. Higher yields and more desired species can be cultivated and maintained with the ability to harvest crops every 5 years. Factors that affect rattan cultivation include land availability in the swidden cycle, property rights, access to market activities, and knowledge of rattan management (Peluso 1993). Historically, territorial boundaries were established and defended while others were negotiated or purchased from neighboring ethnic groups. Rattan extraction rights were associated with traditional land tenure, and village

customary law. Traditionally and currently, the trade of rattan resources is conducted through middle men along the Mahakam River and other main tributaries; rattan is then sent to urban settings to exporters or for processing (Peluso 1993). The majority of villagers in the study areas continue to sell rattan and rubber to middlemen who in turn sell these products in Samarinda or Balikpapan. The price of rattan and rubber has fluctuated greatly over the last several years, local yields and prices for 2002 for the Benuaq Dayak study villages is detailed and documented in the following section.

6.8.2 Results *Kebotn* (Rubber and Rattan Plots)

The *Kebotn* is a plot of land where various species of rattan (*Calamus spp.*) and rubber (*Hevea brasiliensis*) are cultivated. Rubber and rattan can be found in other land use types such as the *Simpukng* and *Urat*, and wild species harvested from the *Bengkar*, however the majority is cultivated in the *Kebotn*. Due to the variation of reported yields and varieties, and land use types, rubber and rattan will be combined for the analysis. Three species of rattan are cultivated, *rotan pulut merah, pulut putih*, and *sega*, and vary in market prices ranging from 500-7,000 rp/kg. Rattan provides building materials household implements, large containers, and *beranka* (backpacks) or *kiang* (baskets), some villagers make *beranka* to sell at the market, *beranka* can be sold for 15,000-50,000 rp. depending on size (Figure 6.6).

Within the total data set, 73 percent (n=69) of the villagers maintain *Kebotn* with an overall average of 2.69 hectares (range 8, s 1.89)(Table 6.5A). The ANOVA test analysis indicted that there is a significant difference in the number of *Kebotn* hectares between villages (F=5.43 p= .007). The Scheffe Post Hoc test identified a significant difference for in the number of *Kebotn* hectares for the villages of Tepulang and Benung.

Figure 6.6 **Mama Wen Preparing Rattan for Making Baskets**
Benuaq Dayak, East Kalimantan, Indonesia 2002

The villagers of Benung have the largest average size *Kebotn* at 3.68 ha. Dingin has the second highest with 2.44 ha. Tepulang has the smallest average size at 1.92 ha. Of those surveyed who reported gathering rattan (n=61), 64 percent of the villagers harvested rattan for income generation (Table 6.5A). Mean rattan extraction for the entire sample is 1,966 kilos (range 47,095 s 6,287), with an income of 8,624,454 rp./yr (range 158,385,000 s 27,975,657). The average kilograms of rattan extracted in the village of Tepulang is the highest with 3,418 kilos and a mean income of 7,849,200 rp./yr. Benung

follows with a mean of 1,911 kilos of rattan extracted annually and income generated by the sale of rattan at 1,352,650 rp./yr. Dingin residents reported the lowest amount of rattan extraction at 1,113 kilos with a mean income of 1,480,333 rp./yr. The market prices of rattan fluctuate greatly through the year; villagers will wait until prices rise in order to make the best return. In addition, species of rattan significantly vary in value, such as rattan *pulut merah*, the market price while this research was conducted in 2002 sold for 5,000-7,500 rp./kg, while *sega* was valued at 700 rp./kg. After rattan is harvested the average time for full regeneration is 5 years. This is a sustainable resource if the full regeneration time is allotted for the rattan species to mature. Most of the villagers noted that they harvest at a maximum of every five years.

Rattan cultivation and harvesting is far more prevalent than rubber tapping (Figure 6.7). The last years price for a kilo of rubber ranged from 2800-5000 rp./kg.

Table 6.5A ***Kebotn* Resources** (Average per Household)
Benuaq Dayak, East Kalimantan, Indonesia 2001

Kebotn	**Hectares ****	**n=**	**%**	**Rattan** (kg)	**n=**	**%**	**Income Generation** (Rupiah)
Ranges	8 1.89			47,095 6,287			158,385,000 27,975,657
Tepulang	1.92	19	76%	3,418	16	64%	7,849,200
Benung	3.68	22	88%	1,911	11	44%	2,588,636
Dingin	2.44	28	62%	1,113	12	27%	1,480,333
Mean sample	2.69	69	73%	1,966	61	64%	8,624,454
F Statistics	F= .543 p=. 007			F=. 659 p=. 521			F=. 537 p=. 590

**** Sig. @ p=<. 05**

Many villagers interviewed chose not to tap rubber last year due to falling prices thus rattan became the more dominant product harvested. Only 20 percent of those surveyed tapped rubber while 64 percent harvested rattan. The mean rubber yield for the sample survey is 807 kilos of rubber with an income of 2,779,252 rp./yr. Dingin residents reported extracting an average of 1,142 kilos of rubber with a mean income of 5,080,642 rp./yr. Nine residents of Tepulang harvested an average of 229 kilos of rubber with an income of 1,851,400 rp./yr. This number must be interpreted with caution because the calculated mean rupiah value for rubber per kilo is highly elevated with an average 4,794 rp./kilo while if calculated Tepulang rubber is valued at 8,110 rp./kg which is almost double the average price. The residents of Benung located one kilometer from Tepulang, tapped an average of 741 kilos of rubber last year with an income of 1,352, 650 rp./yr. Presently these resources are beginning to be extracted and cultivated more frequently. There are programs developed by non-governmental organizations (NGOs) to assist communities in cultivation and management of rattan. While conducting this research there was a program that allowed villagers from surrounding regions to participate in a workshop to teach methods to measure inventory stock for rattan fields. The Asian Development Bank also sponsored a project to establish rubber tree plots in areas of forest that were severely burned from the fires that devastated the island in 1997-1998. Projects that provide financial assistance and establish group cohesion in the communities have been quite successful. Developing projects related to rattan and rubber will allow the villagers to generate much needed income as well as provide them with knowledge and good management practices to maintain sustainability of these resources.

Table 6.5B ***Kebotn* Resources** (Average per Household)
Benuaq Dayak, East Kalimantan, Indonesia 2001

Kebotn	**Rubber** (kg)	**n=**	**%**	**Income Generation** (Rupiah)
Ranges	5,999 1,656			21,590,000 5,508,464
Tepulang	229	3	12%	1,857,400
Benung	741	9	36%	1,352,650
Dingin	1,142	7	16%	5,080,642
Mean sample	807	19	20%	2,779,252
F Statistics	F=. 307 p=. 740			F=. 971 p= .400

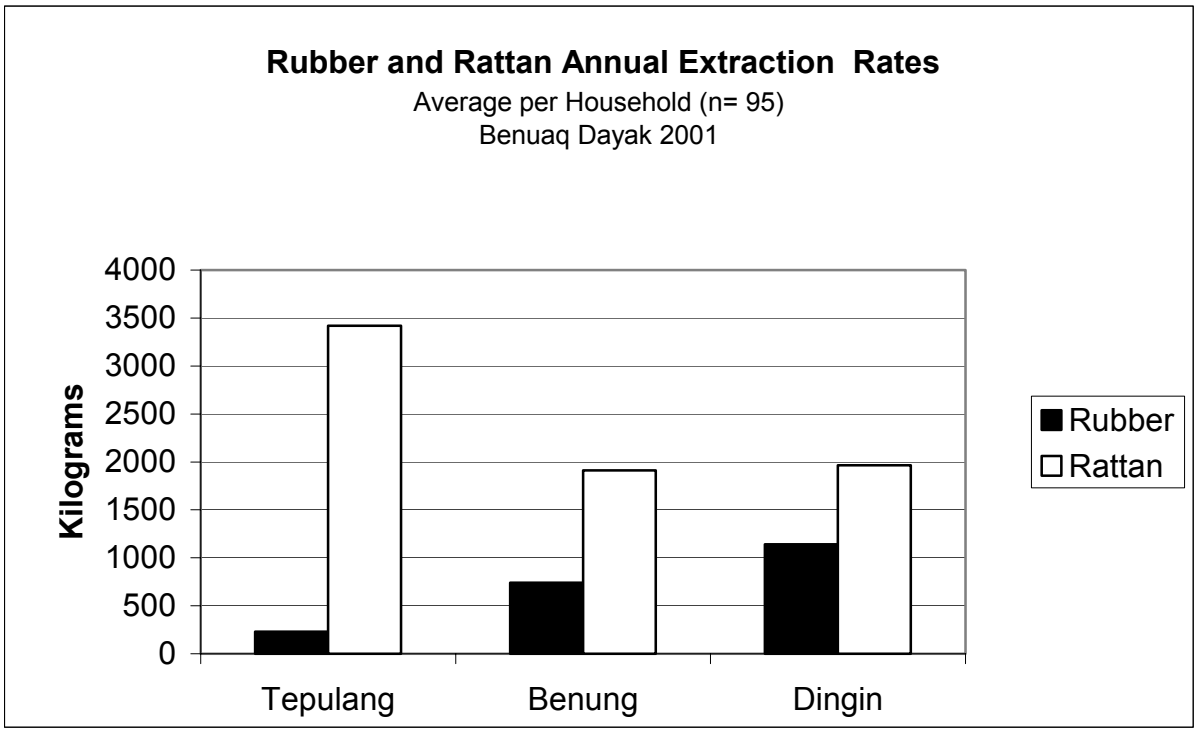

Figure 6.7 **Rubber and Rattan Annual Extraction Rates**
Benuaq Dayak, East Kalimantan, Indonesia 2001

6.9 Conclusions

Forest gardens provide the Benuaq Dayak with a means of income and food sources; this is a valuable land use activity. In agricultural societies such as the Benuaq Dayak all land use activities provide diverse and crucial elements to their livelihood.

The consistent low yields reported for fruit in the village of Dingin indicate that the reoccurring problems with large-scale fires have devastated this community. The potential for subsistence yields and the very low income generated by this land use type has been hindered long term. This community was also struck by floods in shifting cultivation plots, which devastated rice and cassava yields. It is evident that this community will continue to face both subsistence living and economic hardships. The forest resources lost in fires in the long-term can be regenerated, however many villagers stated they were reluctant to replant fearing future large-scale fires. The villagers in Dingin as compared to the villagers from Tepulang and Benung appeared to be less motivated to actively work their land; this was noted in the daily activities of the different communities. For example in the villages of Benung and Tepulang during the day most of the villagers are working in their shifting cultivation plot or forest gardens, therefore villages were basically deserted. In the village of Dingin many of the residents gathered throughout the day in the village center on the river. While conducting interviews, interviewees did not show motivation in attempting to change their current situation. Many appeared upset by the loss of crops and income potential but were not expecting that the situation would improve. Since natural disasters have struck this region frequently over the last five years some villagers have given up on the possibility of regenerating lost farming and forest gardens plots. With the aid of development programs there is a possibility to help this community rebuild its considerable losses.

The residents from the villages Tepulang and Benung are involved in various activities that are improving their livelihood. They have been fortunate in that they have had the assistance of international, national, and local NGOs that have provided programs in rubber and rattan cultivation and projects have been developed to teach participatory methods for rattan inventories in cultivation plots. With the aid of the Samarinda based NGO, SKH (Sistem Hutan Kerakyatan), the residents of Benung have developed a small-scale handicraft industry using various species of rattan. These handicrafts are sold in the provincial capital, Samarinda. It is unfortunate that this village has been plagued so heavily by natural disasters. If the village of Dingin was able to receive aid they have the capability to recover from their current situation. It is also very important that the villagers themselves shift their mindset to create a positive setting on order to help themselves out of their situation.

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CHAPTER 7

NATURAL RESOURCE EXTRACTION IN DAYAK COMMUNITY FOREST RESERVES IN EAST KALIMANTAN, INDONESIAN BORNEO

7.1 Overview

This research took place in East Kalimantan, Indonesia approximately 250 kilometers from the provincial capital of Samarinda. In 1999, the district of Kutai Negera in East Kalimantan was divided into three new districts. One of which formed Kutai Barat, where research was conducted for this project. Three Benuaq Dayak villages located in the upper watershed of the Makaham catchment system were chosen for this research project. These villages were selected because they are composed of 100 percent Benuaq Dayak ethnicity. Benuaq Dayak villages have been established in this area for over 300 years. The area ranges in altitude from 80-120 meters above sea level with an annual precipitation of 3000 mm.

Prior to the division of the district, the costs and length of time associated with travel to the district capital were prohibitive for local people. Thus the government rarely acknowledged the needs of the villagers in outlying regions. The district capital is now located 1-2 hours from the villages, which provides much easier access. During the past two years there has been an influx of money and projects to develop the region. The government decentralization and the forestry sector are also having an impact on Kutai Barat, monies earned from exploitation of resources are in the process of being directed to local governments.

Projects such as electricity lines and road development have begun to filter into the newly formed district. Currently there is a reforestation program in which the local population is able to reforest disturbed land. This is a government-sponsored project

where timber companies must pay a tax for replanting after harvesting. Reforestation can take place at any location of disturbed forests, not necessarily where the timber concession is located. Local people can apply to the local government to reforest their own land in which case they are provided with seedlings and are paid a daily wage for replanting. The Benuaq Dayak communities have been very successful in recent efforts to reforest degraded land near the community forest reserves. Seedlings provided by the government are mixed dipterocarp and native fruit trees. In addition, Asian Development Bank also sponsored a project after the devastating forest fires of 1997-98, where villagers received rubber tree seedlings and were given loans for pesticides. The loans are to be repaid when the rubber trees reach productive age. Because there is much development in this region, there are new opportunities and changes in lifestyles among this indigenous group. Although access is now much easier than prior to the new district being formed, the Benuaq Dayak are continuing their traditional land use systems, while taking advantage of new opportunities.

This research was conducted in 2002 under the indirect supervision of Natural Resource Management, an NGO based in Samarinda, the provincial capital of East Kalimantan and by the head of the forestry sector in the district of Kutai Barat.

7.2 Objectives

This study's purpose is to identify natural resource use in subsistence economies and the economic utility of these resources in the villages of Tepulang, Benung, and Dingin. Geography and environmental factors were hypothesized to play a role in variation of resource utilization among the Benuaq Dayak villages. The reliance of natural resource use for subsistence and income generation is a significant aspect of the livelihood of this ethnic group but differ in degree between villages. In addition, the land

management system for the Benuaq Dayak at its current condition appears to be sustainable but again this may vary between villages.

Specifically, the objectives of the study are:

1.Study indigenous knowledge systems in relation to land use practices.

2. Describe land use systems of the Benuaq Dayak.

3. Describe agricultural practices.

4. Describe economic utility of agricultural activities.

5. Identify forest resources extracted and yields of these resources.

6. Analyze land use systems sustainability.

7. Identify variation among resource use in the three study sites, taking into account ecological disaster caused by fires and flooding.

This study also aims to identify the willingness to conserve and maintain community forest reserves among the three study sites. In addition to the decentralization of the forestry sector, this region is also going through rapid changes in the government due to regional autonomy. This area including local communities are being developed and have more opportunities than ever before. Critical to this change is the understanding that continued sustainable extraction and forestry practices among the Benuaq Dayak should be maintained.

Variables used from survey are as follows:

Bengkar

Timber
Meranti Wood (m^3)
Benkirei Wood (m^3)
Borneo Ironwood (m^3)
Other Wood (m^3)

Bengkar

Fauna
Wild Boar
Deer
Mouse Deer
Birds
Honey (liters)

Riverine Resources

Fish (kg)
Roof Thatch (branches)
Fern (kg)

7.3 Methods

This research encompassed a broad but integrated system of human-land relationships among the indigenous group the Benuaq Dayak of East Kalimantan, Indonesia. The Benuaq Dayak make up the main population in the district of Kutai Barat where this research was conducted. Data were collected through qualitative and quantitative methods to determine current land use and forest management practices among the Benuaq Dayak in the three chosen study sites.

First, In-depth interviews were conducted to understand traditional belief systems as they pertain to land management and *Adat* (customary) law. Interviews also provided biographical data on land management activities in these communities. Second, sampling households and conducting land use surveys accomplished data collection. I conducted the interviews and household surveys myself in Indonesian with the assistance of a local research assistant. Having a local assistant helped the villagers become comfortable with my presence in the villages as well as in their homes. Although impossible to quantify, I believe the villagers were comfortable with and enjoyed the interview process which lead to high response rates and overall quality of the interviews.

The households surveyed were randomly selected in each of the three villages. In each village approximately 50 percent of households were surveyed. Interview sessions were scheduled in the evening after the villagers had returned from working in their cultivated fields. Whenever possible interviews were conducted with all adult members of the household present, for the most part both men and women gave equal responses, although one gender may have been more informed about certain information. Those interviewed were generally interested in the survey and answered the questions to the best of their ability. Questions were repeated, explained, and followed up to ensure that all pertinent information was gathered. In general, data were collected in local units and then converted to international standardized units. The units were generally consistent and accurate.

The information used in this section of this dissertation include household information, demographic information, expenditures, income generation activities; non-agriculture and agriculture related activities; land ownership agriculture; cropping intensity; resource extraction of flora and fauna in the communities forests and rivers; livestock ownership; and opinions concerning conservation activities. The surveys were also intended to identify the varying types of forest resources used, to catalogue the frequency and volume of use, as well as to determine the demographic apportionment of use.

Surveys were supplemented with objective field observations. I became involved in some of the daily activities associated with agricultural activities as an active observer. I studied the methods of extracting and processing resources such as rubber and rattan. I assisted some of the villagers in extracting forest products and harvesting agricultural

products. In addition, I also learned techniques in weeding agricultural plots, husking rice, as well as daily animal husbandry tasks.

The third phase of research entailed setting up land use plots to sample for species diversity of trees and agricultural foodstuffs. With the aid of two local plant experts in each of the three study sites, species diversity plots were sampled on three of the various land management units. Sites were chosen randomly. These plots determined density, abundance, and stature (tree size) of forest resources. When Indonesian names of trees were unknown the local name was used and later an attempt was made to identify the Indonesian or Latin name. Three 20X20 meter plots were sampled in each village for the chosen land use types to identify species diversity. The plots included; 1) *Umaq* – rice cultivation and agricultural plots, 2) *Simpukng* - fruit gardens, 3) *Bengkar* - community forest reserves. In the 20X20-meter plots diversity and abundance data were collected. Two additional samples were set up in all the *Bengkar* plots; the smaller plots identified smaller trees and seedlings. The 20X20-meter plots in the *Bengkar* measured the diversity of trees over 20 cm diameter at breast height (dbh). The 10X10-meter plots measured trees between 10-20 cm dbh. The last survey plots were 2X2 meters in which seedlings were identified with their common names. The number of species and abundance were calculated for each plot. The species diversity plots were used to compare the natural resource availability among the different land use types.

7.3.1 Statistical Tests

My dissertation's focus is to determine the relative conditions and economic use of forest resources, as well as the lifeways of the people living within three Benuaq Dayak villages. The rationale was to identify the differences in areas disturbed by a natural disaster and ascertain differences in villages not affected by a natural disaster.

Descriptive statistics were calculated to provide a summary of characteristics of the data set. The mean for all variables in each data set was calculated to identify measures of central tendency for each village. The ranges of variables were calculated to analyze variability among the largest and smallest values for each village. Standard deviations provided measures of variability in the data set among the three villages. The most appropriate statistical test is the Analysis of Variance test that can be used to compare a range of variables between villages. The Scheffe Post Hoc Analysis of Variance Test was used to identify significant differences between individual villages.

1) Analysis of Variance (ANOVA -one way) tests are used to determine differences and similarities between and within groups in the three study areas of natural resource extraction and use levels. The ANOVA comparison of means test will indicate if there are differences in the extraction of natural resources, levels of household expenses, livestock ownership, and other related variables between households living in the three villages.

As defined by McGrew and Monroe in Statistical Problems in Geography, Analysis of Variance is defined as follows:

The Analysis of Variance or ANOVA is defined as a descriptive statistic measuring variability about the mean. The Analysis of Variance involves separation of the total variation found between nominal groupings or samples into meaningful components: (1) Variability *between* the groups or categories; and (2) variability *within* the groups or categories. ANOVA determines which is more dominant or pronounced and accounts for a greater portion of the total variation (McGrew and Monroe 1993). The ANOVA test statistic (F) is:

$$F = \frac{MS_B}{MS_W}$$

where: MS_B = between group mean squares
MS_W = within group mean squares

Formula 5.1 Source: McGrew and Monroe 1993:173

7.4 Survey Information

Surveys were conducted in the villages of Tepulang, Benung, and Dingin in the Kutai Barat district, East Kalimantan, Indonesia sampling roughly 50 percent of households in each village (Table 7.1). In this survey there were 95 household units sampled.

Table 7.1 **Number of Households in Villages and Number Sampled**
Benuaq Dayak, East Kalimantan, Indonesia 2002

Village	**Approximate Number of Households**	**Number Sampled**
Tepulang	57	25
Benung	52	25
Dingin	92	45

Households are approximated for each village because some villagers have residences or reside part time with their adult children in other villages or in the provincial capital of Samarinda, thus they are not residing in the study site villages on a continual basis. The villages are considerably small which is the reason for the small sample size. Due to the great amount of variance and large numbers of zeros within the dataset the mean as opposed to the median value was used in data analysis.

7.5 Land Parcels, Yields, and Agricultural Income Generation.

The Benuaq Dayak have several different types of managed land units; *Umaq* are cultivation plots containing staples such as rice and cassava, *Uratn* is an *Umaq* fallow where resources continue to be extracted, a *Simpukng* is a fruit garden, *Kebotn* is a plot of land where resources such as rattan and rubber are cultivated (Table 7.2). The *Bengkar* is the Benuaq Dayak community for reserve that provides wild game and forest resources such as rattan, wood, and medicinals. Livestock are kept including pigs, chickens, cows,

Table 7.2 **Major Benuaq Dayak Subsistence Activities**
Benuaq Dayak, East Kalimantan, Indonesia 2001
Values are % of n interviews households.

Activity	Village **Tepulang** n= 25	**Benung** n=25	**Dingin** n=45	**Total** n= 95
Agriculture				
Rice Cultivation	80%	80%	44%	65%
Cassava Cultivation	80%	88%	60%	73%
Forest Gardens				
Own Fruit Garden	80%	88%	71%	80%
Own Rubber and Rattan Gardens	76%	88%	64%	74%
Livestock				
Own Pigs	88%	88%	60%	75%
Own Chickens	80%	92%	53%	71%
Non-Agricultural Activities	48%	68%	60%	59%

and in one village goats and water buffalo are raised. Riverine resources provide fish and vegetation. The majority of people derive income by selling natural resources.

The Benuaq Dayak maintain large land parcels in which they cultivate a variety of crops. The mean total number of hectares for the entire survey was 8.33 ha per household. The highest reported average for total hectares was from the village of Benung with 9.48 ha per household. The village of Dingin had the second highest average at 9.56 ha per household. Tepulang had the lowest average with 4.95 ha per household. The ANOVA test at a significance level of sig = .05 indicated that there is no significant difference between villages for the total number of hectares per family. Additional activities are practiced to supplement resources for the communities. Income generation is primarily based on agriculture related activities including selling a variety of fruit, rubber, rattan, and livestock. At the time of this research (2002) the Indonesian Rupiah had an exchange of 10,000 Rupiah to 1US$. Table 7.3 summarizes variables for

the entire study. Relevant information on Benuaq Dayak demographics for each of the three study sites is included such as annual household income, expenses, education, and number of hectares actively farmed for each land use type. Yields of agricultural products, livestock ownership, and natural resource extraction rates of flora, fauna, and riverine resources are summarized. These data are described individually in detail according to each land use type.

Table 7.3 **Summary Data**
Benuaq Dayak, East Kalimantan, Indonesia 2001

Variable (mean per village/yr)	**Tepulang** n=25	**Benung** n=25	**Dingin** n=45	**Mean Total** n=95
Demographic Information				
Number of Children	2.00	2.12	2.31	2.19
Total Family Size	3.28	3.04	3.62	3.38
HH Age	37	40	38	38
HH Education (1-7)	3.04	3.44	3.23	3.24
Spouse Age	32	30	35	32
Spouse Education (1-7)	2.82	3.00	2.89	2.90
Agricultural Income (Rupiah)	6,912,652	4,743,860	4,715,411	5,031,118
Non-Ag Income (Rupiah)	4,158,400	6,500,600	3,524,622	4,727,874
Total Income (Rupiah)	11,071,052	11,244,460	8,240,033	9,775,676
Total Expenses (Rupiah)	5,735,980	5,270,480	4,125,000	4,850,752
Total Hectares	4.95	9.48	9.56	8.33
Umaq (ha)	1.43	1.40	1.24	1.34
Rice (kg)	293	581	285	393
Cassava (kg)	2,367	3,357	1,892	2,497
Uratn (ha)	3.3	5.2	5.9	5.43
Con. Wood (trees)	72	95	90	88
Bamboo (poles)	50	111	187	130
				Table continued on next page.

Variable	Tepulang n=25	Benung n=25	'Dingin n=45	Mean Total n=95
Edible Rattan	0	149	1,334	1,102
Edible Bamboo	267	187	171	181
Firewood (total)	408	567	412	534
Simpukng (ha)	1.21	2.32	1.83	1.84
Rambutan (kg)	248	232	135	200
Langsat (kg)	750	258	203	357
Mango (kg)	100	167	117	135
Durian (# fruit)	471	154	96	204
Jackfruit (# fruit)	825	694	160	557
Kebotn (ha)	1.92	3.68	2.44	2.69
Rubber (kg)	229	741	1,142	807
Rattan (kg)	3,418	1,911	1,113	1,966
Bengkar Resources				
Meranti Wood (m^3)	2.64	3.86	2.45	2.89
Benkerei Wood(m^3)	4.13	3.83	1.33	3.44
Ironwood (m^3)	0	2.00	1.00	1.25
Other Wood (m^3)	4.20	3.00	4.00	3.70
Wild Boar (animals)	3.43	10.67	4.53	10.11
Deer (animals)	3.67	2.50	3.58	3.50
Mouse deer (animals)	3.00	2.50	3.00	2.78
Birds (number)	14.33	0	0	14.33
Honey (liters)	83.60	7.50	5.33	44.90
Riverine Resources				
Fish (kg)	341	165	431	312
Roof Thatch (branches)	165	156	100	132
Fern (kg)	77	56	71	68
Livestock				
Pigs Owned	8.64	5.41	2.74	5.39
Pigs Sold	3.67	2.23	1.29	2.21
Pigs Consumed	2.50	2.67	1.74	2.21
Chickens Owned	3.95	17.00	8.63	11.00
Chicken Sold	11.00	22.67	6.79	12.53
Chickens Consumed	15.73	4.63	7.80	8.50

7.6 Indigenous Reserves

Throughout the tropics forest dwelling peoples are dependent on a variety of land use types and extraction of forest products for subsistence. Many local forest products make substantial contributions to the livelihoods of local communities in the form of subsistence and trade (Peluso 1992). Political ecology and progressive contextualization (human ecology theory based on policy relevant environmental issues) focus on resource related-actions of local people and the link with broader social political and economic settings. These approaches begin with the resource users and consider the particular way in which users act or react to a particular resource. The approaches attempt to identify why people use the environment in particular ways, sometimes causing deterioration of an essential resource (Peluso 1992). Political ecology focuses on the interplay of social relations and the use of environment rather than the shared human-environmental interactions of a set of individuals (Peluso 1992). Political ecology also assumes that larger social structures and political-economic units will have an affect on local resource users (Blaikie 1985). In the context of indigenous forest dwelling people, natural resources extracted from the forests can link rural communities to national and international markets. This allows marginal otherwise subsistence farmers to participate in market economies without completely relying on them. On the opposite end of the spectrum, indigenous groups may rely on the extraction of forest resources solely for subsistence. The Benuaq Dayak, the focus group of this study, extract rattan for commercial purposes, while other forest products extracted are for household use and consumption.

Forest management by local groups for control and access over resources has long been in existence (Eghenter 2000, Furze et al., 1996, Peluso 1992). Indigenous groups

have long used extractive reserves to restrict access to resources for community members and outsiders who have encroached on traditional lands (Furze et al. 1996). Extractive reserves forested areas are where natural resource extraction is available to community members. There are often strict rules regarding the exploitation of resources within the reserve. Extractive reserves are often identified as a way to maintain biodiversity as well as providing sustainable economic return to local peoples and governments (Schartzmen 1989). Indigenous communities often form extractive reserves in order to protect resources from outside encroachment and extraction.

The extraction of timber and non-timber forest products (NTFPs) are generally associated with other activities such as Swidden agriculture, fruit gardens, and other subsistence practices. Extraction of NTFPs in reserves in the long-term outweighs profits made from timber exploitation alone and can be sustainable if resources are not over-extracted (NRM 2000). Extractive reserves in the Amazon have been quite successful in sustainable harvesting of non-timber forest products (Peluso 1992). However, policy makers in Latin America have often failed to include the role of NTFPs in local and regional economies, by doing so they have omitted the benefits of indigenous knowledge and pre-existing patterns of forest management (Pinedo-Vasquez et al. 1990). Community reserves set up in Loreto, Northeast Peru were formed to protect and control extraction of forest resources (Pinedo-Vasquez et al. 1990). Strict rules have been placed on the cutting of timber and extraction of NTFPs is permitted only by community members. This reserve will ensure that there will be resources available in the future.

Extractive reserves have also been created with the intent for conservation and development policies to conserve natural resources while empowering local communities through benefits gained by harvesting. Creating reserves also enables groups to stake

claims on ancestral lands. Reserves have been developed to ensure land tenure to indigenous groups that may otherwise have traditional lands taken from them by the government for other purposes such as large-scale timber harvesting or conversion to palm oil plantations. Herlihy (1990) in research conducted in Central America with local communities, found that lack of land tenure and deforestation are closely related. Providing land users with secure access to property rights will result in more sustainable land use, protection of biodiversity, and less deforestation (Nelson, Harris, and Stone 2001). For example, in India there are an estimated 50 million people who live in or along the periphery of forests (Narendran 2001). There are over 3,000 plant species that contribute economically important products in India, many of these products are collected by marginal communities who live in proximity to the Niligiri Reserve (5,520 km^2) in Southern India (Tewari 1994). The majority of these people rely on NTFPs for subsistence and cash income. In India there is a large commercial market for NTFPs, the Nilgiri reserve is being used for NFTP extraction by several different ethnic groups. Aside from abundance of species, the utility, traditional knowledge, and commercial importance, ethnicity plays a large role in the extraction of NFTPs (Narendran 2001). Understandably, different ethnic groups may use a different mix of forest products. For example, ceremonial plants used by certain ethnic groups may or may not be important to another ethnic group. There are a variety of different resources collected in different forest types within the reserves for personal and commercial use. For example, fuel wood, fruits, greens and tubers are collected for subsistence, where the most important commercial products are *Acacia sinuate* (Sekai) and *Eblica officinalis* fruits (Indian gooseberry). Indigenous reserves are in effect protecting forests and the people who rely on them for survival. Although the Benuaq Dayak and many other indigenous groups

create reserves, it is now recognized while developing national reserves that local participation and forest conservation is crucial to their success.

When reserves or tenure rights of local communities are not adhered to, problems arising from outside extraction lead to social conflicts (Dove 1985, O'Neill 1995). The Nuaulu an indigenous group on Seram, one of the largest of the Moluccan Islands, in Indonesia, have been encountering threats to their natural resource base by government sponsored logging and transmigration programs (Ellen 1999). They have, however, successfully defended land claims in court to protect their ancestral territories. The Nuaulu practice Swidden agriculture, forest resource extraction, and extract sago palms for subsistence. The pith of the palm contains a flour that is extracted from the shredded trunk and filtered out through water processing. The Nuaulu historically extracted timber for ritual houses and cleared land for government-sponsored projects. They choose timber that best matches the finished product, thus minimizing overall effort and waste. The Nuaulu have had a long history of forest modification and participation in the market (Ellen 1999). Land on Seram has been cleared to grow cloves, nutmeg, and tree crops such as coconut, cacao, and coffee, and in addition for transmigration settlements. Large tracts of the island have been developed into transmigration villages. Transmigration projects have lead to deforestation on many of the outer islands of Indonesian (Whitten 1987). Violent conflicts have arisen over resource rights throughout Indonesia; this is a reoccurring problem throughout the archipelago. Natural resource related conflicts on Borneo from 1998-2000 resulted in several thousand deaths of Madurese and Dayaks, and larger numbers left homeless. The country's transmigration program to relocate people from over populated Java and Madura has lead to conflict regarding land tenure, displacement of indigenous people, deforestation and tribal warfare. Access to forest

resources is only one of many problems associated with the transmigration program and spontaneous migration by other ethnic groups (Dove 1993, Sochaczewski and McNeely 2001, Whitten 1987).

7.7 Extraction of NTFPs in Kalimantan

The island of Borneo is extremely rich in natural resources including forest resources, natural minerals such as gold, diamonds, nickel, and large deposits of coal and natural gas. The forests of Borneo contain a cache of products such as highly valued timber, rattan, fruits, honey, resins, wild game, medicinal plants, and other various natural resources. The worldwide trade of Indonesian forest products has been well established for centuries throughout Southeast Asia and the Middle East (Hall 1985). Until the 1960s, extraction of these resources was primarily small-scale and localized. The government aggressively began exploiting resources often ignoring traditional land claims and resource access (Peluso 1992). In addition to forest products, extraction of NTFPs has provided important income generation to the livelihood of forest dwelling peoples and the regional economy of East Kalimantan (Peluso 1992).

Aggressive industrial development policies initiated in the late 1960s allowed East Kalimantan to become the wealthiest province in the country, providing the highly centralized government of Indonesia with large amounts of raw materials and significant income generation (Brookfield, Potter, and Byron 1995, Dove 1985, King 1993). The river system in Kalimantan allows for easy access to resources in the interior of the island, which, in turn, leads to large-scale removal of resources far into the hinterlands. Lands were allocated for plantation forests, timber concessions, and transmigration projects, national parks, wildlife reserves, and watershed protection areas were also developed (Peluso 1992).

Investors and migrants to the region were interested in exploiting the vast resources of Kalimantan. Newcomers including individuals, corporations, and the government have threatened the nature of non-timber forest management from a system based on common property laws to open access with no controls (Peluso 1992). This is a fundamental problem in Indonesia's remote regions. In addition, transmigration projects introduced migrant populations to Kalimantan which dispersed widely throughout the provinces. New migrants to a region such as these often practice agricultural and extraction techniques that are unsustainable (Dove 1985). This is due to the practice of over-extraction of forest resources and the temporary cultivation of various high yielding crops with no fallow periods. High extraction rates and temporary cultivation methods are practiced in order to generate rapid income, often ignoring traditional tenure rights of indigenous access to resources. Although problems associated with transmigration can be serious, large-scale extraction of resources by concessions, mining companies, etc., is an even bigger threat to local communities' tenure rights and resources (Dove 1985, King 1993).

Earlier indigenous reserves were discussed in general terms. In Indonesia, reserves developed by local communities attempt to place constraints on extraction of forest resources and curb the potential problems of illegal logging activities by concessionsaires and small-scale loggers. In Indonesia, the government has the control to protect against the large-scale destructive timber harvesting. However, it is the government of Indonesia (GOI) that is responsible for allocating timber concessions, and ultimately indigenous extractive reserves are under its control. In addition, traditional land claims are often not recognized by the GOI, therefore, land is for the most part state-owned. This has lead to many traditional peoples losing control of ancestral lands. The

Basic Agrarian Law of 1960 and the Basic Forestry Law of 1967 are at the same time fundamentally contradictory and overlapping (Ellen 1999). At times these laws are used to defend the land of indigenous people, however in most cases are they used to legitimize land confiscation, and criminalize local inhabitants who insist on asserting ancestral land tenure (Colchestor 1993, MacAndrews 1986, Zerner 1990). The loss of control of traditional lands occurs due to many reasons with timber concessions on one end of the spectrum and the development of national parks that restrict resource access on the other (Dove 1985, King 1993, Peluso 1993). Many protection areas and national parks have been developed where indigenous groups have resided for centuries (Crevello 1998, Furze et al. 1996, Lawrence and Mogea 1996).

7.8 Control Over Forest Extraction and Trade

Historically, ruling sultans throughout Borneo placed taxes on forest products brought down river from the interior by indigenous people who would trade with the coastal Malays. Alliances were made by different ethnic groups to allow access and trade of natural resources. Contemporary laws governing trade of forest products by local extractors are intertwined in the complex governmental regulations and access laws imposed by the centralized government that is committed to large-scale rapid exploitation of natural resources (Peluso 1992: 52).

The Foreign Investment Law No. 1/1967, instituted under the Suharto regime, forever altered the balance between volumes and value of timber and non-timber products in East Kalimantan (Peluso 1992). Manual logging which dominated the industry in the 1960s, provided employment opportunities for local people and others who came from all over Indonesia to participate in the timber industry. In 1968 only two mechanized logging companies operated in East Kalimantan (Peluso 1992). As a result of the 1971 ban in

Indonesia on hand-cut logs, due to their lower quality and a change in the political economy of the timber production, Japanese buyers would not purchase logs from Indonesia (Peluso 1992). This devastated the timber industry in East Kalimantan. Local communities returned to their agricultural and extraction activities placing higher dependence and pressure on the extraction of NFTPs (Peluso 1992).

7.9 Rattan Trade

There are a large variety of rattan species found in Indonesia. Rattan are the tropical climbing palms of Southeast Asia, they use other trees for support and can grow several hundred meters in length. The stems are of great strength and are used in a multitude of industries but primarily to build furniture. There are a number of factors that had huge affects on the rattan trade in the 1960s and 1970s. The post-independence regime under Suharto's New Order entailed large-scale industrial capital development, which changed the face of forest policy and forest use (Peluso 1992). The influence of the international market for the raw natural resources of Indonesia, which in that time frame was plentiful, led the way to massive exploitation of resources. Rattan, already an important international commodity, was ideal for Indonesia to develop as an industry through foreign investment. Between 1967 and 1977 the price of raw rattan doubled and between 1977 and 1978 the price tripled, this was due to the ban that the Philippines had placed on unprocessed rattan (Peluso1992). A ban in the sale of raw rattan in 1979 in Indonesia also affected rattan trade as it was easier for local extractors to collect and sell rattan than to process it themselves. Rattan products such as mats and carpets were processed in South Kalimantan which influenced extraction in the other provinces of Kalimantan. By the end of 1989, East Kalimantan rattan provided an example of wide spread, virtually uncontrollable, forest extraction (Peluso 1992:65). The fires of Borneo

in 1982-83 devastated large tracts of forested land containing stocks of rattan and other forest products. Subsequent fires over the last decade have contributed to forest loss and Kalimantan continues to lose large tracts of land used by local populations and migrants to extract forest products. The extraction and cultivation of rattan continues to expand due to market demand, access structures, government policies and priorities, and natural disasters (Peluso 1992).

It is the flexibility and diversity of local management strategies that has contributed to the multitude of resources in the forests of Borneo (Peluso 1992). Kinship ties remain important in the access and control of forest resources via inheritance. In East Kalimantan where there is state control over the extraction of rattan, harvesters are granted a license to extract rattan in a given area (Peluso 1992). This protects the harvester from others extracting in their forest territories. Within the extraction territory there is flexibility in the local regulation of access thus not preventing disruption of social dynamics (Peluso 1992). Due to destruction of natural rattan stands from fires, logging, conversions to plantations, migrant populations and increased extraction, cultivation of rattan stands is now becoming more prevalent in Kalimantan. Rattan cultivation among the Benuaq Dayak has greatly expanded with the aid of national and local NGOs developing programs in cultivation, participatory inventory workshops, and handicraft market expansion. Many groups of shifting cultivators have turned to rattan cultivation in fallow fields.

7.10 Indigenous Dayak Reserves

Documentation of land use practices by other Dayak groups have indicated similar forms of community reserves. In the past, the Dayak Kenyah practiced their own

form of community reserve, "*tana ulen*", a primary forest reserve rich in natural resources (Eghenter 2000). This was a similar reserve to that of the Benuaq Dayak's *Bengkar* community forest reserve. Another Dayak group in the region, the Kayan Uma Lekan from the Apo Kayan in the upper reaches of the Kayan river, (headwaters of the Mahakam River) had a similar system of forest tenure "*tana ang*" which is restricted or prohibited land (Eghenter 2000). As with the Dayak Kenyah this system historically was under the control of aristocratic families. Although when the Dayak Kayan moved further down river in the 1940s the management of a new reserve was governed by a village council of elders and leaders. Other groups such as the Dayak Kenyah and Punen maintain customary communal land management systems where customary laws are still enforced. These reserves are evidence of how local people have protected and conserved their forest by implementing community forest management and reserves.

7.11 *Bengkar* (Benuaq Dayak Forest Reserves)

All Benuaq Dayak villages possess a *Bengkar* (community forest reserve) that provides forest resources such as timber, medicinals, honey, wild vegetables, and animals (Figure 7.1). The reserves are mixed dipterocarp forests found in the middle stretches of the Makaham Basin. The *Bengkar* provides wild game and forest resources such as rattan, wood, and medicinals. The communities' reserves have had minimal timber extraction and are primarily used for hunting and small-scale extraction. The *Kapala Desa* (village head) grants permission for resource extraction by community members.

Figure 7.1 **Village of Dingin *Bengkar* (Community Forest Reserve)**
Benuaq Dayak, East Kalimantan, Indonesia 2002

Fees are associated with extraction of timber; non-timber forest products including flora and fauna are extracted at the discretion of community members. Timber and NFTPs can only be extracted by members of the community. Timber is extracted for personal use such as for construction or repair of homes. In 2002, the fee for one cubic meter of any wood type was 50,000 rp or US$ 5.00. At the time of this research no commercial logging was taking place in these reserves. The Benuaq Dayak do not extract large amounts of any forest resources in the reserves, and extraction of NTFPs are not focused as income generators to the local economy. Rattan and rubber cultivation and the sale of livestock provide income to the household.

7.12 Results

7.12.1 Forest Type and Density of Tree Species

In order to understand the forest products extracted by the Benuaq Dayak it is crucial to recognize the diversity of trees found in the community forest reserves. The species diversity plots in the *Bengkar* reserves that were conducted as part of this study where located in the lowland rainforests of East Kalimantan. The lowland rainforests of Borneo are characterized by highly diverse plant species that have a complex horizontal structure with three to five canopies of vegetation. There are 10-15,000 flora species on Borneo (Mckinnon et al. 1993). The Benuaq Dayak *Bengkar* are located in mixed dipterocarp forests. There are over 100 species of *Dipterocarpaceae* in Indonesia. Dipterocarp trees commonly reach 45 meters in height, on occasion 60 meters or more. The canopies of lowland rainforests are 80 percent dipterocarp trees. Within the top canopies, the most dominant trees are *Diptocarp T. Shorea, Dipterocarpus, Caeasal pineceae,* and *Dryobanalops* (Whitmore 1984). Diptercarp trees are highly valued hardwoods that have been heavily exploited throughout Borneo (Mackinnon et al. 1996). The smaller trees found in the lower canopies are *Burseraceae, Saptaceae, Eurphorbiaceae, Rubiac, Annonaceae, Lauraceae*, and *Myristicaceae* (Whitmore 1984). *Meranti* (*Shorea spp*.) trees were the most commonly identified species in the sampling plots. This is a highly valued hardwood that has been heavily logged throughout Borneo. Characteristics of dipterocarp trees are based on color, density, and anatomical features. Several common species of *Meranti* found in the region are identified by the color of the wood which include red, yellow, and white *Meranti*. Various *Meranti* species were the dominant tree types in the *Bengkar* sample plots.

In each of the three villages studied, while conducting sample plots in *Bengkar*, it was rare to come across extremely large old growth trees. However, as seen in Table 7.4, there are a fairly large number of trees over 20-cm diameter at breast height (dbh) (mean 26 trees) within a 200 m^2 sample plot. The average number of trees over 10-cm dbh in a 100 m^2 was 16 trees or an estimated 32 trees per 200 m^2 plot. Saplings have a high density for 2X2 meter plots with a mean of 23 saplings. The mean average for all nine sampled plots was used to estimate the number of trees per hectare. As indicated in Table 7.4, the Benuaq Dayak community forest reserves remain heavily forested and have not been disturbed by commercial logging. Customary laws regarding the extraction of trees from the *Bengkar* remain strict and are still heavily enforced. Removing trees remains restricted for personal use and fees are associated with each cubic meter removed from the reserve (50,000 rupiah or 5 US$ per cubic meter). Community forest reserves also provide a number of non-timber forest products, which will be further discussed in this chapter. As indicated in Table 7.5, low volumes were extracted from the *Bengkar* evidence that this resource is not over-harvested. There are three primary types of wood that are extracted from the community forest reserves, *Meranti* and *Benkirei* (*Shorea laevis*) trees from the dipterocarp family and *Kayu Ulin*. These trees are highly valued hardwoods that have been heavily extracted throughout Borneo (Figure 7.2).

Table 7.4 **Tree Density in Benuaq Dayak Reserves**
Benuaq Dayak, East Kalimantan, Indonesia 2002

Stature (Tree Size)	**# Sites Sampled**	**Total Area Sampled** (Combined) m^2	**Mean**	**SD**	**Estimated Trees per Hectare**
20 cm + dbh	9	1800	26	5.09	1,300
10 cm + dbh	9	900	16	6.26	1,600
Saplings	9	36	23	11.63	57,500

Borneo Ironwood (*Eusideroxylon zwageri*) or *Kayu Ulin* is a slow generating highly valued tree species that is found in mixed dipterocarp forests of Borneo. It is so slow to regenerate that generations or centuries may pass before the wood is mature (Peluso1992). Ironwood produces very dense silica that is termite resistant, which makes the wood invaluable for building (Salfasky 1993). This rare tree is extremely hard thus making it useful for many products for industrial and local enterprises. Dayak communities in the interior of Borneo use ironwood for construction and in making handicrafts. In the 27 sample plots surveyed in the *Bengkar* there were only 2 specimens of ironwood found. Much of the ironwood on Borneo has been over extracted not by local communities but by timber concessions (Peluso 1992).

The sample mean annual extraction of *Meranti* (*diptercarpis sp*.) wood per household was only 2.89 m^3, *Benkire*i (*diptercarpis sp*.) wood mean extraction was 3.44 m^3, Borneo ironwood 1.25 m^3 and other wood 3.7 m^3. Therefore the annual mean extraction for all wood types was only 11.89 m^3. This number is extremely low when taking into account the extraction rates of timber concessions. The village of Benung had an average household collection rate for *Meranti* of 3.86 m^3, 3.83 m^3 *Benkirei* wood was extracted annually, Borneo ironwood at 2.00 m^3 and other wood types 3.00 m^3 were collected from the reserve. Benung has been and continues to repair their longhouse, however instead of extracting from the *Bengkar* residents of Benung reported purchasing *Meranti* and *Kayu Ulin* (Borneo ironwood) from a mill to repair the longhouse. When asked why they purchased the wood instead of removing from the *Bengkar*, it was noted that it was easier to purchase the wood than find it and cut it in the reserve, return to the village, and cut it into needed specifications. Tepulang residents collection of *Meranti* averaged 2.64 m^3, *Benkirei* wood mean extraction rate was 4.13 m^3, and for other wood

Figure 7.2 ***Bengkar* Reserve, Tepulang (Mixed Dipterocarp Forest)**
Benuaq Dayak, East Kalimantan, Indonesia 2002

types 4.20 m^3 were removed annually from the *Bengkar*. Of those villagers surveyed in Dingin, 22 percent extracted *Meranti* at an average of 2.45 m^3, *Benkirei* wood was extracted annually at 1.33 m^3, Borneo ironwood mean removal was 1.00 m^3 and other wood types 4.00 m^3 were collected from the reserve annually (Table 7.5). These numbers as noted above are particularly low; this is also due to the fact that no commercial logging is allowed on the reserves.

Rattan is another resource that is collected from the reserves. The total yields for all rattan collection was combined in the *Kebotn* section. Collection of wild rattan is generally extracted while participating in other forest activities such as hunting. While conducting species diversity sample plots the local informant collected rattan along the

way to the sample plots, he extracted only a small number of stems equaling roughly 10-12 meters. The mean annual extraction of rattan from the *Bengkar* was 566 kilos (n=37, range 5,194, s 1,294). Rattan is cultivated in *Kebotn* (gardens), the average household extraction rate is 1,693 kilos (n=44, range 13,180, s 2,100) annually, three times the amount extracted from the *Bengkar*.

Firewood was another resource that is extracted from the *Bengkar*, however it was collected far more frequently in other land use types, the overall mean for firewood collection was 45 *ikat* (range 299, s 93). Firewood extraction is discussed in another chapter of this dissertation. Only forest resources that are needed are removed from the reserve, ensuring a sustainable extraction rate. Future needs and timber concession encroachment may altar these sustainable extraction rates.

7.12.2 Wild Game and Other Resources

Although livestock provide some of the protein source for the communities, fish and wild game provide most of the protein in the Benuaq Dayak diet. Pigs and chickens are usually

Table 7.5 ***Bengkar*** **Timber Resources**
Benuaq Dayak, East Kalimantan, Indonesia 2001

Bengkar **Flora**	**Meranti wood m^3**	**n=**	**%**	**Benkirei wood m^3**	**n=**	**%**	**Ironwood m^3**	**n=**	**%**	**Other wood m^3**	**n=**	**%**
Ranges	8 2.13			11 3.19			1 .500			7 2.2		
Tepulang	2.64	9	36 %	4.13	4	16 %	0	0	0%	4.20	5	20 %
Benung	3.86	7	28 %	3.83	9	36 %	2.00	1	4%	3.00	4	16 %
Dingin	2.45	10	22 %	1.33	3	6%	1.00	3	6%	4.00	1	2%
Mean sample	2.89	26	27 %	3.44	16	17 %	1.25	4	4%	3.7	10	10 %
F Statistics	F=. 999 p=. 384			F=. 791 p=. 474			_			F=.302 p=.749		

sacrificed for ceremonial purposes and provide an income for villagers so they are less apt to eat their own livestock. Hunting is a very common practice in most of the villages. Generally groups of men will go hunting together and share the meat from the hunt. Animals are hunted with spears and dogs. Wild boar is the most common wild animal hunted in the *Bengkar*, some weighing up to 300 kilos. It is not uncommon for 2-3 dogs to be wounded or killed during the hunt as wild boar are extremely aggressive and dangerous. As seen in Table 7.6A, the overall sample mean of wild boars of killed annually per household is 10.11 boar. Although only 28 percent reported catching wild boars, several men will go on the hunt to help. The meat is usually divided up regardless as to whom actually kills the wild boar; in most cases it is a joint effort by all those involved in the hunt. The villagers of Tepulang reported the highest mean (23.43) of successful hunts for wild boar. The second highest yield for wild boar was 10.67 boars from the village of Benung, however only 12 percent of residents were successful in their hunt. More villagers from Dingin reported successful hunting but with a lower yield of 4.53 boars.

Deer were also hunted but less abundant than wild boar; the total annual mean per household for hunting deer was 3.50 deer (Table 7.6A). Dingin also led in the numbers of villagers reporting to hunt deer with a mean of 3.58 deer. Tepulang residents had a higher mean (3.67) but a lower number of residents reporting hunting deer. One young man has a deer that he trapped and will keep until it reaches maturity and then hopes to sell for a relatively high price. Benung had the lowest mean of 2.50 deer, with only 8 percent of villagers hunting deer. The mousedeer, a less commonly hunted animal, is a small frugivorous ungulate. Of those surveyed only 9 percent hunted for mousedeer with a mean of 2.78 mousedeer. Trapping birds is also uncommon. The only village that

reported this activity was Tepulang, with an average of 14.33 birds and a range of 39 (Table 7.6B). Birds were trapped and not hunted; they were usually kept as pets or sold at the local market. In general the community of Tepulang had greater yields and hunt more frequently than in Benung or Dingin. Most of those surveyed whether they were successful in catching hunted animals or not they enjoyed going hunting for the sport of it. The Benuaq Dayak continue to hunt traditionally with spears although they have access to modern weapons.

Honey is an abundant foodstuff that is readily accessible in the *Bengkar*, although it is plentiful, the process of extraction can be quite dangerous as all honey must be collected at night. Smaller trees surrounding the honeycomb trees are climbed using a series of different sized ropes, and then the gatherer must reach the larger tree and collect the honeycomb. One villager in Tepulang reported collecting 20 liters of honey in trees on the riverbank. The overall mean for honey collection was 44.90 liters with a range of 299 (Table 7.6B). Villagers in Tepulang extracted the most honey with a mean of 83.60 liters. Of the villagers in Tepulang who collect honey, most will sell honey at the local market or divide it among family members. At the time of this research (2002) the price for a 2-liter bottle of honey was 37,500 Rupiah. The villagers in Benung (mean 7.50 liters per household) and Dingin (mean 5.33 liters) only collected honey for personal use. The *Bengkar* offers a variety of forest products for the Benuaq Dayak. Until the present time *Bengkar* have not been over extracted thus resources remain plentiful. This is partially due to low population densities and no interest in commercial timber harvesting. At the present these forests are safe guarded. Community forest reserves hold valuable resources and assets to the Benuaq Dayak, and they recognize the necessity of conserving these resources for future generations.

Table 7.6A ***Bengkar*** **Fauna Resources**
Benuaq Dayak, East Kalimantan, Indonesia 2001

Bengkar **Fauna**	**Wild boar**	**n=**	**%**	**Deer**	**n=**	**%**	**Mousedeer**	**n=**	**%**
Range s	105 21.47			15 3.61			4 1.56		
Tepulang	23.43	7	28%	3.67	6	24	3.00	2	8%
Benung	10.67	3	12%	2.50	2	8	2.50	4	16%
Dingin	4.53	17	38%	3.58	12	38	3.00	3	7%
Mean sample	10.11	27	28%	3.50	20	21	2.78	9	9%
F Statistics	F=2.08 P=. 147			F= .078 P=. 925			F=. 088 P=. 917		

Table 7.6B ***Bengkar*** **Resources**
Benuaq Dayak, East Kalimantan, Indonesia 2001

Bengkar **Fauna**	**Birds**	**n=**	**%**	**Honey** (liters)	**n=**	**%**
Range S	39 16.62			299 93.22		
Tepulang	14.33	6	24%	83.60	5	20%
Benung	0	0		7.50	2	8%
Dingin	0	0		5.33	3	6%
Mean sample	14.33	6	6%	44.90	10	11%
F Statistics	-			F=. 829 P=. 475		

7.12.3 Riverine Resources

Riverine resources provide important goods for the Benuaq Dayak including fish, palm fronds for roof thatch, and edible ferns (Table 7.7). The annual frequency and the yield for fish and ferns were collected. The total mean annual extraction rate for fish is

Figure 7.3 **Girls from village of Dingin going fishing (*mancing*).**
Benuaq Dayak, East Kalimantan, Indonesia 2002

352 kilos with an average of 173 days fishing. Not all villagers reported extracting fish from the river. Very few villagers reported fishing for shrimp or other fresh water protein resources. The residents of Dingin reported fishing an average of 202 days annually with a yield of 431 kilograms (range 3,634, s 695), which is not surprising due to the fact that the village is located on the Pahu River. Benung residents fished a mean of 161 days per year with an annual yield of 165 kilograms (range 543, s 169). There is one man in the village who fishes with a net, he reported catching 9,000 kilos of fish last year, this

number was an extreme outlier and was taken out for the analysis. Tepulang had an annual mean of 341 kilos (range 1,914, s 611) of fish with a mean of 96 days per year fishing. Often when villagers have completed their work in the *Umaq*, they enjoyed fishing in the late afternoon (Figure 7.3). There were only 5 people surveyed who reported selling fish and that was not on a regular basis. One of the boys whose family the researcher resided with in Dingin used to catch fish on a wooden raft located at the river bank over the water that is used for bathing, washing, and other purposes. He was quite successful in catching several small fish that we would usually eat for dinner.

Another resource that was collected at the river was palm fronds, used as roof thatch in homes and field houses. The overall mean was 132 branches of palm fronds extracted annually per household (n=23, range 994, s 203)(Table 7.7). Only 20 percent of Dingin residents collected a mean of 100 branches annually. In Tepulang, 8 percent of those surveyed reported collecting palm fronds with a mean of 165 branches. In Benung, 44 percent of the sample survey collected an annual mean of 156 branches. Although during the last year not a large number of the residents collected palm fronds, it is a resource that is crucial to provide roof material and sometimes walls of field houses. It is also collected to repair old and damaged roofs. In the provincial capital of Samarinda this is a commonly sold item in the markets.

As mentioned earlier edible fern was a resource that was collected, the sample mean for fern collection is 68 kilos annually per household (range 311, s 71)(Table 7.7). In Dingin 58 percent of the sample population extracted an average of 71 kilos (range 311, s 76) of fern in the last year. Because Dingin is located on the Pahu River, there is easy access to collecting fern. In Benung 60 percent of those surveyed collected an average of 55 kilos of fern (range 311, s 77). In Tepulang 40 percent of residents

reported an average of gathering 77 kilos of fern annually (range 132, s 45). There are several small streams in the area and one large river approximately a two hour walk from the village which is conveniently located near many of the rice fields. One woman in the village occasionally collects fern to sell on market days. The price for ½ kilogram of fern is 1,000 rupiah. There is a season when fern is more abundant and when she collects at that time of the year she can gather up to 12 kilos for the day. In the village of Dingin two people reported extracting *sagu*. The trunk of the sago palm is shredded and then the pulp is filtered to extract a flour like substance. This can be cooked in bamboo shoots or leaves. In some parts of Indonesia this is the staple food crop. Many people have mentioned that if they are returning from their work in the field they will often collect food on the way home, often times stopping to gather fern or fish for the evening's meal.

Table 7.7 **Riverine Resources**
Benuaq Dayak, East Kalimantan, Indonesia 2001

Riverine Resources	**Fish** (kg)	**n=**	**%**	**Roof Thatch** (branches)	**n=**	**%**	**Fern** (kg)	**n=**	**%**
Ranges	8897 1229			994 203			311 50		
Tepulang	341	12	48%	165	2	8%	77	10	40%
Benung	165	15	60%	156	11	44%	56	15	60%
Dingin	431	39	86%	100	10	20%	71	27	58%
Mean sample	490	66	69%	132	23	24%	68	52	55%
F Statistics	F=. 99 p=. 38			F=. 21 p=. 81			F= .34 p= .72		

7.13 Opinions Regarding the Reduction of Natural Resource Extraction

Villagers were asked a series of hypothetical questions regarding current land use, willingness to reduce current resource extraction, and land conversion. Villagers were asked what percentage of their current extraction rates in the *Bengkar* they would be willing to reduce to conserve for future generations. The ANOVA test indicated that there is not a significant difference in percentages between the villages in willingness to reduce natural resource extraction (F=1.25 p=. 292). As seen in Figure 7.4, the village of Tepulang (52.4 percent) had the highest average percentage of willingness to reduce current extraction rates. Dingin residents were willing to cut extraction rates by 51.8 percent. Only in Benung (44 percent) were residents not willing to reduce at least 50 percent. This is still a very high percentage for reduction of forest resources. These communities were agreeable to reducing their resources for future generations if it becomes imperative. Rupiah values were then placed on the forest and forest products in order to identify the monetary values the Benuaq Dayak hold for the forest and their reserves. The villagers were asked in order to conserve their own community forest reserve and allow full regeneration of resources, if for a period of time, would they be willing to extract resources in other reserves for an entrance fee. Villagers were described three different forests types with varying degrees of degradation from primary untouched forests to forests with minimal resources available. Fees increased with the 'quality of the forest.' The first fee for use of forest resources was a value of 5,000 Rupiah; this forest was degraded with a limited amount of resources. The second option was a fee of 10,000 Rupiah where forest resources would be adequate. The last option was for the villagers to pay a fee of 20,000 Rupiah however, forest resources were

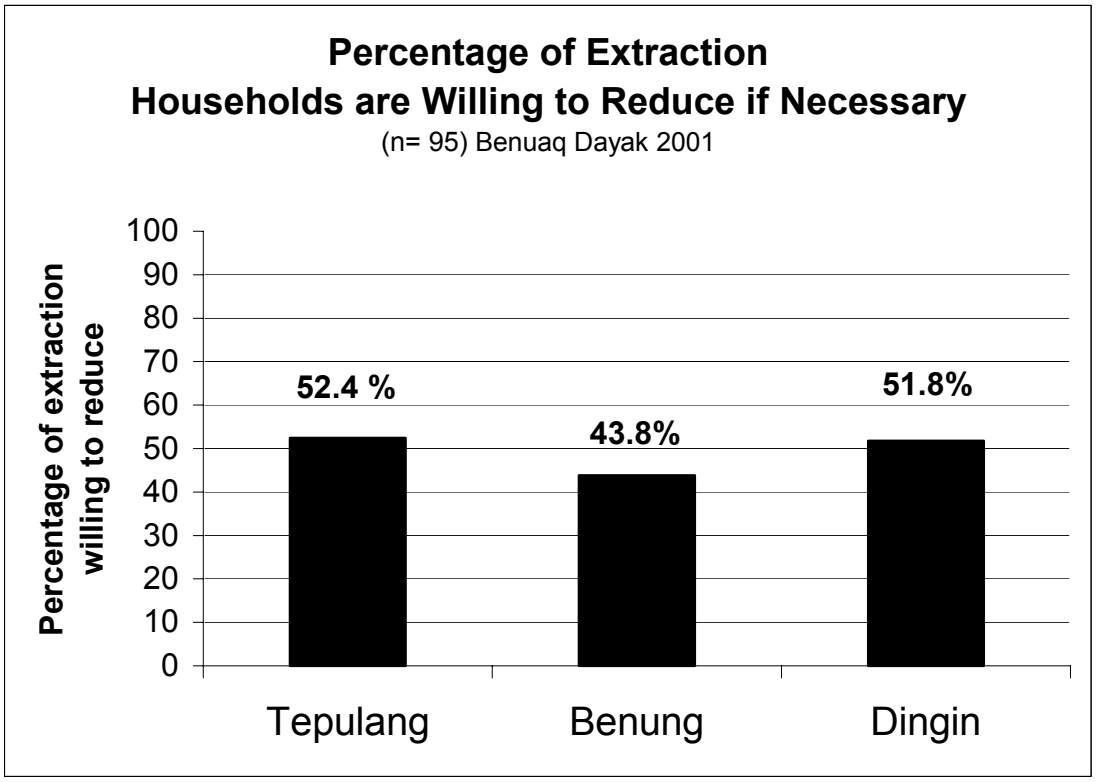

Figure 7.4 **Percentage of Extraction Households are Willing to Reduce if Necessary** Benuaq Dayak, East Kalimantan, Indonesia 2001

plentiful and time spent searching for resources would be minimal. A large amount of time was spent explaining the purpose and the question itself. This is a concept that is not familiar to most of the community members. The ANOVA test indicated that there were significant differences in the amount of Rupiah villages were willing to spend to extract resources from a reserve other than their own (F= 3.97 p= .022). The average amount of Rupiah willing to pay for resource extraction for residents of Dingin was the highest with a mean of 14,777 Rupiah (Figure 7.5). Dingin residents have had the lowest income and resources throughout most of the study; it is interesting that although financial resources are not as readily available they are willing to pay the most for forest product extraction and willing to pay a higher price for forests with the easiest access to high quality forest

resources. The villagers in Benung were willing to pay an average of 12,400 Rupiah for access to forest resources. The village of Tepulang reported the lowest Rupiah value to pay for forest resources at 9,920 Rupiah. This is somewhat surprising because many of the people interviewed were very conservation oriented, they were however willing to reduce resource extraction by over 50 percent. There were only a small number of people (5.3 percent) who were not willing to reduce extraction rates if it were to become necessary to protect resources for future generations. Those villagers not willing to extract resources in another reserve were very minimal (6.3 percent). Those not willing to reduce or pay fees for forest resources did not correlate, they did however choose one of the two responses.

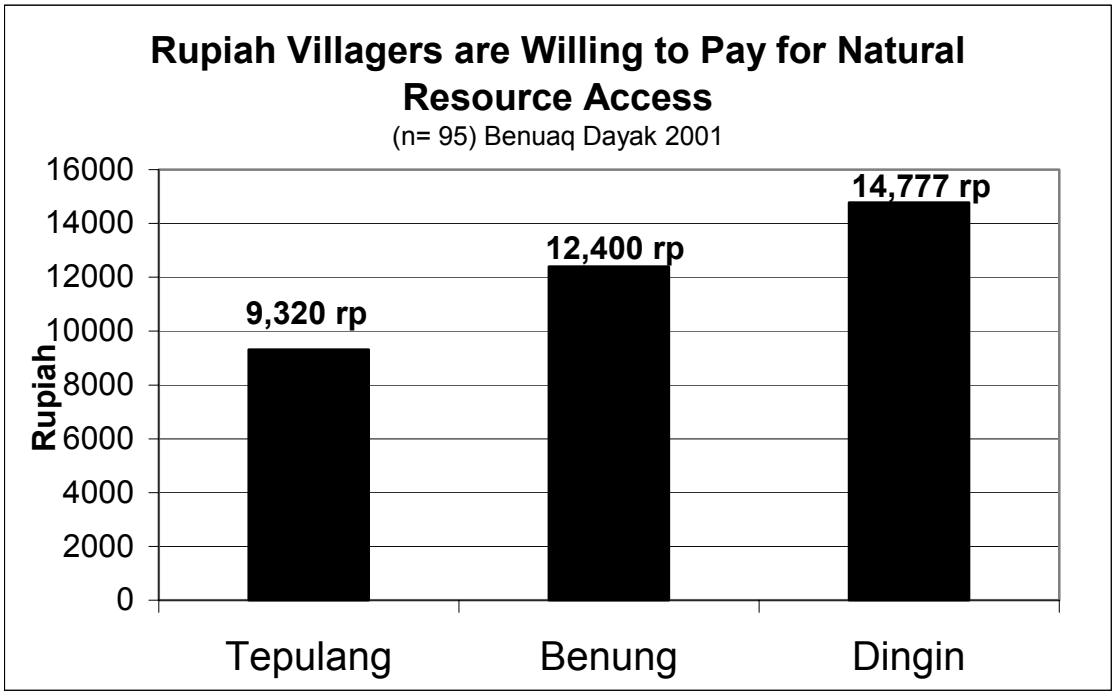

Figure 7.5 **Rupiah Villagers Willing to Pay for Natural Resource Access**
Benuaq Dayak, East Kalimantan, Indonesia 2001

7.14 Conclusions

Sustainable harvest of renewable natural resources such as NTFPs can theoretically lead to the economic stability of forest dwelling peoples (Uma Shankar et al. 1996). This venue has not been thoroughly explored by the Benuaq Dayak. Their system of land management is based on cultivation and collection of resources from a variety of land use systems. The Benuaq Dayak rely the most heavily on shifting cultivation plots, as it provides them with staple crops. The *Bengk*ar provides the Benuaq Dayak with resources including, building materials, protein sources, medicinal plants, and rattan. These resources are essential to their existence, however are extracted at very low rates. In identifying types of forest products extracted it was clear that there is not a huge reliance on forest products for subsistence or income generation. There were generally relatively low numbers of villagers in the sample surveys who extracted resources from the *Bengkar*. Benuaq Dayak community forest reserves actually seem to be under utilized, because of the low number of respondents who extracted natural resources. *Bengkar* reserves are also considered a stock resource base for future generations (Figures 7.4 and 7.5). There is a willingness to reduce the current low rates in order to conserve for the future. Most of the villagers recognize the importance of forest resources and the forest itself. There are conscious efforts to extract only resources that are needed from the reserves, thus current extraction rates are indeed sustainable because of low numbers for extraction of flora and fauna resources. The Benuaq Dayak have a great respect for the forest, they are a proud forest dwelling people. They depend in a variety of agricultural, forest gardens, and forest products for subsistence needs. This ethnic group has maintained their traditional customs while assimilating themselves into

the market economy by selling forest products such as rubber and rattan. Indonesia and East Kalimantan is in a time of great change with the decentralization of the government and the restructuring of forest policy issues (Colfer and Resosoudarmo 2001). It is hoped that the Benuaq Dayak and other forest dwelling peoples are able to continue their current land use systems while also having the opportunity to become active participants in forest policy issues in the region.

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CHAPTER 8

CONCLUSIONS

8.1 Summary

This research documented a variety of land use practices among the indigenous group the Benuaq Dayak of East Kalimantan, Indonesia. The Benuaq Dayak are a forest dwelling people who rely on forest resources and a variety of agricultural practices to maintain a subsistence economy. Historically, and currently, their populations are sustained through a mosaic of land use practices. The Benuaq Dayak continue to uphold traditional laws pertaining to land tenure and other associated laws. They have also successfully immersed themselves in the market economy by collecting and cultivating rattan and rubber. The Benuaq Dayak's multiple land management practices are a dynamic system created by an intimate relationship with nature intermingled into socioeconomic and political factors reacting to the ecological environment. This study identified the diversity and yields of crops within Benuaq Dayak *Umaq* (shifting cultivation plots), *Simpukng* and *Kebotn* (forest gardens), and the extraction of natural resources found in the *Bengkar* (community forest reserves). This study also documents dominant subsistence crops and analyzed the differences among villages and the affect ecological disaster has on harvest yields. Although Benuaq Dayak traditional culture and practices remain strong they have incorporated themselves into mainstream Indonesia in times of change in the region. Although the Indonesian government has marginalized indigenous groups, this culture, as well as many others in the outer islands, have chosen to continue their traditional lifeways.

It is crucial that indigenous knowledge systems are documented throughout the tropics as these cultures have survived and flourished in rainforest environments. With the devastatingly high rates of tropical deforestation caused by logging, mining, economic crises, and other actions, documenting, and incorporating indigenous knowledge systems into conservation plans may aid in the conservation of tropical forests (Colfer and Resosoudarmo 2002). For example, indigenous peoples have been more successful in conserving larger tracts of land from deforestation by large-scale logging than land areas set aside for national parks (Schatzmen, Meira, and Nepstad 2001).

Shifting cultivation or Swidden agriculture is one of the earliest forms of agriculture practiced by people living in the tropics (Yuskel 1999). There is evidence of shifting cultivation on Borneo as early as 2500 B.P. (Maloney 1985). Shifting cultivation practices by the Benuaq Dayak and other indigenous groups on Borneo have continually been under scrutiny from the Indonesian government (Colfer 1997, Dove 1985, King 1993, Yuskel 1998). The practice of shifting cultivation has inaccurately been blamed for destroying tropical rainforests (Colfer 1997, Dove 1985). Shifting cultivation systems such as the practices of Benuaq Dayak, are examples of knowledge of the local environment and the use of indigenous management practices to overcome local environmental problems (Yuskel 1998). If the Swidden cycle is allowed full regeneration then the land once used in shifting cultivation will eventually be reforested, often with a higher diversity of useful species than the original forest cover (Conklin 1961, Colfer 1997). Fallow rice fields are heavily managed and cultivated to become productive forests when regenerated. This practice has flourished and maintained populations for thousands of years without the large-scale damage caused by logging and other natural

resource extractions activities on Borneo (Dove 1985, Geertz 1963). The Benuaq Dayak continue to practice shifting cultivation as their main activity and all aspects of their life are centered around hill rice farming.

Staple crops grown in shifting cultivation plots provide foodstuffs for households and livestock. Rice and cassava are the most important crops to Benuaq Dayak communities, these staples are rarely sold and are consumed at the household level. In identifying the yields of staple crops found in the *Umaq* plots reported by the three villages studied, it was possible to identify the differences in villages affected by flooding and those that were unaffected. The disturbances caused by flooded *Umaq* plots in the village of Dingin were very apparent when in terms of the low yields produced in the last year. Flooding and fires have plagued the village of Dingin over the last several years; this has devastated the subsistence base and the village economy. Without staple crops, fruit, and low potential for income generating activities, the village of Dingin is currently in crisis. This community needs the support of the local government and NGOs to assist in the recovery of subsistence goods and other associated losses.

Forest gardens provide the Benuaq Dayak with a means of income and food sources; this is a valuable land use activity. In agricultural societies such as the Benuaq Dayak all land use activities provide diverse and crucial elements to their livelihood. The forest resources lost in fires can, in the long-term be regenerated. However, many villagers in Dingin stated they were reluctant to replant fearing future large-scale fires. The residents from the villages Tepulang and Benung are involved in various activities that are improving their livelihood. They have been fortunate in that they have had the assistance of international, national, and local NGOs that have developed programs in

rubber and rattan cultivation, and projects have been created to teach participatory methods for rattan inventories in cultivation plots. With the aid of the Samarinda based NGO, SKH (Sistem Hutan Kerakyatan), the residents of Benung have developed a small-scale handicraft industry using various species of rattan. These handicrafts are sold in the provincial capital, Samarinda. If the village of Dingin was able to receive similar types of aid they may have the capability to recover from their current situation. It is also very important that the villagers themselves shift their mindset to create a positive setting in order to help themselves out of their situation.

The three villages that were the focus of this research were all 100 percent Benuaq Dayak. Being of the same ethnic group they practice the same land management systems as well as maintaining the same cultural traditions. The factor that makes them unique from each other is the ecological condition that each village faces. The village of Tepulang was given the opportunity to reforest land destroyed in the fires in 1998 with the cultivation of rubber trees.

The village of Benung at the time of this research in 2002 was working with Samarinda based NGO, SHK to develop a cottage industry for rattan handicrafts that were sold in the provincial capital of Samarinda. The residents in both villages also had access to short term loans through a credit union set up by SHK. SHK and other NGOs are also developing workshops on the local rattan industry and teaching methods of cultivation and participatory inventory techniques. Of the three study areas, Dingin is the village most devastated by natural disasters in the past five years. It had the lowest agricultural yields, the least amount of livestock, and the lowest income of the three villages.

The village of Dingin is administratively part of a different sub-district. It is possible that aid and development of different administrative centers will first develop unevenly and then eventually all sub-districts will have the same opportunities. NGOs who are working in various regions of East Kalimantan are working to identify villages that have the motivation and potential to benefit from various projects. Motivation and morale have become considerably low in the village of Dingin due to the recent disasters. This study has documented the loss of food crops associated with the loss of cultivated and forested land from ecological disaster. Possibly through the documentation of these recorded losses, the potential for much needed aid may be recognized. It may be the first step in a long process to rebuilding this community.

8.2 Sustainability of Land Use Practices Among the Benuaq Dayak

Due to low population densities of the Benuaq Dayak, their multiple land use systems appear to be sustainable. The land availability as of August 2002 remains plentiful. Fallow fields are managed heavily in order to cultivate multi-species forest gardens, providing useful resources while the forest is regenerating. The management of fallows, fruit, rubber, and rattan gardens allow for income generation and income "stock." The mosaic of land management systems create diversity in the landscape as well as the opportunity to benefit from the assorted diet and income generation activities created by these systems. Although the main activity for the Benuaq Dayak are their shifting cultivation plots, other activities remain important. Throughout the creation of this culture, the Benuaq Dayak have developed a well rounded system of land management and customary laws that allow them to benefit from forest resources through extraction and management of fallow fields. If their system of shifting cultivation

continues through the full cycle, long-term forest loss will be at a minimum. There remains a conscious effort by all three study villages to maintain the community forest reserves for future generations even at times of crises. Minimal extraction and land conversion is recognized through customary laws. This system is continuing in current times due to the strong bonds the Benuaq Dayak have with nature and their consideration for future generations (Figure 8.1). This strong cultural trait is what has allowed the Benuaq Dayak to remain attached to traditions without compromising the benefits of the market economy in Indonesia.

If the Benuaq Dayak can continue to use their indigenous strategies of resource management to address concerns as they have done so in the past, then environmental degradation can be prevented and sustainable forestry and development can continue successfully. The community-based approach is vital to the success of the Benuaq Dayak and other indigenous group's land management systems. This has been a key component to the long-term success of many indigenous land tenure systems. This approach, if implemented on a larger scale, can improve larger broad-based extraction practices (Colfer and Resosoudarmo 2002, Yuskel 1999). If indigenous strategies of land management can be incorporated into governmental laws and guidelines for extractive resources, such as timber concessions, it may be possible to create sustainable extraction of Indonesia's rich natural resources. The decentralization process currently taking place in Indonesia is intended to shift the power structure from the historically highly centralized government in Jakarta to provincial governments. Only time will tell if this shift of power will be supportive or hindering to indigenous groups in the region. The Benuaq Dayak maintain several land use practices, they uphold traditional laws

Figure 8.1. **Future Land Holders from the village of Tepulang**

pertaining land tenure, and they have immersed themselves in the market economy by collecting and cultivating rattan and rubber. Although their traditional culture and practices remain strong they have incorporated themselves into mainstream Indonesia in times of change in the region.

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APPENDIX A

QUESTIONNAIRE FOR HOUSEHOLDS IN BENUAQ DAYAK VILLAGES, KUTAI BARAT, EAST KALIMANTAN, INDONESIA 2002

Questionnaire No._____
Village Name _____
Household No._____
Date_____

1. HOUSEHOLD INFORMATION

1.1. Household Composition and related information

What is the total composition of this family? _____Children _____Total

1.1. Household members- head of household and Spouse only

Gender:	1	2
0= male		
1=female		
Age		
0= under 15 years		
1= 15-18		
2= 19-30		
3= 31-40		
4= 41-50		
5= 51-60		
6= 61++		
Education		
1= no schooling		
2=Primaryschool incomplete		
3= Primaryschool- complete		
4=Junior-highschool graduate		
5= High school- graduate		
6= Practical training		
7= Additional Education		
Profession		
1= Work in Office		
2= Hunter		
3= Agriculture		
4= Student		
5= Do not work		
6= Other		

2. Income Generation

2.1 Total income other than Agriculture _____

2.2 Total income from Agriculture _____

3. **Crops and Yield**
3.1 Umaq : _____ Hectares.

Crops cultivated (in the last 12 months)

No.	Crops grown last year	Approx. hectares sown	No.of labor days	Total Yield (specify units)	Fraction Sold	Fraction Consumed	Information
1	Rice						
2	Corn						
3	Cassava						
4	Fruits						
5	Vegetables						
6	Firewood						
7	Other						

3.2 Simpukng : _____ Hectares

Resources Cultivated (in the last 12 months)

No.	Resources Cultivated	Approx hectares sown*	No.of labor days	Tot. Yield (specify units) **	Fraction Sold	Fraction consumed	Information
1	Fruit						
2	Rattan						
3	Rubber						
4	Palm Sugar						
5	Medicinals						
6	Coffee						
7	Candlenut						
8	Honey						
9	Wood /other						

3.3 **Kebotn/Dukuh** : _____ Hectares

Resources cultivated (in the 12 months).

No.	Resources Cultivated	Approx hectares sown*	No.of labor days	Total Yield (specify units)	Fraction sold	Fraction consumed	Information
1	Rattan- Pulut merah						
2	Rattan Pulut putih						
3	Rattan Sega						
4	Rattan Pulut						
5	Rubber/ Other						

3.3. **Uratn** : _____ Hectare

Resources Extracted (in the last 12 months).

No.	Resources Extracted	No. of labor days	Total. Yield (specify units)	Fraction Sold	Fraction consumed	Information
1	Construction Wood					
2	Firewood					
3	Bamboo					
4	Edible rattan roots					
5	Edible bamboo shoots					
6	Vegetables					

7	Other					

3.5. **Bengkar** : _____ Hectare

Natural resources extracted (in the last 12 months)

No.	Natural Resource extraction	No. of labor days	Total Yield (specify units) **	Fraction Sold	Fraction consumed	Information
1	Meranti					
2	Bengkirai Wood					
3	Borneo Ironwood					
4	Rattan					
5	Honey					
6	Medicinals					
7	Ceremonial forest Products					
8	Other woods					
9	Gaharu/ Damar-resins /other					
10	Wild animals					

3.6 Fresh Water and River resources (collected over the last 12 months)

No.	Type of Yield	No. of labor days	Total. Yield (specify units)	Fraction Sold	Fraction consumed	Information
1	Fish					
2	Other aquatic life					
3	Roof thatch material					
4	Edible fern					
5	Sago palm starch					
6	Other					

4 Livestock Ownership (in the last 12 months)

No.	Species	No. Owned	No. Sold	Number Consumed	Additional information
1	Pig				
2	Chicken				
3	Cow				
4	Goats				
5	Water buffalo/ other				

5. Expenses

Expenses over the last 12 months

Item	Amount
Food	
Clothing	
Medicine	
Schooling costs	
Travel	
Ritual/ ceremonial	
Other	

APPENDIX B

SPECIES FOUND IN *UMAQ* BENUAQ DAYAK SHIFTING CULTIVATION PLOTS

English Common Name	Indonesian Name	Latin Name
Vegetables and Starches	**Sayur-Sayuran**	
Upland Rice	Beras Gunung	*Oryza sativa*
Cassava	Singkong	*Manihot esculenta sp*
Corn	Jagung	*Zea mays*
Sweet Potato	Ubi	*Ipomea batatas*
Turnip	Ubi Jalar	*Brassica rapa*
Eggplant	Terong	*Solanum melongena*
"Sour" Eggplant	Terong asam	
Longbean	Kacang pangang	*Vigna sinensis*
Chives	Bawang rumbut	*Alluin sp.*
Onion	Bawang	*Allium cepa*
Peanut	Kacang Tanah	*Arachis hypogaea*
Cucumber	Timun	*Cumumis sativas*
	Tebu Telur	
Fruit	**Buah-Buahan**	
Banana	Pisang	*Musa sp.*
Durian	Durian	*Durio zibethinus*
Jackfruit	Nangka	*Artocarpus heterophyllus*
Papaya	Pepaya	*Carica papaya*
Pineapple	Nanas	*Ananas comosus*
Tomato	Tomat	*Lycupesicon lycopersicum*
Spices	**Bumbu**	
Sugarcane	Tebu	*Ceanothus sp.*
Lemongrass	Sereh	*Cymbopogon citratus*
Turmeric	Kunyit	*Curcuma domestica*
Chili peppers	Cabe / Lombok	*Capricum frutescens*
Candlenut	Kemiri	*Aleurites moluccana*
Ginger	Jahe	*Zingiber officinale*
Other		
Rubber tree	Pohon Karet	*Hevea brasiliensis*
Rattan	Rotan	*Calamus spp.*
Bambo	Bambu	*Bambusa sp.*

APPENDIX C

FRUIT TREE VARIETIES FOUND IN SIMPUKNG, BENUAQ DAYAK FRUIT GARDENS

English Common Name	Indonesian Name	Latin Name
Rambutan	Rambutan	*Nephelium lappaceum*
	Langsat	*Lansium domesticum*
Durian	Durian	*Durio zibethinus*
Jackfruit	Nangka	*Artocarpus heterophyllus*
Papaya	Pepaya	*Carica papaya*
Mango	Manga	*Magnifera indica*
Beetle nut	Pinang	*Areca catetchu*
Coconut	Kelapa	*Cocos nucifera*
Coffee	Kopi	*Coffea sp.*
	Aren	
Candlenut	Kemiri	*Aleurites moluccana*
Other		
Rubber tree	Pohon Karet	*Hevea brasiliensis*

APPENDIX D

ANIMAL HUSBANDRY INFORMATION

Variables used from survey:

Livestock Ownership
- Pigs Owned
- Pigs Consumed
- Pigs Sold
- Chickens Owned
- Chickens Consumed
- Chickens Sold

Animal Husbandry

Livestock ownership is very important to the Benuaq Dayak, it provides a protein resource as well as income, and is also an indication of wealth. Pigs and chickens are the most prevalent livestock in all three villages. Cows, goats, and water buffalo are less abundant. This study did not focus on animal husbandry practices, thus this data is summarized in the appendix.

Pigs

Raising pigs is very common amongst many indigenous groups in Indonesia. Pigs are a very important resource both for monetary and for ceremonial purposes. All pigs for this study have been grouped together whether they were full-grown or adolescent. In several cases there are families that own a large number of piglets. The mean total for pig ownership as indicated in Table D-1 was 5.39 (range 46, s 7.7). The ANOVA test indicates that there is significant difference among villages for ownership of pigs ($F=3.83$ $p=.026$). The village with the most pigs was Tepulang with a mean of 8.64 pigs. Two families in Tepulang reported having 45 and 46 pigs, the majority of these pigs would have to be young piglets, and most likely be sold while relatively small. It is difficult for

families to maintain large numbers of full-grown pigs. They are usually fed a mixture of cooked cassava and water. Benung had the second highest average of pig ownership with a mean of 5.41 pigs. Dingin had the lowest mean of 2.74 pigs owned.

As seen in Table D-1, out of the 75 percent of villagers surveyed who owned pigs, 55 percent sold pigs within the last year. The results of the ANOVA test indicate that there is a significant difference in the amount of pigs sold last year (F= 3.41 p=. 041). A Scheffe Post Hoc test indicates that there is a significant difference of income generated by the sale of livestock between Tepulang and Dingin and between Benung and Dingin but not between Benung and Tepulang. The sample mean for number of pigs sold per family was 2.21 pigs (range 20, s 2.90). However the range of those sold were 20 pigs, thus very few families sell relatively large numbers of pigs while the majority does not. The villagers surveyed in Tepulang sold an average of 3.67 pigs last year. The annual mean for Benung was 2.23 pigs, and Dingin had the lowest mean with 1.29 pigs. Pigs are sold for 10,000 Rupiah a kilogram, thus depending in the weight, can bring in a substantial income. Pigs are not usually sold until they are at least 15-20 kilograms; this ensures a return on the investment of raising the animal. They are typically sold locally for ceremonies or celebrations held in the villages. There was a farewell party held in Tepulang where the researcher purchased a 30-kilo pig with a selling price of 300,000 Rupiah. This is more than half of what a villager would make for working two weeks on a forest rehabilitation project. Please see table below for data on consumption of pigs, it generally follows the same pattern as those sold, the overall mean for pig consumption was 2.21 pigs (range 6, s 1.52).

Table D-1 **Pig Ownership, Consumption, and Number Sold**
Benuaq Dayak, East Kalimantan, Indonesia 2001

Livestock	Pigs Owned **	n=	%	Pigs Sold**	n=	%	Pigs Consumed	=n	%
Range **sd.**	46 7.7			20 2.90			6 1.52		
Tepulang	8.64	22	88%	3.67	15	60%	2.50	8	32%
Benung	5.41	22	88%	2.23	13	52%	2.67	15	6%
Dingin	2.74	27	60%	1.29	24	54%	1.74	19	42%
Mean sample	5.39	71	75%	2.21	52	55%	2.21	42	44%
F Statistics	F=3.83 p=. 026			F=3.41 p=. 041			F= 1.82 p=. 176		

**** Sig.@ p= <. 05**

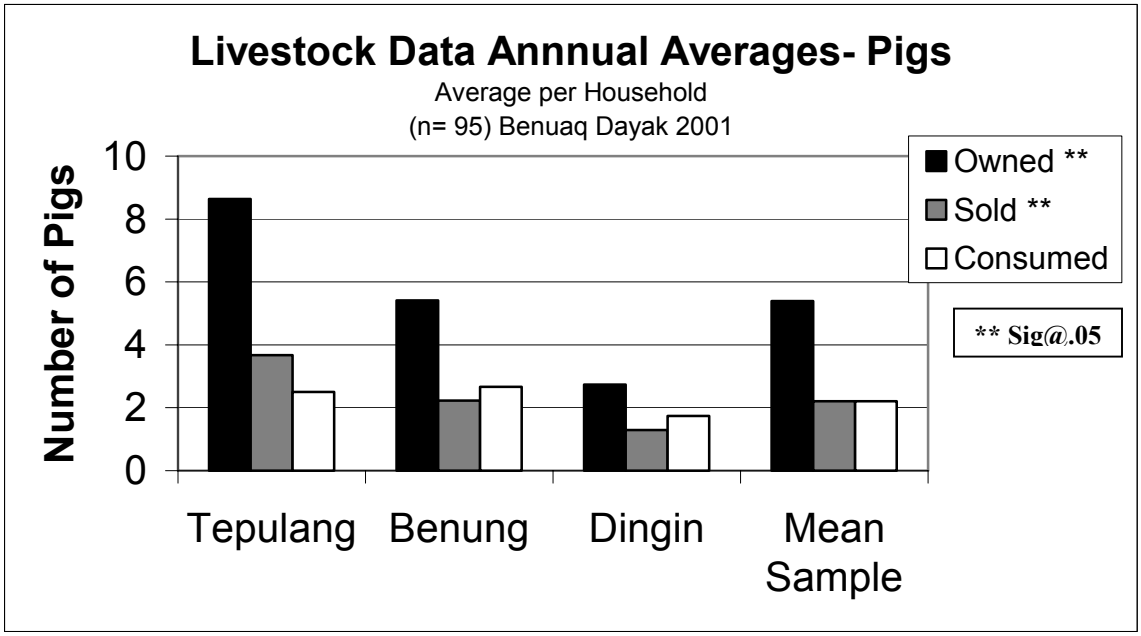

Figure D-1 **Livestock Data Information - Pigs**
Benuaq Dayak, East Kalimantan, Indonesia 2001

Poultry

Table D-2 provides information regarding chicken ownership, number sold, and consumption. Apparently in the past most villagers kept larger stocks of chickens, however, many of the people surveyed have had problems with their chickens dying of illnesses this year. The mean sample of chickens owned was 11.0 chickens (range 49, s 10.35). As can be seen in the range (49) the amount of chickens owned varies greatly. In Benung the mean (17.00) was much higher than the total mean, the reason is that a few villagers raise chicks and sell them once they are full-grown. Most people raise chickens not with the direct intent of selling, when or if the opportunity arises they are sold. Surprisingly, those sampled in Dingin had a mean of 8.63 chickens, which was higher than that of Tepulang (mean 6.95 chickens). This was not expected since Dingin for the most part lags behind the other villages in ownership of livestock and agricultural products.

Chickens can be sold for 15,000 rp, they are often purchased for ceremonial purposes. When a person is ill most healing ceremonies require sacrificing of chickens and a pig. The mean total for numbers of chickens sold was 12.53 chickens (range 155, s 27.86) and the mean for consumption was 8.50 chickens (range 99, s 15.14) as can be seen in the table below. The ANOVA test run on this variable proves that there is a significant difference (F=7.15 p=. 002) in the amount of chickens sold annually. Benung leads in the number of chickens sold with an average of 22.67 chickens, this was expected as it was relative to the number of chickens owned and as mentioned above a few villagers raise chicks to sell, however Benung had the lowest mean for annual

Table D-2 **Chicken Ownership, Consumption, and Number Sold**
Benuaq Dayak, East Kalimantan, Indonesia 2002

Livestock	Chickens Owned **	n=	%	Chickens Sold	n=	%	Chickens Consumed	n=	%
Range **sd.**	49 10.35			155 27.86			19 15		
Tepulang	6.95	20	80%	11.00	7	28%	15.73	11	44%
Benung	17.00	23	92%	22.67	9	36%	4.63	16	64%
Dingin	8.63	24	53%	6.79	14	31%	7.80	25	55%
Mean sample	11.00	67	71%	12.53	30	32%	8.50	52	55%
F Statistics	F= 7.15 p=. 002			F= .89 p=. 419			F= 1.87 p=. 166		

**** Sig.@ p= <. 05**

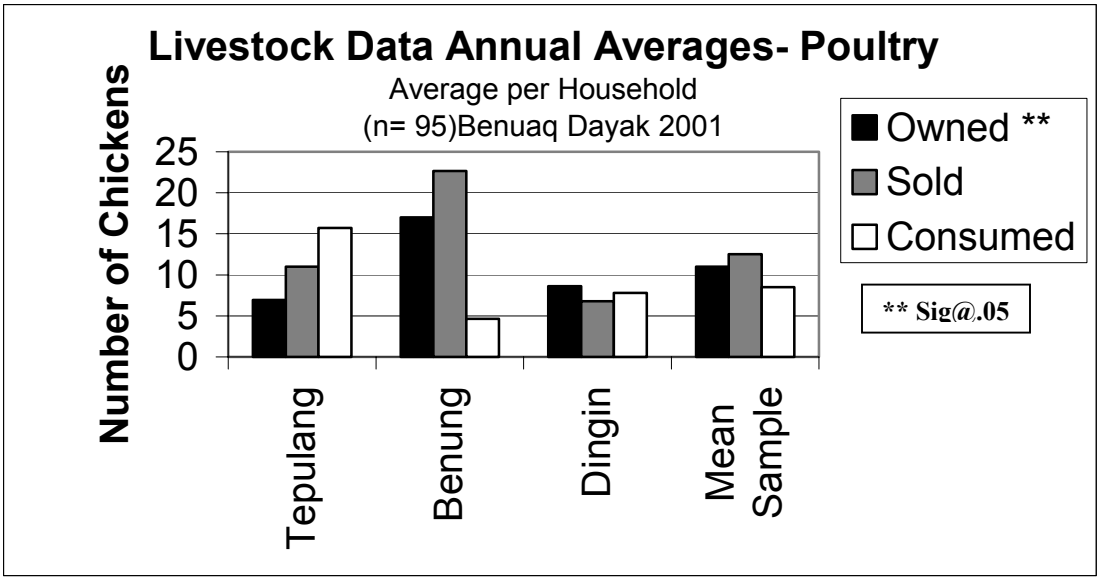

Figure D-2 **Livestock Data Information – Poultry**
Benuaq Dayak, East Kalimantan, Indonesia 2001

consumption 4.63 chickens. Tepulang on the other hand, had the lowest mean for numbers sold (11.00) but the highest mean for consumption (15.73) chickens. Dingin had relatively the same numbers for chickens sold as (6.79 mean) those consumed (7.80), however a higher percentage consuming than selling chickens. The ANOVA test indicated that there was not a significant difference in the number of chickens sold or consumed.

Additional Livestock

Cows initially are a much larger investment than the above-mentioned animals; they also give very large returns. Cows were usually sold to nearby logging or mining companies for prices up to 3.0 million Rupiah or 300 $U.S. for one full grown cow. Of those villagers surveyed, there were not many respondents who owned cows (n=18 or 19 percent), the mean total owned was 1.68 (range 3, s 839). Tepulang had the most number of cows with a mean of 1.69 and the most number of respondents. Benung residents had a mean of 1.80 cows, and there was only one cow in the sample for the village of Dingin. Of those households surveyed, 19 percent reported owning cows and sold a mean of 2.11 cows within the past year (range 5, s 1.5). The cycle of selling cows is a slow process taking several years for cows to mature and before receiving a high price, so it is to be expected that there are a low number of respondents in this category. Only in the village of Benung were water buffalo (n= 5, mean 1.45) and goats owned (owned n= 2, mean 4, sold n= 5, mean 2.60). In addition, there was one water buffalo in the village of Dingin. Large livestock take much energy and resources to maintain, smaller animals such as chickens and pigs are more manageable and the return is quicker than in larger livestock.

The sale of livestock provides families with substantial income generation. There is a statistically significant difference between the three villages studied in the income generated by livestock activities (F=7.33 p=. 001). The mean rupiah value of annual income generation by livestock was 1,413,562 rp./yr (n= 64, range 8,810,000, s 2,017,008). Tepulang (n= 19 or 76 percent) had the highest mean of 2,187,000 rp./yr (range 8,796,000, s 2,355,834). Benung (n=18 or 72 percent) had the second highest mean of 2,143,611 rp./yr (range 8,105,000, s 2,489,956). Dingin (n=27 or 60 percent) had an overwhelmingly low mean of 382,592 rp./yr (range 820,000 s 227,813) and also had the overall lowest averages of livestock ownership between all three villages. This could be due to lack of funds to purchase initial animals. The Benuaq Dayak are subsistence farmers, they raise livestock on a small scale, however protein resources and income generation can still be gained by maintaining relatively low numbers of animals.

APPENDIX E

VILLAGE PARTICAPATORY MAP PROJECT

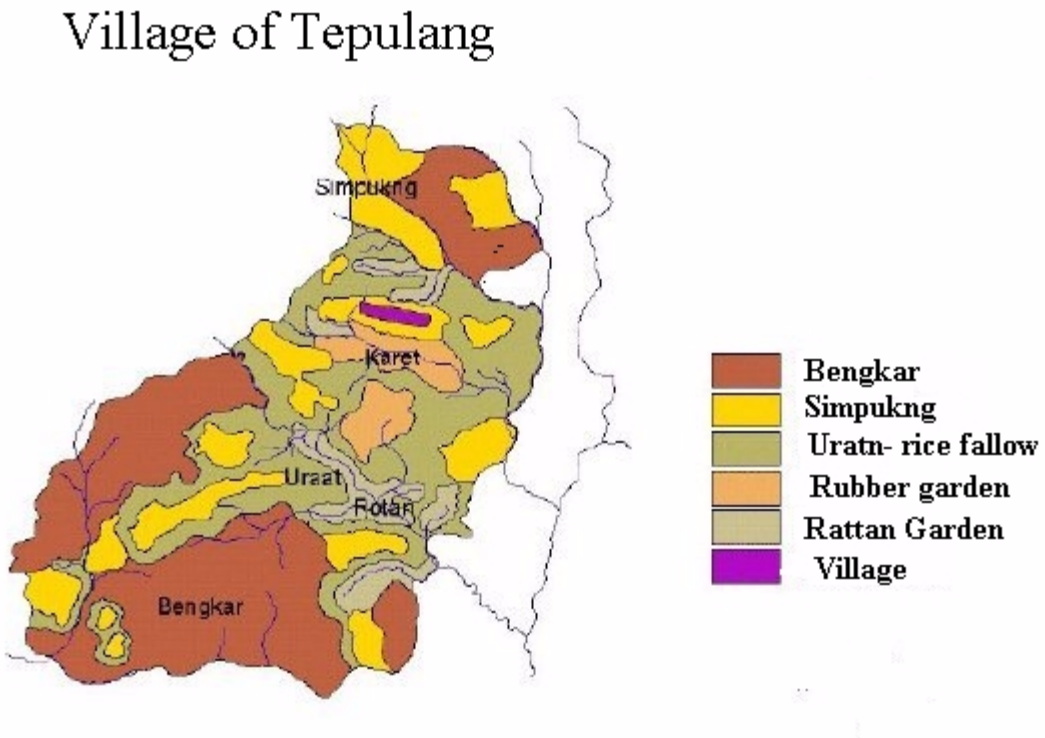

Figure E-1. Participatory Map of Tepulang. (NRM 2000)

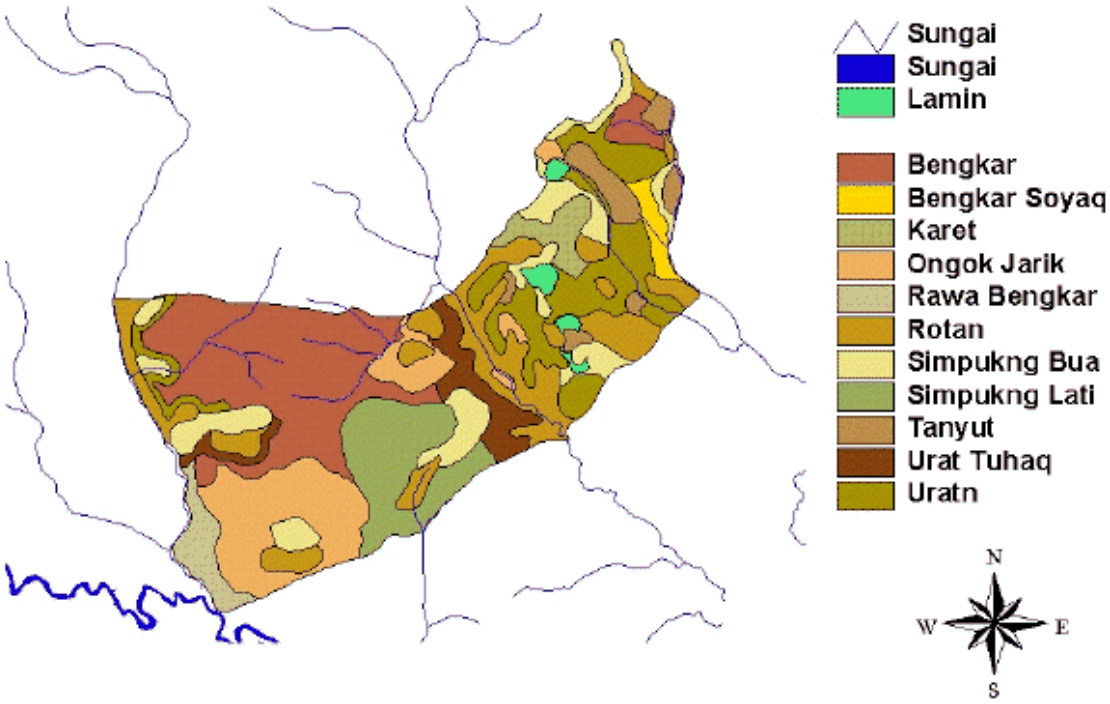

Figure E-2. Participatory Map of Benung.
(NRM 2000)

APPENDIX F

INSTITUIONAL CONTACTS IN INDONESIA

A. Location Indonesian Government Agency	Non-Governmental Organizations
Agencies and Organizations Visited	Agencies and Organizations Visited
Jakarta/ Bogor Indonesian Institute for Sciences Department of Forestry Directorate General for Nature Conservation BAPPENAS Indonesian Development Agency	 Natural Resource Management Progam Center for International Forestry Research Sustainable Forest Management Project. Deustsche Gesselshaft fur Technische Zusammanarbeit (GTZ)
Samarinda, East Kalimantan	 Natural Resource Management Program Sistem Hutan Kerakyatan (SHK) Pengelolaan Hutan Berbasiskan Masyarakat di Kalimantan Timor
Kutai Barat Department of Forestry District Office	 Rio Tinto Foundation

VITA

Stacy Marie Crevello was born to be an adventurer and work in the jungles throughout the tropics. She was born in 1970. She enjoyed beach life in Miami until she moved to the Rocky Mountains in Colorado. Wanting get back to warm waters she headed west to California where she received a bachelor of arts degree from University of California, Los Angeles. Upon completing this degree, she moved to Indonesia to experience life's adventures and travel throughout Southeast Asia. She then moved to Louisiana to obtain a master's degree in geography researching indigenous communities and tropical forest conservation in Southeast Asia. The opportunity arose for Stacy to achieve a Doctor of Philosophy from Louisiana State University in forestry. This further opened doors for her to continue conducting research with local communities in the tropics. She has trekked through the jungles of Latin America and Southeast Asia working with indigenous communities. She hopes to continue this stream of work upon graduation.