Analyzing Pathways to Sustainability in Indonesia

# East Kalimantan Case Study:

# Energy Prices, Natural Resources, and Livelihoods

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### *About PROFOR*

PROFOR is a multi-donor trust fund program housed at the World Bank within the Environmentally and Socially Sustainable Development (ESSD) Forests Team. PROFOR is funded by the Department for International Development (DFID) of the United Kingdom, the Finnish Department for International Development Cooperation, the Japanese International Forestry Cooperation Office, Swiss Development Cooperation (SDC). The German Government is an in-kind contributor. Initially established in 1997 at the United Nations Development Programme (UNDP), PROFOR relocated to the World Bank in 2002. PROFOR's objectives are consistent with those of the World Bank's Forest Strategy and Policy (approved in October 2002), and PROFOR collaborates closely with the Bank in implementing the Strategy, which is built on three pillars: harnessing the potential of forests to reduce poverty; integrating forests in sustainable economic development; and protecting global forest values. A Management Board comprised of representatives from donor agencies, client countries, international organizations, NGOs and the private sector provides strategic guidance to PROFOR and determines what activities are included in the PROFOR portfolio. The Management Board holds one formal meeting each year, maintaining an active role through correspondence and informal meetings in the interim. (***www.profor.info)***



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**About the Project**
**"Analyzing Pathways to Sustainability in Indonesia"**

Indonesia has a wide range of choices for how to develop its economies, aiming for growth, sustainability and poverty reduction. The "Pathways Project" aims to help Indonesia's planning agencies use modeling to understand the consequences of macro policy decisions on the economy, society and environment. The project approach strives to address the fact that macro policies that appear sound at the national level can sometimes have unforeseen and adverse consequences for individuals or local communities, including overexploitation of fragile natural resources.

The "Pathways Project" aims to interpret the impact of macro decisions on different socio-economic groups, and how their behavior affects natural resources such as water, energy and forests. Novel modeling approaches are applied to understand the triple bottom line (economic, social, environmental) outcomes of proposed macro level policy interventions for local communities. The project has developed an inter-regional Computable General Equilibrium model with environmental and social variables for analysis at national level. The project also produced an Agent Based Model that works in a bottom-up fashion to explain how local agents' behavior in response to macro level policy signals produces consequences for society, the environment and the wider economy.

The approach is designed to support policy makers in making better national and local development decisions. The intent is to give the planning agencies tools that can be used to test and fine tune policy decisions before they are adopted. The project partners include Indonesia's National and Provincial Development Planning Agencies (BAPPENAS and BAPPEDA), The World Bank with PROFOR support, The Commonwealth Scientific and Industrial Research Organization of Australia, and AusAID

More information is available from CSIRO Sustainable Ecosystems:
http://www.csiro.au/science/IndonesianPathways.html

# Table of Contents

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## 1. Introduction

This report describes part of an ongoing project that is developing tools for modeling the impacts of macro-economic policies on local livelihoods and natural resources. The Analyzing Pathways to Sustainability project is being carried out by CSIRO with support from AusAID and with complementary activities managed by the World Bank using funding from PROFOR. The main output of the project is an Agent-Based Modeling (ABM) tool that will simulate local social and environmental impacts of macro-economic policies under review by the central government. PROFOR's interest in this work is derived from the project's potential to lead to a better understanding of the linkages between forests, livelihoods, and national policies. The modeling tool, which will initially cover two regions in Indonesia, is being developed in parallel to a national Computable General Equilibrium (CGE) model. Together, these should allow for better consideration of local impacts when national policies are developed.

PROFOR is also interested in the work because the models are tools that can be used to investigate questions of interest to planning, management, and budgeting agencies concerned with natural resources management and sustainability. PROFOR expects that through examination of useful and interesting policy scenarios, the activity can demonstrate the utility of the approach and the implications of different choices. The ABM model will also have the ability to examine questions of climate change implications, such as an increase in rainfall, which are increasingly interesting in the global context. ABM modeling is described briefly in a text box on the following page.

PROFOR support was mainly devoted to several activities that were carried out in conjunction with two case studies in Indonesia. The East Kalimantan Province case study, which is covered in this report, was completed at the end of 2008 and the Central Java case study should be finalized by mid-2009. Both case studies are concerned with identifying the local impacts of changes in energy prices, which are largely controlled by the central government through fuel subsidy policies. In East Kalimantan, PROFOR supported a survey of 3,000 households across four districts and two cities in the southern half of the province and detailed interviews of 540 households in the area. PROFOR also funded analytical and descriptive work as well as activities that strengthened collaboration with stakeholders from different levels and sectors of government and civil society.

The household survey was designed to provide data about household use of a range of natural resources as well as information about the values that people place on them. Household interviews were used to identify households' changes in natural resource use in response to rising energy prices. While designed largely to develop behavioral response functions as a base for the ABM, the survey

provides valuable stand-alone information. Specifically, the survey results make an important contribution to our understanding of the role of natural resources in the lives of people in East Kalimantan and elsewhere. A key finding from the survey is the high proportion of households that use or value natural resources in the study area.

**Agent-Based Modeling**

ABMs allow decision makers and researchers to study the interactions of individuals, or households, with their environment and economic setting, in response to various factors. For example, they can link decisions by individual humans with biophysical processes such as rainfall, fish catch or crop growth, with economic processes such as market price and supply/demand or taxation or subsidy policy, or with social processes such as population movements.

ABMs are computer models that simulate complex systems. Typically, they consist of a set of micro-level entities or agents, an environment in which they operate, and a dynamic that specifies how they interact and a sequence of simulation events. Each agent is given certain attributes and modes of interaction with other agents and with their environment. The environment is given a state. The dynamic of agent interactions is an input to the model and is based on surveys and data analysis. It is the interactions of the agents with each other and with their environment as the model runs that results in the simulated system outcomes.

Agent-based models are often used in regional planning to simulate changes in land use or management in response to various stimuli or changes affecting local people. Typical applications include modeling traffic flows, disease patterns and the group dynamics of humans or animals. They are, in essence, a method of simulating human behavior and its consequences for the economy, society and environment. The disaggregated approach allows analysis not only of economic but also of social and environmental dynamics. It helps in the detection of unintended side-effects – on the environment or natural resources for example – that could be triggered by a macro policy decision.

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PROFOR also supported a series of seminars and workshops with stakeholders from civil society and various levels of government. Through the case study, policy makers at the regional and national levels were engaged in a dialogue about local impacts of national policies and about the modeling approach. Working group meetings and workshops provided a venue where ideas from the field could be discussed at the center, and where central officials could see simulations of impacts in the field. This process had a distinct impact on communication pathways and institutional relationships between various levels of government and different government agencies involved in policy development.

It should be noted that this report is not concerned with the technicalities involved in developing and implementing the ABM, or with the theory behind such models. Instead, the report focuses on outcomes of the project that have direct relevance to our understanding of forestry and poverty issues in Indonesia and the link between environmental impacts and macro-policy. The following section provides a brief background on the role of forest resources in the livelihoods of

rural communities and a discussion of Indonesian energy pricing policy and the potential impacts on people's use of natural resources. This is followed by a section on East Kalimantan that provides a more detailed background on the importance of the province's natural resources to local people and to the Indonesian economy. This sets the stage for several sections that analyze and discuss the results of the household survey and interviews. Prior to concluding, there is a brief section describing the ABM.

## 2. Natural Resources, Livelihoods, and Policy Development

When central governments design national policies, they often do so without properly accounting for the full range of impacts on the environment and on local people. The ADB's Governance Assessment report for Indonesia states that lack of effective consultations with stakeholders within and outside the government, including business associations and non-governmental organizations (NGOs), leads to low quality of regulations, difficulties in enforcement, and weak compliance (ADB 2004). Furthermore, there is an established link between the lives of many rural Indonesians and the health of their environment, which is often not fully addressed by policies that lead to environmental changes. Thus, policies developed to improve national economic outcomes, such as economic growth or energy security, can lead to unintended consequences for the environment may create unwanted ripple effects on the livelihoods of people that depend on natural resources.

Analysts looking at deforestation in Indonesia often point to the importance of forests to local people. Forests support timber industries, which provide rural employment, and they provide habitat for natural resources that form important components of the livelihood strategies of rural people. These resources include timber, as well as non-timber products such as rattan, rubber, bush meat, honey, and medicines. While estimates of the number of people that depend on forests in Indonesia vary, one credible figure suggests that some 20 million people live in villages near forests, of which about 6 million receive a significant share of their cash income from forest resources (Sunderlin et al 2000). Besides providing jobs and cash incomes, forests are essential to the needs of the poorest households in forest areas, who rely on them for fuel, medicines, food, construction materials and other goods.

Forests' contributions to livelihoods extend well beyond the forest boundary and forest loss may have negative downstream impacts. Besides providing forest-based products, forests in some cases help reduce the likelihood of floods, and help to stabilize soil. Therefore, loss of forests may lead to more flooding in some areas, which imposes high social costs. Increased erosion can lead to more sedimentation in rivers and lakes creating adverse impacts on downstream fisheries, as well as ports and shipping.

The importance of forests to livelihoods is difficult to quantify because a large portion of forest products does not enter formal markets, or is not captured by national statistics (Warner 2000, cited in World Bank 2006). Most measures also do not account for the safety-net effects that forests provide in times of economic hardship (World Bank 2006), or of the cultural and recreational values that forest products may have for local people. In part, the lack of information about the number of forest-dependent people and about their livelihood strategies is also due to their political and economic marginalization (Colchester, cited in World Bank 2006).

Responsibility for a wide range of policy decisions, many of which are likely to have impacts on local livelihoods as well as on the environment, lies with the central government. Indonesia's size, ethnic diversity, and the remoteness of many of its domains combined with an ongoing process of decentralization create significant challenges to fully addressing local livelihood and environmental concerns in policy development. Indonesian national energy pricing is a policy outcome that is directed by the center and that has strong implicit equity and livelihood concerns for people across the nation.

Historically, domestic prices of fossil fuels in Indonesia have been heavily subsidized and averaged less than 50% of international prices. With Indonesia's oil reserves depleting and national consumption increasing, along with the rising global oil prices, fuel subsidies have become an increasing drain on the national budget, and Indonesia's development strategy is geared toward a gradual phase-out of the subsidies. In March 2005, the government increased fuel prices by 30 percent and again by 125 percent in October, leading to inflation and public criticism. Still, in 2008 the costs of fuel subsidies to the national budget were estimated to reach USD 22 billion due to soaring global fuel prices (Jakarta Post 2008). Oil prices had increased far above the budgeted figure, and the government was forced again to raise fuel prices in May 2008 on average by 28.7 percent (Herald Tribune, 2008). In January 2009, with global oil prices declining rapidly, the Government decided to lower the price of domestic fuel by a small amount (500 Rupiah) relative to prior increases. Analysts expect that in future subsidized prices will track market prices up to a given price ceiling (Jakarta Post 2008).

Increases in energy prices will affect local people and their relationship to natural resources in several ways. Higher energy prices have a direct negative impact on people's livelihoods by raising the costs of goods and services. For people that depend on natural resources for part of their income or as social safety nets, increased costs may strengthen this reliance, which may lead to adverse effects on natural resources through over harvesting. Increased energy prices will also change people's incentive framework, by decreasing the marginal returns of energy intensive activities, which may have an impact on the way they use natural resources. For example, an increase in the price of petrol may decrease the profitability of logging or fishing, or an increase in the price of kerosene may increase the use of fuel wood for cooking. Lastly, increasing prices of fuel may lead to changes in the behavior of industries involved in natural resource extraction with attendant impacts on the environment and on job availability in those industries. [1]

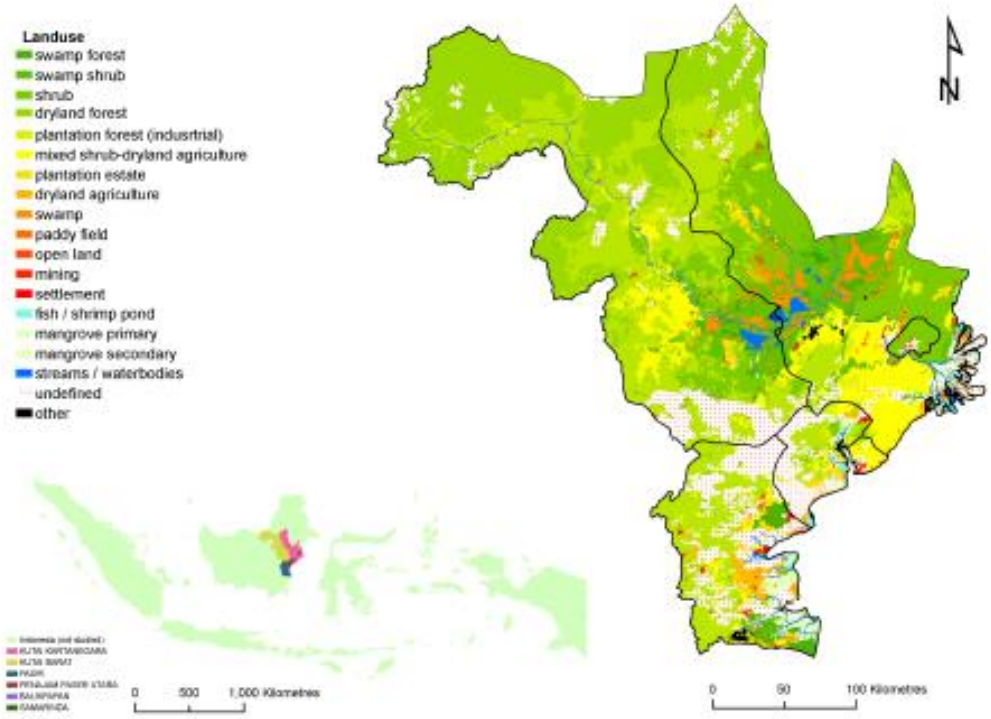
A considerable amount of prior research exists that specifically analyzes the impacts of macro-policies on forests. A common theme emerging from these

[1] One concern with increasing fuel prices is that this may lead to an increase in the use of firewood for cooking purposes, which in turn may increase pressures on forests. However, even if there is limited substitution of kerosene by wood for cooking in rural areas, the impacts on forests are likely to be small. Fuel wood use is not a major driver of deforestation or land use change in Indonesia, as large-scale activities (commercial logging and agricultural expansion) tend to dominate (World Bank 2007).

studies is that the linkages between macroeconomic drivers and deforestation tend to be complex and variable (Kaimowitz and Angelsen 1998). Importantly however, Kaimowitz and Angelsen point out that there is no substitute for careful, quantitative micro-level empirical research. One reason for the lack of such empirical research at the household level is that such micro-level studies are time and resource intensive. Besides lacking empirical research, the existing models are often abstractions that are not of immediate relevance to decision makers and that do not allow policy makers to model different policy choices.

The overarching goal of this project is to create a process and tool that will allow various tiers of government and multiple sectors to communicate effectively about environmental and social consequences of policy decisions. The project's final product is designed to be a set of agent based models that allows stakeholders to simulate the impacts of different policy scenarios in a number of selected regions of Indonesia. As discussed above, one of the areas that such a model needs to address is the intricate relationship between policy, livelihoods, and natural resources. One of two case study regions chosen for the project covered six districts in the southern part of East Kalimantan Province- Pasir, Balikpapan, Samarinda, Kutai Kartanegara, Kutai Barat, and Penajam Paser Utara (PPU). Within these districts a household survey and interviews were conducted to gain a better understanding of people's relationships to natural resources and of the impacts of energy price changes on their behavior.

Figure 1
The Case Study Site in East Kalimantan, Indonesia
On the East side of the island of Borneo



# 3. Profile of East Kalimantan

East Kalimantan is a suitable location for exploring the linkages between central policies, local livelihoods, and natural resources. The province is known for its wealth of natural resources, which provide important livelihood benefits to local people, as well as significant national development benefits. The value of these natural resources to different stakeholders, and for different purposes, creates a challenge for policymakers to promote equitable sharing of these benefits. For several of the natural resource sectors past extraction rates have been unsustainable which has led to a declining natural resource base, underscoring the importance of developing appropriate policies.

With an area of approximately 20 million ha, East Kalimantan is Indonesia's second largest province, and comprises 11% of the country's land area. The province is located on the east of Borneo, and is administratively divided into four cities (*kota*) and nine districts (*kabupaten*)[2]. There are two major cities. Samarinda is the provincial capital and is known as a centre for timber production. Balikpapan is known as the centre of commerce. The province's natural resources include forest products and deposits of gold, coal, oil, and natural gas. The economic value and exploitation of these resources has been a major factor in the province's history and development. Figure 1 provides a map of the case study site within the province of East Kalimantan.

## 3.1 East Kalimantan's Social Profile

East Kalimantan's population in 1961 was around 550,000 but a steady influx of transmigrants mostly from East Java, South Sulawesi, South Kalimantan, and Central Java rapidly increased the population to its current (2007) level of 3.2 million (Jakarta Post 2008a). This migration created a patchwork of cultural and linguistic diversity that is evident in the 80 or so regional languages and dialects spoken across the province. East Kalimantan's population is a mixture of ethnic groups that includes indigenous Dayak and Kutai as well as immigrants dominated by Javanese, Chinese, Banjarese, Bugis, and Malay people. Bugis and Malay, who are mostly Muslim, dominate the southern part and most coastal areas; the northern and north-western parts are home to important minorities of Christians and indigenous peoples.

About the same amount of people live in rural as in urban areas, leading to a skewed distribution of population densities. Nearly 40% of East Kalimantan's inhabitants live in the cities of Samarinda and Balikpapan, and population densities in these there are 818 people/km2 and 629 people/km2 respectively. In contrast, the average population density for the entire province is only around 13 people/km2.

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[2] East Kalimantan's districts (*kabupaten*) are: Pasir, Kutai Barat, Kutai Kartanegara, Kutai Timur, Berau, Malinau, Bulungan, Nunukan, and Penajam Pasir Utara.

According to official statistics, around 11% of East Kalimantan's population, or 325 thousand people, were classified as poor in 2007, which is significantly lower than the national average of 16.7%. Most of the poor live in rural areas and around 71% of them work in agriculture. The districts Kutai Kartanegara, Bulungan, and Malinau have significant amounts of poor households relative to the province as a whole (World Bank 2006).

In terms of school enrolment, East Kalimantan lies near the middle of Indonesia's provinces. Around 50% of the populace aged 10 and above has not finished junior high school (*Sekolah Menengah Pertama*, SMP) and 26% did not go beyond pre-school (*Sekolah Dasar*, SD). People with higher education tend to live in urban areas.

Statistics summarized by the World Bank show that coverage of roads and access to telephones is better in East Kalimantan than in Indonesia as a whole. However, more than half of the roads in Kalimantan were found to be in poor or bad condition and appeared to be deteriorating. Also, in spite of being rich in energy sources, access to electricity in East Kalimantan is slightly lower than average (World Bank 2006b). East Kalimantan faces recurrent shortfalls of electricity, with demand outstripping supplies from the national electricity company (PLN), which leads to routine blackouts (GOI 2008).

**Table 1: Selected Development Indicators for East Kalimantan**

| SOCIO ECONOMIC INDICATORS | E. KALIMANTAN | INDONESIA |
|---|---|---|
| Villages with PLN electricity | 93% | 96% |
| Villages with concrete or asphalt roads | 88% | 74% |
| Villages with a telephone | 84% | 69% |
| Poor people | 11% | 16.7% |
| Population | 3.2 million | 237.5 million |
| Population Density | 13 people/km2 | 130 people/km2 |

Sources: World Bank 2006b, CIA World Fact Book, Jakarta Post 2008a

From a governance standpoint, an important feature of East Kalimantan's social profile is the divide between rural and urban, and immigrant and indigenous, along cultural and economic lines. Most poor live in rural areas, while the cities attract the more educated. Large tracts of East Kalimantan's interior are remote and accessible only by way of the extensive river system that criss-crosses the province. Communities in remote areas often practice traditional lifestyles, governed by *adat* law and customs, and practice swidden farming as their main economic activity. For example, in the mountainous areas of Pasir district, access to land continues to be regulated by traditional law and agreements between communities, rather than by national law or government policies (Bakker 2006). In northern East Kalimantan, perceived imbalanced regional development and a poor state of public services has led to a proposal for several districts to form an autonomous North Kalimantan province (Jakarta Post, 25/2/2008).

One of the arguments brought by proponents of decentralization is that it makes local government more accountable to local people. There are reports of increased popular influence on governance at the district level, which has led to an increased role of *adat* rights in political discourse (Bakker 2006). In Berau, many forest dependent communities began to voice claims against forest

concessionaires who they felt were encroaching on their traditional territories. In some cases, communities were awarded payments by concession companies, but often without long-term benefits (Obidzinski and Barr 2003).

## 3.2 East Kalimantan's Natural Resources

East Kalimantan's natural resource base makes the province important to the national economy, but the extraction of its many resources also creates governance challenges related to the distribution of taxes and royalties and to the rights of local communities. Timber, mining, and the oil and gas industries are the base for Kalimantan's wealth and the region's largest contributions to GDP come from the extractive industries (24.5%) and manufacturing (28.6%). The region's agricultural sector is small in comparison (contributing only 15.6%), but plays a disproportionately important role for the province's poor (World Bank 2006).

Demand for greater control over revenue derived from local natural resources was one of the drivers for greater independence from the center, and the decentralization process was met with jubilation in resource rich areas such as East Kalimantan (Obidzinski and Barr 2003). However, the partial reversion of the decentralization process and the ensuing lack of clarity over responsibilities for resource allocation continues to create tension between district level and central government.

Also, economic pressure to develop the natural resource based sectors may conflict with the interests of local people whose livelihoods depend on the existence of productive forests and waters. Several of the natural resource sectors, including forestry, oil, and fishing are facing declining yields due to overharvesting or lack of investment, underscoring the need for policies that support the sustainable use of natural resources.

### 3.2.1 Forestry Sector

Borneo, which includes Kalimantan, supports the largest expanse of tropical rainforest in the Indomalayan region. These rainforests are among the most species rich in the world and have a high level of endemism, making them globally important for the conservation of biodiversity (MacKinnon et al. 1986). East Kalimantan's forests also provide national economic benefits by supporting a large wood processing industry that creates jobs, revenue, and foreign exchange earnings. East Kalimantan's forests also provide significant livelihood benefits to local communities, ranging from agroforestry crops, to medicinal plants.

Data from Indonesia's Ministry of Forestry (MOFR) indicate that East Kalimantan's Forest Estate (*Kawasan Hutan*) covers 14.7 million ha, of which approximately 10 million ha are forested. The Forest Estate is comprised of 2.8 million ha designated as Protection Forest (*Hutan Lindung*), 5.1 million ha designated as Production Forest (*Hutan Produksi*), 4.6 million ha designated as Limited Production Forest (*Hutan Produksi Terbatas*), and 2.2 million ha of nature reserves (*Suaka Alam*). Timber plantations cover around 1.2 million ha. In

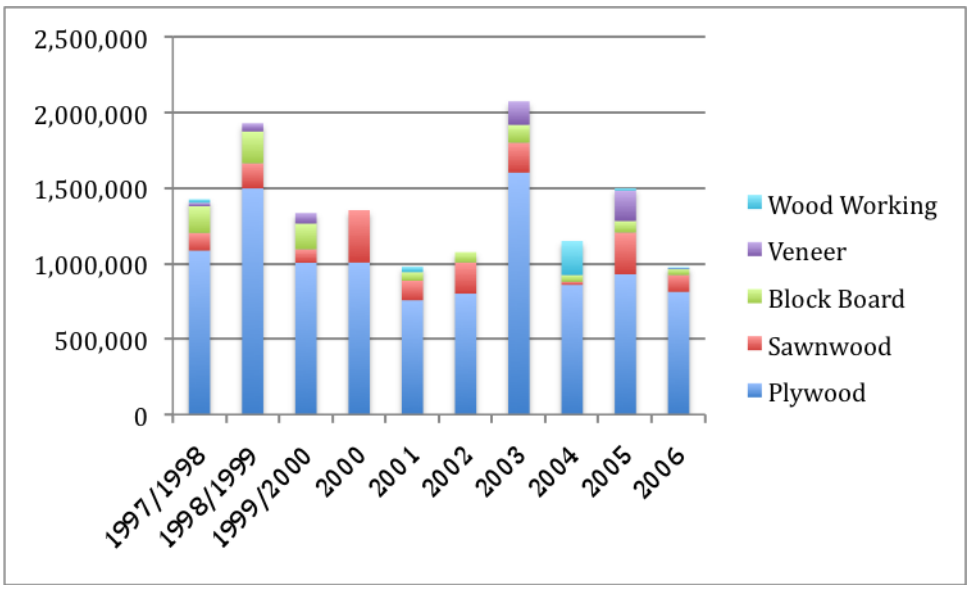
addition, areas excised from the Forest Estate, for non-forestry uses (*Areal Penggunaan Lain*) cover 4.8 million ha (MOFR 2007).

Timber produced by East Kalimantan's forest areas mainly supplies the province's wood manufacturing sector. Licensed production capacity for primary wood products (which exclude pulp) is approximately 3 million $m^3$ per year. Annual production capacity for plywood and veneer is around 1.7 million $m^3$, for sawn timber 0.7 million $m^3$, and for wood chips 0.6 million $m^3$. In total there are around 28 primary wood processing mills in East Kalimantan (MOFR 2007). PT Kertas Nusantara (ex-Kiani Kertas, name changed in 2007) is located in Berau, around 300 km north of Samarinda, and is East Kalimantan's only existing large scale pulp mill. There are also reports of plans to develop at least one other large-scale pulp mill in East Kalimantan (Asia Pulse 2008).

MOFR data, recapitulated in Figure 1, show recorded primary wood products manufacturing since 1997 with an output approaching 1 million $m^3$ in 2006. Two things stand out from the production data- firstly, the overwhelming dominance of the plywood subsector which accounts for around 90% of East Kalimantan's production of primary wood products by volume; and secondly, the significant amount of idle production capacity.

Production levels since 1997 were consistently less than 70% of potential volume, and less than 30% of capacity in 2006. The low capacity utilization is largely due to a shortage in raw material supplies caused by the decreasing availability of timber from East Kalimantan's forests. In recent years, many plywood producers were forced to shut down, as the level of legal timber supplies did not allow profitable operation. Also, the PT Kertas Nusantara pulp mill has as at times been beset with fiber supply problems and production has been far below capacity. Remaining plywood producers in East Kalimantan, such as Sumalindo Lestari Jaya, are increasingly developing industrial plantations to make up for decreasing supplies of timber from natural forests.

**Figure 1: East Kalimantan's Production of Primary Wood Products ($m^3$)**



Source: MOFR 2007

East Kalimantan's forests are also endowed with numerous non-timber forest products (NTFPs) that provide important economic benefits to local people. Indonesia's forests produce a wide range of NTFPs, including rattan, various resins, medicinal plants, bird's nests, gaharu wood, honey and many other products (Bennett and Walton 2003). The most important, and increasingly recognized feature of NTFPs is their subsistence use and the role they play in serving as social safety nets during times of economic hardship. The following excerpt from Peluso (1991) provides a useful description of rattan harvesting and how this fits into the livelihood strategies of swidden cultivators:

> Rattan collection is generally a part time activity for various members of peasant or off-farm laboring households who work individually or in groups. It is but one of a variety of economic activities, which in the course of the year might include swidden cultivation (of rice, legumes, and vegetables); cultivating rubber, pepper, cloves, rattan, coconuts or other cash crops; gathering other non timber-forest products; making shingles, planks and posts; hunting wild animals or raising livestock; or working for wages at logging concessions, distant timber camps or tree crop plantations. The opportunities to engage in these activities, including rattan collection depend on the seasons, the market, or the agricultural cycle in the locality.

Recorded rattan production for the province in 2006 was 2,791 tonnes out of 24,554 tonnes produced nationwide (MOFR 2007). Most rattan production in Indonesia is exported, either unprocessed, or as furniture. Domestic rattan furniture production is centered in Java.

### 3.2.2 Agriculture and smallholder plantation crops

While agriculture is not a major contributor to regional GDP, the sector plays a disproportionately large role in providing livelihoods for the province's poor. East Kalimantan's land is generally unsuitable for large-scale cultivation and yields per area are only around 60% of those achieved in Java and Bali (Oosternaan 1999). However, small-scale cultivation of various agricultural products is widespread and tribal groups in the province's interior, such as the Kenyah and Dayak, mostly practice swidden agriculture (Peluso 1991). According to East Kalimantan's Agricultural Department, small-scale crop production employs over 200,000 people, which does not include those involved in cultivating subsistence crops, such as rice, legumes or vegetables (Dinas Perkebunan Kaltim 2007).

**Table 2: Smallholder Plantation Crops in East Kalimantan**

| Product | Area (ha) | Production (t) | Employment |
|---|---|---|---|
| Oil Palm | 72,909 | 414,007 | 48,914 |
| Rubber | 56,242 | 52,806 | 38,447 |
| Coffee | 15,288 | 4,860 | 26,961 |
| Coconut | 35,056 | 33,907 | 43,806 |
| Pepper | 14,511 | 11,153 | 14,764 |
| Cacao | 35,415 | 27,632 | 35,232 |
| Others | 8,320 | 7,004 | 12,082 |
| **Total** | 237,741 | 551,369 | 220,206 |

Source: Statistik Dinas Perkebunan Kaltim, 2007

Both oil palm and rubber are produced by smallholders as well as by large businesses that use an industrial plantation mode of production. Agricultural Service data indicate that in East Kalimantan smallholders (*perkebunan rakyat*) produce 92% of the rubber. Nearly half of the roughly 56,000 ha devoted to rubber production is located in Kutai Barat District, but significant areas are also located in Kutai Kartanegara, Pasir, PPU and Balikpapan. Most of the rubber harvest is shipped to Banjarmasin, in South Kalimantan, for processing (Dinas Perkebunan Kaltim 2007).

Coffee and coconut have a long history of cultivation in the province and are mostly consumed locally. Pepper used to be an important export product of East Kalimantan, but the combination of a drop in global pepper prices, extensive damage to plantations from fires, and an extended drought in 1982 greatly reduced the output, which is now mainly for local consumption. Cacao, on the other hand is largely produced for export to Sabah, Malaysia and to the USA via Makassar, South Sulawesi (ibid.).

### 3.2.3 Oil Palm

Oil palm plantation establishment in East Kalimantan began in 1982 through a government sponsored community based plantation scheme (*Proyek Perkebunan Inti Rakyat* or PIR). Oil Palm plantations are found in nearly all of East Kalimantan's districts, and official statistics place the area under oil palm production at 338,013 ha. Of this area, 72,909 ha are classified as smallholder owned (*perkebunan rakyat*), 251,554 ha are owned by large plantation companies, and 13,551 ha are state owned. The sector employed 104,172 people in 2007: 48,914 in smallholder plantations, 50,231 in large-scale private plantations, and 5,300 in large state-owned plantations. In recent years, the area under oil palm has increased dramatically, more than doubling between 2002 and 2007(Dinas Perkebunan Kaltim 2007).

Table 3: Palm Oil Production by District, 2007

| District | Area (ha) | Production (t) | Employment |
|---|---|---|---|
| Samarinda | 332 | - | 135 |
| Balikpapan | - | - | - |
| Kukar | 60,692 | 256,865 | 23,693 |
| Kubar | 5,371 | 6,124 | 1,987 |
| Kutim | 93,984 | 288,930 | 17,336 |
| Bontang | - | - | - |
| Paser | 66,119 | 653,739 | 30,110 |
| PPU | 24,076 | 197,228 | 4,876 |
| Berau | 24,195 | - | 3,687 |
| Bulungan | 13,351 | - | 3,179 |
| Malinau | - | - | - |
| Nunukan | 49,895 | 636,576 | 19,172 |
| Tarakan | - | - | - |
| Total | 338,013 | 2,039,461 | 104,172 |

Source: Dinas Perkebunan Kaltim

**Table 4: East Kalimantan's Palm Oil Production, 2002-2007**

| Year | Area (ha) | Production (t) | Employment |
|---|---|---|---|
| 2007 | 338,013 | 2,039,461 | 104,172 |
| 2006 | 225,337 | 1,268,600 | 88,014 |
| 2005 | 201,087 | 1,012,789 | 77,757 |
| 2004 | 171,581 | 957,058 | 72,250 |
| 2003 | 159,079 | 791,064 | 64,339 |
| 2002 | 132,174 | 760,293 | 51,737 |

Source: Dinas Perkebunan Kaltim, 2007

### 3.2.4 Fisheries

East Kalimantan's coastal fishery area spans around 12,000 ha, the area potentially available for aquaculture in brackish water is around 91,380 ha, and general water bodies cover 2.8 million ha (GOI 2007). Total fish production in 2006 was 101,187 tonnes, production from general water bodies was 30,964 tonnes, and land-based fishery production was 50,465 tonnes. Most of East Kalimantan's international fish exports are to Japan, but lesser markets include the USA, Hong Kong, Malaysia, Singapore, and several European countries (GOI 2007).

**Table 5: East Kalimantan's Fishery Exports 2002**

| Product | Weight (kg) | Value (US$) |
|---|---|---|
| Fresh Fish | 44,350 | 200,950 |
| Live Fish | 213,218 | 332,970 |
| Frozen Shrimp | 13,500,300 | 15,138,280 |
| Fresh Shrimp | 692,500 | 13,140,000 |
| Others | 3,598,351 | 82,324,740 |
| Total | 18,048,719 | 111,136,940 |

Source: http://kelautan-perikanan.kaltimprov.go.id Dinas Perikanan Dan Kelautan Kaltim

Freshwater fish and shrimp farms are widespread in rivers, lakes, ponds and swamps. Major rivers where aquaculture occurs include, the Mahakam, Kayan, Kelai, Segah, and Sesayap rivers (Kompas 2004). However, most of the output from freshwater sources continues to come from traditional fishing rather than from aquaculture, which according to some commentators has not reached its full potential (Kompas 2004, Kaltim Post 2007).

Fish catches are reportedly declining due to the erosion of East Kalimantan's mangrove forests and seagrass beds, which are important fish habitats. Most of the 150,000 ha of mangroves in the Mahakam delta have been converted into fish and shrimp ponds (Delft University, 2007). Other causes of mangrove loss are sediment dumping from the rivers due to erosion from over-logged areas, and loss to other development causes, such as urban pollution and reclamation (Rhee et al 2004). Environmental degradation in Indonesia's coastal areas, which includes damage to mangroves and reefs, may have led to declines in the fish population of between 5% and 10%, and to corresponding declines in catches (GOI 2004).

### 3.2.5 Oil and Gas

Indonesia's production of crude oil and condensate has been declining largely as a result of maturing oil fields and declining investment. In 2006 Indonesia produced an average of 1 million barrels per day (bpd), down from 1.5 million bpd in 1999. Data for overall oil production from East Kalimantan was not available, however, the US Embassy's Indonesia Petroleum Report for 2007 mentions that daily gross production from Chevron's East Kalimantan sites averaged 34,000 barrels of oil and condensate. The Balikpapan refinery, one of nine in Indonesia, refined 254,500 barrels per day of crude oil in 2006, out of 958,500 bpd for Indonesia as a whole. However, the Balikpapan refinery is designed to refine only imported crude oil (US Embassy 2008).

Indonesia is currently the second largest exporter of liquid natural gas (LNG) providing around 14% of global supply. National gas reserves are abundant, and nearly four times as large as Indonesia's oil reserves. Around 55% of Indonesia's gas is exported, 5.6% is used for domestic electricity, 6.4% is used for fertilizer production, and 3.4% to supply city gas. LNG exports were valued at US$ 10.4 billion in 2006.

East Kalimantan's gas resources constitute around 25% of Indonesia's total offshore gas deposits. Also, the largest LNG plant in the world is the Bontang facility in Badak, East Kalimantan. The plant, which has an annual production capacity of 21.6 million tonnes is supplied by Chevron, Vico, and Total. Production at Bontang was 19.6 million tonnes in 2004. The national gas company, PGN, is planning the construction a 1,200 km gas pipeline that will connect Badak to Semarang in Central Java (US Embassy 2008).

### 3.2.6 Mining

East Kalimantan has around 28% of Indonesia's total coal resources (MEMR 2007) and some of Indonesia's most productive coalmines. In 2008 the province's recorded coal production was 94.5 million tonnes, out of 169.7 million tonnes for Indonesia as a whole (MEMR 2009). Coalmines are found in Kutai, Pasir, Berau,

Bulungan and Samarinda. Other mineral deposits include gold, silver, iron, nickel, phosphate, and lead (GOI 2007). Besides large scale coalmining operations, since 1998 there has been an increase in illegal mining which often leads to increased pollution and damage to forests (GoI 2005).

**Table 2: East Kalimantan Coal Production, 2008**

| Company | Production (t) |
|---|---|
| Kaltim Prima Coal | 32,502,184 |
| Kideco Jaya Agung | 19,884,675 |
| Berau Coal | 11,926,212 |
| Indominco Mandiri | 9,959,412 |
| Trubaindo Coal Mining | 4,172,888 |
| Gunung Bayan Pratamacoal | 3,204,939 |
| Mahakam Sumber Jaya | 2,816,541 |
| Tanito Harum | 2,557,335 |
| Mandiri Intiperkasa | 1,822,939 |
| Multi Harapan Utama | 1,441,720 |
| Lanna Harita Indonesia | 1,261,626 |
| Perkasa Inakakerta | 959,922 |
| Bukit Baiduri Energi | 741,490 |
| Insani Bara Perkasa | 696,236 |
| Kartika Selabumi Mining | 207,844 |
| Teguh Sinar Abadi | 196,766 |
| Fajar Bumi Sakti | 93,377 |
| Firman Ketaun Perkasa | 23,064 |
| **Total** | 94,469,171 |

Source: Ministry of Energy and Mineral Resources 2009

While mining is currently productive, there are signs that underinvestment in the sector will lead to supply shortfalls in the future. A recent PwC survey (cited in Forbes 2008) found that the main impediments to investment in Indonesia's mining sectors are as follows: conflict between mining and forestry regulations; duplication or contradiction between the central and local government; taxation issues; delay to finalization of the mining law; and lack of fairness in divestment of foreign mining interests.

# 4. Household Survey Results

The design of the Agent Based Model (ABM) for the East Kalimantan case study required an extensive household survey that yielded a wealth of information about the role of natural resources in the lives of local people. Households were grouped into a discrete number of types where each member would respond in the same way to a given policy change. A survey consisting of 27 questions relating to household characteristics was carried out among 3,000 households, spread equally across the six kabupaten/kota. Data were collected on household location, composition, assets, wage income, and benefits derived from natural and social resources (Table 6).

**Table 6: Categories of Survey Questions**

| Household identification & location | Household composition | Assets | Wage income | Benefits from natural & "social" resources |
|---|---|---|---|---|
| Name of household head<br>Address<br>District<br>Village<br>Type of house | Identity of respondent (e.g. role in household)<br>Size<br>Demographics<br>Education<br>Origin<br>Ethnic group(s) | Number of assets owned (e.g. house, car, motorbike, fishing boat)<br>Assets owned that are worth more than annual salary | Who earns<br>Type of work<br>Location of work<br>Time spent working<br>Daily wages | Type of use or value of natural resources<br>Type of use or value of social resources (education, roads, recreation areas, social networks)<br>Frequency of use<br>Distance traveled to use<br>Mode of transport to use<br>Importance for income, nutrition, health, cultural values, recreation, security |

## 4.1 Natural resource use and values

### 4.1.1 Use of Natural Resources

A major component of the survey was related to the use of various natural resources by households. Natural resources covered were the following:

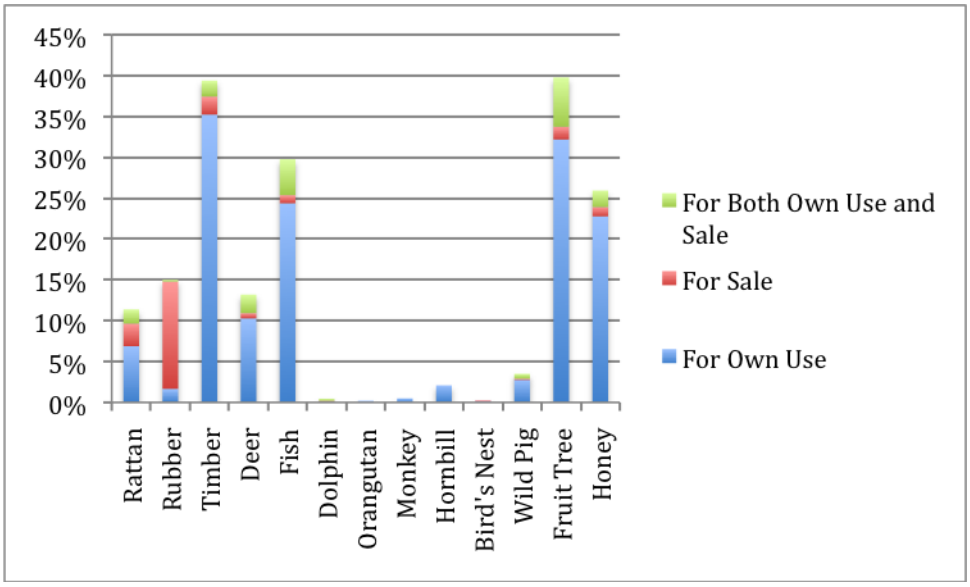
- Rattan
- Rubber
- Timber
- Deer
- Fish
- Dolphin
- Orangutan
- Monkey
- Hornbill
- Bird's Nests
- Wild Pig
- Fruit Trees
- Honey

Among other questions, households were asked which of these resources they use, and whether this use was for own consumption, for sale, or for both. 'Use' for the purpose of the survey was defined to cover harvesting as well as value-added activities but to exclude resources that were purchased.

Close to 40% of households indicated that they use timber and fruit trees. Most of this use is for household consumption. Other natural resources used by a significant percentage of households are fish (30%), honey (26%), rattan (11%), rubber (15%), and deer (13%). Rubber is the only natural resource where a significant amount of household 'use' is for sale.

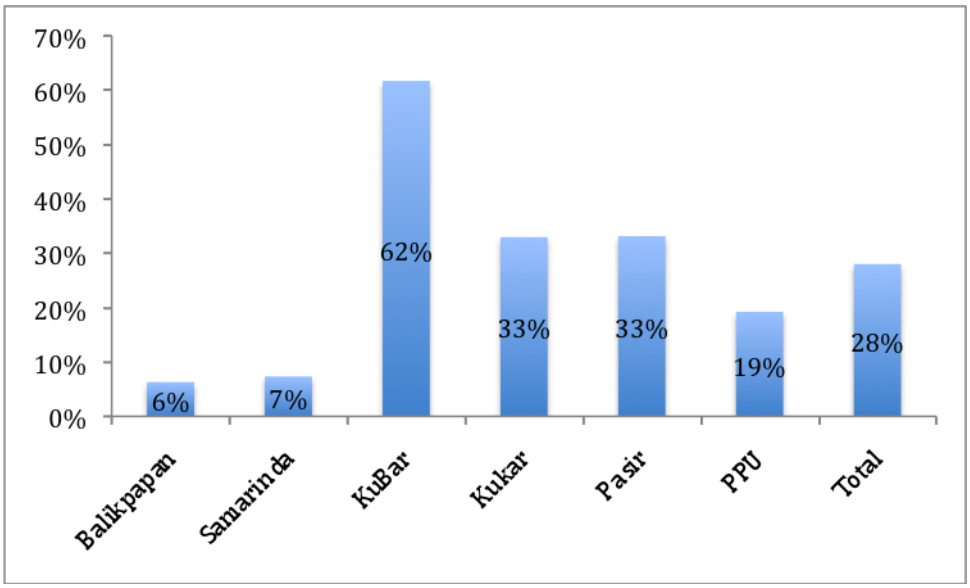
The number of households indicating that they sell natural resources declines somewhat as household wealth increases. For the 400 households with the lowest household income, 39% indicated that they sell natural resources. This proportion declines to 11% for the 400 households with the highest income.

**Figure 3: Use of Natural Resources by All Households Surveyed**




In total 28% of households indicated that they sell natural resources (this category includes those households that indicated that they only sell and those that indicated that they sell and use natural resources for their own consumption). This proportion varies somewhat by district with Kutai Barat having the highest proportion of households (62%) that sell natural resources. In the urban districts of Balikpapan and Samarinda the proportion is only 6% and 7% respectively (Figure 4).

**Figure 4: Proportion of Households Selling Natural Resources by District**




### 4.1.2 Values of Natural Resources

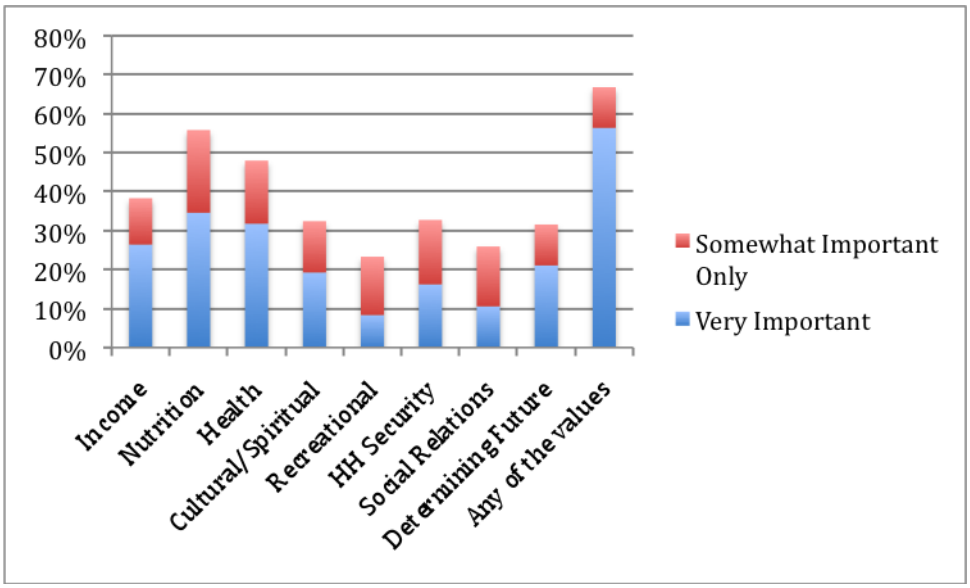
In addition to questions about the use of the thirteen natural resources studied, households were asked to indicate the importance of these resources to the following eight "values":

- Income
- Nutrition
- Health
- Cultural or Spiritual
- Recreational
- Household Security
- Social Relations
- Determining Future

Households were asked to limit their answers to resources that were not purchased, and were given three choices in answering the survey: not important at all, somewhat important, and very important.

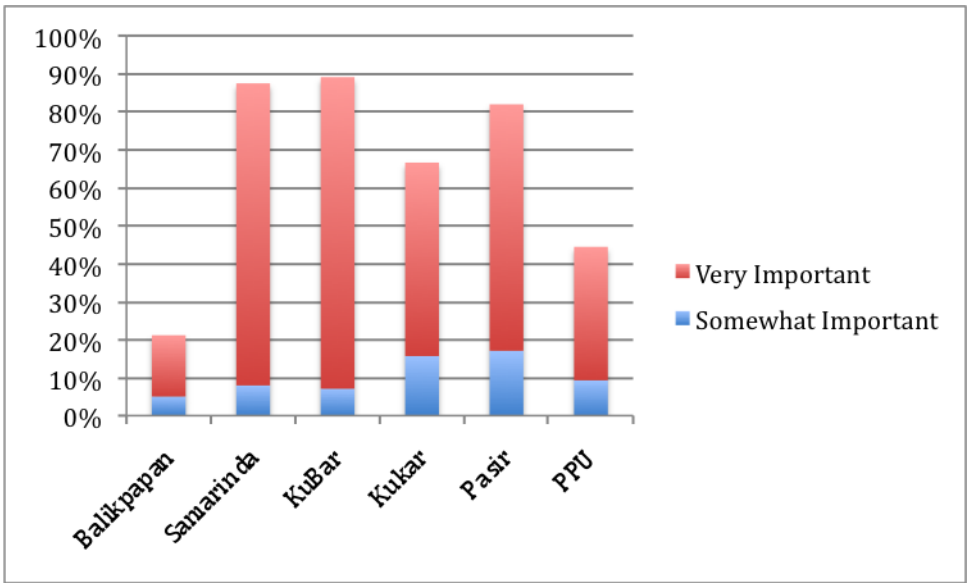
One indicator of the importance of natural resources to households is the number of households that value at least one natural resource for at least one of the values. The result of this analysis, shown in the last bar of Figure 5, is that 56% of all households found at least one natural resource to be very important for at least one of the values measured, and an additional 10% found at least one natural resource to be somewhat important.

**Figure 5: Percentage of Households Indicating Importance of at Least One Natural Resource**




Household responses show significant variation across districts. Only 21% of households in Balikpapan value at least one natural resource for at least one of the values investigated, compared to 89% in Kutai Barat. A logical explanation for the low valuation of natural resources in Balikpapan is that most of the households there live in an urban environment, with less exposure to, and dependency on natural resources than rural households. However, in Samarinda – the other urban district- the proportion of households that claimed to value natural resources is higher than average. Valuation of natural resources seems to be unrelated to household income.

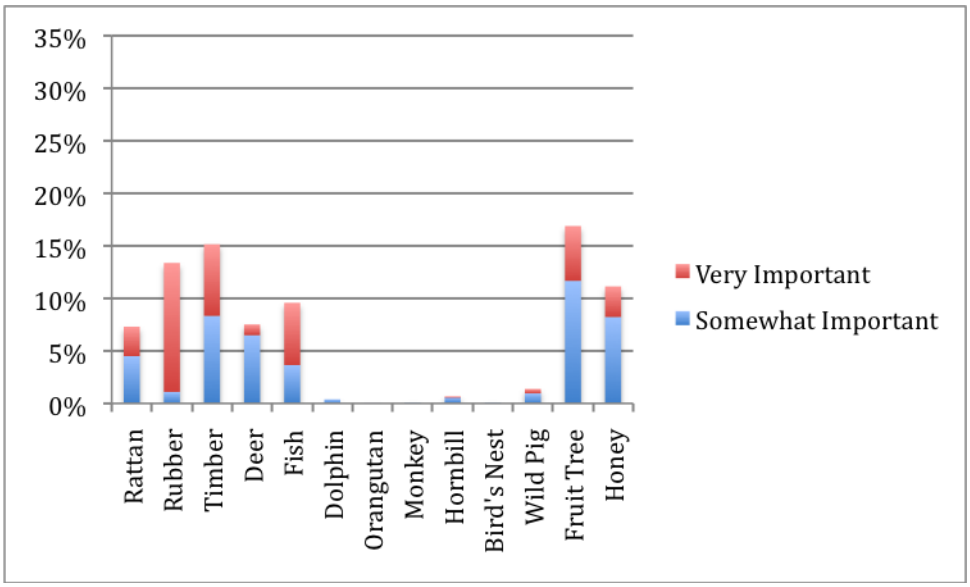
**Figure 6: Importance of Natural Resources, for Any Value, to Households by District**




**Value of Natural Resources to Household Income.** In the area of income, the number of households indicating that at least one natural resource was very

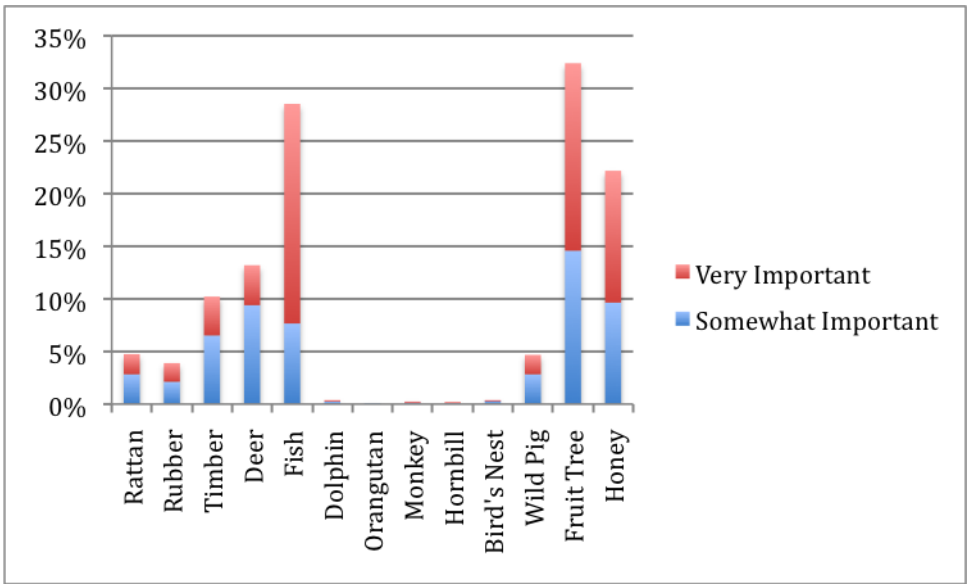
important or somewhat important was 38% (26% very important, and an additional 12% somewhat important, Figure 5). The natural resources that were very important for income to a significant percentage of households were rubber (12%), timber (7%), fish (6%), fruit trees (5%), and honey (3%) (Figure 7). Many households indicated that natural resources were somewhat important (but not very important) to income: Fruit trees 12%, honey 8%, rattan 5%, timber 8%, deer 6%, fish 4%. The numbers of households indicating that these natural resources are only somewhat important to them gives weight to the argument that income from these resources is often part of a mixed livelihood strategy. As a counterpoint, the number of households indicating that rubber is only somewhat important for income (1%) compared to the number stating that it is very important (12%) is small, suggesting that for most households involved in rubber production this is a main source of income.

**Figure 7: Importance of Natural Resources to Household Income**



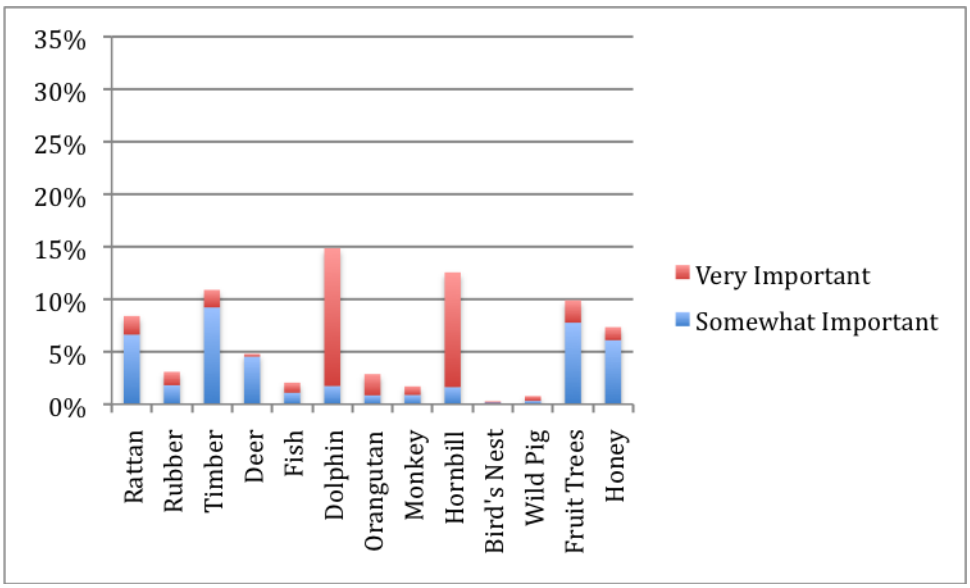

**Value of Natural Resources to Household Nutrition and Health.** Comparing individual household values, as presented in Figure 5, shows that the area of nutrition has the greatest number of households (56%) that value at least one natural resource. Analyzing the responses in the area of nutrition, shows that the natural resources most valued for nutrition are fish, fruit trees, and honey (Figure 8). The same three resources stand out in importance for household health.

**Figure 8: Importance of Natural Resources to Household Nutrition**




**Value of Natural Resources for Cultural or Spiritual Purposes**. A significant share of households indicated that they found natural resources somewhat important for cultural or spiritual purposes (Figure 5). Dolphins and hornbills stand out for having very important cultural or spiritual value to more than 10% of households surveyed (Figure 9). Both the fresh water dolphin and hornbill are associated with East Kalimantan's natural heritage and this may explain the value placed on them by local households. However, given this reasoning, the relative low number of households indicating that they find orangutan to have cultural or spiritual value is somewhat surprising.

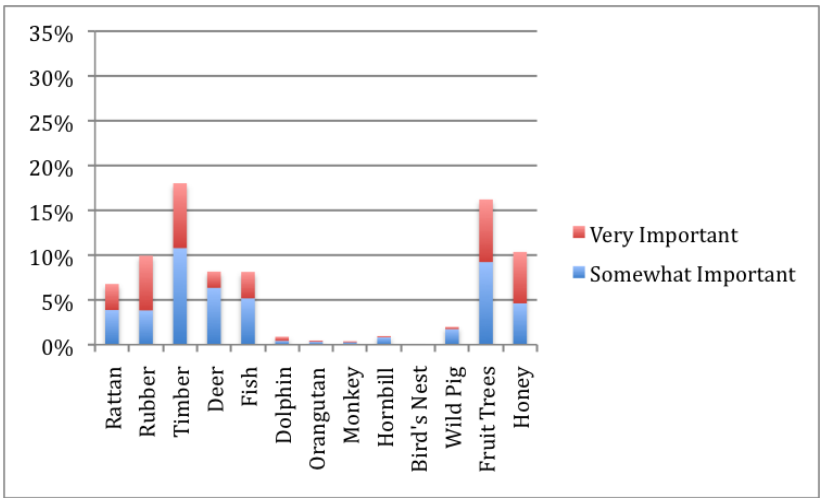
**Figure 9: Importance of Natural Resources to Cultural or Spiritual Values**




**Value of Natural Resources for Household Security.** From an economic development perspective, the importance of natural resources for household security and for determining the future are arguably the most important indicators, as these encompasses several other values. For both household

security and determining future, slightly over 30% of households indicated that at least one natural resource was either somewhat or very important; 16% and 21% indicated that at least one natural resource was very important to household security and determining the future respectively (Figure 5). For household security, the natural resources that were indicated by more than 5% of households as being very important were: rubber (6%), timber (7%), fruit trees (7%) and honey (6%) (Figure 10).

**Figure 10: Importance of Natural Resources to Household Security**




## 4.2 People's Perceptions of Local Climate Change in East Kalimantan

Climate change has emerged as a key development and environmental issue in Indonesia, with important policy implications. Therefore, in addition to the questions asked of households to develop a household typology, the survey included a category of questions concerning the perceptions and behavior of households related to local changes in climate. The following five questions were asked:

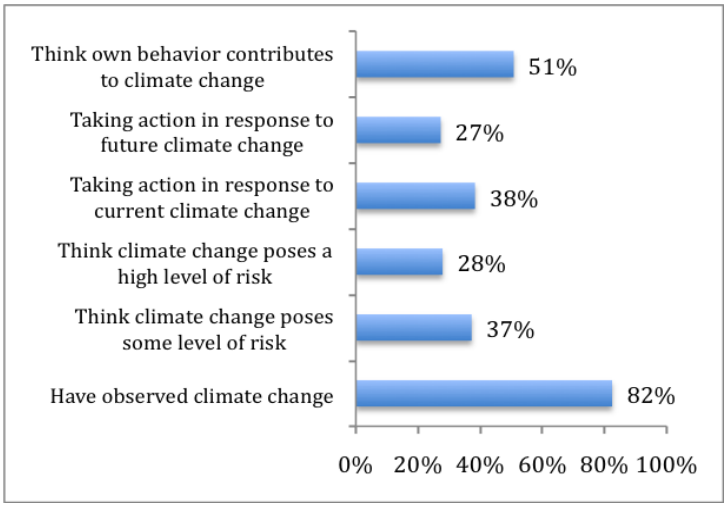
- *Have you observed climate change in your lifetime, such as changes in annual rainfall, temperature or stream flow?*
- *What level of risk do you think climate change poses to you and your household?*
- *Are you taking action in response to climate change that is now occurring?*
- *Are you taking action to reduce climate change that you expect to occur in the future?*
- *Do you think your behavior contributes to climate change?*

The results of the survey show a surprisingly high level of awareness of local climate change as observed in changes in annual rainfall, temperature, or streamflow. Of the total households who answered the question, 82% claim to have observed this kind of local climate change in their lifetime. This number is somewhat lower for Balikpapan (65%), and Samarinda (70%).

Overall, 28% of households think that climate change poses a high level of risk, with another 37% thinking that climate change poses some level of risk. The

proportion of households who do not think that climate change poses a risk is highest in the city districts (Balikpapan 48%, and Samarinda 45%).

**Figure 11: Perceptions of Climate Change, All Households Surveyed**




A possible explanation for the difference in perceptions of rural and urban households is that people in the cities are less exposed to local climatic changes than people living in rural communities. Rural people are more likely to be involved in livelihood activities that rely on favorable climate conditions, such as farming or fishing.

In total, 51% of households think their own behavior contributes to climate change. This proportion is higher for households where the household head has not had any formal schooling (72%), and for households located in Samarinda (70%), Kutai Kartanegara (61%), and PPU (61%). On average, 37% of households claim to be taking action in response to current climate change, and 27% claim to be taking action against expected climate change. These proportions are noticeably higher for households where the household head has not had any formal schooling (59% and 42%), and for households located in Kutai Kartanegara (49% and 34%) and Pasir (56% and 54%).

An interesting result is that there is a discrepancy between the number of households who think that their own behavior contributes to climate change and the number that claim to be doing something about it. This discrepancy is highest in PPU where 61% of households think their behavior contributes to climate change, and only 22% claim to take action in response to current changes. A tempting explanation is that land use and population dynamics in PPU are forcing people to engage in unsustainable land use practices against their better judgment. However, without a better understanding of how households interpreted the survey questions (what exactly is meant by 'own behavior' and 'actions to reduce climate change'?) it is not possible to draw such simple conclusions.

## 4.3 Household Types

Following the survey, a typology was designed to capture the key characteristics distinguishing households in the region- their livelihood strategies, and their

values- in order to identify their likely behavioral responses to certain policy or economic changes at the broader (national or regional) level. The details of how the typology was derived are fairly complex and are part of the technical specifications of the model, which is beyond the scope of this report. However, this section provides a cursory overview of the design and a brief description of the household types that encompass households that are directly dependent on natural resources.

In brief, the typology designed for this case study is based on the assumption that people that face the same conditions (e.g., education), and do the same thing (livelihood) for the same reason (value set) will respond similarly to the same change. A cluster analysis was used to determine household types. The analysis included a two-step approach, where the final type of a household depended on an overall set as well as site-specific sets of clusters. In total 3 main types of agents were identified, each with several subtypes, for a total of 19 household types for the region. Profiles for each household type were developed based on the characteristics that households have in common within each cluster.

The variables with the greatest ability to distinguish types were unique to each site. For example, two household types in Samarinda were identified on the basis of household dependence on natural resources (as expressed by the importance placed on these resources for income and other purposes), the ethnic group to which the household belongs, the number of boat engines the household owns, and the extent to which the household values recreation, roads, education, and social networks for income.

The cluster analysis grouped most natural resource-dependent households into four types, as profiled in

Table 7. In Kutai Kartanegara most rubber dependent households fall under the type KuKar2, while most fish dependent households of this district fall into the type KuKar3. In Pasir the majority of natural resource dependent households fall under type Pasir4 and in Kutai Barat under type KuBar2. If the focus is set more narrowly on small-scale timber logging, the data reveal that nearly all surveyed households that depend on timber are located in Pasir (and fall in the type Pasir4). A similar concentration can be observed for Rattan, while the distribution is more spread for rubber and fish.

**Table 7: Profiles of the Four Natural Resource Dependent Household Types**

| Name and Location | Profile |
|---|---|
| **KuKar2** | 283 households out of 440 surveyed in region |
| **Kutai Kartanegara** | Largest group in Kutai Kartanegara; |
| | Includes nearly all rubber dependent households of Kutai Kartanegara |
| | Many unemployed; |
| | Do not value social networks for income and do not own boat engine; |
| | Do not value fish, timber or social networks for income; |
| | Majority has no valuable assets; |
| | Migrants/newcomers, live from illegal logging mostly, live in upper parts, squatting areas/new development, below average income |
| **KuKar3** | 44 households out of 440 surveyed in region |
| **Kutai Kartanegara** | Employed in fishing; |
| | Includes nearly all fish dependent households of Kutai Kartanegara |
| | 100% value fish for income, 40% value education for income, 78% do not value social networks and 70% not roads for income; |
| | Low income group |
| | Fishermen that live in more accessible areas (Kecamatan Kota Bangun & Danau Jempan, Muara Wis), have good transportation and market access (buyers come), |
| **Pasir4** | 263 households out of 499 surveyed in region |
| **Pasir** | Largest group in Pasir; |
| | Includes nearly all timber dependent households of total surveyed; |
| | Dominantly employed in primary industries; |
| | Value Rattan, Honey, Timber, Fruit trees, and roads for income; |
| | Average income for region |
| | Traditional area in Pasir; no significant oil palm plantation program; road segment from Kuaro to Muara Komam; Depend often on Ladang; Natural resources highly used; Good market access by road |
| **KuBar2** | 66 households out of 518 surveyed in region |
| **Kutai Barat** | Smallest group; |
| | Majority employed in primary sector; |
| | Value timber, hornbill, fruit trees and social networks for income; |
| | Rubber very important for majority; |
| | Majority owns TV, water pump and other valuable assets; |
| | Above average income |

# 5. Interview Results: Energy Policy and Household Adaptation

A total of 540 households were interviewed on their behavioral responses to three scenarios that respectively involved an increase in the price of fuel (scenario 1), kerosene (scenario 2), and electricity (scenario 3). Five additional scenarios were included in the interview to allow the model to deal with ripple effects- i.e. identifying the effects on households of resource depletion linked to the first three scenarios. Thus, scenarios four and five deal with responses to depletion of forest stocks and fish stocks respectively. Scenarios six, seven and eight are concerned with increased availability of jobs in mining, logging, and oil palm industries. This last set of scenarios was included based on stakeholder input, and represents potential regional policy outcomes that may impact local household behavior. The eight scenarios are outlined in the table below.

**Table 8: Interview Scenarios and Questions**

| Scenario | Question Type |
|---|---|
| 1. Fuel Price Increase | If the petrol price increased from its current price (Rp. 4500/litre) to Rp. 5400/litre, would you change your household activities? |
| 2. Kerosene Price Increase | If the price of kerosene changed from its current price (Rp3500/litre) to Rp5250/litre, would you change your household activities? |
| 3. Electricity Price Increase | If your electricity bill doubles, would you change your household activities? |
| 4. Forest Depletion | Imagine that forest stocks were depleted and it became very difficult to log timber at the places you currently use. Would you change your household activities? |
| 5. Fish Stock Depletion | If fish stocks were depleted and it became very difficult to continue catching fish at your usual place, would you change your household activities? |
| 6. Employment in Coal Mining | Imagine there were new jobs advertised by the coal mining industry in KalTim (upstream in the Mahakam). Would you apply, and if employed would you change your household activities? |
| 7. Employment in Logging | Imagine there was new work advertised by a logging company in KalTim. Would you apply, and if employed would you change your household activities? |
| 8. Employment in Oil Palm | Imagine there was new work advertised by an oil palm plantation in KalTim. Would you apply, and if employed would you change your household activities? |

A local research team from the Center for Social Forestry at the University Mulawarman in Samarinda conducted semi-structured interviews in order to identify the major behavioral responses to the eight policy scenarios. Ninety households were interviewed at each of the six sites in which the survey had been conducted, and at least 10 households belonging to each household type at each location were interviewed. The interview began with a series of questions designed to identify the type of household within the typology. Next, each of the eight hypothetical scenarios was introduced and respondents were asked how

each scenario would affect a household's behavior related to changes in the following:

- Household use of timber, rattan, rubber, and fish
- Weekly hours of paid work
- Migration with and without the rest of the household
- Investment in assets (i.e. a motorbike, house or boat)
- Application for work should a new coal mining, logging, or oil palm company begin operating in the area
- Where migration or new work was involved, the household was also asked where it would most likely go

Households were also asked if they would respond in ways that were not covered by the main interview questions. A final set of open-ended questions on natural resource related livelihoods was asked to give respondents the opportunity to elaborate on their earlier responses and to allow for cross-checking of consistency.

## 5.1 Interview Responses Related to Natural Resource Use

**Timber.** Of the total households interviewed, 32 indicated that they log and sell more than 1 cubic meter of timber per month (25 households 1-75 m3, 5 households 76-125 m3, 2 households > 140 m3). Overall, most households responded that they would reduce or stop logging given fuel price increases or fish stock depletion.

**Table 9: Frequency of Responses Indicating Change in Logging Behavior**

| Scenario | Decrease by 100% | Decrease by 50% | No Change | Increase by 50% | Increase by 100% | Total Response |
|---|---|---|---|---|---|---|
| Petrol Price Increase | 7 | 17 | 3 | 0 | 0 | 27 |
| Kerosene Price Increase | 6 | 6 | 5 | 0 | 0 | 17 |
| Electricity Price Increase | 5 | 4 | 5 | 1 | 0 | 15 |
| Fish Stock Depletion | 3 | 6 | 3 | 0 | 0 | 12 |

**Rattan.** In total, 35 households indicated that they use more than 100 kg of rattan per year (24 use 101 to 750 kg, 5 use 751 to 1,250 kg, 1 uses 1,251 to 2,000 kg, 5 use more than 2,000 kg). As in the responses related to logging, households had a clear tendency to indicate decreased use of rattan under all scenarios, including the additional scenario of forest depletion. However, there was also a significant minority of households claiming that they would increase their use of rattan by 50% for the first four scenarios.

**Table 10: Frequency of Responses Indicating Change in Rattan Use**

| Scenario | Decrease by 100% | Decrease by 50% | No Change | Increase by 50% | Increase by 100% | Total Response |
|---|---|---|---|---|---|---|
| Petrol Price Increase | 7 | 17 | 1 | 1 | 0 | 26 |
| Kerosene Price Increase | 4 | 7 | 3 | 3 | 0 | 17 |
| Electricity Price Increase | 5 | 5 | 5 | 1 | 0 | 16 |
| Forest Stock Depletion | 2 | 1 | 1 | 2 | 0 | 6 |
| Fish Stock Depletion | 1 | 6 | 3 | 0 | 0 | 10 |

**Rubber.** Of the households interviewed, 52 indicated that they use more than 50 kg rubber per week (27 use 51-60 kg, 12 use 61-80 kg, 3 use 81 to 125 kg, 10 use more than 125 kg). Answers to the scenario questions were less skewed toward decreasing use, with a significant portion of households claiming that they would not change their use of rubber, and several stating that they would increase their use.

**Table 11: Frequency of Responses Indicating Change in Rubber Use**

| Scenario | Decrease by 100% | Decrease by 50% | No Change | Increase by 50% | Increase by 100% | Total Response |
|---|---|---|---|---|---|---|
| Petrol Price Increase | 3 | 12 | 12 | 4 | 0 | 31 |
| Kerosene Price Increase | 1 | 6 | 13 | 7 | 0 | 27 |
| Electricity Price Increase | 3 | 3 | 12 | 7 | 0 | 25 |
| Forest Stock Depletion | 2 | 2 | 1 | 2 | 0 | 7 |
| Fish Stock Depletion | 3 | 3 | 5 | 1 | 0 | 12 |

**Fish.** Households stating that they use more than 4 kg of fish per week totaled 106 (47 use 4 to 8 kg, 21 use 9 to 12 kg, 13 use 13 to 20 kg, 25 use more than 20 kg). The largest groups of households were those answering that they would not change their fishing behavior in the given scenarios.

**Table 12: Frequency of Responses Indicating Change in Use of Fish**

| Scenario | Decrease by 100% | Decrease by 50% | No Change | Increase by 50% | Increase by 100% | Total Response |
|---|---|---|---|---|---|---|
| Petrol Price Increase | 5 | 18 | 30 | 7 | 7 | 67 |
| Kerosene Price Increase | 2 | 7 | 26 | 3 | 7 | 45 |
| Electricity Price Increase | 10 | 5 | 34 | 4 | 6 | 59 |
| Forest Stock Depletion | 4 | 7 | 16 | 0 | 1 | 28 |

For timber, rattan, and rubber, respondents predominantly indicated that they would reduce their reliance on these natural resources given an increase in energy prices. This outcome is most uniform in the answers to logging related questions. Here there were very few respondents who answered that their behavior would remain unaffected by an energy price increase, and only one who stated they would increase logging. This result seems to confirm the theory that the price of petrol is a significant cost factor of logging operations. However, the stated decline in logging activity following increases in kerosene or electricity prices is more difficult to explain.

Some of the responses to the interview questions are counter-intuitive. For example, there is no apparent reason why depletion in fish stock should lead households to decrease their reliance on logging or on rattan, as respondents indicated. Conversely, there is no ready explanation for a decrease in fishing activity if forests become depleted, at least not in the short-term.

## 6. Modeling Forest Depletion and Poverty Levels

The agent-based model, which was being developed in collaboration with BAPPENAS with the help of the household survey and interview data described in this report, simulates potential impacts of changes in fuel prices on forest cover and livelihoods. The full set of assumptions and definitions used in the model can be found at the project website (CSIRO Sustainable Ecosystems: http://www.csiro.au/science/IndonesianPathways.html), where project discussion papers and background information can be found.[3] This section serves only as an illustration of the model's potential capabilities. Also, due to difficulties in accessing accurate data, the model's simulation results reflect a high level of uncertainty and care needs to be taken in translating the results to real world policy recommendations. However, the model does provide some interesting results that may be useful when analyzed in relation to other scenario simulations. This section provides a very brief description of the model's user interface and describes a simulation of impacts on forests and livelihoods of the reduction of fuel subsidies that occurred in 2008.

The model interface allows the user to change assumptions concerning the additional number of logging concessions (HPH) and the annual allowable cut for all existing licenses. Similarly, the user can change assumptions concerning additional coal mining concessions, off shore fishing licenses, and the allocation of land conversion permits. For the latter, the model operator can specify the size and location of the area converted, and the new land use (oil palm, timber plantation, or rubber).

To simulate poverty levels, the agent-based model accounts for the interaction of several factors related to household livelihoods, including the following:

- Decrease of fish catch as a result of sedimentation
- Changes in the availability of natural resources
- Changes in policy-based direct cash transfers
- Population growth dependent changes
- Cross-relationships between natural resources, such as the availability of honey and forest area
- Changes in the labor market due to changing access rights, i.e. logging concessions

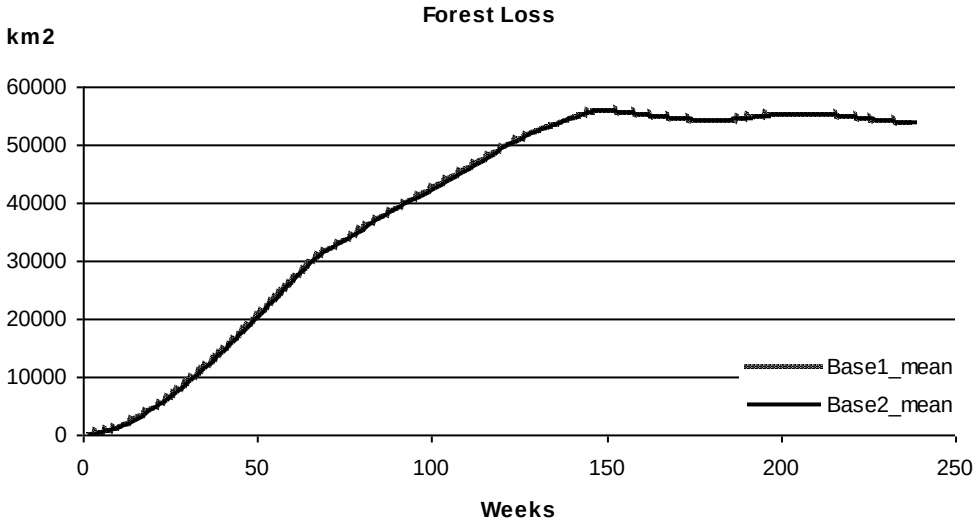
In June 2008, following budgetary pressures caused by soaring global oil prices, the Government of Indonesia reduced fuel subsidies, leading to increases in petrol prices of 27.5%, and in kerosene prices of 15%. In order to reduce the impact on poverty the GoI provided each poor household with quarterly cash payments of IDR 300,000. The ABM was used to model the impacts of this combination of policies on forests and livelihoods in East Kalimantan. The simulation's baseline

[3] This section draws on a recent project discussion paper which provides more scenario analysis. Smajgl, Alex, et al. 2009. Assessing impacts of fuel subsidy decisions on poverty and forest depletion in East Kalimantan, Indonesia: An agent-based analysis. Analyzing Pathways to Sustainability in Indonesia – Discussion paper #2. February 2009.

defines an illustrative situation as it would have been without the fuel price hike and without the cash payments ("Base 1"), while the simulation includes the impacts of the fuel price increase as well as the cash transfers ("Base 2").

Assuming that no additional logging concessions are issued, the illustrative baseline of forest depletion follows an S-shaped curve (see Figure 12). Initial forest loss in the baseline is due to assumed over-logging within existing concessions. This loss slows down as concessions become depleted, and logging levels match re-growth. The numbers shown do not include large-scale illegal logging activities.

**Figure 12: Simulated Impact of Energy Price Increases on Forest Depletion**




**Note: Base1_mean represents the simulation without the fuel price increase and cash transfer and Base2_mean represents the simulation with the energy price shock and the cash transfer.**

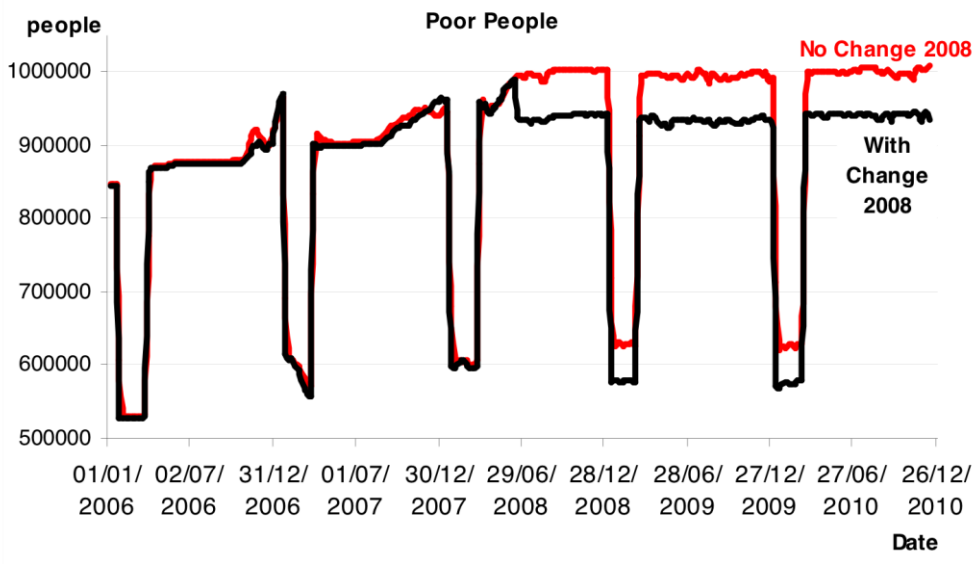
Even though the interview results indicated that households would reduce logging given an increase in energy prices, the simulation (which includes the fuel price hike and cash payments) results in a curve that shows no meaningful deviation from the baseline. This result confirms existing literature on Indonesia's forestry sector, which states that the drivers of deforestation tend to be industrial forestry and agricultural expansion rather than small-scale logging. Also, the simulated cash transfer is likely to have an offsetting effect on people's behavioral response to fuel price increases.

The baseline simulation of poverty levels follows a slowly increasing trend, partly due to population growth and the fact that the model assumes that there will be no major expansions in secondary or tertiary industries. Over the simulation period of 240 weeks, the mean number of poor persons in the simulation increases by nearly 15,000 to 795,552. According to the model, due to the high degree of dependence on natural resources, the incomes of households fluctuate in a very regular pattern in step with the harvesting cycle and this leads to a

corresponding fluctuation in the number of poor below the poverty line over time.[4] The red line in

Figure 13 represents the number of poor persons without any changes in fuel subsidies with a simulation start of January 2006.

**Figure 13: Simulated Impact of Energy Price Increases on Number of 'Poor' Persons**




The simulation of the number of poor persons below the poverty line at any given week following the fuel price hike and the associated cash transfers is depicted by the black line in

Figure 13. The model shows a sharp decline in poverty in week 130 when cash transfers begin causing the number of poor persons to drop dramatically. The difference between the baseline and the simulated policy impact decreases to 47,000 persons in periods of seasonal poverty reduction.

In summary, the model suggests that the June 2008 decision to raise fuel prices in combination with a cash transfer to poor households had nearly no impact on deforestation while it reduced the number of persons below the poverty line by an

[4] The model runs on a daily time step. Agents conduct activities and earn and spend income. The model calculates the daily poverty based on GOI poverty levels defined on a monthly basis. In the model, agents do not save or buy longer term consumption stocks to smooth income over longer periods. In reality, people can save income and store goods so that income (and poverty) are averaged over time. In another pictorial representation, income levels in the model could be averaged over a longer period, say monthly or quarterly.

average 8.8%. During the harvest season this number drops to 6.6% as many households lift their income naturally above the poverty line.

## 7. Strengthening Communication Pathways

The process of developing the ABM model contributed to stronger communication between various levels of government and to improved capacity for policy development that takes into account local and cross-sectoral impacts. The ABM's design included, from the outset, a strong process for collaboration across the levels of government and across all relevant sectors. The project design was informed by stakeholder opinions through a continuous process of interaction. Local capacity building was a key project outcome.

GOI stakeholders played an active role in choosing macro policy scenarios and case study locations. Three stakeholder meetings were facilitated and more than 20 meetings were held with a range of sectoral ministries, including BAPPENAS and the Ministry of Finance. The meetings explored topical macro- policy issues on the agenda for the GoI in the coming years that would have significant cross-sectoral consequences. As a result, energy policy was chosen as a focus of study.

Local researchers and other stakeholders were extensively consulted during the development and implementation of the household survey and interviews. Inputs from researchers based in the study area helped to identify the major attributes that would distinguish household types. Primarily Indonesian counterparts were used to implement fieldwork in East Kalimantan, contributing to the capacity building component of the project. The survey and interviews were largely conducted by the Center for Social Forestry (CSF) at Mulawarman University in Samarinda. CSF was established in 1997 and is involved in education, training and research related to social forestry.

Following the survey, a three-day workshop with experts and stakeholders, including university research staff and officials from national and regional government, was conducted to elicit their views on the household typology and on the interview responses to decide how to best represent these in the ABM.

Working groups brought together officials from planning and economic development agencies at the regional and national levels. These working group meetings and workshops provided a venue where ideas from the field were discussed at the centre, where central officials could see real impacts in the field, and where the modeling framework could focus their attention on specific policies and responses of economic agents managing resources.

Apart from the programming, all aspects of model design were developed in partnership with BAPPENAS staff. A significant development was the establishment of a team of six champions within BAPPENAS taking responsibility for detailed interaction with the technical teams, developing capacity through training, and working on the development of key aspects of the model. These teams increased the level of engagement between the project team and the Government partners. This created the venue for deeper and more detailed discussions of scenarios of relevance in the planning process. This growing engagement will be important for building the findings and results into the national development planning and budgeting context.

# 8. Conclusions

## 8.1 Natural resource dependency of households

The survey results confirmed the high level of importance of natural resources to the people of East Kalimantan, underscoring the need to consider impacts on these resources in policy development.

The survey of 3,000 households in four southern districts and two cities of East Kalimantan, provided a wealth of data related to the value of natural resources to local people. Around 43% of surveyed households indicated that their main livelihood was derived from timber (not including employment by a logging company), rattan, rubber, or fish. Close to 40% of households indicated that they use timber and fruit trees, mainly for household consumption; 30% indicated that they use fish; 26% indicated they use honey; 11% that they use rattan; 15% that they use rubber; and 13% that they use deer. Rubber is the only natural resource where a significant amount of household 'use' was indicated as being for sale. Among the 400 households with the lowest income, 39% indicated that they sell natural resources. This proportion declined to 11% for the 400 households with the highest income.

In addition, 66% of households indicated that they value at least one of the natural resources measured for at least one of the values investigated. This number showed significant variation across districts, ranging from 21% in Balikpapan to 89% in Kutai Barat. The categories Nutrition and Health had the highest number of households indicating value of natural resources. In these areas nearly 30% of households stated that they value fruit trees, and around 25% indicated that they value fish, and 25% indicated that they value honey.

An interesting implication of the high level of dependence of households on natural resources is that the well-being and income of households may fluctuate naturally in parallel to harvesting cycles. The simulation provided a graphic depiction of a possible link between poverty levels and seasons, showing how a significant number of households may seasonally be lifted out of poverty. (Though, as noted above, agents' income could be averaged over a longer period or saving could be introduced into the model to improve the graphic representation of poverty over time.)

Policies that lead to degradation of the natural resources that people depend upon might have far reaching impacts on people's wellbeing. In some cases natural resource degradation is an outcome of extractive or land use activities that receive government support with the rationale that these will lead to employment, and poverty reduction. However where such activities take place near to people that depend on natural resources, this may lead to unintended negative impacts on their livelihoods and may be less desirable for that reason.

## 8.2 Local impacts of climate change

Climate experts predict that global climate change will lead to changes in local weather patterns, and the household survey results imply that this may pose a significant threat to rural people in Indonesia. A large proportion of survey

respondents claim to have noted local climatic changes, such as changes in rainfall patterns, and see such changes as a significant risk in the future. This proportion is particularly high in rural districts where many people depend on land or water based economic activities that require favorable rainfall patterns. This kind of exposure to climate change is likely to be similar for millions of rural people throughout the tropics, emphasizing the need to ameliorate global climate change. The results also highlight the need for more in depth analysis of the particular risks that people in East Kalimantan face from changing local climate, as well as the types of interventions that could help people adapt to future changes.

### 8.3 Communication pathways

The idea of quantifying local impacts of macro-policy by looking at household behavior appeared to fit well with a bottom-up approach that has become more common in Indonesia since the *reformasi* period. The project supported an iterative process of engagement with a variety of stakeholders including District Government agencies, the Ministry of Finance, other central ministries, the district level government and communities, and the World Bank to support the outputs of all project components. The model has shown itself to be useful in stimulating discussions among stakeholders at various levels of government and civil society. Through the case study, policy makers at regional and national level were fully engaged in a dialogue process in the real world application of this modeling approach. Working group meetings and workshops provided a venue where ideas from the field could be discussed at the center, where central officials could see real impacts in the field, and where the modeling framework could focus their attention on specific policies and responses of economic agents managing resources.

### 8.4 Development of further case studies

The East Kalimantan case study is an illustrative example. To provide more valid and representative feedback to the national level planning process, there is recognition of the need to have more local case studies that can be used to compare and contrast results and impacts in different types of Indonesian provinces. Although there is vast diversity across Indonesia, one of the key distinctions is locations that are rural, low density, resource rich, and off Java in contrast to locations that are semi-urban, densely populated, and on Java. For this reason, a second case study site has been selected, centered on the northern part of Central Java Province covering the districts of Jepara, Pati and Demak. Energy, land use, and forestry issues remain the focus of work on this second case study site.

These three districts include timber and rattan-based furniture manufacturing (linked to East Kalimantan in sourcing both timber and rattan), fishery dependent communities (linked to energy use), shrimp ponds, rice production, and a mix of rural and peri-urban livelihood strategies. This north coast of Java could provide a good example of how macro or energy policies impact on communities that are not quite as resource dependent as in East Kalimantan, but certainly need to factor energy and timber prices into day-to-day decisions about how much to produce, or how far to travel to find fish.

## 8.5 Potential to influence Macro Policy Dialogue

PROFOR is also interested in supporting the uptake of forest and livelihood analyses in World Bank policies and actions at the macro level. The GOI and World Bank are in fairly constant policy dialogue on a number of fronts dealing with macroeconomic management and borrowing needs. Several key documents provide an overview of the rationale and direction of the policy dialogue. For example, the Development Policy Review, the Country Environmental Analysis and the Country Partnership Strategy provide the analytical underpinnings for the World Bank's strategic engagements and investments in Indonesia (www.worldbank.org/indonesia). Development Policy Lending is one instrument for supporting the Government's own actions toward policy reform toward greater sustainability and the GOI has embarked with the World Bank on a series of development policy loans for macroeconomic management, as well as for infrastructure investment. The modeling and analysis developed under the APSI project did not explicitly contribute to those documents. However, the engagement with the National Development Planning Agency and other ministries that emerged from this project contributed to the understanding and relative priority of sustainability issues. The concept of planning for sustainability is now firmly included in the GOI's medium and long term planning documents. In this way, the project is contributing to the ongoing dialogue and the longer term direction of Indonesia's sustainable development. Now that the models are completed, they can be used for more explicit analysis in support of the sustainability dialogue between the GOI and its several donor and lending partners.

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