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Sistem Hutan Kerakyatan

Valuation of a Dayak Benuaq Customary Forest Management System (CFMS) in East Kalimantan

The benefits of CFMS compared to alternatives

December 2000

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Developed by:

NRM/EPIQ Program
SHK Kalimantan Timur

December 2000

The NRM Program's Policy and Planning Group supports cross-cutting policy analysis and institutional development and provides economic and quantitative policy analysis services to all project components and partner organizations. Working with BAPPENAS and its provincial government counterparts, NRM Policy and Planning Group works in three main subject areas: spatial and land use planning; environmental economic valuation; economic analysis/impact assessment. In addition, policy issues related to community-based resource management and land use issues are supported in collaboration with the Forestry Management Group.

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Abstract

The overall objective of this work is to translate traditional land use practices into terms and quantities that can be presented and discussed in the language of regional development and spatial planning. Using limited empirical findings, this study quantifies the value of key Customary Forest Management System (CFMS) activities in three study areas located in the upper watershed of the Mahakam River catchment of East Kalimantan. Estimated values are then employed to compare CFMS in the study areas to proposed alternative land uses, notably oil palm. Comparisons are from the perspective of both local communities and overall public welfare.

1. Introduction

This study is the result of a collaborative effort between NRM EPIQ and a local NGO – SHK or *Sistem Hutan Kerakyatan* (community forest system). SHK is focused on CFMS and community capacity building. Considering the potential impact to CFMS from alternative land uses being proposed for the study areas, SHK is interested in the economic, social, and environmental ramifications of such developments in areas where the communities they represent seek formal land tenure. Moreover, developing them as proposed would almost certainly act to undermine efforts by several Dayak Benuaq communities to secure land tenure over areas that currently support functioning CFMS.

Our collaborative effort applies the tools of economic valuation to better understand the benefits and costs that would be associated with such land conversions. Communities, moreover, are using the results to better understand and articulate the value of their own activities, including how they compare to alternative land uses.

At the inception of this study, the objectives were to:

1. Design a process for studying and applying economic information on the Dayak Benuaq CFMS in a river catchment area in East Kalimantan.
2. Improve the capacity of SHK members to understand and apply valuation study outcomes and to articulate the economic dimensions of alternative land uses, such as customary forest management systems.
3. Compare the economic costs/benefits of these systems to other land use systems, accounting for environmental and social costs/benefits where possible.
4. Develop concepts for enhancing the economic value and viability of existing alternative land/forest use practices.
5. Use the results of valuation work and the concept development from #4 above to better articulate the economic aspirations of communities.
6. Apply analytical results to spatial planning, forest policies etc. at the regional level.

Valuation and Comparative land use analysis

To varying degrees, alternative land use practices proposed in the study areas would require converting land that supports a variety of CFMS to other uses. Developing oil palm in proposed areas could significantly alter, through direct or indirect means, the diverse flow of benefits currently realized by communities in the areas studied.

As proposed, oil palm plantations would require converting land both inside and outside the boundaries of spatial areas claimed by the three communities studied: Besiq, Benung, and Tepulang. Conversion of a portion of the total land area directly used for CFMS activities (i.e., land currently cultivated or from which goods are collected and benefits directly derived) would occur. To a larger extent, areas that indirectly support the CFMS system (e.g., extensive collection of NTFPs, etc.), act as buffer zones, or serve as an inventory of land for future direct use (the CFMS system involves shifting agriculture) would also be converted. From the community perspective, the primary benefit of land conversion to oil palm would be unskilled labor jobs on estate crop plantations. Government's primary benefit would come in the form of tax and fee revenues.

To date the NRM EPIQ team has worked with SHK staff to design and implement a survey of 14 interrelated CFMS activities in three communities. Numerous additional activities – including income generating activities, staple food production, gathering and processing of building material, and production for own consumption - were identified in discussions with stakeholders. Most of these activities and products were not addressed quantitatively in the survey and the study due to lack of time and resources. A more complete list of these products and activities appears in Table 2.1 in Section III. Survey data are used to estimate the direct financial value to each community that is associated with each activity. This work also provides a quantitative comparison of the direct net benefits associated with CFMS activities vs. per capita income statistics for Indonesia and vs. the alternative financial benefits likely to be received by communities if proposed oil palm plantations are developed.

Comparison of direct benefits, however, reveals only a partial picture of how local and public welfare is likely to change depending on land use decisions in the areas studied. The value and significance of a land use practice is tied to more than monetary financial returns that are modeled for this study. For example, natural forests support the production of tangible goods, such as NTFPs, and facilitate some cultural practices and values that are primarily or completely intangible. Intangible values are especially significant to CFMS but difficult to assess because they are not associated with established markets. While non-market and intangible benefits are not considered quantitatively in this study, they are contrasted with the type of direct financial/economic net benefits that are often used, for better or worse, as a conventional basis for land use decisions.

Ideally, all these factors would be taken into consideration meaningfully, using a universal unit of measurement. The concept of Total Economic Value (TEV) seeks to render this type of valuation and comparison by incorporating numerous categories of tangible and intangible values. Unfortunately, putting such concepts into practice is proving extremely difficult, at best, and a seemingly impossible challenge, in the worst case. Arguably, economists have yet to develop widely accepted and believable practices for quantitatively analyzing important non-market/intangible goods and services – this work is no exception.

Our approach toward informing land use decisions takes a step around this problem by showing, for example, what value must be placed on environmental/social costs (including non-market and intangible benefits) to render the existing or traditional land use practice equally or more valuable than alternatives. Showing the relative size that these values would need to assume is, we think, a significant first step toward establishing a basis for land use decisions that recognize the significance of environmental/social costs and benefits.

This work does not result in a statement about one land use being economically favorable to another. It does, however, clarify the reasons why some land use decisions are likely to result in greater welfare than others, given known or probable biophysical and market conditions. It also clarifies the financial motivations for converting land that are likely to be at play, and offers insights and information that can be used to articulate a variety of economic perspectives and livelihood aspirations.

2. Study Area Background

Study areas correspond to three communities (*Desa*) and respective surrounding areas, over which natural resource use rights are claimed in accordance with a traditional (adat) land right system. All communities claim to have been utilizing the forests as the basis for their local economy for several generations. They are located in the upper Mahakam catchment system in East Kalimantan: Tepulang and Benung in DAS Idaatn, and Besiq in DAS Kedang Pahu. **Study area maps appear in Appendix A.**

2.1 Description of the Villages

Desa Besiq

Meaning iron or steel in Dayak Benuaq dialects, Besiq was established in 1918 at Kedang Pahu Ulu (Pahu Dayaaq) watershed. Is is also called *Besiq Pelakng Mahing* (very hard steel). The first settlements came from Idaatn (from Mencimai, Benung and Engkuni Pasek villages), although previous migrations are known to have originated upstream of the village (at a place called Bonah) that had already been occupied by Benuaq people. Henceforth, both communities established the community now known as Besiq.

The area of Besiq, approximately 565.1 km^2 or 56,510 hectares, is under the authority of Kecamatan Damai, Kabupaten West Kutai. The area is bounded by several other communities: Bermai village in the north, Central Kalimantan in the south, Intu Lingau village in the west, and Kecamatan Muara Lawa in the east. It is located about 30 kilometers from Kecamatan Damai, a distance that can be traveled by boat in two hours. Typical tropical weather patterns prevails, with average temperatures falling between 25-26 degrees Celsius and an average annual rainfall of 1,700-3,500 mm/year that normally falls over a period of between 60 and 100 days.

A March 2000 census reports a local population, the majority of which is Dayak Benuaq, consisting of 1,578 people divided into 410 households. The census records 813 male and 765 female inhabitants.

Desa Benung and Tepulang

Both communities are located near the Idaatn watershed of the upper Mahakam watershed, located about 250 kilometers from Samarinda (the capital city of East

Kalimantan). The dominant river flowing through the area is a tributary of the Kedang Pahu river, itself a tributary of the Mahakam river. Both communities are under the authority of Kecamatan Damai, Kabupaten West Kutai. They can be reached only by arduous travel: about 22 hours by motorboat (from Samarinda) followed by about 90 minutes by car or motorcycle. Additional time is required during the wet season.

2.2 The Customary or *Adat* System

Several aspects of the Dayak Benuaq *adat* system in the study areas are relevant to this study:

1. Households continue to organize themselves (spatially and otherwise) around the multi-family systems facilitated by the longhouses in which they reside.
2. There is a well-delineated community system affording clear property and legal rights at both the family and multi-family levels.
3. The adat system stipulates rights granted to families in relation to communal land management and use in the vicinity of longhouse residences.
4. The system provides a legal structure employed locally to settle disputes.
5. The legal structure also plays an important role in distributing labor and determining the activities to which labor is allocated.

2.3 Key Activities and Features of CFMS

In a broad sense, the system is composed primarily of extensively cultivated, rain-fed agriculture, supported by semi-wild inventories of plants found in surrounding forests. Livestock is kept, and wild resources, including animals and plants, are collected from local forests. The system generates stable subsistence food and building material supplies, and is evolving to provide sources of increasingly higher cash income.

Cultivated Areas (ladang and simpukng)

At the heart of the system are the customary *ladang* and *simpukng* practices. The most intensive cultivation occurs in the *ladang* areas in which paddy and stick rice are grown. In typical cropping cycles, other crops such as maize, cassava, and various vegetables, are alternatively grown (usually following an intensively cultivated rice crop). By local definition, a *simpukng* corresponds simply to a group of plants growing in a designated area. Such areas vary in size, species mix, and function. *Simpukng* produce a variety of fruits (e.g., durian, rambutans, cempedak, asam), medicinal plants, religious/ritual plants, rattan and rubber. Cultivated areas are typically cycled from one of these systems to the other in an effort to enhance soil fertility and conservation: field farming (sticky and padi rice) is usually limited to one cropping cycle per year.

Forests (Bengkar)

Forests provide building materials (e.g., timber, bamboo, and rattan), medicinal and ritual plants, wild vegetables, and a source of animal protein, both from cattle raised in the forests and hunted animals (e.g., wild pigs, birds, deer). Farming activities also take place in the forest; therefore, the forest is considered a rice stock (*lumbung padi*). Because they are an important bank of wild plant and animal species, forested areas form the foundation of food, livelihood, and cultural security. For example, rattan and rubber seedlings and saplings are regenerated and banked there.

Rattan field (Uwe)

Rattan is an important input to local livelihoods: it provides building materials for household implements, large containers, and backpacks (*anjat*). Rattan inventories also serve as a supply of cash in that they provide the key input to saleable goods such as handicrafts, and supply raw or partially processed saleable materials. Rattan plants are typically cultivated along with rice after land is cleared. Several types are cultivated, including *sega*, *jahap*, and *pulut merah*.

Livestock

Each household raises animals as a supply of meat. The dominant animals are pigs and chickens. Some households also raise cows, water buffalo, and goats. Cattle are normally for own consumption as well as ritual ceremonies. In some cases they are sold to earn cash income.

Timber Extraction

Traditionally, timber was extracted to supply local building needs only. It continues as such in all study areas; however, it has developed on a small but commercial scale into a key source of cash in the relatively resource rich area of Besiq. Our findings suggest that cash earnings from this activity are much higher than other sources (see Figure 1). It is likely that this activity represents the largest source of new cash income available (but not to all study areas). Of all emerging economic activities at the community level that we studied, this one has the greatest capacity to stress traditional use right and legal systems, generate conflict, and result in greater cash income disparity.

3. Methods

Survey methods

The process of collecting data on the direct use value of CFMS activities entailed numerous steps:

1. Focus group discussions with SHK staff members who are residents of the study areas to define the qualitative significance of activities.
2. Developing a catalogue of activities of which the CFMS is composed.
3. Compiling information on activities that result in goods or services sold and that, therefore, have an observable and measurable cash market value – these activities are quantifiable.
4. Designing a simple questionnaire survey instrument that is used to collect data on the activities perceived by SHK as the most significant to livelihoods and the local economy.

Data collected from this survey (conducted by SHK staff) and data from village monographs is used to specify simple financial models of the direct, quantifiable, monetary returns to CFMS activities. They represent conditions in one year, not a time series of multiple years. Data gleaned from village monographs that are used in the model include information on the percent of households and the spatial area corresponding to each CFMS activity we investigated.

The following points summarize the quantitative analytical approach we applied:

- A simple financial model is used to estimate the direct value only of selected CFMS activities. We were not able to value all aspects of CFMS. A list of activities we studied appears in Table 2. A complete list of CFMS activities identified in discussions with stakeholders appears in Table 2.1.;
- The model requires many assumptions, some of which exert significant influence on estimated values (see section on spreadsheet analysis and models below);
- Assumptions are based on limited empirical data, focus group discussions with SHK, and/or fragmented but relevant data from the study areas (e.g., village monographs, etc.);
- Model assumptions are "preliminary" at best, and require further discussion and refinement.

To estimate the direct value of each activity, several steps are taken in the model:

1. Data on the value from individually surveyed households is averaged for each activity for each community (with some exceptions where data sets are very small, see below);
2. Using village monograph data on the percent of households involved per activity (participation rate), weighted average values are derived for households; and
3. Average household values are applied to yield total value of an activity for each community.

Using the empirically based estimates above, a simple model is specified based on the following assumptions:

Table 1.
Model Assumptions

General assumptions:

Discount rate:	10%
Exchange rate (Rp./1$US):	7,000

Land area, population, household size:

(Source: SHK village monographs or derived through focus group discussion with SHK staff and utilizing village monograph data).

	Study Area		
	Besiq	**Tepulang**	**Benung**
Total study area size (ha)**	56,510	3,782	3,880
Assumed area (ha)/hh actively used*:	25	25	25
Total households (hh)	410	64	54
Total population	1,578	245	257
Average hh size	3.85	3.83	4.76
Average area (ha)/hh**:	138	59	72

*Area directly/intensively used (e.g., cultivated, containing NTFP) to support CFMS activities evaluated (source: focus group discussions with SHK)

**Area corresponding to Adat land tenure claim (source: SHK village monographs)

LABOR ASSUMPTIONS:

(Source: SHK village monographs or derived through focus group discussion with SHK staff and utilizing village monograph data).

Total labor Q. per hh (15<age<65):	2.5
Labor days/person:	300
Wage labor rate (Rupiah)/day:	16,000
CFMS proportional use:	27%
Estimate of annual labor cost (Rupiah)/hh:	= total labor x labor days/person x labor rate x proportional use = 2.5 x 300 x 16,000 x 27% = 3,240,000

Table 2. CFMS Activities Participation Rates: Percent of households engaged in each activity			
	Study Areas		
Activity	Besiq	Tepulang	Benung-pintuq
Rotan/Rattan	100%	100%	100%
Karet/Rubber	50%	100%	100%
Beras/Rice	100%	100%	100%
Ketan/Sticky rice	100%	100%	100%
Buah/Fruits	100%	100%	100%
Babi Hutan/Wild pig	15%	14%	6%
Babi/Domestic pig	88%	92%	96%
Sapi & kerbau/Cows	29%	50%	17%
Ayam/Chicken	83%	84%	93%
Kayu Meranti/Wood	50%	5%	4%
Kayu Bangkirai/Wood	39%	5%	4%
Kayu Ulin/Wood	98%	98%	98%
Ikan Baung/Fish	32%	31%	19%
Ikan Gabus/Fish	32%	31%	19%
Source: Village monographs (1999) developed and documented by SHK			

Our data collection resources were limited; hence, our data set is not comprehensive or statistically analyzed for significance. In some cases, rattan for example, few reliable data points per community were obtained (when the survey was conducted, rattan producer prices were so low that few households said they are currently processing/selling rattan, although nearly 100% were working to maintain rattan inventories for future production). Rather than base estimates on such small data sets, we chose to combine the data from all three communities and apply the arithmetic mean benefit across all communities. This technique was used only for CFMS activities that, according to village monographs, are undertaken (albeit sometimes sporadically) by 100 percent of households in a given community.

Initial discussions identified a wide range of products grown or gathered from 6 basic types of land use areas, defined by the communities. In addition to forest and riparian areas, the communities there distinguish four types of agricultural land use, as indicated in Table 2.B below. For each product, we also identified the main purpose or use of the activity, including income generating activities, staple food production, building materials, and own consumption. As indicated on the left side of Table 2.B, only 14 basic categories of this wide range of activities were studied in detail to produce the quantitative results in this study. The longer list of activities identified but not quantified are on the right side of the table. In section V, this issue is discussed in more detail.

Through focus group discussions conducted after the survey period, we estimated that only about 25% of households' available labor time was spent on the subset of quantified activities noted below.

Table 2.B. Description of Products Identified vs. Those Valued in This Study	
Values Quantified	Additional Products, not valued
Bengkar ***(Reserve Forest Area)***	
✓ Kayu jenis meranti (kapur, kruing, tengkawang) *(Meranti wood)* ✓ Kayu bengkirai *(Other wood)* ✓ Kayu ulin *(Ironwood)* ✓ Rotan alam: botet, manau, rotan merah *(Natural forest rattan, various types)* ✓ Babi *(Forest pigs)*	• Payau (rusa) hewan buruan (Kijang/Kancil, Trenggiling, Monyet) *(Hunted animals, various deer, monkeys, pangolin)* • Burung/unggas (Ayam hutan, Srindit) *(Game birds and forest fowl)* Obat-obatan *(Medicinal plants)* Bahan-bahan upacara adat *(Materials for traditional ceremonial use)* Kayu gemor, nyatoh, batu *(Other kinds of wood)* Madu *(Wild honey)* Gaharu, Damar *(High value tree resins)*
Umaq ***(Paddy & Annual Crop Area)***	
Padi *(Rice: paddy and sticky)* Buah-buahan (Pisang, Nanas) *(Fruits, bananas, pineapple)* ✓ Binatang peliharaan (Sapi, Babi, Kerbau, Ayam) *(Livestock: cows, pigs, buffalo, chickens)*	Umbi-umbian *(Root vegetables, sweet potatoes)* Jagung *(Corn)* Sayuran *(Vegetables)* Rempah-rempah *(Pepper)* Kayu bakar *(Fire wood)*
3. Simpukng ***(Perrenial Mixed Agroforest Area)***	
✓ Buah-buahan (Kelapa, Pinang)*(Fruits: coconut,palms)* ✓ Rotan *(Rattan)* ✓ Karet *(Rubber)*	Aren *(Palm fruit)* Obat-obatan *(Medicinal plants)* Kopi *(Coffee)* Kemiri *(Type of spice)* Madu *(Cultivated honey)* Kayu tua *(Wood)*
4. Kebotn – dukuh ***(Intensively Managed Agroforest Area)***	
Rotan (Pulut merah, Sega, Jahap, Pulut putih) *(Various rattan)* Karet *(Managed/planted rubber)*	None
5. Uratn ***(Modified Forest Area, Capital Stock)***	
None	• Kayu bangunan *(Building wood)* • Kayu bakar *(Fire wood)* • Bamboo *(Bamboo)* • Umbut rotan *(Edible rattan roots)* • Rebung bamboo *(Edible bamboo shoots)* • Sayur-sayuran *(Vegetables);* Betete *(Peppers)* • Bahan kerajinan (Ulap doyo, Kulit kayu) *(Handicraft materials, fibers, bark)* • Pandan *(Edible, fragrant plant)*
6. Sungai ***(River – Riparian Area)***	
✓ Ikan (Baung, Gabus) *(Important or high value fish)*	• Ikan Lain (Jelawat, Lele, Patin) *(Fish, other types)* • Atap rumbia *(Roof thatch material)* • Pakis *(Fern)* • Sagu *(Sago Palm for Starch)* • Pasir & Batu (Sand & Rocks)

4. Results and Discussion

Spreadsheet analysis and financial models:

Preliminary estimates for the direct market value of the most significant CFMS activities are calculated using the results of a survey instrument designed by NRM EPIQ and executed by SHK. Monetization of some direct benefits does not, however, imply that all such benefits could be converted into cash. Our approach uses market prices to place a cash value on benefits so that they can be directly compared to the benefits of other land use practices. Table 3. and Figure 1. present direct (financial) value estimates for each activity and community.

Our approach is to offer insights to the communities on the value of their activities, put our estimates into context, and compare them to land use alternatives. Our approach was also to consider the values associated with the regular flow of goods and services in the area, not the value of resource stocks or capital investments (such as standing rattan). This approach yielded estimates that are more practical and useful in the context that the stakeholders and sponsors of this study find themselves.

We express estimated direct values in three forms: as an average value per household, as per capita income, and as a value per area. Our model directly estimates the value per household. We then use information from village monographs on average household sizes to estimate per capita incomes (see Table 4). Likewise, we employ assumptions on the area required to support CFMS activities studied to estimate the net present value (NPV) per hectare for each study area. See Tables 1 and 2 above for assumptions and monograph data applied.

Our estimates of CFMS household annual values are lower bounds because they do not consider all the activities comprising the system. For example, vegetables and medicinal plants are not valued. Consequently, the direct values of CFMS reported in Table 3 are likely to be substantially undervalued.

Table 3. Direct Household (hh) Gross Annual Value Estimates (Rupiah)			
	Study Areas		
	Besiq	**Tepulang**	**Benung**
ACTIVITY	**hh average**	**hh average**	**hh average**
Rattan (Rotan)	1,899,221	1,899,221	1,899,221
Rubber (Karet)	1,490,167	1,490,167	1,490,167
Rice (Beras)	2,910,345	847,778	1,367,500
Sticky Rice (Ketan)	784,143	299,167	435,000
Fruit (Buah)	467,786	467,786	467,786
Wild Pig (Babi Hutan)	3,261,912	925,000	660,000
Dommestic Pig (Babi)	597,500	775,000	1,320,556
Livestock (Sapi/Kerbau)	3,972,222	5,444,444	2,500,000
Chicken (Ayam)	360,529	203,661	283,556
Meranti Wood (Kayu Meranti)	8,937,857	562,500	250,000
Bang. Wood (Kayu Bang.)	-	2,000,000	-
Ulin Wood (Kayu Ulin)	1,500,000	-	-
Baung Fish (Ikan Baung)	915,217	375,000	-
Gabus Fish (Ikan Gabus)	368,182	375,000	-
Total value per hh* (Rp.):	**14,975,446**	**11,078,537**	**7,652,552**

* Weighted average using participation rates cited in Table 2 above.

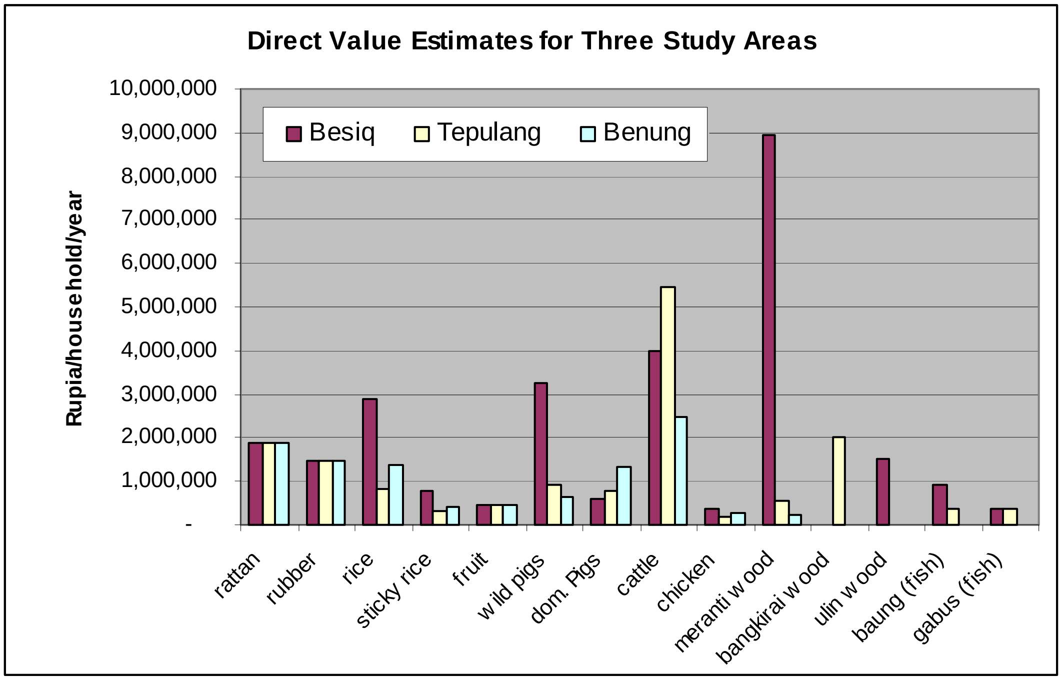
Table 4. Estimates of CFMS Value: Per Capita Income, Direct Value, and Net Present Value (NPV) Per Hectare (ha)			
	Besiq	**Tepulang**	**Benung**
Per capita income* (Rp.)	3,890,959	2,893,985	1,607,929
Direct annual value (Rp./ha)	469,418	313,541	128,674
NPV10 (Rp):**	4,694,178	3,135,415	1,286,736
NPV10 ($US):**	671	448	184

* Converted from hh average estimates using information on household size presented in Table 1.
** Computed from average household values using assumptions presented in Table 2 on land area required as an input to CFMS activities studied.

NOTES:

1. Per hectare estimates account for (internalize) the cost of labor applied to CFMS activities studied -- in contrast to gross per household values and per capita incomes.
2. Estimates are moderately to very sensitive to assumed land area required, discount rate, and assumptions used to account for labor costs (for example, if a discount rate of 18% is assumed, the NPV for Besiq goes from $US 671 to 373 per hectare).
3. CFMS activities are discounted on an infinite time horizon.

Figure 1.
Relative size of valued CFMS activities in three study areas:
Besiq, Tepulang , and Benung.



In addition to estimated values, several general conclusions can be drawn about the nature and significance of CFMS activities valued:

- Values are variable across study areas. Intuitively, this appears to be a function of several study area attributes and characteristics: proximity to a river large enough to transport bulky and heavy goods (e.g., meranti wood) to market, relative size of land areas available for CFMS activities, and the abundance and availability of wild resources such as wild pigs (babi hutan). Variability also appears to be a function of intermittent or chance events: for example, rice (beras) values in Benung and Tepulang during 2000 were negatively affected by pest problems.

- CFMS activities in the villages studied were conducted extensively over many types of land uses. Some parts of the system are managed more intensively than others, for example, the production of cash or subsistence crops. Other parts of the system are only partly or intermittently managed, or used as a stock, or savings account, against hard times. Some parts of the system are used opportunistically, such as the hunting of wild game. Per hectare and per household values obtained as a result of this study only partially reflect the varying degrees of intensity of activity on different lands.

- Goods and services are realized through a constant flow process that does not require large initial investments and provides returns either immediately or annually.

- CFMS is composed of many activities that can be ramped up or down in response to changing markets, supply conditions, or preferences. For example, little rattan is sold during periods of depressed prices, although rattan inventories are maintained. During such periods labor inputs are likely reallocated to other CFMS activities. Rising producer prices of rattan increase the propensity to allocate labor back to rattan production and sales at expense to some other (ostensibly now less attractive) activity.

- CFMS are evolving over time to include activities capable of generating large cash incomes. The best example from our work is the harvest of meranti wood in Besiq on a small but commercial scale. Household incomes from this activity are high relative to other CFMS activities. However, they may result in social tension and some environmental degradation on a scale that is probably unprecedented among CFMS activities and may not be fully accepted by the traditional communal management system.

CFMS Values Compared to Per Capita Income Statistics for Indonesia:

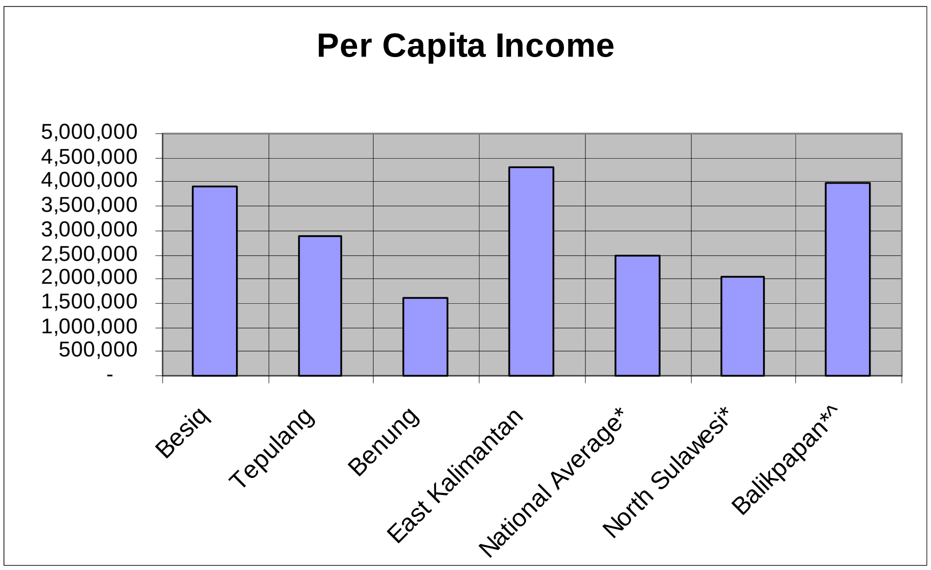
Various estimates and assumptions were used in developing the estimates reported in this study. In an effort to place these estimates of the value or return to CFMS activities in a larger context, we compared these estimates with average or per capita earnings from various parts of Indonesia. The results of this comparison are illustrated below in Figure 2. The average income estimates resulting from this assessment of CFMS are roughly comparable to per capita income statistics reported for Indonesia and some of its jurisdictions, as reported by the Central Bureau of Statistics for 1997.

Of course, per capita incomes in Indonesia vary widely from province to province, with East Kalimantan being relatively higher than the national average. Urban areas, like

Balikpapan, may also have higher per capita incomes due to the higher concentration of manufacturing, service, and export activities. Still, the values we identified for Besiq, Tepulang, and Benung fall within the range of variation for national and provincial per capita income figures from other parts of the country. Keep in mind that this is true even for the relatively small set of activities that were valued quantitatively in this study. The full value of all the activities conducted in these villages is likely to be much higher than the estimates produced and compared here.

Figure 2.

Per Capita Income Statistics (1997) for Study Areas and Other Parts of Indonesia



* Figures for 1997

^ Does not include income from the oil and gas sector

Source: Indonesian Central Board of Statistics

Comparing CFMS to Alternative Land Uses

From the Local Perspective:

The CFMS values resulting from this study are compared to per capita and per hectare earnings from oil palm, the key alternative land use option being proposed for portions of the study areas. From the local perspective, the key financial benefit of oil palm plantations would be unskilled labor employment. Two proxies for the return to oil palm labor are applied to estimate the direct value of such employment from the local perspective:

- The reported unskilled minimum daily wage labor rate for East Kalimantan in year 2000 – Rp. 9,320 (source: Kanwil Tenaga Kerja, Kaltim, 2000); and
- A daily wage reported during focus group discussions with SHK staff – Rp. 16,000, which includes the value of meals likely to be received as part of normal compensation as a laborer at an oil palm plantation.

Our CFMS direct value estimates assume the average household contains 2.5 laborers who work a combined total of 202.5 labor days each year (about 81 days per laborer) on the activities studied (the rest of their available labor is applied to the activities we did not study and miscellaneous other). Applying these assumptions to oil palm, the two proxies for wage labor would yield annual returns per household of between about 1.9 and 3.2 million rupiah, substantially less than the 7.7 to 15 million rupiah range from the three CFMS study areas (from Table 3.). Even if we assume full-time oil palm wage labor (49 weeks X 5 days per week), a household would be compensated between about 5.7 and 9.8 million rupiah annually by allocating its labor pool to work for an oil palm plantation. In this case, the subset of CFMS activities that we quantified in this limited study (which account for about 25% of the activities conducted regularly by the communities) yielded greater returns than full-time labor on oil palm plantations would to the households in Besiq and Tepulang, where average household incomes are 15.0 and 11.1million/year, respectively. By our estimates, Benung, with average household income of about 7.6 million per year, would fall in the middle of the range associated with palm oil plantation labor – not clearly better or worse.

From the perspective of public welfare:

While the previous discussion is from the local perspective (i.e., what is the benefit to local communities?) – this section considers CFMS values compared to oil palm from the perspective of public welfare, including government. There are several aspects of oil palm that distinguish it from CFMS:

- It provides a return to private investors (measured as a net present value per hectare).
- The return to investors accounts for the cost of labor (a benefit to local communities and perhaps others), and taxes paid to government (also a benefit).

- In contrast, CFMS does not provide a source of tax revenues, and the investors are local communities who invest their labor and materials to realize a return (measured as direct gross annual household value displayed in Table 3.).

Generic per hectare direct financial returns (NPV10, $US/ha) to oil palm investment in Kalimantan have been recently estimated[1], as reported in Table 5 below. It must be noted that these figures are purely *financial – or monetary* – returns. The figures do not include total *economic* returns, which must include environmental and social costs both in the short run and the long run. Discussion in LaFranchi and Manurung, 2000, cited below, indicates that there are potentially substantial environmental and other costs associated with oil palm plantation development. These costs are not reflected in Table 5, which emphasize primarily net financial benefits, not a complete reckoning of all benefits and costs. Thus, Table 5 states the returns to oil palm in the best possible light.

Table 5.
Per Hectare Financial Returns to Oil Palm Investment (NPV10 in US$)

	TOTAL	First Year Return (from Timber)	Later Year Returns (from Palm Oil)
Return to investors	4,451	2,080	2,371
Value of government revenues:	1,392	819	573
Employment value	1,045	-	1,045
TOTAL:	6,888	2,899	3,989

Several aspects of these estimates are notable:

1. About $US2,900 or 42% of the total NPV is tied to the revenues generated in the first year from timber, suggesting that almost half of the estimated value would come from liquidation of merchantable hardwoods.
2. About 47% of the return to investors and 59% of government revenues are tied to the proceeds from a natural forest cut. From the perspective of investors and government, half or more than half of the value of a forest conversion to oil palm project is realized after the first year and attributable to liquidation of hardwoods.

[1] C. LaFranchi and T. Manurung. November 2000. A micro-economic model of oil palm plantations and associated timber exploitation. Simulating returns to a generic large-scale estate in Kalimantan, Indonesia. Unpublished report.

3. Estimates are very sensitive to crude palm oil prices. If the average price drops by 15%, the model predicts a 37% decline in investor returns.

Our incomplete estimates for CFMS amount to between about $US 200 and 700 per hectare (Table 4.) for 14 key activities that occupy about a quarter of the households' available labor time. Because we were not able to value several important activities, this range clearly understates the value of CFMS by a substantial factor.[2] More work would have to be done to more thoroughly quantify the complete set of activities in the CFMS. These preliminary results indicate that additional study would be worth conducting to illustrate that the returns to CFMS activities could be substantially higher than some of the activities that they are being compared to.

As noted, however, per hectare CFMS values (Table 4.) are not directly comparable to per hectare values for oil palm (oil palm is a return to investors but CFMS provides a return to the communities). A conclusion can be drawn, however, that is relevant to the comparison of oil palm as an alternative to CFMS: oil palm developed in the study areas is at the expense (i.e., opportunity cost) of the CFMS benefits it would displace.

[2] We do not have the data to properly address this issue. However, theory would suggest that economic agents should allocate available labor time to different activities until the marginal benefit achieved from each is equal. Otherwise, an agent could achieve higher benefit by reallocating some time from a low value activity to a higher value activity. Here, "benefit" refers to any enjoyment or value obtained from the activity. This idea of benefit would also have to be "net" so that any discomfort or costs associated with a particularly arduous but high value activity would have to be factored into the comparison. Then marginal returns to labor could be used as a minimum estimate of the benefits received from non-quantified activities. That is, using this notion that marginal returns for all activities are similar, then the marginal return from the quantified activities could be projected to the other 75% of available labor time as an (under) estimate of the values received from those activities.

Our study yielded average, not marginal, values for the quantified activities. The only proxy we have for a marginal return to labor is the minimum wage rate of Rp. 9000 per day. Also, in practice, measured marginal benefits across activities may not be equal if substantial disutilities are not accounted for or if there are constraints in the system, like supply limits, or required minimum activities, like obtaining drinking water. To apply this approach, we would have to develop marginal returns for a number of tangible, quantifiable activities, test to determine if they are similar, develop a much more rigorous estimate of the total available pool of labor, and further examine the opportunity value of labor (i.e., is minimum wage labor available in these villages? If not, what return to labor can be used as an estimate of the opportunity cost of not working, or working on one activity instead of another?)

Developing oil palm plantations in the study areas would come at the cost of displaced CFMS activities. Displacing CFMS, considering only financial attributes, would cost in the range of $US 200 to 700 per hectare, depending on the attributes of the CFMS location. Based on our survey findings, this range represents a lower-bound as it does not account for the full range of CFMS activities or intangible and non-market costs and benefits.

Furthermore, developing oil palm would require the immediate liquidation of merchantable hardwoods. Liquidating hardwoods would have two effects:

1. Environmental and social costs greater in scale, scope, and irreversibility relative to CFMS as they are currently practiced (including loss of previously mentioned intangible values of CFMS that our work does not capture – see Figure 2 below).
2. Diversion of existing and potential benefits, from merchantable hardwoods, away from local communities to other groups, including government and foreign entities.

Liquidating merchantable hardwoods diverts a potential source of cash income away from communities to other entities. Consequently, comparing CFMS to oil palm, and other alternative uses, is as much about how the benefits and costs flowing from natural resource utilization will be shared as it is about the relative size of benefits that could be captured from existing or alternative land use practices.

Public welfare, as noted, is intimately connected to what our financial picture *fails to capture*. Our analysis captures a *partial* picture of direct financial returns to CFMS: not all goods and services flowing from this system are valued in this study in monetary terms. The benefits provided by oil palm are, however, captured nearly completely. The comparison of monetized values is skewed, more specifically, because this approach is not very good at capturing the environmental/social/intangible costs associated with oil palm and the full range of benefits flowing from CFMS (note that CFMS also entails social/environmental costs, as illustrated by the emerging meranti wood trade in Besiq).

Suppose we could estimate the unaccounted aspects of an economic comparison -social and environmental costs, non-market, and intangible costs – all the elements of Total Economic Value. What value would these elements need to reach to make the total benefits package of CFMS approximately equal to proposed oil palm plantations (not considering the issue of how benefits are distributed among stakeholders)?

Based on Tables 4 and 5, total unaccounted costs would need to be in the order of about $US 3,000 to $6,000 per ha, in order to make the CFMS comparable in value to the oil palm (from the perspective of all the returns to each part of society, including the government and the investor). Note however, that this includes the value of timber from the oil palm site, which really should be considered as a return independent of the oil palm investment.

These "unaccounted" values comprise a number of concepts that are reasonably well-defined in economics. These values are difficult to quantify and may not be familiar to the average reader. For example:

Direct Use Values (e.g., collection of medicinal plants)
Indirect Use Values (e.g., ecosystem functions)
Option Value (the value of keeping open the option to decide later)
Bequest Value (the value of leaving something to one's children)
Existence Value (the value of knowing something exists)

Only a subset of direct use values is captured quantitatively in this study.

There are aspects of the comparison that are not captured even by an economic analysis that captures environmental and social costs. The form, type, and rate of flow of benefits over time also impact welfare. Following are additional practical and operational aspects of the comparison.

- Oil palm requires large upfront costs and derives a great deal of its value from harvesting the existing natural forest. Generally, oil palm investment yields negative cash flows for about the first half of the typical 28-year project time horizon. CFMS, in contrast realizes returns continuously or annually, reducing risk from uncertain events (e.g., bankruptcy) that could negate the return on invested labor and capital.

- There is a relatively large and short-term financial incentive to harvest the natural forest and put off investment in palm oil plantations. Corporate entities with access to many sites would find it financially advantageous to harvest natural forest as quickly as possible and put off investment in palm oil for as long as possible. Notoriously low planting rates have resulted (Kompas story 19 May, 2000).

- Price risk: the returns to oil palm are directly dependent on the international commodity prices of exportable oil palm products. A sustained price reduction would lead to a situation in which, having invested in conversion to oil palm, stakeholders would be forced to continue operating at a loss rather than paying the high cost of converting to another land use. CFMS, being composed of numerous activities that can be ramped up or down in response to market conditions, offers far less risk and more flexibility with respect to changing prices or other fluctuating economic conditions.

V. Conclusions

Initial collaboration with SHK has generated limited empirical data on three study areas located in the Mahakam catchment system in East Kalimantan. The data are used to estimate the direct value of key components of the Customary Forest Management System, which is applied to a simply specified quantitative model. Results of this model are put into context by comparing them to per capita income statistics and the likely value of proposed oil palm plantations from the perspective of local communities and the public. The basic findings of this study can be summarized as follows:

1. **CFMS values are roughly comparable to average per capita income values in Indonesia.** Limited empirical findings suggest a large and varied range of direct returns to CFMS studied. Depending on assumptions and location the range is from about $US200 - 700 per hectare (NPV) or 7.7 to 15 million rupiah annually per household, on average. Estimates are incomplete in that they do not account for the direct value of all goods and services flowing from the CFMS (medicinal plants, and vegetables, for example, are not valued). Neither do estimates capture values associated with social/environmental/intangible values, nor do they account for the likely significance of some of these activities to local livelihood stability, economic risk aversion, or related issues such as food supply.

2. **We conclude that, from the local perspective, CFMS provides a greater return to labor than oil palm**, even without unaccounted benefits and costs and the intangible benefits associated with CFMS. Furthermore, developing oil palm that requires natural forest conversion redirects benefits from communities to other entities through the process of merchantable hardwood liquidation.

3. **Total oil palm returns (to investors, government, and labor) are much higher than CFMS values but closely tied to the proceeds of a natural forest cut (hardwood liquidation).** In reality, "Oil Palm Returns" include returns to two distinct activities: forest clearing and plantation development.[3] About 42% of the NPV of the oil palm land use alternative is tied to timber revenues received in the

[3] In practice, these two activities often occur together, but they need not do so. In fact, there are examples where forest harvesting occurs, but palm oil plantation is not developed. In other cases, palm oil plantation is developed on land that has already been cleared, burned, or otherwise degraded, with no clearing of natural forest.

first year. Furthermore, model outcomes suggest that more than half of the NPV would go to private and possibly foreign entities.

4. **Comparing CFMS to alternative land uses may be as much about how benefits flowing from natural resources are distributed as it is about relative returns.** The oil palm alternative would involve liquidating an important natural asset (i.e., trees) and diverting proceeds to government and private investors.

5. **Unlike some alternative land uses such as oil palm, CFMS is relatively resistant to market shocks, and does not require long time horizons or large initial investments to realize returns.** Oil palm requires exposure to risks associated with fluctuating international prices and the potential effects of social conflicts.

6. **The vastly different nature of these two land use alternatives complicates the comparison.** The two land uses being compared are different in almost every way imaginable:
   - Oil palm requires converting natural forest to a monoculture crop, substantial initial investments, and a time horizon of about 28 years. Benefits are provided to private investors, government, and employees. Environmental and social effects are on a large-scale and some are irreversible.
   - CFMS generates annual returns for local communities only; environmental and social effects are relatively small in scale. There are no major tax revenue streams accruing to local government.

Furthermore, there are several other factors that complicate the comparison:

- We were not able to fully value CFMS because we did not survey all of the important activities.
- Unlike oil palm, a large component of CFMS value is tied to non-monetizable values.
- Conversely, a large portion of the indirect costs associated with oil palm are not readily converted into monetary terms.

As noted, this study had several important limitations. Possible steps that could be considered to improve upon and expand this work include the following.

- Conduct further survey or field work to estimate the direct use value of additional CFMS activities. This study did not focus on valuing the activities of women, the role and value of medicinal plants, the value of small scale agricultural crops and subsistence vegetables.

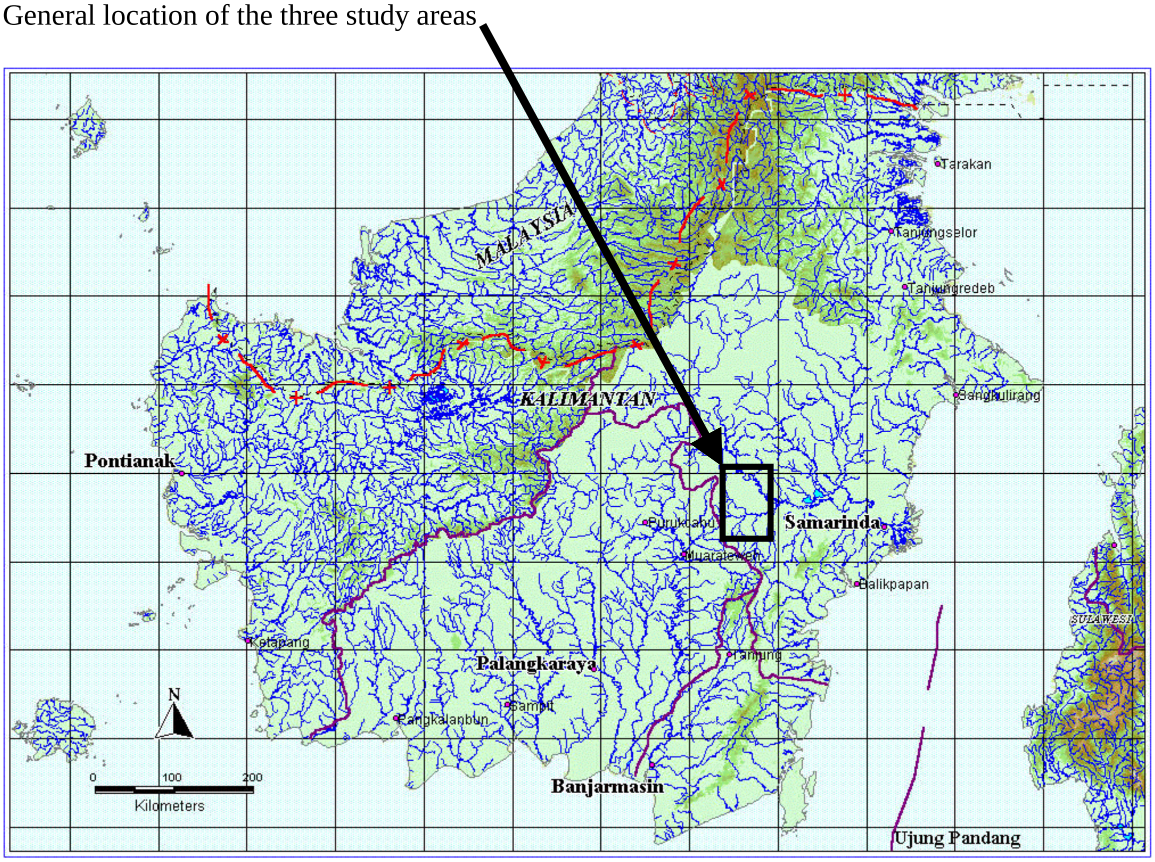
- Develop and apply a more comprehensive, efficient and accurate methodology for estimating the labor allocation over the array of available CFMS activities. The focus of this effort would be to further quantify household labor allocation decisions with the goal of providing a more accurate estimate of returns to labor for different activities. The study would have to consider that the labor allocations are changing over time.

- Develop methods to capture the value of resources that are likely to have great value and significance at specific times, such as crises, though they may not be often or routinely important. For example, a certain wild food may go unutilized unless there is a crisis or natural disaster, such as fire or flood. In ordinary times, such back up resources would have low value and would have a low probability of being captured in a survey. In crisis periods, however, and as an element of overall food security, the value could be substantial (value of risk reduction).

- Non-economic studies of the biophysical outcomes of forest conversion, palm oil plantation, and other land uses would also contribute to a better understanding of the level and value of associated environmental or socio-economic losses or health effects. Some of the effects that would need to be quantified include rate of loss of topsoil, sediment loadings in streams, loss of tourism value, effects of immigration by outsiders, etc.

Appendix A: Site Maps

General location of the three study areas



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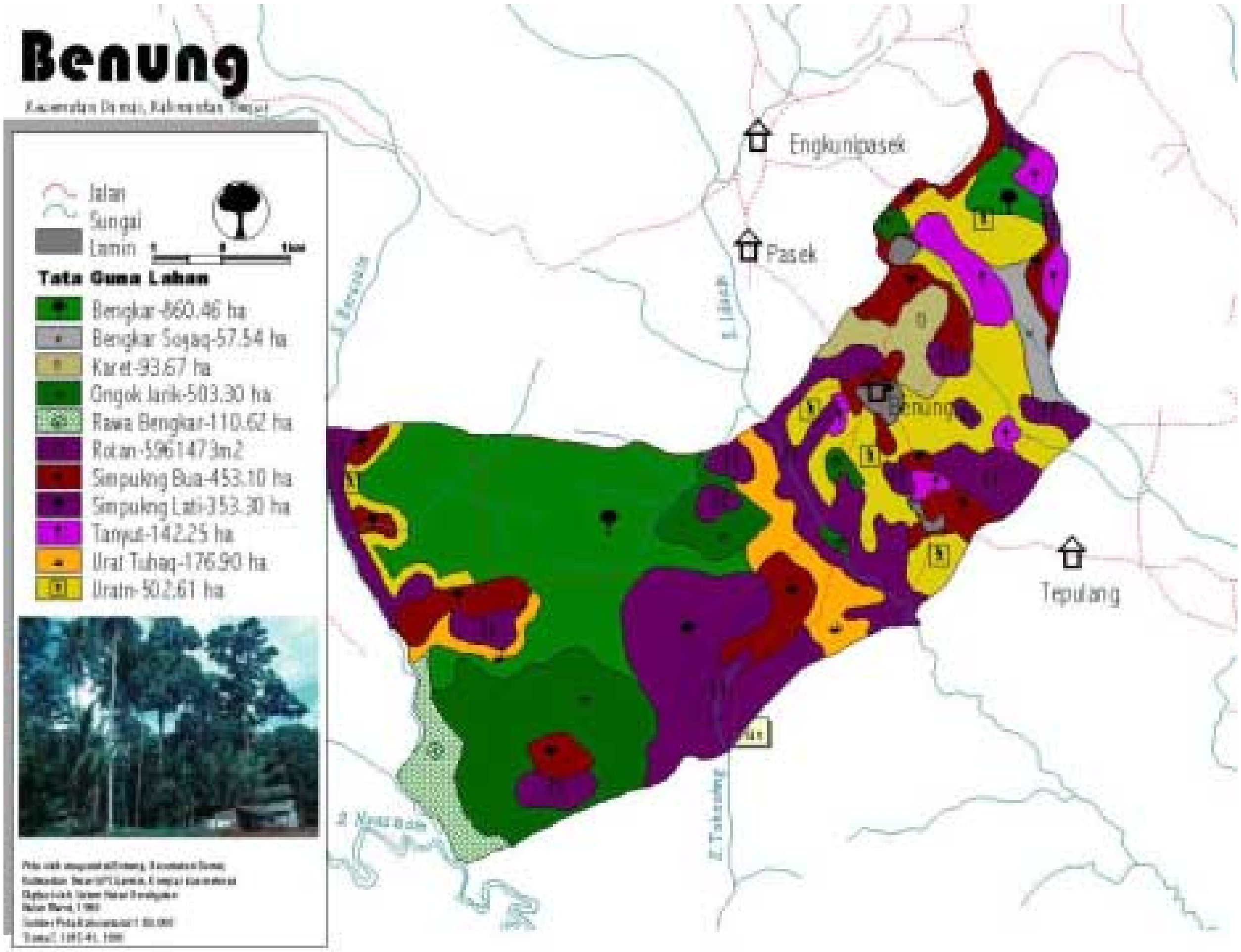

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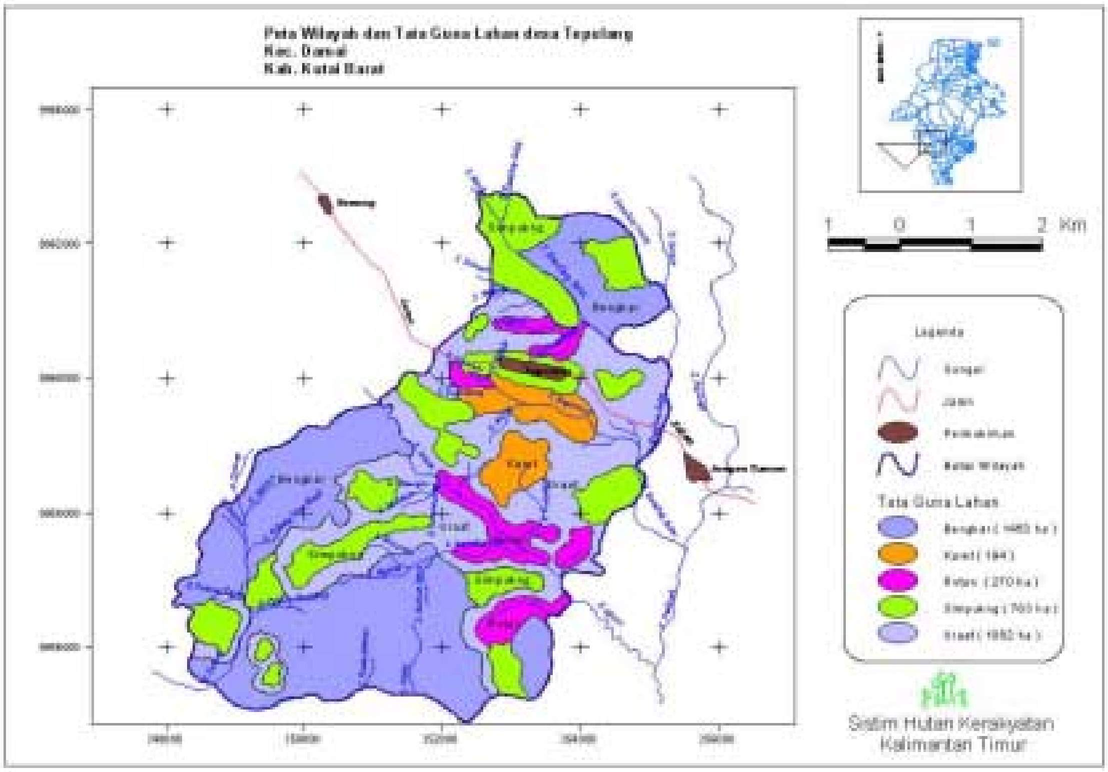

Appendix B: Financial Model Description

The assumed land use requires clear-cutting 10,000 ha of natural forest and developing a large-scale monoculture oil palm estate (the actual area required by the operation would be larger to accommodate housing, processing facilities, steep slopes, etc). At this size, economy of scale is sufficient to justify associated processing and transportation infrastructure. A time horizon of 28 years is assumed, over which oil palm trees produce fresh fruit bunches (FFB) that are processed into the two primary products: crude palm oil (CPO) and palm kernel oil (PKO). These products supply domestic markets and capture foreign currency as they are also exported. A typical yield scenario is assumed in which about 2,000 ha are planted each year for the first five years, and trees start producing marketable product after four years. Because the investment climate in West Papua is influenced by many uncertain events, a discount rate of 18 percent is applied.

Model specification and associated analysis requires several main tasks:

- Gauge the probable FFB yield scenario in West Papua, given soil types, climatic conditions, etc.
- Assume appropriate extraction rates for converting FFB into CPO and PKO, given current processing technology employed in Indonesia.
- Derive producer prices (at the farm gate) considering historical price fluctuations and recent prices. Producer prices are derived from international CPO prices. The international price assumed in the model equals the average of a time series of 25 years of average annual international prices.
- Assume appropriate planting and investment rates, given conditions in West Papua.
- Estimate the net revenue to investors per m^3 of wood cleared and harvested, and revenues associated with supply of CPO and PKO to both domestic and export markets.
- Estimate costs of production, revenue and profits to estate investors (an investor could be a private foreign entity or government).
- Estimate the royalties and tax revenues collected by the government of Indonesia.
- Estimate the employment generated and associated wages.
- Develop a discounted cash flow analysis for the period of estate operation (time horizon).
- Test the sensitivity of results to changes in prices, costs, and timber volumes.

The model is deterministic (there are no stochastic elements); all calculations are computed using an Excel spreadsheet. Anticipated yields and extraction rates are applied to estimate revenues from three sources: roundwood from natural forest conversion, CPO and PKO. Annual financial costs (e.g., production, processing, taxes, land use fees) are estimated and tallied over time and subtracted from the sum of annual revenues to produce a stream of net revenues to investors and government. Estimates of the average labor input per hectare and unskilled labor rates are applied to estimate the value of wages. There are three primary outcomes or results:

- The return to estate investors = present value (PV) of the sum of annual net revenues for the 28 year time horizon
- Total government revenues = PV of the sum of land use fees (year 1 only) and taxes levied on exported CPO, exported PKO, and harvested timber.
- The total value of labor wages = PV of the sum of average annual labor input values (person-days/ha).

The financial opportunity cost of conserving these areas equals the sum of these three results.

Several assumptions are made that are specific to West Papua sites:

- Low yields are assumed to best simulate conditions (i.e., soil types) in study areas, based on the low, medium, and high scale specified by Manurung (1999).
- The average international CPO price used in the model equals the arithmetic mean of average annual prices for the last 25 years (see the "Prices" sheet of the spreadsheet model).
- Although natural forest conversion requires clear-cutting, only roundwood with a diameter greater than 30 cm is valued (smaller diameter trees would normally be processed in a pulp mill; however, there is no pulp mill in West Papua and it is assumed to be uneconomic to transport pulp timber to the nearest mill).

Model Structure

The financial model has three major components and numerous subcomponents:

1. Oil palm estate

A. Yield and extraction rates

These correspond to assumptions with respect to FFB yield and extraction rates to CPO and PKO, the two main products. Yields and extraction rates are not constant over time, but grow beginning in year 4, begin peaking around year 9, then decline around year 17. Yield assumptions are based on experiments performed at the Marihat and Medan Research Centers. Lands in Indonesia are classified (into three categories) according to fertility and suitability for palm oil cultivation. High, Medium and Low yield scenarios, based on study findings and fertility classifications and specified by Manurung, are applied to this model.

B. Price derivations

The producer price (paid to investors for CPO and PKO exported and sold domestically) is derived from the reported price of CPO CIF Rotterdam. This portion of the model contains the assumptions and multipliers with respect to taxes applied and transportation costs that are subtracted to derive a producer or farm gate price paid to investors. PKO price is a function of CPO price (a multiplier of 1.24 is used to derive PKO price). Prices remain constant during the entire time horizon of 28 years.

C. Planting investment

This subcomponent specifies the rate at which planting investment is carried out over a period of five years.

2. Cash flow

A. Revenue

This section computes annual gross revenue streams for CPO, PKO, and timber using estimates of FFB yields, extraction rates, derived prices, and volumes of cleared timber. Net revenues per cubic meter of timber that appear in the model are equal to the producer price of timber minus the cost of extraction and government fees and taxes. All timber harvesting is completed by the end of year one.

Table 2. Government revenues from timber exploitation

Fee, royalty, or tax	**$US/m3 (>50 cm diameter roundwood)**
Resource rent tax (PSDA)	5.63
Reforestation fund (DR)	16.00
Local retribution fees	.60
Total	**22.20**
Source: Per Com, Oct, 2000 Kalimantan timber concession manager	

B. Costs

Various annual costs of production include: cost of land permitting (cost of getting HGU for oil palm plantation); planting; harvesting; upkeep; fertilizer; transportation; factory investment; processing; overhead; depreciation.

3. Model Outputs

A. Return to investors

Return to investors is expressed as: annual net revenues; discounted annual net revenues; present value for the entire time horizon.

B. Government revenues

Government revenues are expressed as: annual revenues; discounted annual revenues; and, present value for the entire time horizon.

C. Labor wages

Labor wages are expressed as: discounted total annual labor costs (wages); present value of wages for the entire time horizon.

Table 2. Sources of Model Assumptions

MODEL COMPONENT	KEY ASSUMPTIONS	SOURCE
Yield and Extraction rates		
FFB yield	Range: 4.2 – 20.0 tons/ha/year	#1 (see full citation below)
CPO factory processing rate	50 tons/hour	#1
CPO/KPO extraction rates	KPO: 4.5 – 5 % CPO: 15 – 24 %	#1
Domestic/export volume	50%/50%	#1
Price Derivations		
CPO CIF Rotterdam (Int'l price)	$483/ton	Oil World web site, average of 25 years of average annual prices
Int'l ship transport	$40	#1
Mill to port transport	$5	#1
CPO/KPO Export Tax	10 %	The government is obliged to keep the tax to a maximum of 10% in accordance with an IMF agreement (Casson, 1999).
Timber Harvest		
Average vol. per ha	120 m3/ha (total)	Pers. Comm.
Diameter 10-30 cm	84 m3/ha; 10 $/m3	Pers. Comm.
Diameter > 30 cm	36 m3/ha; 35 $/m3	Pers. Comm.
Land clearing rate	10,000 ha/year	Pers. Comm., and #3
Outflow (production costs)		
The cost of land permitting	$20/ha (one time cost)	# 3
Planting investment	$1317/ha	# 1
Harvesting	$24.29/ton palm products	# 4
Upkeep	$12.17/ha/year	# 4
Fertilizer	$240.95/ha/year	# 4
Transportation	$12/ton palm products	# 4
Factory investment	$14.35 million total	# 1
Processing	$19.35/ton palm products	# 4
Overhead	$133.75/ha	# 4
Depreciation	$47/ton palm products	# 4

1) CIC. 1997. Study on Palm Oil. Capricorn Indo Consult. Jakarta.
2) Indonesian Business Data Centre. Table on page 26. World Market Prices of Palm Oil, 1979-1997. (CIF Roterdam//US$/Ton).
3) Feasibility study of oil palm plantation company (name of company confidential).
4) Liang, T.S. Oil Palm Cost In Indonesia. 1998. Paper presented at 1998 International Oil Palm Conference: "Commodity of the past, today, and the future". 150 Years of Oil Palm in Indonesia. September 23-25, 1998. Bali, Indonesia.

Personal Communication: management and forest concessions staff; university faculty of forestry.

Two proxies ("LOW, "HIGH") for the private return to oil palm labor are considered as a basis for model assumptions on the direct value of such employment from the local perspective:

- LOW: the reported unskilled minimum daily wage labor rate in year 2000– Rupiah 9,320 (source: Kanwil Tenaga Kerja, 2000). This wage rate is consistent with a post-crisis rate reported in Casson (1999) of Rupiah 250,000 per month or about 9,615 per day (the LOW wage rate is assumed in the model); and
- HIGH: a daily wage reported in LaFranchi (2000) that corresponds to unskilled oil palm estate labor– Rupiah 16,000. This estimate includes the value of two meals likely to be received as part of normal compensation as a laborer at an oil palm plantation

Labor requirement assumptions applied in the model are based on the average of two sources presented in the table below.

Table 3. Labor requirement assumptions

Source 1. T. Tommich, 1998***:***	**Labor Requirement**
Establishment phase	532 person-days/ha
Operational phase	83 person-days/ha/yr
Total Labor (annual average input)	108 person-days/ha/yr
Source 2. Project proposal for a 19,800 ha estate in West Kalimantan (PT. Prakarsa Tani Sejati:)	
Land clearing (from natural forest cover)	142 person-days /ha
Establishing and maintaining oil palm nursery	802 person-days /ha
Planting land-cover crops	93 person-days /ha
Year 0 - oil palm (seedling) planting	77 person-days /ha
Year 1 - maintenance (including fertilizing and pest and disease control, etc.)	93 person-days /ha
Year 2 - maintenance	96 person-days /ha
Year 3-4 – maintenance	78 person-days /ha
Years 5-10 – maintenance	46 person-days /ha
Year 11-18 – maintenance	48 person-days /ha
Year 19-28 – maintenance	40 person-days /ha
Total Labor (annual average input)	90 person-days/ha/yr
ASSUMED LABOR REQUIREMENT	**99 person-days/ha/yr**