

# **The Ecological and Social Dynamics of Land Use in the Wallace Narrows, Indonesia**

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## Report Organization

### Scope of Work and Introduction

*Map 1: Land Use and Deforestation in East Kalimantan and Sulawesi*

### Typologies of Industry Development

Oil Palm Plantations  
Palm Oil and Timber Processing Mills  
Timber Plantations  
Selective Logging Operations  
Industrial Mining  
Artisanal Gold Mining

### Extractive Industry Companies: Activity and Reputation

Palm Oil Producers  
Timber Pulp Producers  
Coal Producers

### Bushmeat Hunting and Trade

Flying Foxes and Disease Transmission  
Macaques and Disease Transmission

### Study Region 1: East Kalimantan

Background  
East Kalimantan Bushmeat Hunting  
East Kalimantan Extractive Industry  
*Map 2: East Kalimantan Deforestation Hotspot 1*  
*Map 3: East Kalimantan Deforestation Hotspot 2*

### Study Region 2: North, Central, and West Sulawesi

Background  
Sulawesi Bushmeat Hunting  
Sulawesi Extractive Industry  
*Map 4: Central and West Sulawesi Deforestation Hotspot 1*

Conclusions: Weighing the Prevalence and Importance of Land Use Change and Deforestation between Study Regions

### References

## Scope of Work and Introduction

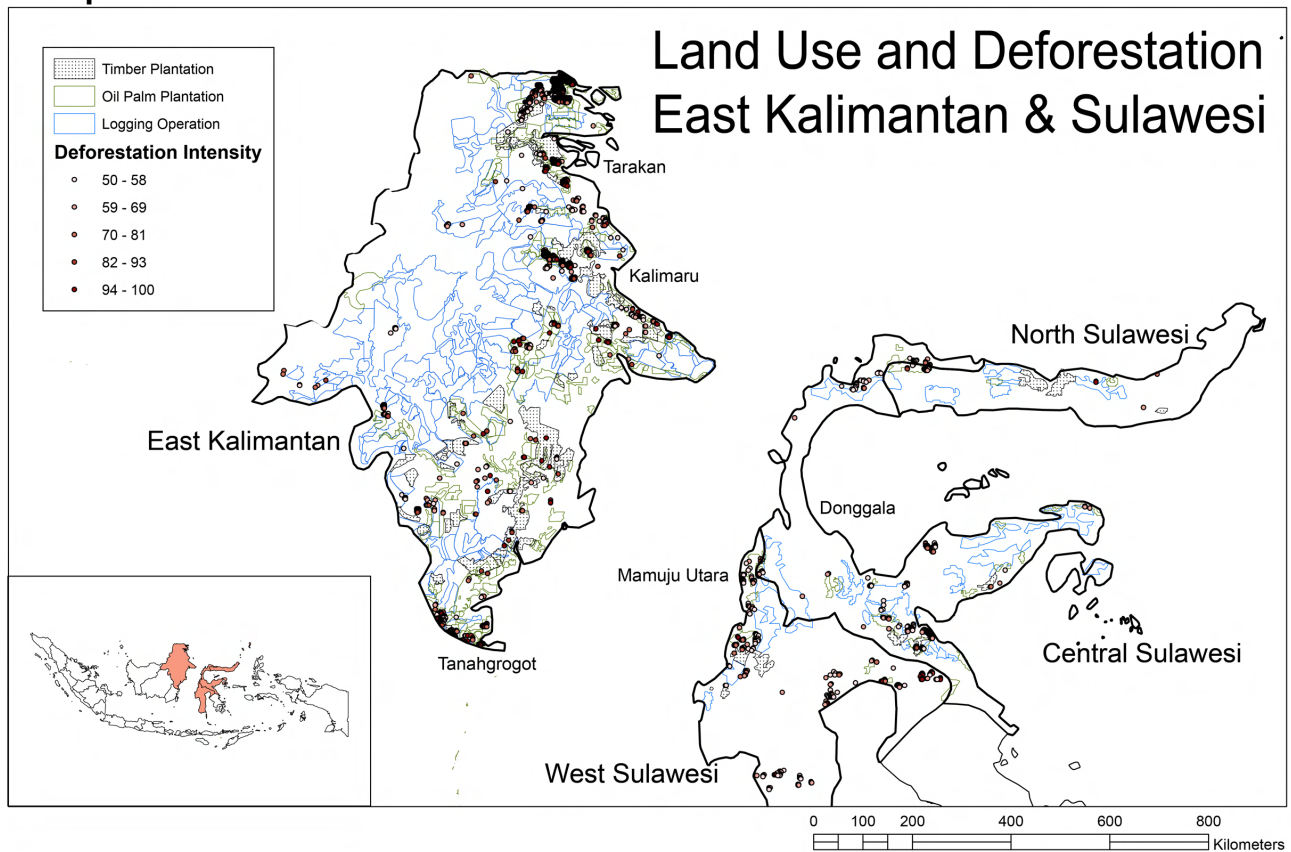
This desk study of demographics, ecology, and company characteristics at sites of recent and large-scale land use change, as described in the referenced Scope of Work *Indonesia Desk Study to Support Programming Decision* (RFP #: 3879-06-165), has been carried out in support of FHI 360's USAID-funded project, "Global Avian Influenza and Zoonotic Behavior Change and Communication Support Activity," also known as the PREVENT project. To the best extent possible, given time and data constraints, this report summarizes available land use, biodiversity, demographic, labor, and company characteristics that pertain to recent and large-scale land use change by extractive industry in the Wallace Narrows region of Indonesia.

The scope of this study includes the Indonesian provinces of East Kalimantan, located on the island of Borneo, and the North, West, and Central provinces of the island of Sulawesi. The Wallace Narrows refers to the less-than-100-kilometer strait that separates East Kalimantan and Central Sulawesi, also known as the Makassar Strait. The Wallace Line, a theoretical divide of two biogeographic regions, the Indian and the Australian, runs through the strait. Of primary importance to this study are the ways in which the specific ecological and social changes associated with extractive industry influence human-animal interactions. Material summarized includes published papers, NGO technical reports, and publicly available government data. To the extent possible, we have screened materials for reliability and crosschecked references, although for the sake of brevity, only the most credible source has been referenced. A series of four maps has been constructed depicting location of recent and large-scale extractive industry expansion and land use and land cover change at these sites.

The presence of extractive industry varies between Sulawesi and East Kalimantan. Both regions contain palm oil plantations, timber plantations, and mining, but their extent and overall impacts are vastly different. All extractive industry, with the exception of artisanal illegal gold mining, is more prevalent in East Kalimantan.

The larger goals of the PREVENT project include identifying the specific pathways through which different human behaviors affect exposure to and risk of transmission of new diseases. Research on typical environmental changes observed as locations transition from various forest types (e.g., intact primary forest, secondary forest, agroforests) to a location of extractive industry provide the basis for this site selection study. For each aspect of extractive industry, to be listed in detail below, a summary at the provincial scale will be provided. To add further understanding of the many interactions that occur at much smaller scales of analysis, an effort is made to describe these changes at two specific deforestation hotspots in East Kalimantan and one such hotspot in Sulawesi.

Map 1.



Map 1 shows the geographic boundaries of East Kalimantan and North, West, and Central Sulawesi. Land use data includes government-recognized palm oil plantations, timber plantations, and logging operations. Concession area boundaries are compiled from Government of Indonesia Ministry of Forestry data, and includes all current permits (*Ijin Lokasi*) as of 2010. It is important to note that a current palm oil or timber plantation concession lease does not imply that clearing is ongoing; these plantations can be at any point in development -- from standing natural forest, to closed-canopy palm oil or timber plantation, to inactive.

Deforestation is shown as single geo-referenced pixels of deforestation intensity. An individual point represents a single pixel of Modis-derived satellite data, encompassing monthly observations from 2005-2010. Pixel size is  $250m^2$ . Intensity is measured on a scale from 0-100, with 100 representing the strongest deforestation signal in the dataset. Values of lower than 50 are dropped based on statistical significance tests of signal-to-noise ratios of the underlying data.

The correlation between observed deforestation events and extractive industry are apparent from Map 1. Palm oil plantations are associated with deforestation in both study regions. Timber plantations and logging operations also play a clear role in East Kalimantan. The same is largely true for Sulawesi, although there is a strong cluster of deforestation that is not associated with concession areas in West Sulawesi. Deforestation also occurs outside of palm oil, timber and natural logging concessions; the exact cause of these individual events cannot be concluded from this analysis. It is known, however, that deforestation outside of concession areas includes: irregularities in compiled concession data for

this study; clearing for plantations and logging outside of legal concessions; small-scale swidden clearing; legal and illegal mining activities; and natural and man-made fires. The highly clustered spatial pattern of West Sulawesi deforestation outside of known concession areas suggests clearing for oil palm or timber plantations. Their large scale suggests it is unlikely that these are unlicensed areas; it is more likely that the concession areas in question were not obtained for this analysis. There is the possibility that this deforestation is being driven by agricultural expansion by smallholders and swiddeners, large-scale legal mines, and small-scale illegal gold mining.

Table 1 provides estimates from the spatial data presented in Map 1 on current plantation and logging concession lease areas in East Kalimantan and North, West, and Central Sulawesi. It is important to note the largely inactive status of logging operations, making their role in large-scale deforestation much more limited compared to oil palm and timber plantations.

**Table 1. Extent of Extractive Industry Operations**

Current Concession Leases	East Kalimantan	North, West and Central Sulawesi
	Area (Hectares)	
Palm Oil Plantations	2,607,341	401,763
Timber Plantations	1,167,403	205,659
Logging Operations	5,435,923	1,181,977

*From study analysis*

### Typologies of Indonesian Extractive Industry

Oil palm plantations, timber plantations, logging operations, and mining vary significantly in their typical patterns of deforestation, local ecology, labor utilization, and nearby or internal human settlements, including typical housing arrangements of workers, workers' families and non-workers at a typical industry development site. These dynamics are considered below.

#### ***Oil Palm Plantations***

West African oil palm (*Elaeis guineensis*) is grown for its valuable fruit, which is harvested up to four times a year and sold for processing. Historically, palm oil has been cultivated in many forms in Borneo and Sulawesi. Today, palm oil is produced in three ways, considered separately below:

##### *Individual Smallholder*

Perhaps 15% of palm oil production is in small monoculture plots, next to family fruit orchards, rubber tree plantations, rice paddies, and homesteads. These plots are generally smaller than 5 hectares. The fertilizing and insecticide requirements of the forms of hybridized *Elaeis guineensis* seed now available in East Kalimantan and Sulawesi entail that even small plantations are grown in monoculture. Often these plots are located in what was *Alang Alang* grassland, or land previously used for other crops (e.g., tobacco, rubber, coffee). These plots are rarely near primary forest, as the types of agriculturalists that live in remote forest areas rarely have the capital or market access needed to grow oil palms. Family units provide the needed work of planting, weeding, and harvesting, which tends to be more irregular and less-intense than other forms of palm oil agriculture. Individual smallholders live in a range of housing, from wood siding with zinc or grass roofs, to the evermore-popular and ubiquitous cement homes that can now be built more cheaply due to the scarcity of timber.

### *Plasma Nucleus*

Roughly 50% of palm oil production is at large oil palm plantation complexes called “Plasma Nucleus” schemes. The “nucleus” is the inner ring of the plantation that is cultivated by full-time laborers and managers, while the “plasma” consists of the smallholder contract farmers who cultivate the outer ring of oil palm plantations. Plasma farmers typically harvest a small home garden and rice paddy, along with another two hectares or so of oil palms. They typically live far from their oil palm plots. This is different from individual smallholders, who typically live next to their oil palm plots. Often, when companies develop plasma oil palm plots in Indonesia, they create a grid of plantation roads that result in long rows of closely set homes, with rectangular gardens adjoining each other behind the front-facing homes. These gardens are very different than the unbounded, more loosely organized gardens of most older, individual smallholder gardens. Village fowl, pigs, and other livestock are held more closely together in the plasma gardens than in typical smallholder homesteads. These homes tend to be wood, with zinc roofs and built more closely together than non-plasma communities

### *Cooperative and Corporate Laborer Programs (Tenaga Kerja)*

The remaining 35% of palm oil production occurs in plantation estates that do not have plasma contract farmers, and are operated exclusively by full-time laborers employed by companies. At their most extreme, worker settlements in these estates consist of barracks, or single-roofed shotgun housing, densely packed with no running water and no bathrooms. The wealthiest plantations build cement and tile barracks with plumbing, electricity, and a small shared kitchen. These remain in the minority, however.

The initial workers at a new plantation suffer harsh conditions regardless of the wealth of the developer. At the earliest stages, land-clearing teams live in plastic-tarp-covered encampments. Planters tend to live in wooden shacks that house hundreds of men and typically less than half as many as women. The least-funded corporate plantation typically employs eight people per hectare (Pirard and Mayer 2008), leading up to as many as 200,000 workers per plantation, with most living in wooden barracks or single-room family homes. Better-funded plantations may employ more workers per hectare, and allow a limited number of laborers to purchase 500-square-meter plots to build freestanding homes on the plantation grounds. Older plantations have many hundreds of these homes sprinkled throughout the plantation, shaded underneath a canopy of oil palms.

These plantation inhabitants are few in number but face an entirely unique human ecology. Increased levels of disease, chemical exposure, and other social ills can result. For example, increased rates of malaria have been found in Papua New Guinea plantations (Pluess et al. 2009). In a plantation in Sarawak, however, vector-mosquito density dropped significantly as a forest was converted to a four-year oil palm plantation (Chang et al. 1997).

Although individual and contract farmers maintain high levels of agricultural activity and diversity -- including raising fowl and pigs, forest activities, and intensive rice paddy agriculture -- the laborers of the ‘nucleus’ and cooperative corporate plantations are limited in their agricultural activities. They have no claims to the land, and likely live in the midst of either a planted or developing plantation monoculture where there is simply no possibility for rice paddy or agroforestry agriculture. Home gardens are extremely limited and rarely present.

Cooperative plantations are so-named because of Indonesian legislation that requires that local people must be allowed to invest in plantation development through local palm oil cooperatives (*Kooperasi*). *Tenaga Kerja* is the Indonesian workers program that sends employees to agribusiness plantations.

*Tenaga Kerja* workers make up varying percentages of cooperative plantation labor forces, in addition to locally sourced labor, private-company-recruited labor, and *Transmigrasi* (a second, older but still ongoing government resettlement program) resident laborers. These workers all live, intermixed, in the nucleus and cooperative plantations.

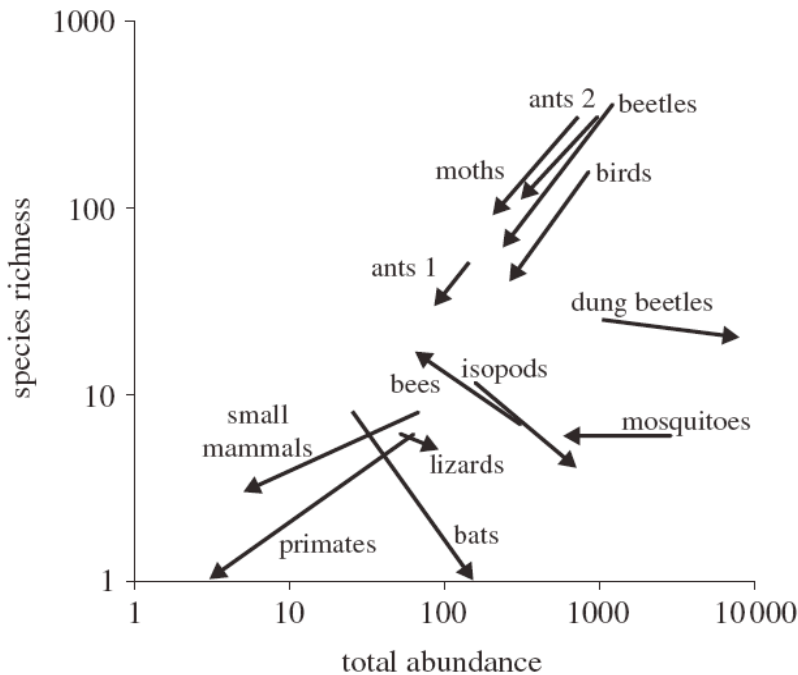
Oil palm plantation managers often openly prefer immigrant laborers for their greater drive, tendency to not work in other kinds of agriculture or employment while working on the plantation, and the greater likelihood that they will remain in the employ of the company year-round. Plasma workers, on the other hand, often leave the plantation to tend their own paddy or other crops when harvest time arrives.

### *Oil Palm Plantation Ecology*

Only plantation estates run by private companies and various forms of public-private partnerships have the capital and equipment required to operate large-scale plantations (i.e., over 100 hectares) and to convert standing forests to plantations. These estates should thus be the focus of studies and projects interested in the effects of large-scale land use change.

Production landscapes continue to expand in both East Kalimantan and Sulawesi. Research published in 2011 includes a meta-analysis of 13 studies that include field data on biodiversity in oil palm plantation habitats in Latin America and the islands of Sumatra, Borneo, and Papua (Figure 1). A general reduction of species richness and abundance was observed across a range of indicator taxa. Bat species diversity dropped to one, while total abundance actually increased. Mosquito species were unaffected by palm oil development, but overall abundance was decreased. Small mammals and primates suffered a decrease in both species richness and abundance.

**Figure 1. Species Richness and Abundance of Various Species in Primary Forest and Oil Palm Plantations**



*Figure 1 notes: Arrow tails denote observed species community richness and abundance in primary forest habitat. Arrow heads denote species community richness and abundance in palm oil plantations. (Figure data was compiled by Foster et al. 2011 from 13 peer-reviewed published articles based on studies carried out in Malaysia, Indonesia, Papua New Guinea, Colombia, and Ecuador.)*

In a careful study carried out by the London Zoological Society in Sumatra, only four species (10% of the number detected within the landscape) were regularly detected in the oil palm plantation itself and none of these species had a high conservation value. These species are, in order of abundance observed in palm oil plantations: wild pig, bearded pig, leopard cats, and common palm civets. High densities of rodents and reptile species were also observed. Some species, including deer, macaques, and pangolins showed limited tolerance. Some species continue to survive in the vicinity of oil palms by utilizing other habitat types also present in the land-use matrix, presenting the opportunity for hunting and other human-animal interactions near the plantation. Surveys of the overall landscape of oil palm plantations -- including the planted areas, uncleared forests of varying quality, and grasslands that fell within the area directly controlled by palm oil companies -- revealed the existence of 38 medium to large mammal species. Figure 2 shows the abundance of all species recorded in the plantation landscape. It is important to note that this study relied on camera trapping for data collection and thus is unable to reliably include data on small-bodied rodents or bats. The authors note, however, that a wide variety of rodent species were observed in the plantations (Maddox et al 2007).



**Figure 2. Recordings of mammals in a plantation landscape of North Sumatra**

Order	Latin name	Common name	Photos	Tracks	Faeces	Sightings
Artiodactyla	<i>Cervus unicolor</i>	Sambar	41	748	32	10
	<i>Muntiacus muntjak</i>	Muntjac	101	297	28	8
	<i>Sus barbatus</i>	Bearded pig	442	0	0	8
	<i>Sus scrofa</i>	Pig (wild)	1861	48	583	58
	<i>Tragulus napu</i>	Greater mouse deer	12	15	0	1
Carnivora	<i>Canis familiaris</i>	Domestic dog	59	7	0	3
	<i>Cuon alpinus</i>	Dhole	29	7	3	1
	<i>Catopuma temminckii</i>	Golden cat	0	1	0	2
	<i>Felis catus</i>	Domestic cat	5	0	0	39
	<i>Neofelis nebulosa</i>	Clouded leopard	3	11	1	0
	<i>Panthera tigris</i>	Tiger	115	184	25	4
	<i>Prionailurus bengalensis</i>	Leopard cat	201	324	1069	110
	<i>Prionailurus viverrinus</i>	Fishing cat	0	0	8	1
	<i>Herpestes brachyurus</i>	Short tailed mongoose	25	11	0	2
	<i>Mydaus javanensis</i>	Malay badger	1	0	0	0
	<i>Aonyx cinereus</i>	Small-clawed otter	0	1	0	0
	<i>Lutra sumatrana</i>	Hairy nosed otter	0	3	1	0
	<i>Lutrogale perspicillata</i>	Smooth coated otter	0	7	3	2
	<i>Martes flavigula</i>	Yellow throated marten	2	0	0	2
	<i>Helarctos malayanus</i>	Sun bear	45	116	3	5
	<i>Arctictis binturong</i>	Binturong	0	10	0	1
	<i>Hemigalus derbyanus</i>	Banded palm civet	2	0	30	0
<i>Paradoxurus hermaphroditus</i>	Common palm civet	58	235	2156	51	
<i>Viverra zibetha</i>	Malay Civet	18	4	0	2	
Erinaceomorpha	<i>Echinosorex gymnura</i>	Moon rat	0	2	1	2
Perissodactyla	<i>Tapirus indicus</i>	Malayan tapir	63	506	4	1
Pholidota	<i>Manis javanica</i>	Pangolin	3	8	0	1
Primates	<i>Macaca fascicularis</i>	Long tailed macaque	67	6	0	9
	<i>Macaca nemestrina</i>	Pig tailed macaque	855	13	2	14
	<i>Presbytis cristata</i>	Silvered langur	0	0	0	1
	<i>Presbytis melalophos</i>	Banded langur	1	0	0	11
	<i>Hylobates agilis</i>	Agile gibbon	0	0	0	5
	<i>Symphalangus syndactylus</i>	Siamang	0	0	0	5
	<i>Nycticebus coucang</i>	Slow loris	0	0	0	4
Proboscidea	<i>Elephas maximus</i>	Asian elephant	0	1	1	0
Rodentia	<i>Hystrix brachyura</i>	East Asian porcupine	150	239	4	6
	<i>Trichys fasciculata</i>	Long tailed porcupine	1	1	0	0
	<i>Callosciurus prevostii</i>	Prevost's squirrel	0	0	0	4
	<i>Petaurista petaurista</i>	Red giant flying squirrel	0	0	0	2
Scandentia	<i>Tupaia glis</i>	Common tree shrew	1	0	0	4

The results of this combined research effort show that oil palm monoculture is a very poor habitat for most terrestrial mammal species. Of specific importance is the relatively slight reduction in abundance of bushmeat pig and rat species. Flying foxes, another key bushmeat species, seem to be negatively impacted by palm oil development.

Both oil palm and timber plantations are increasingly expanding on peat forests along the coast of Kalimantan; there are only very small areas of peat soils in Sulawesi. These inundated forests must first be drained before planting is possible. Heavy machinery is used to cut and dredge canal networks that drain the peat soil and also provide a series of boat canals used to transport oil palm fruits or timber. Palm oil processing mills must be located close to production, as palm oil fruit becomes rancid if it is not processed within four days. Thus, palm oil mills are usually located in the middle of plantation areas, and use large storage- and effluent-discharge ponds containing high levels of pesticides and acidity from palm processing. Company managers and full time laborers -- most often members of the *Tenaga Kerja* and *Transmigrasi* programs -- often live in a complex that includes the mill and is usually near the first areas of oil palm planting. At the first stages of construction (i.e., land clearing and oil palm planting) the mill-worker complex may border or be within one kilometer of the forest boundary, presenting opportunities for human-forest interactions. In their off time, laborers living in these complexes have been known to hunt, fish, and gather in nearby forest areas.

### ***Timber Plantations***

Industrial timber plantations operate on the smallest margins of all agribusiness; economies of scale, therefore, are paramount. Only two companies with consistent production operate across Sumatra, Borneo, and Sulawesi -- the three highest-producing regions, listed in order of timber cultivation. Even the smallest plantation covers tens of thousands of hectares; the largest known plantation in Sumatra is on the landscape scale, over 125,000 hectares in Jambi province (Ministry of Forestry 2007).

The large amount of land required for timber plantations places the industry far beyond the reach of smallholder production.

The labor demands for timber crops is much less than for palm oil, however: roughly one worker per hectare of land under cultivation, and even less than this if downstream-processing needs are not considered (Pirard and Mayer 2008). Clearing requires chainsaw crews, log pullers, and bulldozer operators. In one timber plantation in Sumatra of ~90,000 hectares, field managers reported only needing 500 men (and they were exclusively men) to clear the entire concession areas over a period of approximately seven years. The geographic demands of a specific concession can considerably increase this number, especially in the inundated peat swamps or the hill-lands of Borneo and Sumatra.

Planting occurs in phases, as small forest blocks within the concession are cleared and prepped for planting. Planting requires much more labor, including women and young adults, typically for when crops are first planted.

A small compound at the entrance to the concession will house a core set of workers, overseers, and managers. In addition to any workers from nearby villages (typically security guards, chainsaw men, chainsaw assistants, log pullers, seedling nursery workers, planters, and weed clearers), these will normally be the long-term, full-time employees of a timber plantation, responsible for operating any heavy machinery and the actual harvesting of mature timber stands. The continuous entry and exit of migrants and local laborers ensures great turnover between village, independent agriculture, and full-time work in the plantations. All employees are given occasional leave, and when they do not return to their home villages, they tend to establish homesteads in nearby communities, if possible. The limited number of employees needed to run a timber plantation, along with the internal organization of the plantation, lead to limited immigration and urban development around the plantation -- unlike oil palm plantations and mines.

In Indonesia, where religion is an important predictor of hunting behavior, the religion of plantation employees is important. Timber plantations in Borneo and Sulawesi (to a very limited extent) use local labor of indigenous animists that are regular hunters of forest fowl and mammals. Most imported labor tends to be Malay and Muslim, both Islamic ethnicities that strictly follow Muslim food taboos (see the section Bushmeat Hunting and Trade, below).

### *Timber Plantation Ecology*

No known studies of timber plantation ecology have been published for the study region. Studies from tropical forests in Australia suggest that plantations are likely to have limited value for rainforest taxa under conditions which often characterize timber plantations (i.e., when plantations are established on cleared land, at some distance from intact forest, and when plantations are managed intensively for timber production). In Australia, young timber plantations (both monoculture and mixed species) support few rainforest taxa. Birds associated with rainforests were poorly represented in young timber plantations, but were moderately common in restoration plantings; few rainforest lizards and mammals were recorded (Kanowski 2005). It can be surmised that the diversity and abundance of bushmeat species in the timber plantations is even less than palm oil plantations, due primarily to their larger size and greater distance from standing forest.

### *Palm Oil and Timber Processing Mills*

Timber plantations differ from oil palm plantations in the nature and location of their respective processing mills. Palm oil mills must be located near production of the palm oil fruit, and require only heat and water to crush the fruit to create crude palm oil. Palm oil effluent involves comparatively few processing chemicals and is mostly water and organic outputs. Pulp mills, in contrast, are not required to be located near timber pulp production; timber is easily transported and does not spoil. Pulp mills are much more complex chemical processing operations and operate on a larger economy of scale than palm oil mills. Pulp mills involve large quantities of chemicals for processing of timber pulp and production of crude paper products, including toilet and tissue paper and unfinished cardboard. Pulp mills are very few in number; there are only four known mills in Sumatra and only two known mills in Borneo. They are located in urban areas, near a major port and road systems for receiving timber and international export of paper products. These mills' urban location and limited number ensures much higher levels of regulation than the more common and dispersed palm oil mills.

### *Selective Logging Operations*

After the natural resource extraction anarchy of the 1980s and 1990s, the majority of logging operations in Indonesia are now expired, lapsed, exhausted, or bankrupt. Selective logging concessions, known as HPHs in Indonesian, still operate throughout Borneo, specifically in East Kalimantan. It could not be confirmed if any of the approximately 20 logging operations currently under license in the Sulawesi study region are active. The lack of deforestation activity inside concessions likely means none of these concessions are active, although small-scale and targeted harvesting may not be recorded by the 250m resolution of the Modis satellite. According to law, concessions are exclusively to be logged in such a manner, and cannot be “clear-cuts.” Published work shows, however, that as much as 30% of previously logged concessions are now bare soil in Kalimantan (Casson 2002).

Selective logging operations rarely employ more than 200 workers at one time. This work is cyclical for all but the highest-level managers. Chainsaw men and heavy equipment operators live on-site, in

wood barracks, often without any services like electricity or running water. Often workers will make temporary tarp camps in the forest, closer to a forest block that is being logged. The isolated location of logging concessions ensures that laborers stay and work; shifts can span months and are characterized by high employee turnover. Often workers are faced with a shortage of key food staples and develop sophisticated hunting and gathering strategies. Logging operations present the highest possibility for ongoing, long-term human-animal interactions at forest edges and patches. Migrants and landless families often follow logging roads, hunting and clearing small patches of swidden.

Logging is closely associated with increases in hunting activity (Lambert and Collar 2002). Typical logging concessions are freely accessible and have many dozens of access roads.

### *Selective Logging Ecology*

Several recent publications on the biodiversity and ecological value of logged-over forests have recently been published. To a much greater extent than the cases of oil palm and timber plantations and mines, selective logging concessions continue to hold diverse and abundance bushmeat populations. Macaques have been shown to be highly competitive in disturbed areas, with increasing population densities in human-dominated environments (Johns 1997). Wild pigs similarly are competitive in these forests. Some bat species of interest, specifically flying foxes, may increase abundance (Medellin et al. 2000). It is clear that in East Kalimantan, even lowland forests logged several times hold significant populations of bushmeat species – if they are not hunted out – along with other important ecological and hydrological functions (Meijaard et al. 2007; Wilson and Johns 1982).

### ***Industrial Mining***

The 1980s and 1990s saw new legislation and economic forces drive an expansion of mining activity across the archipelago, especially on the eastern islands. The largest mines (Freeport in Papua is the most high-profile example) produce large amounts of tailings, and if improperly handled, leaching can contaminate aquifers and rivers. The largest mines, however, are the most closely regulated, although these regulations remain below international standards. Medium-scale mines, such as the private and state-owned coal enterprises, are less regulated and sites of extreme environmental damage.

Decreasing fresh water for drinking, bathing, and fishing, along with air quality, seem to be the most immediate, widespread and serious environmental impacts of Indonesia's mines. Dust from smelters and ore scars has caused respiratory problems. Relocation of communities is common. The role of mining in deforestation does not seem to be as large as with palm oil or timber plantations, or possibly even selective logging concessions, although there is no published research available on this.

Nationwide, approximately 30,000 people were employed in the legal mining industry in 2000, with at least double that number involved in the illegal mining sector (Wiriodsudarmo 2002).

During the opening and construction phase of a large-scale mine, the project needs workers in large quantity, presenting employment opportunities in construction and other labor that typically attract migrants nationwide. An influx of migrants usually occurs, and settlements built by incoming workers often grow quickly and uncontrollably. After the construction phase of the project has passed, some of these migrants move on, while others stay and establish permanent residence in what were constructed as temporary worker settlements. Some of these workers will end up starting small-scale service businesses, trading, farming, and illegal logging. Incoming workers dwelling in these settlements have

large and serious implications for local communities' relationships with the mining industry (Wiriodsudarmo 2002).

### ***Artisanal Gold Mining***

Artisanal mining has undergone a boom in recent years, and is completely unregulated and certainly a source of considerable environmental damage, especially to water quality. This category noticeably includes the coal and gold mines financed by leading Indonesian agricultural corporation, PT London. Small-scale, illegal gold mining is known to be ubiquitous in both Sulawesi and East Kalimantan. The rise of gold prices in the late 2000s has spurred many wildcatters and families to begin small-scale mining. A rough estimate of the number of Indonesians engaged in illegal mining is 60,000 (Wiriodsudarmo 2002). Mercury exposure, especially eating fish contaminated with mercury, from small-scale gold mining has been identified as a significant health hazard in localized areas (Castilhos et al. 2006).

### **Extractive Industry Companies: Activity and Reputation**

#### ***Palm Oil Producers***

As it has emerged as an important component of Indonesian industry, palm oil production has become a highly watched activity. International palm oil companies (e.g., Sinar Mas, Wilmar, Cargill) are regularly featured in the press, and watchdog groups (e.g., WALHI, Sawit Watch, Greenpeace) devote significant effort to bring palm oil plantations' impacts to light.

In East Kalimantan, palm oil companies include: Sinar Mas, Astra International, BW Plantations, Surya Damai Group, Pipit Mutiara Group, FCB Management Sdn. Bhd., PT Adindo Hutani Lestari, PT Nunukan Bara Sukses, Kutai Kartanegara, PT Rea Kaltim Plantations in Kembang Janggut district, PT London Sumatera Indonesia in Jempang, West Kutai, PT Multi Pacific International in Karangan district, East Kutai, PT Kresna Duta Agroindo in Wahau district, East Kutai and state-owned PTPN XIII in Kebun Long Pinang district (Sulaiman 2011).

In North, Central, and West Sulawesi, two companies dominate production: Astra International (PT Astra Agro Lestari) and its PT Tamaco Graha Krida and PTPN XIV plantations – once government owned -- and the multinational Sinar Mas (30,000 hectares).

The industry operates in close collaboration with the Indonesian Ministry of Agriculture and Forests, among many others. Company data held by the government is considered confidential information and is not generally available. The Round Table for Sustainable Palm Oil is a voluntary oversight certification organization that many palm oil producers participate in, although often companies do not implement the impact-mitigating policies designed by the group.

Sinar Mas, Astra Agro, BW Plantations, and PT London Sumatera are among the largest and most high-profile producers in the world. Sinar Mas, for example, has planned to invest \$3.5 billion in 2012 towards palm oil expansion (Indonesia Today 2012). The first two companies, especially, are known for their lack of transparency and many allegations of illegality. They have drawn attention for their large land banks in the heavily forested outer islands, sites of ongoing deforestation that drive land conflicts and ecological damage. The result of the rise of civil society post-Suharto in Indonesia has

been that the major plantation companies have actually come under fire, and efforts to improve their operations have ramped up. Another result of this increased attention is the tendency for the plantation companies to become harder to approach and collaborate with on research.

***Palm Oil Company Snapshot: PT Astra Agro Lestari Terbuka***

PT Astra Agro Lestari Terbuka operates in the fruit and tree plantation sector. PT Astra Agro Lestari Tbk, based in Indonesia, is owned by Astra International, the agribusiness unit of Astra Group. In 2010, Astra Agro Lestari managed a total plantation area of 263,281 hectares, including both nucleus and plasma (smallholders) farmers in Sumatra, Kalimantan, and Sulawesi. Astra Agro is active in both study site regions and also in the specific deforestation hotspots featured in this report (Maps 2 and 3). As of December 31, 2010, it had 39 palm oil subsidiaries (four of the subsidiaries, located in Central Sulawesi, plan to come online in 2012).

***Timber Pulp Producers***

The industrial timber plantation industry is organized around the capital-intensive timber pulp mills that process plantation timber into paper products. The Indonesian industry is dominated by two companies: Asia Pulp and Paper (a division of the Sinar Mas group) and Royal Golden Eagle (owner of timber plantation company Asia Pacific Resources Intl. Ltd. and palm oil company Asian Agri). In East Kalimantan, production is organized around the one mill in the province, PT Kertas Nusantara (once known as PT Kertas Kiani).

A number of plantations supply timber to any given single mill. Plantation companies are registered as independent operating businesses owned by one of the Indonesian and international timber companies. In North, Central, and West Sulawesi, PT Barito Pacific Timber Group controlled one million hectares of logging concessions and timber plantations in 1992 (Kartodihardjo and Supriono 2000). In Sulawesi, the following timber plantation concessions have been confirmed to be operational, but it is unknown if deforestation is ongoing: PT Mas Minta, PT Multistrada Arah Sarana, PT Inhutani I. Timber plantation company ownership of these plantations could not be confirmed. It is unknown if these plantation concessions are currently clearing forests, but ongoing timber planting and harvesting has been confirmed to be ongoing at these locations.

The political climate and reputation of the timber pulp companies is similar to that of the palm oil industry; as mentioned, the dominant timber plantation companies also own and operate important oil palm plantations. At the highest level of company organization, often a single manager oversees both oil palm and timber plantation development. The regulatory and civil society oversight of this industry is considerably less than that of palm oil companies. Levels of corruption and illegality are higher, given the long-term Indonesian political connections of the major timber companies first established under Suharto in the 1970s. Land conflict at timber plantations seems to be more severe than at oil palm plantations. In fact, along with coal operations, timber plantations are likely the largest drivers of land conflicts in Indonesian industry, primarily because of the low number of jobs at timber plantations for previous local landholders and forest users.

The agribusiness giant Asia Pulp and Paper is currently the target of a number of Indonesian and international negative campaigns. Perhaps in response to these campaigns, the company has greatly increased corporate social responsibility activities pertaining to environmental conservation and health

programs. Asia Pulp and Paper now actively supports a number of health initiatives in Indonesia on the island of Sumatra.

**Coal Producers**

The U.S. Geological Survey in 2006 lists major Indonesian coal mining companies as including: Adaro Indonesia (South Kalimantan, near Paringin city), 22 million tons; Kaltim Prima Coal (East Kalimantan, near Balikpapan city) 36 million tons; Kideco Jaya Agung (East Kalimantan, Pasir, near Tanah Grogot city), 12 million tons; Arutmin Indonesia (South Kalimantan), 11 million tons; Berau Coal (East Kalimantan), 13 million tons; and Bukit Asam (South Sumatra), 19 million tons (Kuo 2006).

A second more recent source (2009) lists the major companies as: Kaltim Prima Coal (East Kalimantan), 33 million tons; Kideco Jaya Agung (East Kalimantan, Pasir, near Tanah Grogot city), 19 million tons; Berau Coal (East Kalimantan), 12 million tons; Indominco Mandiri (East Kalimantan, just north of Samarinda city), 10 million tons; and Truibaindo Coal Mining (East Kalimantan, in between Samarinda and Balikpapan cities), 4 million tons (Figure 3), perhaps reflecting the growth of the dominance of East Kalimantan in the coal industry. The first four companies on the list represent about 80% of the total coal production in the country.

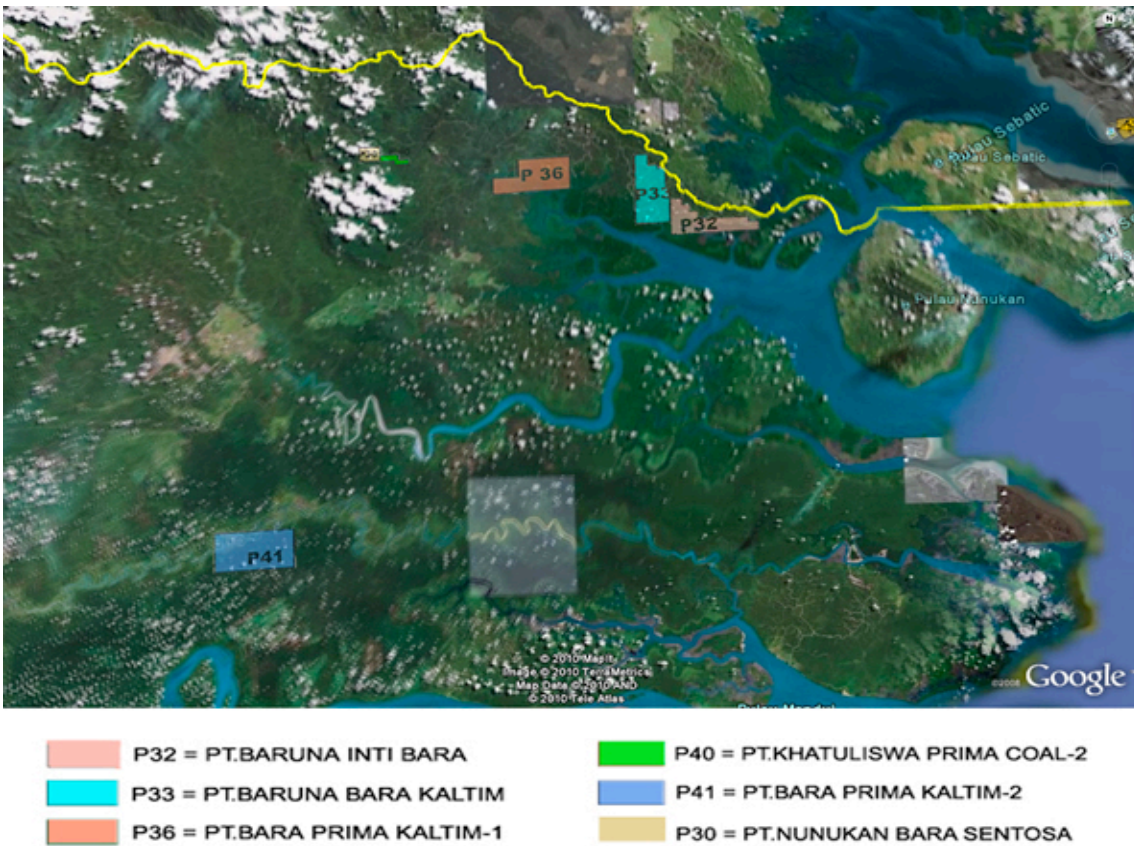
**Figure 3. Coal Production by Company, Indonesia 2009**

<b>Company</b>	<b>Production (t)</b>
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
<b>Total</b>	<b>94,469,171</b>

Source: Ministry of Energy and Mineral Resources 2009

Berau Coal Energy has its central operating offices in East Kalimantan. The Bara Inti Group has at least three mines in the Nunukan district (*kabupaten*) (Figure 4). Six operations are listed by Bara Inti Group in the region. An area expert reported that of these six, only three are operating, with the rest still being undeveloped.

**Figure 4. Bara Inti Group Coal Mines in Nunukan, East Kalimantan**



*From Bara Inti Website, 2012.*

In Sulawesi, PT Inco, owned by Inco Canada Ltd, operates a number of operations; their exact locations could not be determined. There are two active coal mines near Manado, North Sulawesi, according to an area expert, but current ownership is unknown.

International concern and attention to Indonesian coal firms over issues of human and ecological impacts is much more limited than with Indonesia's agribusiness industry. Because most Indonesian coal is traded to China, the industry receives little attention from American and European watchdog groups.

Locally, coal mines are a flashpoint of social conflict; mining companies are considered almost omnipotent after obtaining a mining concession permit from the regional government. Oversight is limited to the largest mines, although all legal mines must file an Environmental Impact Statement known as an *AMDAL*. These are publicly available documents that can usually be found at the provincial-level Ministry of Forestry office. The standards of this environmental permitting and oversight process are far below most international standards (Ballard 2001).

A useful online mapping tool appears to be comprehensive and up to date, giving the locations and company names of coal mines in Indonesia: <http://mapper.infomine.com>.



## **Bushmeat Hunting and Trade**

There are no systematic surveys of the prevalence, importance, or overall impact of bushmeat hunting on the national scale in Indonesia, or representative studies for the two study areas. Nevertheless, hunting is of great concern to environmental and human disease transmission dynamics in the islands of Borneo and Sulawesi (Harrison 2011).

Bushmeat trading and consumption habits are in large part a function of religious food taboos in Indonesia. A useful, if simplified, way to approach understanding these food taboos is by dividing the populations of East Kalimantan and Sulawesi into three groups: Muslim, Christian, and Animist. There is no one, single Muslim faith that Indonesians follow. Although more than 99% of Indonesian Muslims report that they are Sunni, a range of practices exists in practice. According to the dominant interpretations of Sunni Islam, touching or consuming reptiles, amphibians, pigs, dogs, primates, and bats is strictly prohibited. Without any published studies of Indonesian animal taboos, we are forced to rely only on the personal experience of the consultant living in rural Kalimantan and Sumatra for two years for the following details of how these rules are actually observed.

Taboos against any contact with pig and dog are strictly followed, except for when wild pig incursions into crops become a problem. If this is the case, even the strictest Muslims will organize hunt parties to kill these problem pigs. Often, these animals are brought into the village and sold to any non-Muslim villagers or nearby residents. The consultant has never seen any Muslim Indonesians eat primates, but primate pet ownership in forest-edge areas is common. Muslims work in bushmeat markets, but only in the trade of birds, fish, deer, and other, non-taboo meats. The consultant has observed Muslim Sumatrans and Javanese selling primates in markets.

A very significant exception to standing food rules is the case of bats. Bats are widely consumed by Muslim forest groups for meat. Urban Muslims do not eat bats as often as forest dwellers, but the consumption of flying foxes as treatment for a wide range of ailments (e.g., arthritis, bronchitis, cataracts) is very common. Flying foxes are purchased live, butchered, baked, and then ground into a powder to be drunk as a tea. All species of deer are highly valued bushmeat by Muslim groups, and wild deer has been observed by the consultant traded across urban networks hundreds of kilometers from the prey's point of origin.

Christian groups do not follow restrictions related to pigs and dogs. In urban areas, vigilante enforcers of Muslim practices, especially around Ramadan, are common, and often drive the trade of pigs and dogs underground, but the trade and consumption still flourishes. To prevent Muslims from hearing about the consumption of these animals directly, pig is often referred to as “B1” (*beh satu*) and dog as “B2” (*beh dua*). Animist group numbers have been reduced to no more than 5% of both the East Kalimantan and Sulawesi populations, although these official statistics are misleading because many tribal groups have maintained their animist practices even while identifying as Muslim or Christian. Consideration of the full range of food practices of the many hundreds of groups that live in East Kalimantan and Sulawesi is beyond the scope of this report, but taken as a whole, animist groups are more likely to hunt and consume a wide range of reptiles, amphibians, and mammals than are Christians or Muslims.

The remainder of this section considers a few specific dynamics of bushmeat species relevant in both East Kalimantan and Sulawesi. More detailed, region-specific reports of bushmeat hunting are considered in the study area discussion sections of this report.

### ***Flying Foxes and Disease Transmission***

There is a substantial risk of zoonotic disease transmission between bats, hunters, and traders. Flying foxes are kept alive prior to sale, extending risks to market vendors and butchers, who also have the added risk of infection from blood and other body fluids entering open wounds while butchering and from bites or scratches. Two peer-reviewed studies, one from Central Kalimantan and one from Central Africa, report these dynamics (Harrison et al 2011, LeBreton et al. 2006). Flying fox roost sites depend on certain tree species which vary per population, and which reflect the extent and quality of available habitat. Flying foxes are potentially effective transmitters of EIDs because they are capable of foraging over long distances (>80 km in a single night reported for *P. vampyrus* in Malaysia), and may forage in farms and commercial orchards that are populated by domestic animals. In Sumatra, *P. vampyrus* roosts in kapok trees (Bombacaceae: *Ceiba pentandra*) that are found in both remnant and cultivated forest patches. This same species in Borneo roosts in mangrove swamps and dense lowland forest. *P. vampyrus* has been confirmed to cross the Straits of Malacca, a distance of at least 35 km of open ocean (Mohd-Azlan et al. 2001). The Wallace Narrows is 100 km across at its narrowest, making dispersion across the Wallace Narrows a reasonable possibility.

The flying foxes (*Pteropus spp.*) are a natural host of Hendra and Nipah, two members of the genus Paramyxoviridae; Menangle and Tioman viruses, two new members of the Rubulavirus genus in the family Paramyxoviridae; and Australian bat lyssavirus, a member of the Lyssavirus genus in the family Rhabdoviridae, closely related to classic rabies virus (Mackenzie et al. 2001). Antibodies to Nipah virus have recently been detected in *P. vampyrus* populations in Kalimantan (Sendow et al. 2010).

The flying fox trade is widespread along the major roads of East Kalimantan (personal observation 2010), an area that shares similar ecological and land use dynamics as published flying fox hunting hotspots in Central Kalimantan. Flying fox trade abundance ranks high in one study of bushmeat in Sulawesi (Lee et al. 2005). Lee et al. report that 445 flying foxes were counted per hour in their sample of six North Sulawesi markets, making it the single most-abundant species in the markets recorded. To get an idea of proportion, only 0.4 pigs were recorded per hour in the same markets, making the overall biomass of the flying foxes at least comparable to pigs, if not larger.

Another study in Sulawesi reports that the vast majority of respondents were unaware that flying foxes carry potentially fatal viruses, so few people protected themselves from physical contact. Moreover, both hunters and vendors were frequently bitten and the majority of bites drew blood. Most hunters (58%) reported additional species caught in the cages and nets used to trap flying foxes, including keystone bird species and slow lorises (Harrison et al 2011).

No published studies in East Kalimantan have been carried out, but tens of thousands of flying foxes are hunted and sold at bushmeat markets every day in neighboring Central Kalimantan (Struebig et al. 2007). Live flying fox markets are common in East Kalimantan, in both urban and rural areas (personal observation 2010).

### ***Macaques and Disease Transmission***

Disease transmission between macaques and humans can result from pet ownership (e.g., transmission of measles from humans to pet macaques) (Jones-Engel et al. 2001), as well as from increased human-macaque contact due to overlapping resource use (e.g., malaria in macaques and humans in

Malaysia due to increasing deforestation) (Vythilingam et al. 2008). The increasing abundance of macaques and their ability to exploit urban niches makes them of important consideration. A study in Sulawesi found seropositivity for antibodies to measles, influenza A, and parainfluenza viruses 1, 2, and 3 among pet and wild macaques. Older macaques possessed antibodies against more of the selected viral agents than their younger counterparts, suggesting that animals may accumulate exposure to these pathogens over time. Yet, the study concludes, because individuals with these diseases remain infectious for only days or weeks, the wild macaque population is probably too small and geographically diffuse to serve as a pathogen reservoir for continuous epizootic transmission (Jones-Engle et al. 2001). In a follow-up publication, the same authors found pet-keeping to be the main source of macaque-human interaction, with interestingly no difference in the religion of pet keepers. Monkey eating, however, was exclusively recorded by local indigenous groups and Balinese transmigrants, and not any Muslim groups (Jones-Engle et al. 2004).

There are no known studies on the role of macaques in disease transmission in Kalimantan.

## **Study Region 1: East Kalimantan**

### ***Background***

East Kalimantan is the largest of four provinces in Indonesian Borneo (covering approximately 229,855 km<sup>2</sup> or 22,985,500 hectares) (Badan Pusat Statistik 2011). Its tropical forests range from lowland to montane forest to swamp and mangrove forest.

### ***Population Centers***

Approximately 3.5 million people live in East Kalimantan, giving this province a lower population density than any other province in Indonesia aside from West Papua. It has the highest population growth rate (3.8% per year) of all Indonesian provinces. According to the provincial government, the regional distribution of population in East Kalimantan is extremely unbalanced. More than half of the population lives in Balikpapan, Samarinda, and the surrounding areas, with an additional urban center in the north at Tarakan (Table 2). The rest of the population is concentrated in small towns along the coast. The inland part of the province is still only lightly uninhabited (Badan Pusat Statistik 2011).

**Table 2. East Kalimantan Population**

District	Capital City	2010 Population
Samarinda City	Samarinda	726,223
Kutai Kartanegara	Tenggarong	626,286
Balikpapan City	Balikpapan	559,196
East Kutai	Sangatta	253,904
Paser	Tanah Grogot	231,593
Tarakan City	Tarakan	193,069
Berau	Tanjung Redep	179,444
West Kutai	Sandawar	165,934
North Penajam Paser	Penajam	142,693
Nunukan	Nunukan	140,842
Bontang City	Bontang	140,787
Bulungan	Tanjung Selor	113,045
Malinau	Malinau	62,423
Tana Tidung	Tideng Pale	15,147
<b>East Kalimantan</b>	Samarinda	<b>3,550,586</b>

*Badan Pusat Statistik Indonesia (2010 Census,*

The agricultural sector is characterized by a significant degree of underemployment, and the proportion of the agricultural work force has declined continuously in the 1990s as the growth of employment opportunities in other sectors, notably mining and manufacturing, has increased. Agriculture, however, continues to employ more than half of the work force (Badan Pusat Statistik 2011).

The harvesting of non-timber forest products (NTFPs) represents an important source of additional income for many inhabitants of the province, especially in Berau, Bulungan, and Kutai. The main NTFPs are *gaharu*, also known as agar wood (traded throughout Asia as an incense), bird's nests, rattan, and resins. A significant proportion of the production is exported, mainly to Singapore and Hong Kong (Poffenberger and McGean 1993).

The population is a mixture of people from the Indonesian archipelago with local indigenous Dayaks – an umbrella term that encompasses many different groups -- and Kutai, still mostly in rural areas. Other prominent migrant ethnic groups include Javanese (30%), Banjarese (15%), and Buginese (19%), and make up 64% of the population (Table 3). The Banjarese, Bugis, and Malays – primarily Muslims -- dominate the southern and coastal areas. The north and northwest regions of the province are home to primarily Christian and indigenous groups. An unknown percentage of mostly urban residents are Chinese, with “Chinatowns” in the major cities.

**Table 3. Major Ethnic Groups of East Kalimantan**

Language/ethnic group	Dominant religion	Traditional subsistence	Percent of Total (%)
Banjarese	Indigenous/Muslim	Urban/Mixed Agriculture	15
Buginese	Muslim	Lowland agriculture, seafaring	19
Javanese	Muslim	Urban / Mixed agriculture	30
Merap	East Kalimantan	Upland swidden and mixed agriculture	4
Kayan	Indigenous	Upland swidden and mixed agriculture	4
Kenyah	Indigenous	Upland swidden and mixed agriculture	4
Punan	Indigenous	Upland swidden and mixed agriculture	4
Benuaqs	Indigenous	Upland swidden and mixed agriculture	4
Berusa	Indigenous	Upland swidden and mixed agriculture	4
Lundaye/Putuk	Indigenous	Upland swidden and mixed agriculture	4
Tidung	Indigenous	Upland swidden and mixed agriculture	4
Miliau	Indigenous	Upland swidden and mixed agriculture	4

*From Barr et al. 2001*

### *Ecology*

East Kalimantan sits just two degrees north of the equator. Elevation ranges from 0 to 2,400 meters. It was once almost exclusively continuous lowland and montane rainforest. As late as 1996, the province was almost completely forested (32% of the total forest in Indonesia was in East Kalimantan (Government of Indonesia/FAO 1996). It is now 85% forested; almost 15% of this forest cover has since been lost, primarily to large-scale industrial development (Harris et al. 2008); East Kalimantan is among the most highly industrialized rural landscapes in the world.

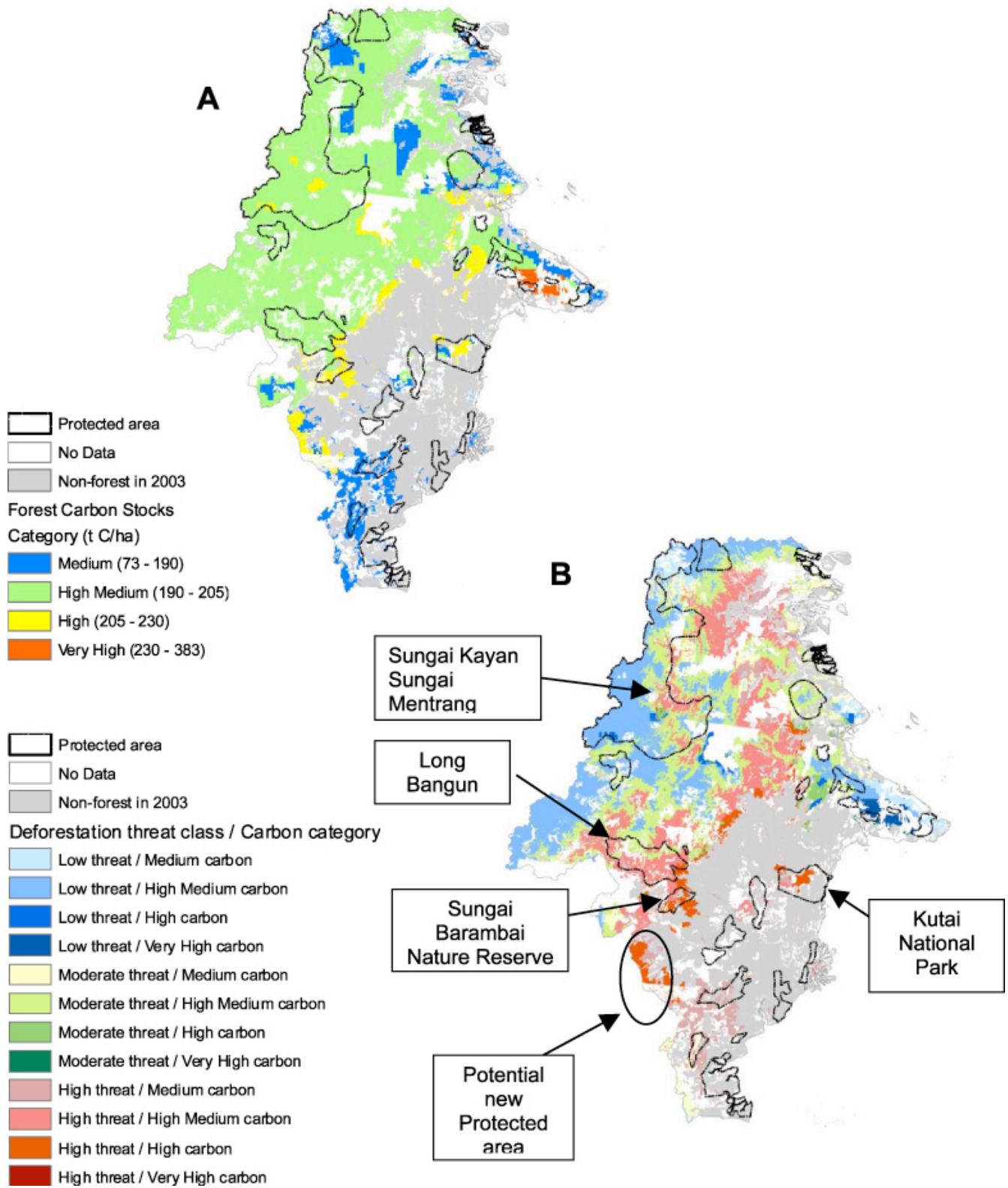
East Kalimantan supports more than 170 forest-dwelling mammal species, with 39 classified as threatened in the IUCN Red List (IUCN 2008). The forests are inhabited by large mammal species such as the orangutan (*Pongo pygmaeus*), proboscis monkey (*Nasalis larvatus*), clouded leopard (*Pardofelis nebulosa*), and banteng (*Bos javanicus*), and bird groups such as pheasants (5 species), hornbills (8 species), and woodpeckers (18 species) (Jepson 2002).

Despite the globally recognized importance of conservation and a relatively high level of protection through laws and regulations (20% of East Kalimantan is categorized as a protected area), hunting affects species important for food or trade, including bearded pigs (*Sus barbatus*), various species of bats, porcupines, pangolins (*Manis javanica*), Sambar deer (*Cervus unicolor*), barking deer (*Muntiacus muntjak*), mouse deer (*Tragulus javanicus*), Bornean gibbons (*Hylobates muelleri*), Hose's leaf monkeys (*Presbytis hosei*), white-fronted leaf monkeys (*P. frontata*), slow lorises (*Nycticebus coucang*), pig-tailed macaques (*Macaca nemestrina*), and Bornean orangutans (*Pongo pygmaeus*) (Meijaard et al. 2006).

The location of protected areas is given in Figure 5A. The names of major protected areas is given in Figure 4B. These figures do not include the land use designation, "Protection Forest" (*Hutan Lindung*). This forest type is, on paper, also protected from conversion, in addition to the national parks and provincially declared protected areas circled in black in Figures 5A and B. Figure 5 also shows carbon stocks (above and below ground) of East Kalimantan. All organic matter holds carbon as biomass. Carbon stocks are reduced in equal proportion to vegetative biomass as the full range of ecosystem types are considered. In Indonesia, mature tropical rainforest has the highest above-ground carbon stocks of all forms of vegetative cover. Below-ground carbon stocks depend upon soil type.

Tropical peat soils are the world's most carbon-dense soil type. In the context of Indonesia, three broad levels of soil carbon content can be considered: peat, lowland, and upland. Peat forests are the most carbon-rich in Indonesia, followed by lowland forest, upland forest, and finally non-forested swamps and grasslands. The issue of carbon stocks is most commonly considered in relation to deforestation, as the destruction of forests leads to the emissions of their carbon stocks, contributing to global greenhouse emissions. Significant funding efforts have recently emerged to prevent these carbon emissions by Reducing Emissions through avoided Deforestation and Degradation (widely known as REDD programs), especially in Indonesia and specifically in East Kalimantan. Figure 5B categorizes the range of carbon stocks (thus, by proxy, ecosystem types) by threat of deforestation. Threat levels are constructed based on data pertaining to proximity of roads, sawmills, and observed deforestation by satellite analysis. Areas of moderate and high threat -- and also moderate, high or very high carbon -- represent closed-canopy forests with ongoing deforestation.

**Figures 5A and 5B. Deforestation and Protected Areas Threat Analysis, East Kalimantan**

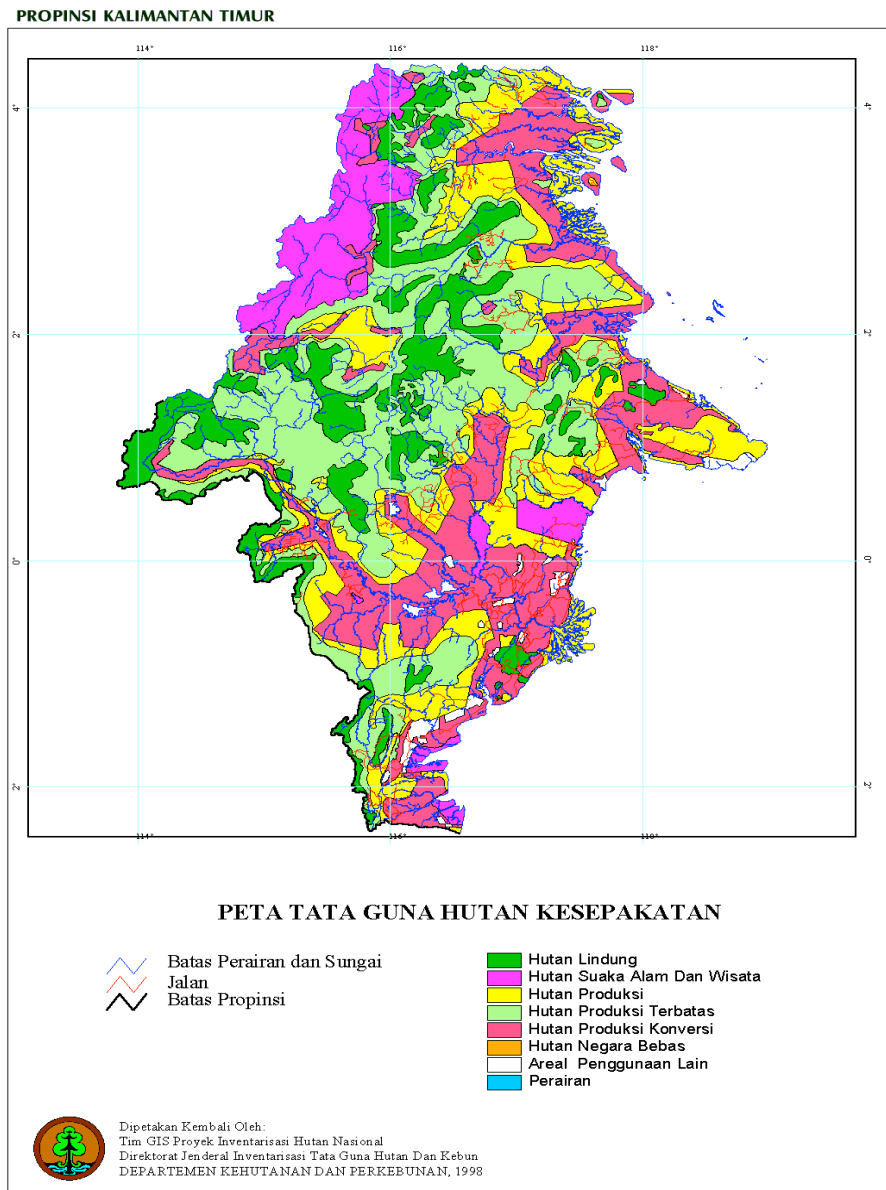


*From Harris et al. 2008*

The government land-use map of East Kalimantan shows the various forest land-use categories, including the classification of “Protection Forest,” is given in Figure 6. Protection Forests and Forest Reserves are legally protected from all deforestation activities. Production forest types are areas inside the government State Forest area that can be legally devoted to logging of various intensities. A Conversion Production Forest is legally permitted to be converted to large-scale agriculture. Upon start of agricultural production, this area is to be removed from the State Forest, and placed into the legal category of Non-State Forest, and managed not by the Ministry of Forests, but instead the Ministry of Agriculture. To a large extent, East Kalimantan has been declared a Limited Production Forest and Conversion Production Forest. Most often, the former category is targeted for logging operations, and the latter category for oil palm and timber plantations. Carbon stock data in Figure 5A implies that most of these two government land-use categories contain closed-canopy lowland forest, making them locations of especially high forest-human interaction.



Figure 6. Indonesian Ministry of Forests Land Use Planning Map, East Kalimantan

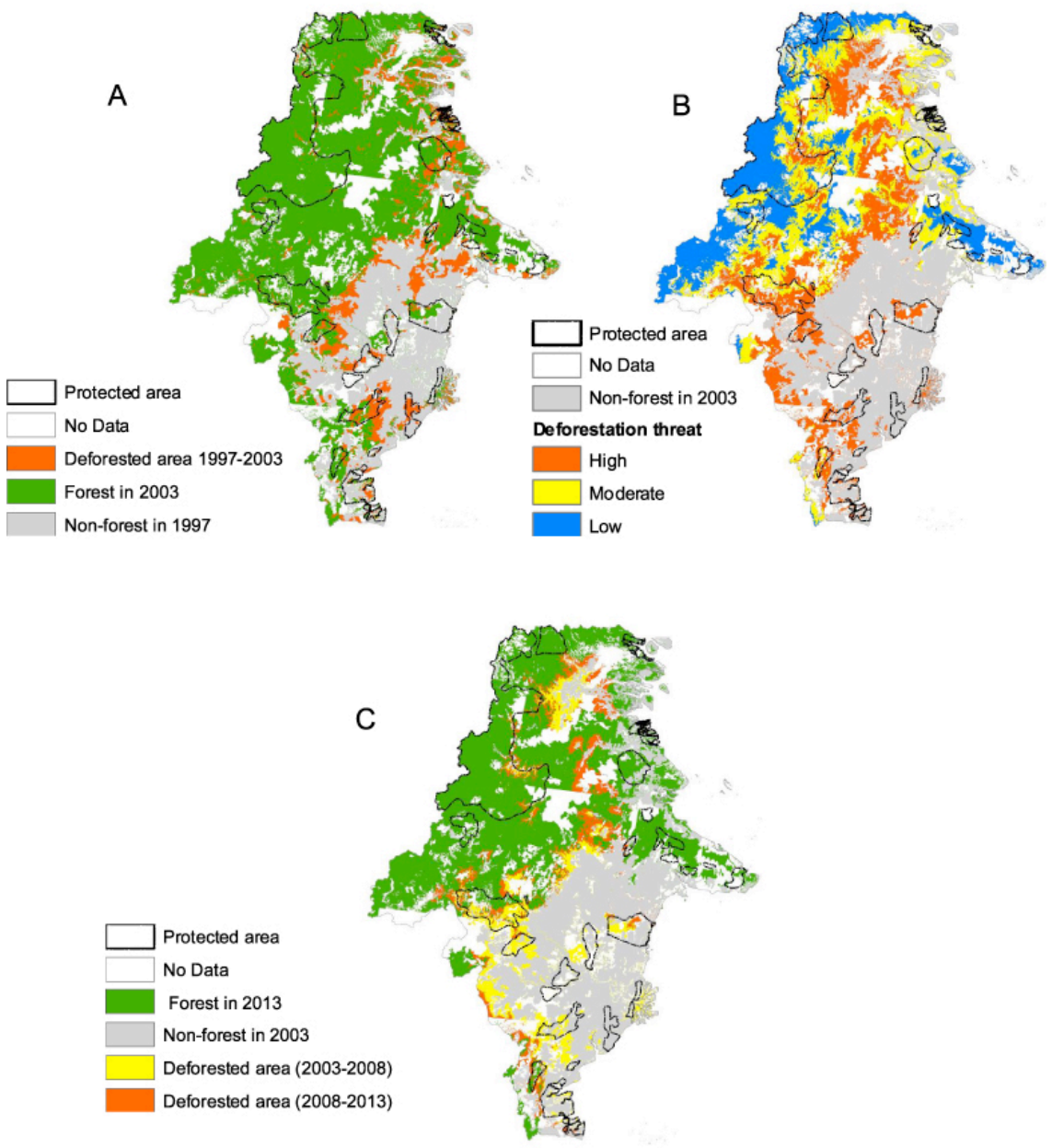


Legend translation: *Hutan Lindung* = Protection Forest, *Hutan Suaka Alam Dan Wisata* = Forest Reserve, *Hutan Produksi* = Production Forest, *Hutan Produksi Terbatas* = Limited Production Forest, *Hutan Produksi Konversi* = Conversion Production Forest, *Hutan Negara Bebas* = Non-State Forest Land, *Areal Penggunaan Lain* = Other Use, *Perairan* = Water

Figure 7 gives land cover and deforestation for East Kalimantan. From Figure 7A we can see that the south of the province has mostly all been deforested before 1997, with deforestation spreading north and east to create the patchwork of forests seen in 2003. In Figure 7B, the existing forests most threatened by deforestation, as estimated in 2003, are along the arc of forests lost in the center northeast of the province from 1997 to 2003. The bulk of the area under threat of conversion lies in the Limited

Production Forest and Conversion Production Forest areas, demonstrating how oil palm and timber plantations are first established close to urban centers of trade and then expand into more remote areas. Figure 7C shows that deforestation continued to move into the interior lowland and upland rainforests of the province from 2003 to 2008, especially in the north (Tarakan region). The figure also shows predicted deforestation from 2008-2013. More current deforestation patterns are considered in the hotspot deforestation analysis carried out for this project, discussed below.

**Figures 7 A, B and C. Deforestation Analysis, East Kalimantan 1997-2003**



*Harris et al. 2008*

### *East Kalimantan Bushmeat Hunting*

Surprisingly, no published accounts of the East Kalimantan bushmeat trade exist. It is known from the work of the Wildlife Conservation Society and TRAFFIC that the Borneo bushmeat industry is thriving in both rural and urban settings. In the consultant's two months time in East Kalimantan, pet trade and bushmeat markets were ubiquitous in the 20 cities and small settlements visited.

Hunting reports for the Iban forest swidden farmers of West Kalimantan show that they are active hunters. This is a useful comparison for East Kalimantan because the Iban and Dayak groups across the island have highly related livelihood habits. In 1993 in Sarawak, a group of relatively isolated Iban hunters rarely sold bushmeat, but change has quickly come for most of Kalimantan, and it is reasonable to expect that bushmeat trade has increased along with all other forms of trade since the early 1990s. Deer, demanded by Muslim groups, is most-often traded rather than consumed. Live primates, orangutans, and gibbons were also likely to be sold. Of non-human primates in a 1997 study, the gibbon, pig-tailed macaque, and white-fronted leaf monkey were most often encountered. Of other mammals, the bearded pig, red barking deer, and small-toothed palm civet were most often captured (Figure 8). The vast majority of game species were taken in old-growth and secondary forests. Swiddens and agroforests supported far less game (Wadley et al. 1997).

**Figure 8. Number of Encounters and Captures of Bushmeat Species, West Kalimantan**

		Number of Encounters (%)	Resulting in capture
<b>A. Primates</b>			
Gibbon	<i>Hylobates muelleri</i>	9 (20.5)	1 (14.3)
Long-tailed macaque	<i>Macaca fascicularis</i>	3 (6.8)	0 (0)
Pig-tailed macaque	<i>Macaca nemestrina</i>	19 (43.2)	3 (42.8)
Orangutan	<i>Pongo pygmaeus</i>	1 (2.3)	0 (0)
White-fronted leaf monkey	<i>Presbytis frontata</i>	8 (18.2)	2 (28.6)
Banded leaf monkey	<i>Presbytis melalophos cruciger</i>	2 (4.5)	1 (14.3)
Unidentified leaf monkey	<i>Presbytis</i> spp.	2 (4.5)	0 (0)
Total primate encounters		44 (100)	7 (100)
<b>B. Other large mammals</b>			
Bearcat civet	<i>Arctictis binturong</i>	1 (1.3)	1 (4.2)
Small toothed palm civet	<i>Arctogalidia trivirgata</i>	10 (12.9)	6 (25.0)
Sambar deer <sup>b</sup>	<i>Cervus unicolor</i>	1 (1.3)	0 (0)
Sun bear	<i>Helarctos malayanus</i>	1 (1.3)	0 (0)
Yellow barking deer <sup>b</sup>	<i>Muntiacus atherodes</i>	1 (1.3)	0 (0)
Red barking deer <sup>b</sup>	<i>Muntiacus muntjac</i>	13 (16.9)	5 (20.8)
Unidentified barking deer <sup>b</sup>	<i>Muntiacus</i> spp.	6 (7.8)	0 (0)
Masked palm civet	<i>Paguma larvata</i>	1 (1.3)	0 (0)
Common palm civet	<i>Paradoxurus hermaphroditus</i>	1 (1.3)	0 (0)
Bearded pig <sup>b</sup>	<i>Sus barbatus</i>	33 (42.9)	7 (29.1)
Thick spined porcupine	<i>Thecurus crassispinis</i>	1 (1.3)	1 (4.2)
Lesser mousedeer	<i>Tragulus javanicus</i>	1 (1.3)	1 (4.2)
Greater mousedeer	<i>Tragulus napu</i>	4 (5.2)	2 (8.3)
Unidentified mousedeer	<i>Tragulus</i> spp.	1 (1.3)	1 (4.2)
Unidentified civet		2 (2.6)	0 (0)
Total other large mammal encounters		77 (100)	24 (100)
<b>C. Total large mammals</b>		121	31

From Wadley et al. 1997

The trade in hornbill species in the “Heart of Borneo” -- the interior upland forest areas of western East Kalimantan, northern Central Kalimantan, and northern West Kalimantan -- by a range of Dayak groups is widespread, both for the bird's meat, feathers, and to be kept as pets. The typical ceremonial dance groups found in most Dayak villages require feathers for costumes from as many as 100 hornbills. Changes brought by development have only increased the trade and hunting of hornbills, according to one study carried out in North Kalimantan and Malaysia (Bennett et al. 1997).

Orangutans are hunted traditionally for food by indigenous people (predominantly Christian) in East Kalimantan, but many more orangutans are killed as pests in oil palm plantations. There are religious prohibitions against eating primates for the predominantly Muslim communities, but this does not stop them from hunting orangutans for the pet trade or in response to bounties on orangutans offered by palm oil managers, likely at a higher rate than Dayak groups. Along with increased hunting of orangutans, the possibility for disease transmission also increases. A study of orangutan populations in East Kalimantan showed that the most-important predictor of this primate's population density was hunting intensity, arguing that the blowpipe is stronger than the chainsaw in reducing orangutan populations (Marshall et al. 2006).

The hunting, live capture, and trade of flying foxes was found to be very intense in Central Kalimantan. No published studies exist for East Kalimantan. The consumption of these bats was not limited to the Dayak and other Christian groups, however. There are no Muslim taboos against bats, and the flying fox is considered a medicinal product by most Muslims. Typically, two live adult bats are purchased and then baked and grounded into a powder and consumed as tea to treat asthma, cataracts, and arthritis (Struebig 2007).

### ***East Kalimantan Extractive Industry***

#### *Oil Palm Plantations*

Oil palm plantations are found in nearly all of East Kalimantan's districts. 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 industry control has increased dramatically, more than doubling between 2002 and 2007 (Indonesian Palm Oil Board 2007).

A recent government estimate placed the area of *fully operational* plantations to be roughly 500,000 hectares. As fully operational, these plantations contain mature oil palm trees (i.e., at least five years old). Given an additional two-to-five years of land-clearing activities before becoming fully operational, the total age of these half-million hectares is roughly seven years old. The increase of operational areas for palm oil production has been estimated by the same group of government analysts to be, on average, 35,000 hectares more than the last decade. This supports the official government of Indonesia's goal to triple production between 2008 and 2025 (DNPI 2010).

In 2009, a total of 750,000 hectares of oil palm plantation concession areas existed. That is, 750,000 hectares had been leased to companies by the government. An unknown area was actually under production. Today, an analysis of compiled concessions by the consultant shows that over 2.5 million hectares has been leased to palm oil companies, with an unknown amount of these concessions being operational (i.e., entailing active land clearing) (Table 1).

Land conversion is an accelerating process, and so the expansion of 35,000 hectares over the past decade should be considered a conservative estimate. The majority of these plantations have been developed in the plasma nucleus scheme. The Directorate General for Estate Crops, part of the Ministry of Agriculture, has targeted East Kalimantan for over 300,000 hectares of palm oil expansion and revitalization, out of a national target of 1,375,000 hectares, to be completed from 2005-2010 (Sulaiman 2011).

BW Plantation is targeting a 25% increase in its crude palm oil production this year after expanding its production capacity in Senyur village in East Kalimantan. The company’s production rose 21.4% last year to 110,771 tons spread across seven plantations in West, Central, and East Kalimantan. Forty-five percent of their total 90,000-hectare land bank is unplanted and in the process of conversion (Handayani 2012).

In January 2010, the local authorities at the Muara Tae Forest issued concessions to two palm oil companies: Malaysian-owned PT Munte Waniq Jaya Perkasa, and PT Borneo Surya Mining Jaya, a subsidiary of Sumatran logging, mining, and plantation conglomerate Surya Dumai.

*Timber Plantations*

Timber plantation concessions currently cover approximately one million hectares in the province.

PT Kertas Nusantara (ex-Kiani Kertas) in Berau is the only operating timber pulp mill. To supply this mill with timber pulp, the agribusiness group opened two timber plantations -- PT Tanjung Redeb Hutani and PT Kiani Lestari -- and have established a 180,000-hectare timber plantation in Berau.

*Logging Operations*

A detailed list from 1995 of East Kalimantan selective logging operations can be found in Table 4, below.

**Table 4. Logging operations in East Kalimantan, 1995**

<b>Logging Operator (HPH)</b>	<b>Hectares</b>	<b>% of Total</b>
P.T. Inhutani I	230,000	15
Kalimanis	130,000	8
Usaha Bhakti	90,000	6
Sumalindo	70,000	5
Dayak Besar	70,000	4
Roda Mas	60,000	4
Bina Lestari	60,000	4
Sahid Timber	60,000	4
Sumber Mas	60,000	4
Others	76,000	47
<b>Total</b>	<b>160,100</b>	

*From Oosternan 1999*

*Coal Mining*

East Kalimantan holds about two billion tons of coal reserves. This is about one-third of the Indonesian total of six billion tons, second only to the massive coal fields of South Sumatra (BKPM – JICA 2005).

PT Kaltim Prima Coal, PT Indominco Mandiri, and PT Perkasa Inakakerta account for most of the coal produced in East Kalimantan, with total production reaching 48.4 million tons in 2008. In East Kutai district, the district where Kaltim Prima Coal is located, only 37 out of 135 villages (50,175 households), have access to electricity. Almost half the population of East Kutai district is regarded as poor, with most living near the mine.

In West Kutai district, there are 87 mining permits spread over 20 subdistricts. The three aforementioned companies mine 9.7 million tons a year in West Kutai (Down to Earth 2010). Coal company PT Gunung Bayan Pratama Coal started operations in the forests around Muara Tae, West Kutai in 2007 or 2008 (REDD Monitor 2012). In 2007, West Kutai District Public Health Service recorded 19,375 people with respiratory tract infections (Down to Earth 2010).

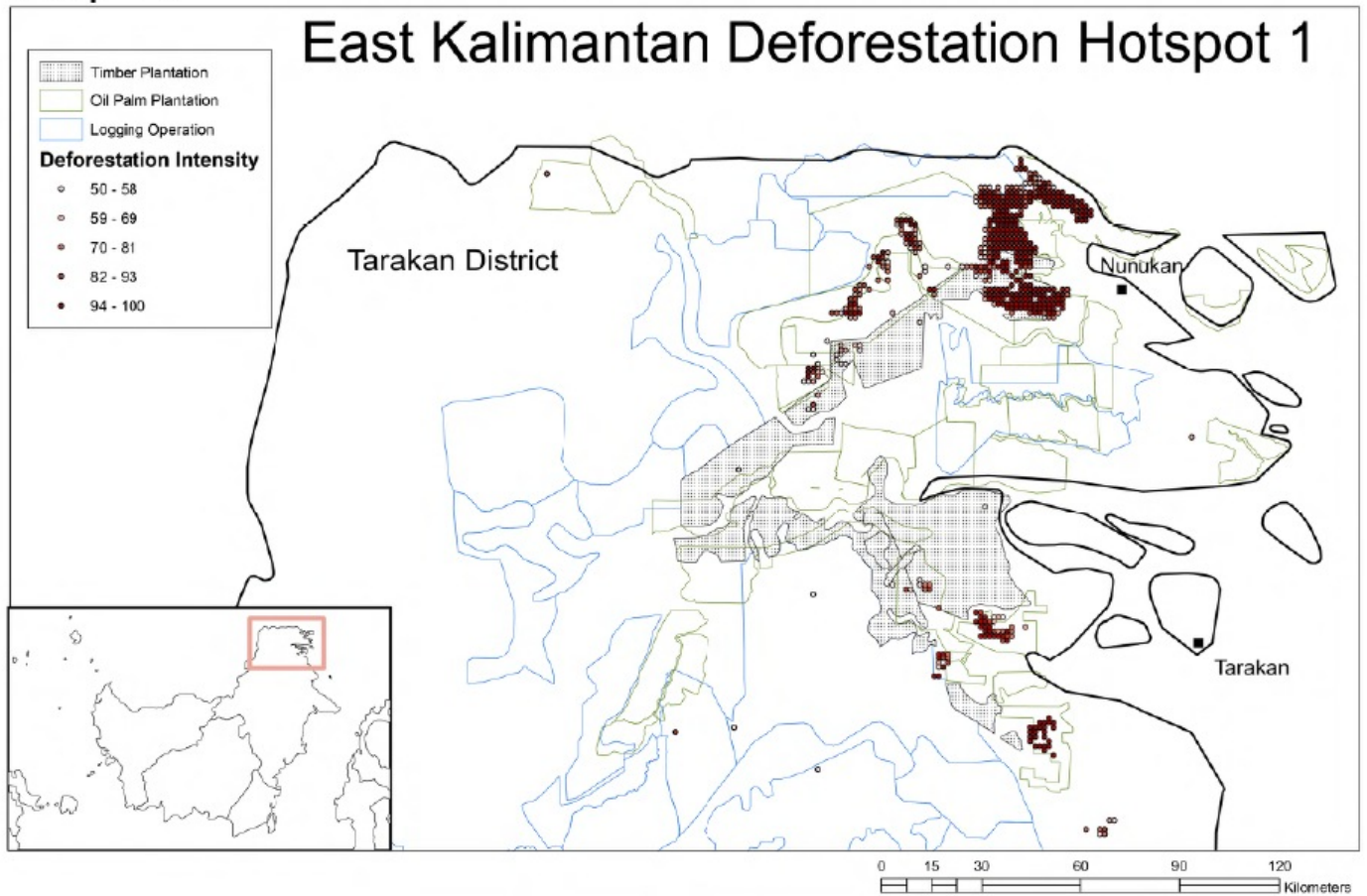
In Melak District, near the village of Muara Bunyut, PT Gunung Bayan Pratama Coal (an Indonesian company) and PT Trubaindo Coal Mining (a Thai company) operate active coal strip mines.

### *Gold Mining*

Both legal, large-scale gold mining and illegal, artisanal mining occurs in East Kalimantan. Following the discovery of alluvial gold in and around the buffer zone of Tanjung Puting National Park, thousands of migrants arrived to mine, contaminating the Sekonyer River. Large areas of heath forest were converted to sand. Due to unregulated use of toxins and forest conversion, the area of contamination is quite large, and large swathes of forest may be converted. Zircon is now also being mined, and there have been multiple fish die-offs over the past two decades due to chemical contamination and sedimentation (Down to Earth 2010).

The International Labor Organization identified the village of Kelian Dalam, Long Iram subdistrict, West Kutai district as a hotspot of artisanal gold mining in general, and more specifically, of child participation in this activity (International Labor Organization 2004).

## Map 2.



Map 2 shows the district (*kabupaten*) Nunukan at the northern-most tip of East Kalimantan, the site of the most-clustered, high-intensity deforestation from 2005-2009 in the province. In the nearby Tulin Onsoi, a subdistrict of Nunukan, palm oil and mining activities are ongoing, high-profile, and fraught with land-change issues and social turmoil. Reports as recent as February 2012 describe ongoing deforestation and conflicts between migrant workers and local communities (Mattangkilang 2012).

The Dayak Agabag people inhabit the Sembakung subdistrict (Nunukan District, along the northern border of East Kalimantan). These people have a unique nomadic history. According to information from a Sembakung indigenous leader, most Dayak Agabag villagers occupied a longhouse until 1945. Each longhouse contained seven to 10 apartments, each home to one or more nuclear families. This lifestyle has rapidly changed with the influx of palm oil production in the area (personal communication 2010). Workers for East Kalimantan's oil palm estates came largely from Sulawesi or Flores (East Nusa Tenggara) rather than East Kalimantan (Tirtosudarmo 2006). In East Kalimantan, where they are known as “Bugis,” a high proportion of these migrant laborers eventually leave East Kalimantan and migrate through Nunukan (the northern-most district of East Kalimantan) illegally into Malaysian Borneo, where palm oil labor is in higher demand than in East Kalimantan.

In 2000, one million hectares of oil palm trees along the Sabah border was announced as a “safety belt” that the governor argued could absorb Indonesians working in Malaysia and slow illegal migration, as well as act as a buffer against illegal logging by Malaysians entering Indonesian Kalimantan from the north. Some lands were given to companies of the Surya Damai group, supposedly to develop palm oil,

but they simply felled the forests and shipped the logs to Sabah. The Governor's "safety belt" idea conflicted with the planned Sebuku-Sembakung National Park (Potter 2009), and met with increasing international outcry over the possible environmental impacts of converting this region of rich, upland forests and indigenous groups to agribusiness. This area, called the "Heart of Borneo" by WWF, is now the site of a joint conservation effort by Malaysia and Indonesia. Nevertheless, many palm oil concessions have been leased to palm oil companies along East Kalimantan's section of the border, triggering ongoing forest clearing in the Nunukan area on a large scale.

In 2002, Malaysia began to expel large numbers of illegal Indonesian immigrants south through the official crossings of Nunukan and Entikong back into Nunukan. In the district of Nunukan, some of those ex-workers secured transmigrant smallholder status and settled on the two oil palm estates near the border (Potter 2009). These oil palm plantations are shown in Map 2, the northern-most plantations on the coast near the city of Nunukan. These plantations also represent the bulk of the deforestation observed in the 2005-2009 analysis period. These plantations are believed to be owned by the Indonesian company Pipit Mutiara through its PT Nunukan Bara Sukses palm oil group, and the Malaysian company FCB Management Sdn Bhd.

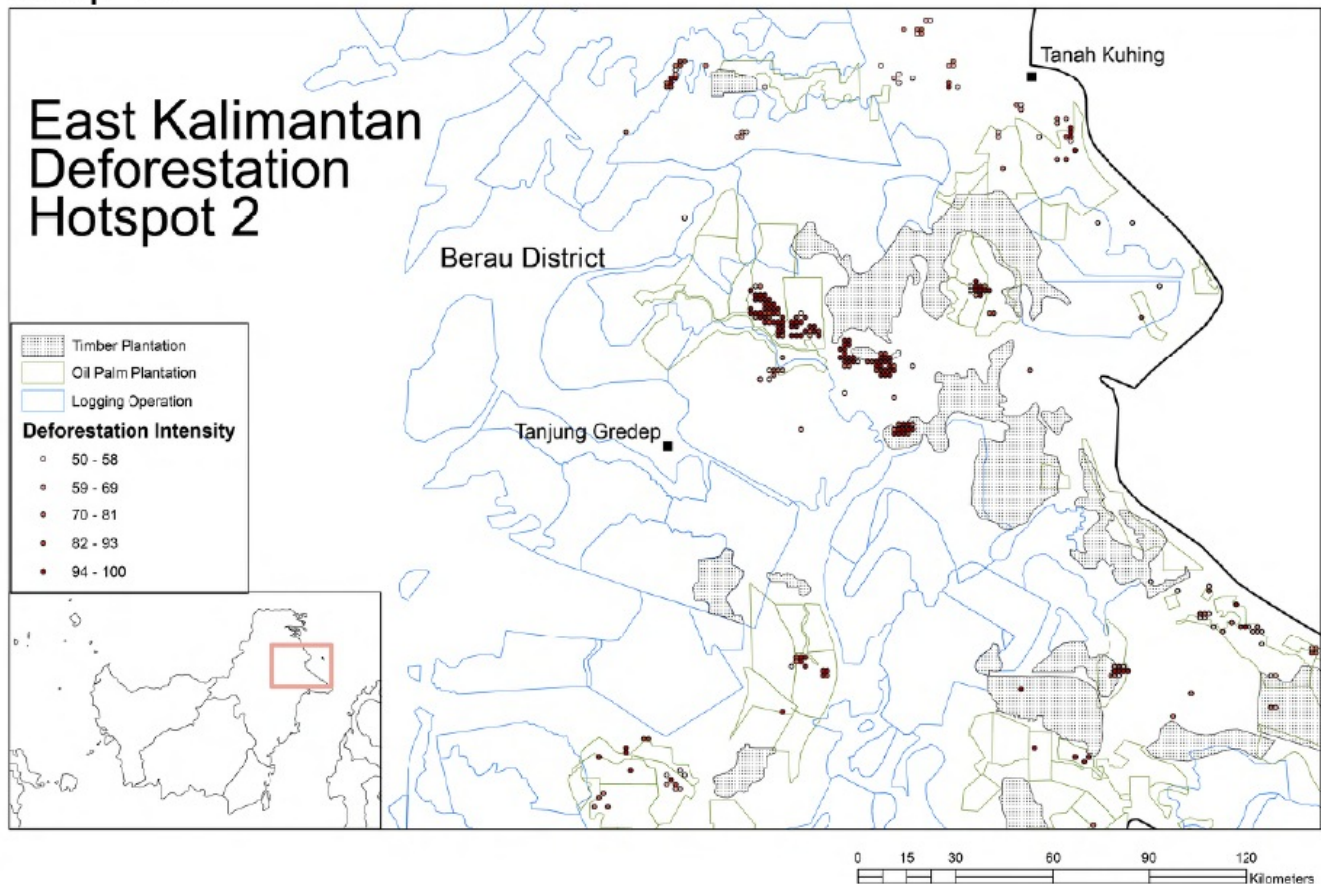
There is apparently an active timber plantation in the district of Nunukan, PT Adindo Hutani Lestari, that is involved in active clearing (Tribun Kaltim 2012). However, from the spatial analysis presented in Map 2, it appears that a significant area of deforestation in the timber plantation overlaps with palm oil concessions, making it impossible to verify why clearing is occurring without additional field work.

Coal is a major industry in Nunukan. The Bara Inti Group, the leading producer with three active mines in the area, plans to launch an additional operation in the near future (Bara Inti Group 2012).

The many selective logging concessions in the area do not seem to be active and no current reports of industrial logging in the area could be found in an online search.



Map 3.



The Berau district is a global hotspot of deforestation, land-use change, and high-conservation-value rainforest. The Nature Conservancy estimates that Berau has retained 75% of its forest cover, with 17% under formal protection. The remaining land area is allocated to commercial logging and timber plantations, oil palm plantations, and coal-mining interests. According to the Nature Conservancy, there are 32 oil palm plantations, 27 mining operations, 11 selective logging operations, and three timber plantations here (The Nature Conservancy 2012). The deforestation analysis presented here shows that of these, most likely only approximately 15 palm oil plantations, three timber plantations and one selective logging operations is currently clearing land.

Currently, BW Plantations is expanding its palm oil holdings in Berau. KL Kepong, a Malaysian company, recently acquired an oil palm plantation here as well. PT Berau Coal Energy, one of Indonesia's largest coal producers, is based here.

One-time timber boss and Suharto confidant Bob Hasan constructed what is still one of the world's largest timber pulp mills in Berau, PT Kertas Kiani, originally owned by the Kalimanis Group. The current ownership of the mill is PT Kertas Nusantara, which is owned by United Fibers System (Pirard and Cossalter 2006). To supply this mill with timber pulp, the agribusiness group founded two timber plantations, PT Tanjung Redeb Hutani and PT Kiani Lestari, and has established a 180,000-hectare timber plantation in Berau.

### *Long-term Effects of Extractive Development in East Kalimantan*

An interesting site to consider to evaluate the longest-term impacts of large-scale land use change is the region south of Kayan Mentarang National Park. The area to the north and west of East Kalimantan, where Kayan Mentarang National Park is located, is the traditional territory of the indigenous Kenyah, Kayan, Lundaye and Penan people. Hunting for bearded pig and sambar deer were among the primary non-agricultural activities. In the 1980s, this area was the site of about 3,000 Apo Kayan people living in low-population densities in remote forests. Beginning in the 1980s, the forest began to be converted to logging and plantation agriculture, and outward economic ties and in-migration increased. By 1991, more migrants than Apo inhabited this particular area, encompassed by the subdistrict of Pujungan. The Kenyah people remain a strong socio-political group in the area, but are no longer a majority and now live in a range of urban, peri-urban, and mountainous forest communities.

### *A Site Without Large-scale Development*

The Kutai Lowlands, East Kalimantan, includes the 62,500-ha Muara Kaman Nature Reserve between the Kedang Kepala and Kedang Rantau rivers. This area is of interest because of the lack of extractive industry activities, providing a possible baseline to understand contemporary livelihoods and social dynamics away from areas of large-scale land-cover change. To the northeast of Muara Kaman, in the drylands, is the Kutai National Park. Most of this area was allocated to logging concessions in the 1970s, but was never logged. There has been no large-scale commercial logging, land conversion, or infrastructure development within the peatlands, although there are timber plantations and some transmigration development in the surrounding drylands. There also has been some recent exploration for oil and oil palm establishment.

People living in and using the swamps are predominantly from the Kutai and Banjar ethnic groups. They have traditional claims on the alluvial strips, including the nature reserve, which they use for cultivating rice, fruit, and rattan. They use the nearby peatlands and lakes on an open-access basis for harvesting fish, reptiles, sedges, timber, and fuel wood. They have also harvested wood since 2001 for a medium-density fiber mill in the area.

Fish is a food mainstay and primary source of income, followed by logging, for the dominant ethnic groups that live in the swamps -- the Kutai and the Banjar. Local people have dug canals in the peatland between Sungai Belayan and Danau Siran to increase fishing access and catch. Major rivers such as the Mahakam, Kedang Rantau, Kedang Kepala, and Belayan provide easy transport routes for ships, boats, and floating timber. The alluvial strips of this river system, with flood-prone clay soils, allow for agricultural development and provide some timber, rattan, and other forest products. In the peatlands, there was only limited harvesting of some wood species, such as *Shorea balangeran*, for house construction and others for fuel wood. Harvesting was limited to areas about 0.5 km from lakes and streams navigable by small boats in the flood season, and from where logs could be floated out. Some resin was collected in this area before 1965, and tree bark was collected in 1997–1998. Generally, there is a low direct value for the trees and other forest products available in the peatlands (Chokkalingam et al. 2005).

## Study Region 2: North, West, and Central Sulawesi

### *Background*

This island is subdivided into six provinces: Gorontalo, West Sulawesi, South Sulawesi, Central Sulawesi, Southeast Sulawesi, and North Sulawesi. West Sulawesi is a new province, created in 2004 from part of South Sulawesi. The largest cities on the island are Makassar, Manado, Palu, and Kendari. Geographic boundaries of districts of Sulawesi are not provided publicly by their respective provincial governments, nor by the national government. This information should be easily accessible, however, via in-person requests are made at the provincial offices of the Ministry of Interior.

Map 1 and Map 4 included in this desk study consider West Sulawesi, Central Sulawesi, and North Sulawesi. The province of Gorontalo has been combined with North Sulawesi for continuity and simplicity, as Gorontalo was carved out of North Sulawesi recently and the published literature and maps do not yet reflect that fact. Currently available GIS data of administrative boundaries is presented in Map 1 and Map 4. Data for the new province, Gorontalo, is not yet publicly available.

### *Population Centers*

Sulawesi is characterized by higher population densities and a more-even distribution of population compared to East Kalimantan (Badan Pusat Statistik 2011). South Sulawesi, not considered in this study, has the largest overall provincial population (46% of Sulawesi), and the second-highest population density after North Sulawesi. Population is increasing at roughly 1% in North Sulawesi, 2.5% in Central Sulawesi, and 2.6% in West Sulawesi. The provinces considered in this study contain a range of population densities that would be considered rural to peri-urban (Table 5).

**Table 5. Sulawesi Population**

<b>Province</b>	<b>2010 Population</b>	<b>Percent of Total Sulawesi Population</b>	<b>Population Density (Ind./Km)</b>
South Sulawesi	8,032,551	46.27	110.4
Central Sulawesi	2,633,432	15.17	39
North Sulawesi	2,265,938	13.05	147.5
Southeast Sulawesi	2,230,569	12.85	58.5
West Sulawesi	1,158,336	6.67	69
Gorontalo	1,038,590	5.98	85

Sulawesi's human population is composed of seven major ethnic groups, which are divided in relation to geography, subsistence, language, and religion (Table 6). Traditional forms of subsistence range from swidden agriculture to fishing and seafaring -- all the way to the most urban of livelihoods for the major ethnic groups of the region (Table 6). Many of the ethnic groups now engage in wet-rice agriculture, and most practice plantation agriculture for cash crops including coffee, cacao, palm oil, and cloves. All of Sulawesi's religions and ethnicities are present in the plantations, but there is a qualitative difference visible in accounts of the plantations, where indigenous groups are much less represented at all levels of employment hierarchy (Henley 2002).

**Table 6. Major Ethnic Groups of Sulawesi**

<b>Language/ethnic group</b>	<b>Dominant religion</b>	<b>Traditional subsistence</b>	<b>Provincial location</b>
Minahasa	Christianity	Plantation and mixed agriculture	North (east)
Gorontalo-Tomini	Muslim	Mixed agriculture	Gorontalo
Kaili	Islam	Mixed agriculture	Central (west)
Bare'e	Muslim	Upland swidden and mixed agriculture	Central (west & central)
Toraja	Muslim	Mixed agriculture	All
Bugis	Muslim	Lowland agriculture, seafaring	All
Makassarese	Muslim	Lowland agriculture, seafaring	All
Mandar	Muslim	Lowland agriculture, seafaring	West
Luwuk-Banggai	Christian/Muslim	Swidden, fishing	Central (east)
Bunku-Mori	Muslim	Swidden, fishing	Southeast
Muna-Buton	Muslim	Swidden, fishing	Southeast (islands)

*From Davis 1976*

Sulawesi today is a riotous mix of ethnicity and religion. To a large extent, enclave communities comprised of a single religion form in cities, but mixed-religion communities -- and even families -- are no longer rare in Makassar and Manado.

Islam is the majority religion in Sulawesi. Christians form a substantial minority. Christians are concentrated in the tip of the northern peninsula around the city of Manado, which was traditionally inhabited by the Minahasa, a predominantly Protestant people. North Sulawesi has a particularly low concentration of Muslims (approximately 30% in 2000). The remainder of the province is mostly Christian, although historical animist practices are continued by many who identify as Christian. The new province carved out of North Sulawesi has among the highest concentrations of Muslims of all of Indonesia (around 98% in 2000) (Suryadinata 2003). In Central Sulawesi, the Toraja people have largely converted to Christianity since Indonesia's independence. Other populations with early conversion to Christianity are in the Lake Poso region in Central Sulawesi, among the Pamona-speaking peoples of the highlands, in the various smaller groups of the Banggai Islands, and in the Eastern Peninsula of the same province (Davis, 1976). Smaller communities of Buddhists and Hindus are also found on Sulawesi, but comprise no more than 5% of the total population each, and are usually within the Chinese, Balinese, and Indian communities (Suryadinata 2003).

### *Ecology*

The central part of the island is ruggedly mountainous, to the point that the island's peninsulas traditionally have been isolated from each other, with better connections by sea than by road. General ecological characteristics for three regions in Sulawesi are reported in Table 7. Sulawesi is part of Wallacea, with a mix of both Asian and Australasian species. Twenty nine protected areas cover 23%

of montane forests, and eight protected areas cover 8% of lowland forests. The national parks with the largest terrestrial area are the Bogani Nani Wartabone with 2,871 km<sup>2</sup>, and the Lore Lindu National Park with 2,290 km<sup>2</sup> (WWF 2008).

**Table 7. Selected ecological characteristics of three regions of Sulawesi**

<b>Characteristic</b>	<b>Poso</b>	<b>Minahasa</b>	<b>Sangir</b>
Province	Central Sulawesi	North Sulawesi	North Sulawesi
Soil fertility	Low	High	High
Characteristic agriculture	Swidden	Wet Rice	Agroforestry
Population density	Low/falling	High/rising	High/rising
Level of commercialisation	Low/falling	High/rising	High/rising
Progressive deforestation	Yes	Yes	No
Land degradation	Yes	No	No

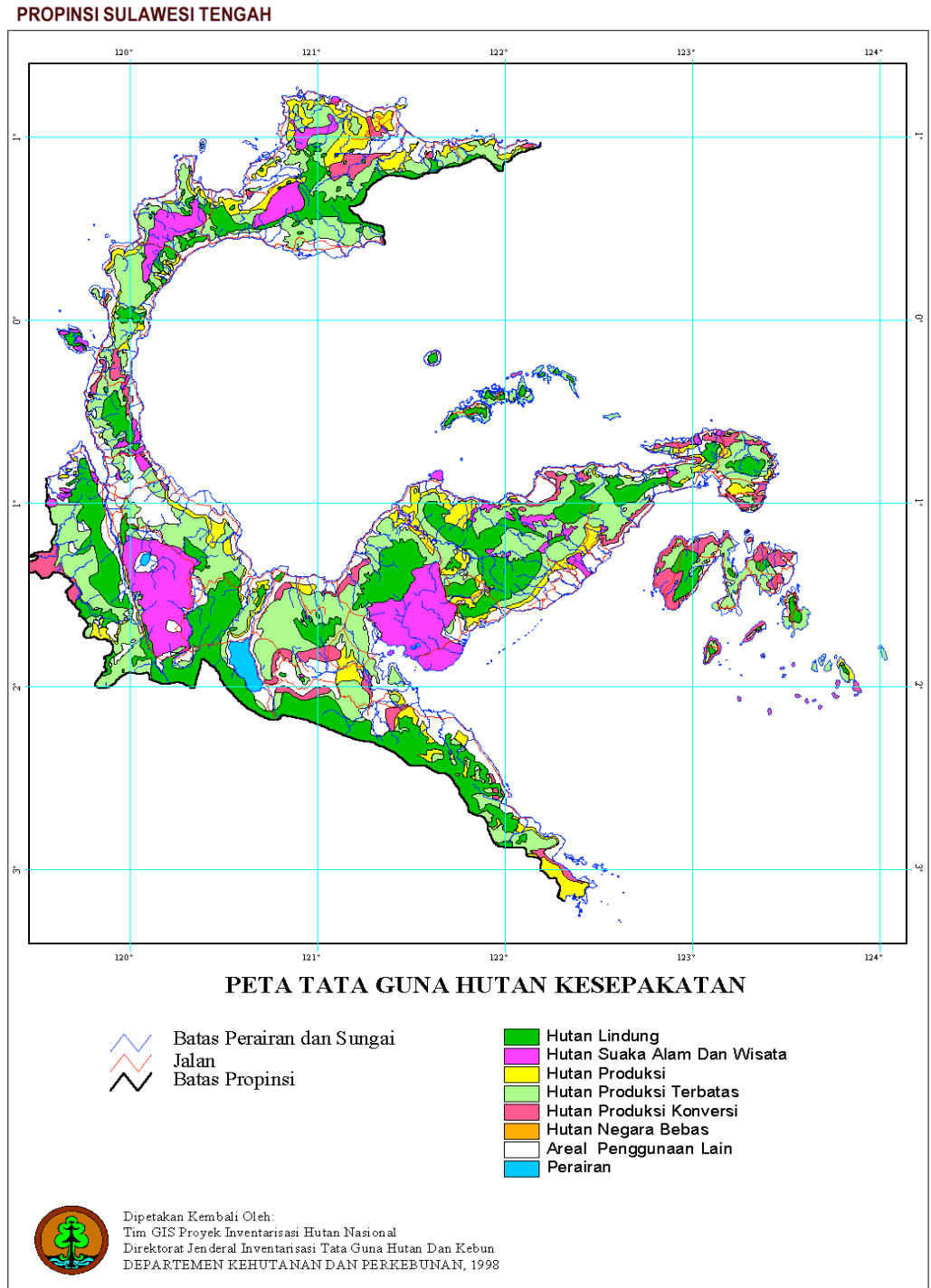
*From Henley 2005*

There are 127 known mammalian species in Sulawesi, and 62% (79 species) of the mammals are endemic. Bushmeat mammalian species include the babirusas, the Sulawesi wild pig, the Sulawesi palm civet, and primates including a number of tarsiers (e.g., the spectral, Dian's, Lariang, and pygmy species) and several species of macaque (WWF 2008).

Large-scale conversion of forest accelerated in the Suharto era due to the emergence of government-supported enterprises including the transmigration program, and development of cash-crop industries, and commercial logging (Whitten et al. 1987).

Cannon et al. (2007) report that 80% of Sulawesi's forest has been altered or destroyed, and only 30% of the remaining land is in good condition (i.e., "forest canopy unbroken by large clearings with only scattered signs of human activity"). The current government land-use map of Central Sulawesi, in Figure 9, demonstrates the large amounts of land categorized as protection forest that have likely been degraded, according to the analysis by Cannon et al.

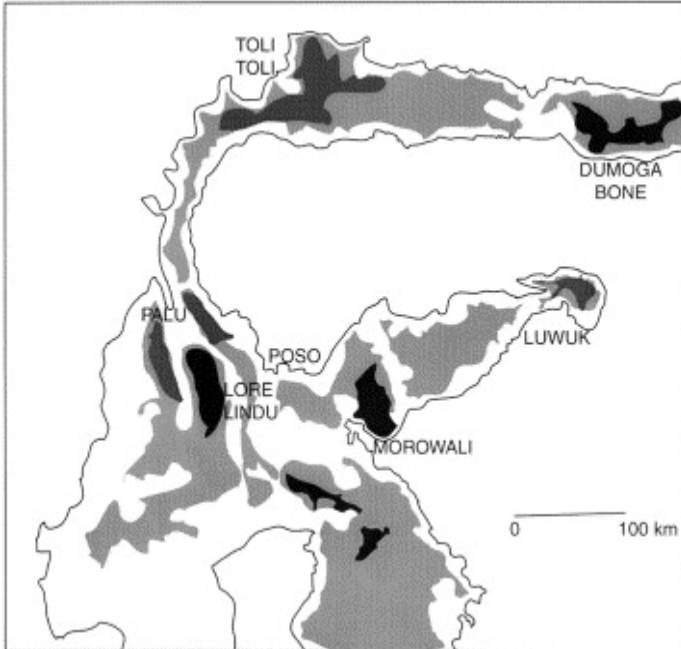
**Figure 9. Indonesian Ministry of Forests Land Use Planning Map, Central Sulawesi**



*Legend Translation: Hutan Lindung = Protection Forest, Hutan Suaka Alam Dan Wisata = Forest Reserve, Hutan Produksi = Production Forest, Hutan Produksi Terbatas = Limited Production Forest, Hutan Produksi Konversi = Conversion Production Forest, Hutan Negara Bebas = Non-State Forest Land, Areal Penggunaan Lain = Other Use, Perairan = Water.*

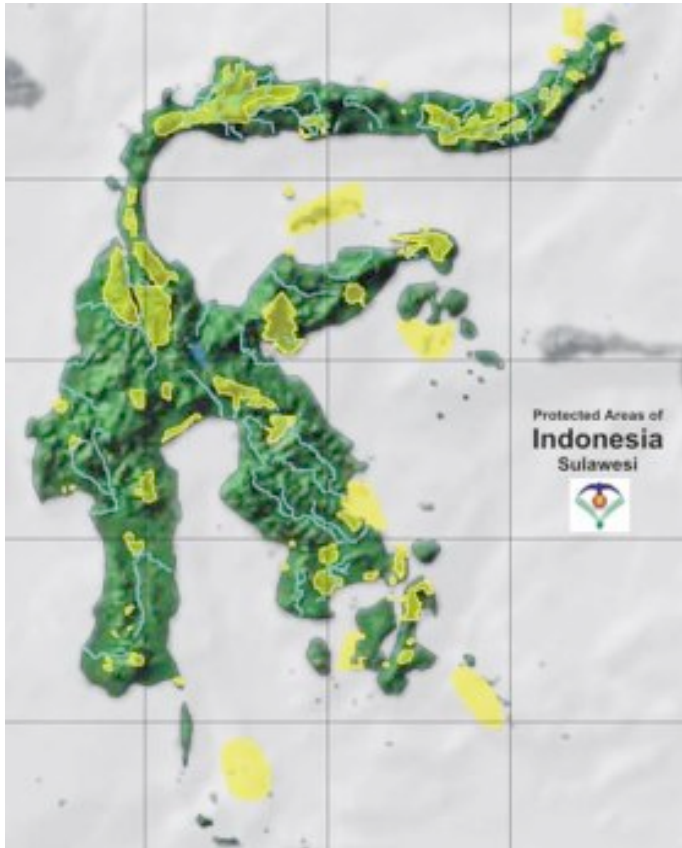
According to the website Mongabay.com, Sulawesi has six national parks and 19 nature reserves. Central Sulawesi contains the most well-known park on the island, Lore Lindu National Park, spanning 229,000 hectares. It is a UNESCO Biosphere Reserve. On the northern peninsula (in North Sulawesi), Bogani Nani Wartabone National Park protects 300,000 square hectares, while Rawa Aopa Watmohai National Park protects 105,194 hectares in south(east) Sulawesi (Figures 10 and 11). Figures 10 and 11 give two similar, if not identical, portrayals of protected areas in Sulawesi. After much effort, these are the only two maps of Sulawesi protected areas found by the consultant.

**Figure 10. Sulawesi Protected Areas and Estimate of Forest Extent**



*Black = Protected Areas, Gray = Estimated Forest Extent  
From Thiollay and Rahman 2002*

**Figure 11. Sulawesi Protected Areas**



Source: Unknown

Most of the parks, however, suffer frequent encroachment for illegal logging, mining, and even conversion into crops. Thousands of illegal gold miners have been found in Bogani Nani Wartabone National Park (Aspinall 2001). Sulawesi also has three national marine parks: Bunaken, Wakatobi, and Take Bonerate.

### ***Sulawesi Bushmeat Hunting***

Bushmeat hunting and trade have been better studied in Sulawesi than in Kalimantan. It is apparent that the trade continues to grow even as selected species' abundance declines locally in many regions. High levels of trading the Sulawesi pig (*Sus celebensis*) and flying foxes (*Pteropodidae*) have been documented, raising concerns about the sustainability of current harvesting (Table 8) (Lee et al. 2005). Unfortunately, this study does not report the total weight of animals observed. Other species groups that are most affected include birds, turtles, primates, and ungulates. Macaques are a holiday staple among some of the local communities and considered a delicacy by the Wana people of Sulawesi (Yeager 2008).



**Table 8. Bushmeat trade species, Central Sulawesi**

Species	Observed species
Macaque	<i>Macaca hecki</i> and <i>M. nigrescens</i>
Anoa	<i>Bubalus depressicornis</i> and <i>B. quarlesi</i>
Civet	<i>Viverra zangalunga</i> , <i>Paradoxurus hermaphroditus</i> , and <i>Macrogalidia musschenbroekii</i>
Cuscus	<i>Strigocuscus celebensis</i> , <i>Ailurops ursinus</i>
Rat	<i>Paruromys dominator</i>
Squirrel	<i>Prosciurillus murinus</i> and <i>Rubrisciurus rubriventer</i>
Small bat	<i>Cynopterus brachyotis</i> and <i>Megaderma spasma</i>
Large bats (flying foxes)	<i>Pteropus hypomelanus</i> , <i>P. alecto</i> , <i>Acerodon celebensis</i> and <i>A. humilis</i>
Tarsier	<i>Tarsius spectrum</i> and <i>T. pumilus</i>
Sulawesi pig	<i>Sus celebensis</i>
Babirusa	<i>Babyrousa babyrussa</i>
Timorese deer	<i>Cervus timorensis</i>

From Lee et al. 2005

North Sulawesi is unique in Indonesia because most of its population is Christian. This population is not constrained by Muslim taboos and has historically relied on a diet rich in animal protein from monkey, pig, bat, and rodent. Over-exploitation has extirpated some mammal species, including anoa (*Bubalus spp.*), babirusa (*Babyrousa babyrussa*), and flying foxes from once-productive hunting sites, such as the Tangkoko-Duasudara Nature Reserve (O' Brien and Kinnaird 2000). North Sulawesi is relatively developed and not dependent on bushmeat hunting; demand for bushmeat is a preference rather than a necessity.

In 1998 the Langown Market was the most important wild-meat market in North Sulawesi, providing a snapshot view of important bushmeat species. At maximum market activity (7 a.m.), the average numbers of animals for sale over the entire years' data collection effort are as follows: eight babirusa, 71 Sulawesi wild pig, 213 rats, and six cuscus. On average, one monkey, 84 fruit bats, 25 domestic pigs, 33 dogs, and one cow were also for sale (Lee et al. 2005).

Outside of markets, along roads, the same study reports that large bats were the most frequently encountered (66.4% of all mammals), followed by the Sulawesi pig (29.6%), and rats (2.6%). The remaining 1.4% of animals recorded included small bats, babirusas, macaques, cuscuses, and civets (Lee et al. 2005).

### ***Sulawesi Extractive Industry***

#### *Oil Palm Plantations*

Current production is distributed across the districts of Central Sulawesi, totaling around 50,000 hectares. About 42,000 hectares of this comprise large-scale planting by companies, and 8,000 hectares comprise smallholder production as follows: Banggai Kepulauan (~50%); Tojo Una-Una (~35%); Morowali (~30%); and Buol (27%) (Badan Pusat Statistik 2010).

As of 2007, Central Sulawesi has been targeted for 1,800 ha of expansion, South Sulawesi for 12,200 ha, and West Sulawesi for 10,000 ha -- amounts that are less than 10% of expansion estimates for East Kalimantan (Indonesian Palm Oil Board 2007). All of the observed deforestation in palm oil areas in the Sulawesi provinces is considered in the discussion of Map 4 below.

#### *Timber Plantations*

Reliable data could not be found related to province-wide timber plantation dynamics.

#### *Selective Logging Plantations*

Only the north of Central Sulawesi shows any signs of active selective logging operations (Map 4). Government statistics report that there has been a 20% decline in activity per year over the last five years in the logging industry (Dalam Angka 2010).

#### *Coal Producers*

The location of coal mines in Sulawesi remains unknown.

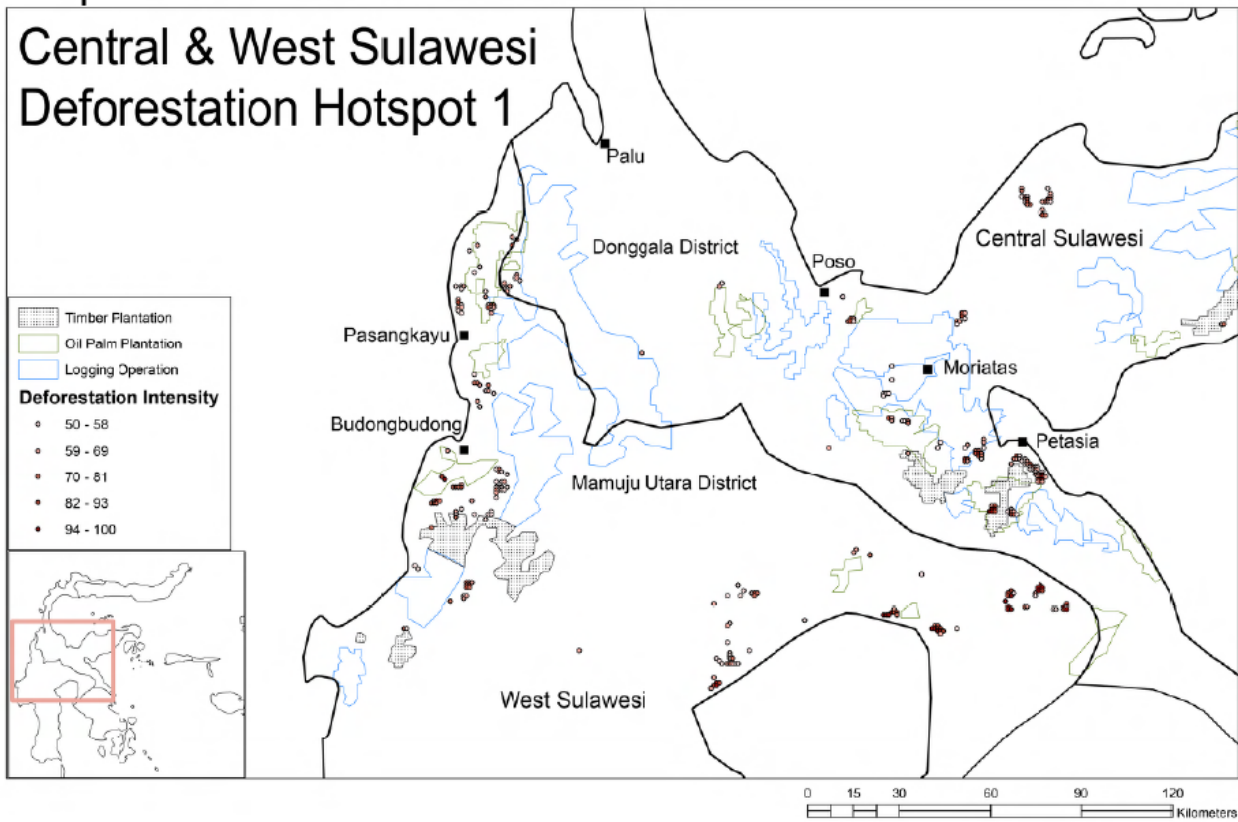
Out of Indonesia's total of approximately 60 million tons of coal reserves, Central Sulawesi holds 1.98 million tons, and South Sulawesi holds 1.32 million tons. Levels of production remain unknown (BKPM – JICA 2005). South Sulawesi provides an example of the social dynamics of large-scale mines. The 1,000-person village of Soroako was swamped by the uncontrolled immigration of roughly 3,000 new mine workers when the nickel mine and smelter, PT Inco, owned by Inco Canada Ltd, expanded operations under a "second-generation" mining contract in 1968, not completing mine expansion until 2001. Indigenous habitants now comprise less than one-third of the region's population, which at 2001 was estimated at 4,000. Inadequate urban development and planning has created drastic overcrowding. "Contract marriages" and prostitution were documented to rise, and only one-third of mine employees were local people. The Bahumatefe PT Inco project site is responsible for displacing an entire transmigration site (about 50,000 families) and reports have emerged questioning the settlement process. In Soroako, almost all full-time skilled mine workers had access to treated freshwater, while less than 35% of the unskilled, part-time laborers had access to water uncontaminated from mine operations (Ballard 2001).

#### *Artisanal Gold Mining*

In addition to large-scale coal mining operations, there has been an increase in illegal gold mining since 1998. These miners use mercury to process gold, and the mercury is often burned off inside homes, putting children at risk of mercury poisoning. Tailings are disposed of in small creeks and rivers, and contaminating freshwater sources, which often leads to increased pollution and damage to forests (Aspinall 2001).

Talawaan Watershed is a known artisanal gold-mining location in North Sulawesi, providing ongoing immigration, mercury exposure, and water contamination. A survey of North Sulawesi in 2000 found over 3,000 miners in the one region of Talawaan. These small-scale miners, from children to the elderly, were mostly immigrants, living just at the poverty line (i.e., \$1 a day). These miners collected gold, using both alluvial collection methods (involving the dredging and sifting of large amounts of river mud) and artisanal (hand crushing and panning, typically on a smaller scale). An estimated 10,000 to 20,000 miners worked in North Sulawesi on these small-scale, illegal gold mines in 2002 (Limbong et al. 2003).

Map 4.



Map 4 spans the provinces of Central and West Sulawesi, representing the highest concentration of deforestation within the Sulawesi study region. There is no published literature on the key hotspot of Mamuju district, West Sulawesi and very little publicly available from other sources outside of the district. Although the exact situation remains murky, it is apparent from remote sensing and GIS analysis that Mamuju is a center of Sulawesi oil palm and timber plantations. Major international corporation PT Astra Agro Lestari is known to operate at least two active oil palm plantations, with an additional one or two expected in the coming years. It appears that none of the logging operations are active in the area, and logging company control of these non-active concessions is unknown.

Astra Agro is active in North Mamuju (also called Matra) district, and PT Letawa and has announced plans to expand 10,000 hectares in Sulawesi, most likely near its existing plantation. It is the consultant's opinion that this area represents a newly established site of palm oil expansion that is likely to continue to expand.

In the nearby Donggala district, Central Sulawesi, PT Mas Minta and PT Multistrada Arah Sarana are thought to be the only two operational timber plantations in the area.

Petasia and Mori Atas, adjacent subdistricts of the district of Morowali, Central Sulawesi is a center of palm oil development. This area is also the center of the Mori indigenous group, providing a high chance of hunting and palm oil laborer interactions with the forest. Astro Agra Lestari, in Mori Atas, operates approximately 100,000 hectares of oil palm at the PT Tamaco Graha Krida and PTPN XIV plantations, which were once government owned. The multinational Sinar Mas owns an additional

30,000 hectares. A single timber plantation appears to be active in this area. It was once owned by PT Barito Pacific Timber Group, a concession area of 1 million ha. Current ownership is unconfirmed (Kartodihardjo and Supriono 2000).

**Conclusions: Weighing the Prevalence and Importance of Land Use Dynamics between Study Regions**

Table 9 provides a summary of the relative qualitative social importance of the land-use dynamics considered in this study for each of the two study regions. It is the consultant's conclusion that East Kalimantan contains a greater number of people participating in extractive industry, holds a greater number of people living in forest areas and along the forest edge, and has a higher rate and overall extent of deforestation than North, West, and Central Sulawesi. East Kalimantan has the second-highest rate of population growth of all Indonesian provinces, higher than any of the Sulawesi provinces considered. It is suspected that this population growth is the result of a very high rate of incoming migrants. These migrants -- responding to rapidly expanding mining operations and oil palm and timber plantations -- are arriving in search of jobs that bring them into "frontier towns," or settlement areas of high population density and poor living conditions that are typically in and along forests. In short these are areas of great concern for human health.

**Qualitative social importance of various regional land use dynamics**

**Table 9.**

<b>Land Use Dynamic</b>	<b>East Kalimantan</b>	<b>Sulawesi</b>
Deforestation	+	o
Palm Oil Plantations	+	o
Timber Plantations	o	-
Selective logging	-	-
Artisanal Gold Mining	o	+
Coal Mining	+	-
Bushmeat Hunting	+	+
Flying fox trade	+	+
Macaque trade	+	o

+ = gauged to be highly important by consultant

o = gauged to be of moderate importance by consultant

- = gauged to be relatively less important than other factors considered by consultant

The scale of palm oil, timber, and coal operations in East Kalimantan is well beyond that of Sulawesi, making the need for health interventions near areas of extractive industry much larger in East Kalimantan than in Sulawesi. One leading palm oil and timber industry corporation, Sinar Mas, already has implemented significant health interventions in its own right. This includes the safe drinking water interventions through the construction of water treatment facilities, and the provision of basic primary care services via clinics in villages where the company operates. There may be opportunities for collaboration on health intervention projects. Any project that aims to carry out research on the social impacts of these industries, however, will likely face obstacles presented by industry.

The overall numbers of artisanal, self-employed gold miners could not be determined in each study region, but it is clear that both East Kalimantan and North and Central Sulawesi have large numbers of families that engage in this risky activity with known health impacts. The 2004 study of artisanal gold miners in East Kalimantan by the International Labor Organization (ILO 2004), in partnership with researchers from the University of Indonesia, is an excellent baseline study and presents a rare case of first-rate scholarship on the issue, providing a nice platform for additional research.

Unfortunately, there are no known comprehensive bushmeat studies from East Kalimantan to compare with those of Sulawesi. The consultant has carried out casual observation of bushmeat dynamics of East Kalimantan, but not in Sulawesi, making comparison of the trade across East Kalimantan and Sulawesi a challenge. The evidence from neighboring Central Kalimantan certainly shows a thriving bushmeat trade there, most likely larger and more fully integrated across rural and urban areas than in Sulawesi. Thus, there is reason to believe the same holds true for nearby East Kalimantan. Based on casual observation by the consultant, the prevalence of the bushmeat trade in East Kalimantan seemed to be much higher than in Northern Sumatra, another published “hotspot” for bushmeat trading. The Dayak Revival in East Kalimantan in the 1990s -- when the Dayak people renewed their animist traditions and rejected attempts at conversion to Christianity -- makes it likely that a higher percentage of the population in East Kalimantan is open to eating and handling a wide variety of wild animals. Sulawesi presents an opposing trend, where many of the forest groups continue to be converted to Christianity, and presumably, become increasingly more resistant to eat and handle forest animals.

In sum, East Kalimantan presents a more pressing situation of large-scale, ongoing human-forest interactions, complete with “frontier town” social dynamics and a higher prevalence of bushmeat trade and consumption than the Sulawesi study regions.

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