WORKING PAPER

Traditional knowledge, perceptions and forest conditions in a Dayak Mentebah community, West Kalimantan, Indonesia

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CIFOR

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Photo by Edith Weihreter/CIFOR
Nanga Dua Village on Penungun River with canoes and a gold digging boat

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You have your way. I have my way. As for the right way, the correct way, and the only way, it does not exist.

FRIEDRICH NIETZSCHE

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List of abbreviations

BAi	individual tree basal area
CIFOR	Center for International Forestry Research
CIRAD	Centre de coopération Internationale en Recherche Agronomique pour le Développement
CoLUPSIA	Collaborative Land Use Planning and Sustainable Institutional Arrangements
D	diversity index (measured by Simpson index λ)
dbh	diameter at breast height
IDR	Indonesian rupiah
IUCN	International Union for Conservation of Nature
IVI	importance value index
NGO	non-governmental organization
PDM	pebbles distribution method
RBA	relative basal area for each species
RD	relative density for each species
Smith S	Smith's index of salience
sp.	species not identified (identified to genus level only)
λ	Simpson index λ

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Finally I would like to dedicate this work to my family and friends – without them I would not have had the fortitude to go through this experience with such lightness and joy.

1 The polite forms of addressing a person in Indonesian are used in this report: Ibu = Mrs or mother; Bapak = Mr or father; Nenek = older women or grandmother

1 Introduction

1.1 Forests in Kalimantan: A changing environment

Indonesia is blessed with an extraordinarily rich natural and cultural heritage. It contains 10% of the remaining global tropical rainforest, placing it in third place, after Brazil and the Democratic Republic of Congo (FAO 2010). These tropical forests house a high biological diversity and provide multiple goods and services. Deforestation for cultivating crops created radical changes during the last decades, resulting in a forest cover drop from 162 million hectares in 1950 (Global Forest Watch, 1995) to 94.4 million ha in 2010 (World Bank 2010; FAO 2011). This induces rapid habitat loss, threatening a high number of endemic species with extinction.

Southeast Asia had the highest deforestation rate among tropical regions in the world at the end of the 1990s (Miettinen et al. 2011). The Indonesian part of Borneo, called Kalimantan, covers an area of 54 million ha. In 2002, approximately 50% of this area, or 26.7 million ha, was still under forest, but this has been steadily diminishing due to deforestation (Fuller et al. 2004; Miettinen et al. 2011; Figure 1). A great number of species can be found in its different

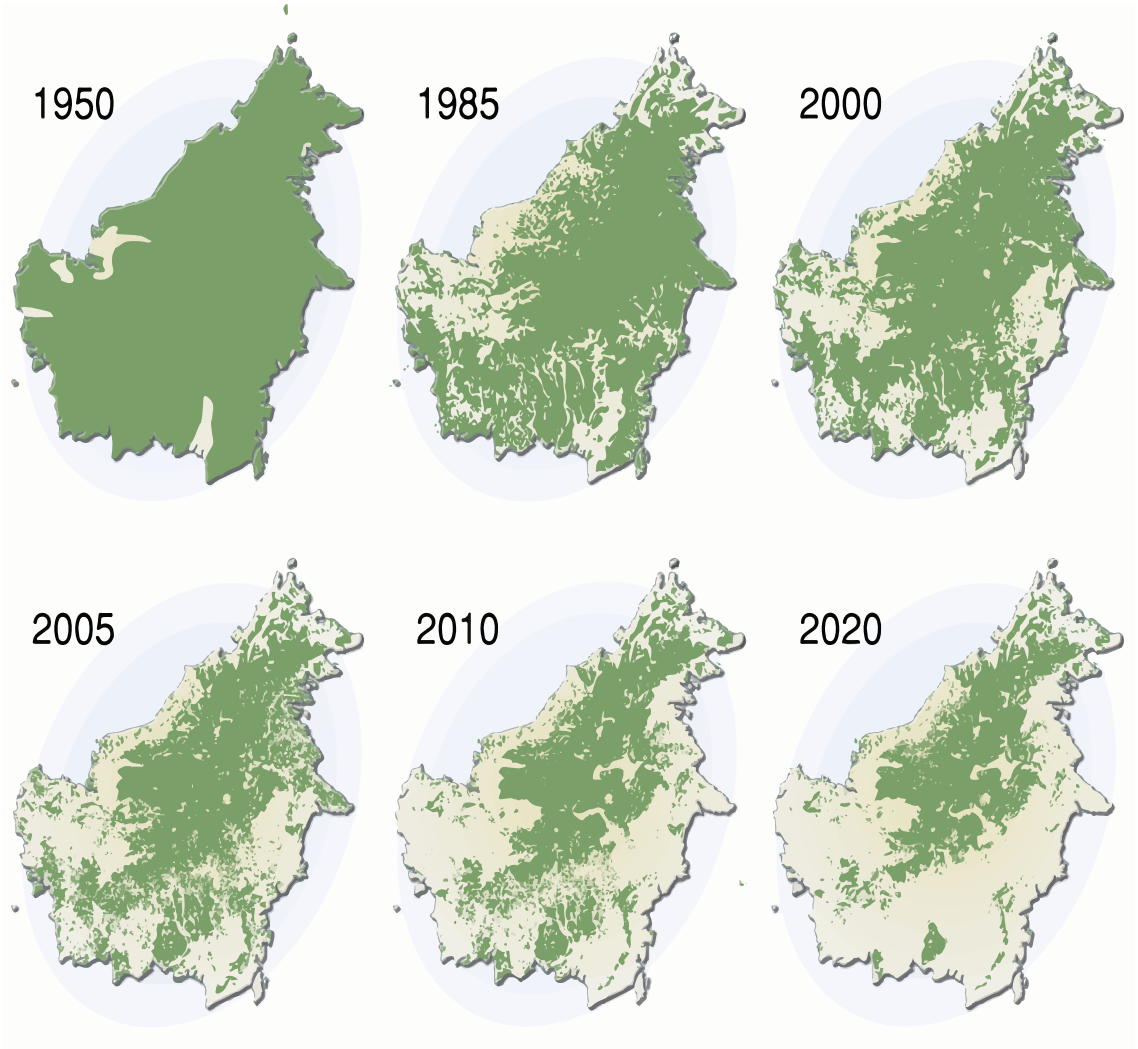

Figure 1. Deforestation in Borneo: Steady depletion of forest cover between 1950 and 2005, and projected loss up to 2020.

Source: Ahlenius (2007)

forest types and habitats. Kalimantan is part of the Sundaland biodiversity hotspot, which means its ecosystems are a priority for conservation issues (Myers et al. 2000). Its forests are home to more than 3000 tree species, including 267 species of the Dipterocarpaceae[2] family, of which 155 are endemic to Borneo (Ashton 1982). The lowland dipterocarp forest is one of the most species rich in the world in terms of flora and fauna (Whitmore 1988). It grows on mineral soils on altitudes under < 300 m or < 500 m, according to the classification of different authors (Symington 1943; van Steenis 1972; Whitmore 1988; Laumonier 1997), where it gradually changes to hilly dipterocarp forest.

In addition to its natural richness, Indonesia's cultural heritage is extremely diverse. According to Istiyani (2008), there are 168 local dialects in the province of West Kalimantan[3]. All over the world, cultural diversity influences both natural resource management and natural diversity (Hill 2008). Numerous publications, such as the Millennium Ecosystem Assessment (2005), demonstrate the links between human well-being and ecosystem services. Directly or indirectly, the Indonesian forests are of great social, economic and environmental importance. The role they play for the national economy, as well as the livelihood of local communities is crucial.

1.2 Indigenous-community-based forest management systems in Kalimantan

The forests of Indonesia and their resources have been managed by indigenous groups for millennia using traditional knowledge and customary laws. These community-based practices differ from the management carried out by the government or industrial firms, as they are generally small-scale and based on diverse consumption and cultural needs. Cultivation usually evolves through swidden agriculture and the planting of selected plant and tree species. According to Kleinman et al. (1995), small-scale swidden agriculture is viewed as a sustainable practice, as smallholders are not dependent on "outside inputs based on fossil energy for fertilizers, pesticides and irrigation." Agroforests cover 6 – 8 million ha in Indonesia and constitute a major income source for smallholders (Michon et al. 2005). The extracted products include: rubber latex, dipterocarp and benzoin resin, spices, fuelwood, fruits, nuts, bamboo, handicraft material, and medicinal plants.

Hunting and gathering is still practiced in the interior of Borneo. Products extracted from the forest can be used for selling or self-consumption. In West Kalimantan, some Dayak[4] communities gather agarwood (*gaharu*) a resinous substance that forms in the wood of trees, belonging to the *Aquilaria* genus, when they are infected with a specific fungus (Subehan et al. 2005). This resin is used as incense or in perfume, and is sold on the national and international market. An important source of income for Indonesian smallholders is the growing and tapping of rubber trees (*Hevea brasiliensis*) (Michon et al. 2005).

The agricultural systems of Kalimantan are traditionally based on swidden agriculture, as it is found in numerous Dayak villages (Jessup and Vayda 1988; Poffenberger and McGean 1993; Comptour 2011). As Kalimantan's soils are poor in minerals and nutrients, shifting cultivation is practiced in order to fertilize the soils through burning of trees (Setyawan 2010). The swiddens, called *ladang*, are fields grown with upland rice and a broad variety of fruits and vegetables (Gönner 2000; Crevello 2003).

The indigenous forest management systems and local resource uses have maintained human health and protected environments, and they may be a key to sustainability (Crevello 2004; Contreras-Hermosilla and Fay 2005; Sobrevila 2008). These systems are not static or unchanging, but adaptable, flexible and influential uses of diverse resources and natural dynamics (Jessup and Vayda 1988; Gönner 2002).

According to Michon et al. (2005) between 40 and 65 million people are forest dependent in Indonesia, but none of them have "any official tenure rights to the lands they manage or to the forest resources from which they make their living." This highlights major threats for smallholders, who live and work on state forest land. The government allocates millions of hectares to timber, plantation and mining companies or declares non-exploitable conservation areas, with little or no regard to the needs of local communities. The challenge for Indonesia as a nation is to improve the management

2 Dipterocarpaceae is a family of tropical hardwood trees, dominant in Borneo (Appanah and Turnbull 1998)

3 Kalimantan has four administrative provinces: West, East, South and Central Kalimantan.

4 'Dayak', meaning 'people of the upstream' (Joshi et al. 2004), is the general name for the indigenous people of Kalimantan. Dayaks have inhabited the island for the past 40,000 years (Jessup and Vayda 1988).

of its remaining forests, in a manner that respects communities' rights and conserves environmental services (Contreras-Hermosilla and Fay 2005). A better understanding of the social, economic and environmental interactions at landscape level is needed in order to establish development versus conservation priorities and enhance the livelihoods of local people.

The CoLUPSIA project

In this context of rapid land use change and important land management issues theCoLUPSIA, Collaborative Land Use Planning and Sustainable InstitutionalArrangements project of CIRAD, funded by the European Union, was launched in partnershipwith CIFOR, TELAPAK and several local NGOs and Universities. Its aim is to contribute toavoid environmental degradation in Indonesia, and to strengthen land tenure and communityrights by integrating all stakeholders' views in rural land use planning processes (CIRAD2010, CIFOR 2012). The outputs revolve around the relationship between land use planningand the provision of ecosystem services, which may lead to payments for environmentalservices later on. The project focuses on two regencies (kabupaten), Kapuas Hulu and Central Maluku.

1.3 Kapuas Hulu Regency

This study is conducted in the regency of Kapuas Hulu, in the northeastern part of the West Kalimantan Province (Figures 2 and 3). The climate is equatorial, with over 200 mm of rainfall per month and average mean temperatures of over 20°C (Fontanel and Chantefort 1978; Oldeman et al. 1980). Trees mostly bear fruits during the wet season, from December to March (Galdikas 2009). Soils in the region are mainly ultisols (Palm et al. 2007).

Kapuas Hulu is called a "conservation regency" as it houses two large national parks and is the source of major rivers and streams. Covering a total surface of 2.9 million ha (BPS-Statistics 2010), the regency has lost 320,000 ha of forests to oil palm plantations (Persoon and Osseweijer 2008). According to vegetation maps established by the Collaborative Land Use Planning and Sustainable Institutional Arrangements (CoLUPSIA) team, approximately 1.8 million ha are still under primary forest cover.

With the improvement of the road network, the pressure of deforestation by further plantations and illegal logging may grow, putting the forests of Kapuas Hulu at further risk. According to Curran et al. (2004) lowland forests are particularly vulnerable, as they contain "distinctive dipterocarp habitats, the majority of vertebrates, the greatest canopy tree diversity, and the majority of land used by humans." In the province of West Kalimantan, the lowland dipterocarp forest has almost disappeared, except for the Kapuas Hulu Regency.

1.4 Aim of this study

The CoLUPSIA team conducted an extensive socio-ecological survey in the regency. Household-level socioeconomic surveys of 20 villages were carried out in 2011 in the northern part of Kapuas Hulu Regency, which are mostly occupied by Dayak Iban villages. Comptour (2011) studied the landscape and agricultural practices in Keluin Village. More data are needed for the southern and eastern part of Kapua Hulu Regency, where gold mining is known to occur. The landscapes of this area, a mosaic of mixed dipterocarp forest and *kerangas*[5] forest, have not been described yet. The CoLUPSIA project focuses on a Dayak Mentebah village called Nanga Dua.

The aim of this study is to assess the local resource-use systems and values related to vegetation cover and associated goods and services in the landscapes of Nanga Dua. A better understanding of the contribution of indigenous knowledge and land uses to biodiversity management is necessary for better planning of natural resource management.

The two main research questions are:

- How do people in a Dayak Mentebah village perceive and exploit their environment?
- To what extent is local plant diversity used in traditional practices, such as traditional medicine?

The objectives are to

- conduct a participatory survey with local farmers, which will highlight their landscape perceptions, the uses and the values they attribute to different species and land uses;
- evaluate the different land uses on a scientific basis and conduct ecological research by assessing tree diversity and vegetation structure;
- carry out a study on medicinal plants, in order to get a deeper insight into this traditional knowledge.

5 *Kerangas*, which in Iban language means "land that cannot grow rice," are heathly forests on sandy soils (Katagiriet al. 1991).

Figure 2. Location of the Indonesian province of West Kalimantan, in green.
Source: Adapted from maps established by Danan Hadi, CoLUPSIA

Figure 3. Location of study site. In color: the Kapuas Hulu district. Red dot: Nanga Dua Village, the study location.
Source: Adapted from maps established by Danan Hadi, CoLUPSIA

2 Materials and methods

2.1 The territory of Nanga Dua

Nanga Dua Village is in Bunut Hulu District, where the Mentebah and Penungun rivers meet. These two rivers belong to important watersheds and a large number of tributaries meet them. Nanga Jerihai to the east is a hamlet belonging to Nanga Dua that was not included in this study. South of it, downstream, is the neighboring village of Nanga Payang. The villages and the rivers are at an altitude of under 100 m. Low but steep hills, not higher then 200 m stretch north of Nanga Dua (Gunung Tahu). Overall, most of the territory is below 300 m in altitude, but to the south hills and mountains (Gunung Tuan) rise up to 1000 m.

The map (Figure 4) established using Landsat satellite imagery gives a general overview of the territory, but it lacks accuracy due to dense cloud cover on the

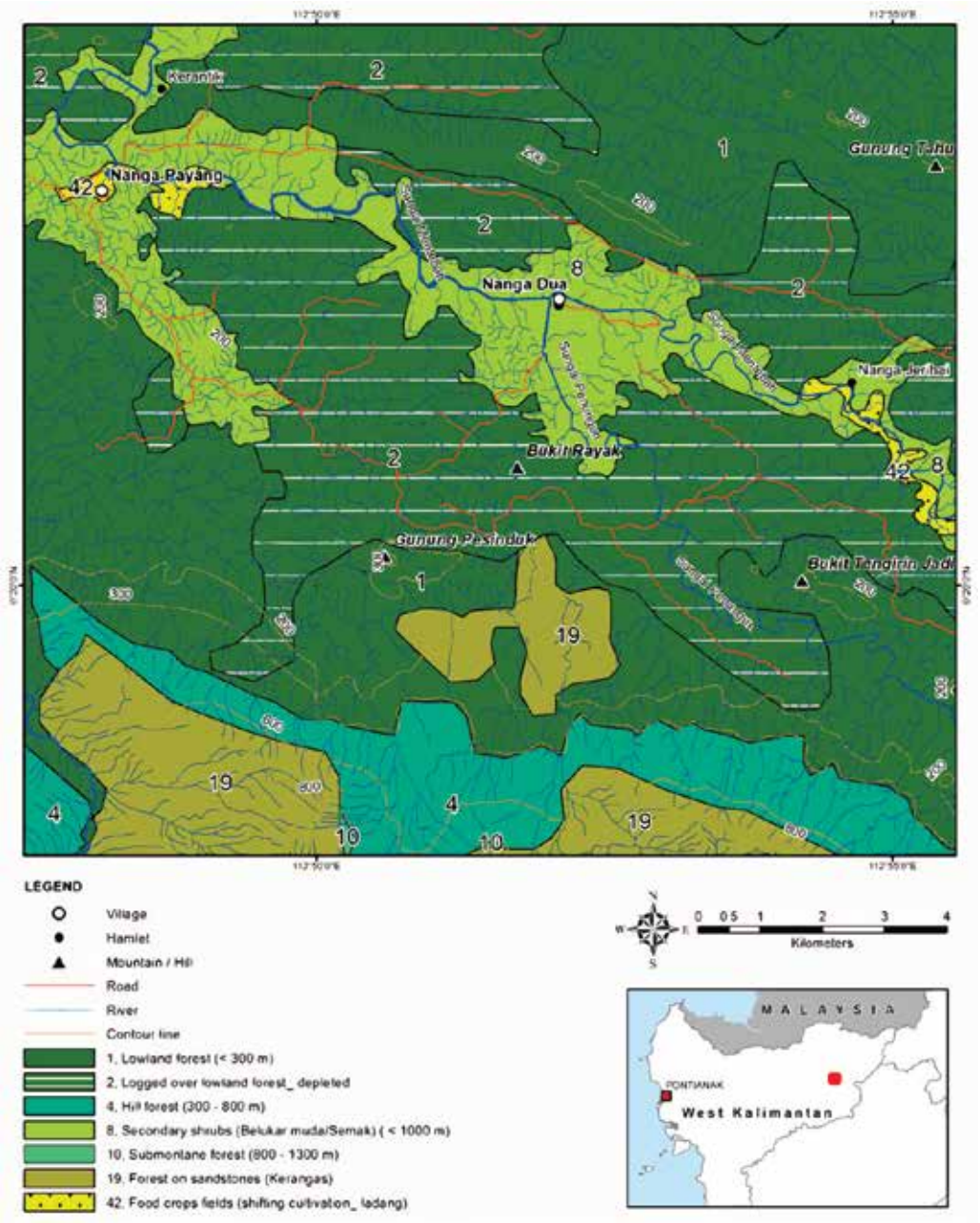

Figure 4. Vegetation map and localisation of the study site, established by CoLUPSIA using Landsat satellite imagery from 2009.

pictures. The scale does not allow for much detail in terms of landscape and agricultural types. The section in bright green around the village and along the two main rivers refers to a mosaic of secondary regrowth, fallows and gardens. Logged over lowland forest stretches to the north of the area and south of River Mentebah. Further south, the forest seems unaffected by logging activities, giving way to intact lowland forest, which is replaced further up by hill forests (300–800 m of altitude). The *kerangas* forest, which developed on sandstone, occurs on hills south of the sector, mainly above 600 m altitude, and on an important section below 300 m.

2.2 Methods

This study describes local people's interactions with their natural environment and refers to ethnobiology or the science of how people understand and use their environment, including plants and animals, based on their culture (Pieroni et al. 2005). The field survey was conducted over a 3-month period from April to July 2012. Preliminary preparation for the study included an intense course in the Indonesian language over a 2-week period.

This study examined three different crucial sources of information to obtain insight in peoples' perceptions and their environment: (i) knowledge gained through observing peoples' activities, (ii) knowledge provided by local people, and (iii) knowledge gained through scientific measurement (Lynam 1999).

2.2.1 Participative observation

One way of gathering information in ethnology is through talking with people, observing what they do and participating in their activities (Gerique 2006). Simple, informal questions and enquiry techniques such as semi-structured interviews (Martin 2004) confirmed the observations made. This was used as a first approach to gain a basic understanding of the activities, history and socioeconomic situation of Nanga Dua Village. Local experts were identified with the help of local people. These experts became key informants for the different research topics, such as forest types, tree diversity or medicinal plants. Interviews provided a way of creating a calendar of agriculture and other main subsistence activities.

2.2.2 Perception of the land use, landscape and species value

To get a deeper insight into the different land uses and the values the villagers attributed to the different landscapes[6] and species, participatory research methods were used. People participated on a voluntary basis.

Focus group discussions

Two topics were examined with the villagers in focus group discussions (Kitzinger 2003). In the first session, 7 women and 1 man were asked to name and define the existing land types, in order to get an overview of the peoples' understanding of existing landscapes and land-use units. During the second meeting, composed of 11 women and 3 men, different categories of uses were defined. Lists were then established containing the most important species (local name), derived from the different land-use types, for each use category. In order to work in accordance with the villagers' understanding of the different landscapes and land uses, the established classifications were subsequently used for all further surveys, such as the pebble distribution method (see below).

Community landscape mapping

Community mapping is a powerful tool to localize the different landscapes, vegetation cover type and the associated specific uses, as viewed by local people (Chambers 1994; Corbett 2009). As well as a base map containing the main rivers and paths, villagers were asked to draw the borders of their territory, the natural resources, the different types of land and the related uses, such as fallows, protected areas, etc. For efficiency, symbols for the different land uses were created before the meeting, in accordance with the land-type classification established by the villagers during the focus group discussion. To ensure that women expressed themselves freely, men and women were divided into two different groups of four people each and each group was consulted separately.

The pebbles distribution method (PDM) or scoring exercise

The pebbles distribution method (PDM) or scoring exercise helps to assess the "importance" of biodiversity to people who rely on natural resources (Carol et al. 1999; Sheil et al. 2003). The method was used during two meetings, one with eight women and one with seven men (Photo 1).

Importance of the land types for use categories

To understand which types of land are valued for what kind of use, informants were asked to distribute 100 pebbles on illustrated cards, representing the different types of land units,

6 The different types of vegetation cover are refered to as landscape units or land-use units

Photo 1. Some of the men during the scoring exercise. (Photo by Edith Weihreter.)

Photo 2. Example of PDM: Importance of the land types regarding products for selling. (Photo by Edith Weihreter.)

according to their importance in terms of different resource-use categories. In order to facilitate understanding, the resource-use categories were also drawn on cards (Photo 2). A high number of pebbles placed on a card means that a high value is given to this land unit and vice versa.

Income

The PDM was also used to assess the value of each type of land use with regard to income. The participants were asked to place the pebbles on the land unit cards according to their relative importance with regard to income. The informers were asked to name income-generating products and species and their price.

Past–present–future

In a context of rapid land-use changes, it was important to enquire about changes in perception over time. The overall importance of the landscape units 30 years ago, now and in 20 years time was evaluated. The villagers were asked to distribute the pebbles on the cards for the present, the past and the future. The data was analyzed using Excel to produce graphs and facilitate visualization of the results.

2.2.3 Medicinal plant use

An additional study was conducted in order to gain knowledge about traditional plant use of the villagers. The choice of the key informants was restricted mainly to women, as men were not present in the village much during the daytime and social constrains forbade field excursions with one man only. Three men were questioned during expeditions in the forest. Among the six surveyed women were three key informants, who are acknowledged as experts in traditional healing practices. Ibu Maria (48 years old), the wife of the village chief Bapak Simon, is consulted by many villagers for all types of diseases. Nenek Lama and Nenek Bui (both around 70 years old) help women to give birth. The womens' home gardens were studied in detail as they plant medicinal plants close to their houses.

During daily field excursions, wild medicinal plants were gathered and conserved in ethanol. This herbarium collection enabled scientific identification of most of the species at CIFOR headquarters, Bogor[7]. The location, local name, use and route of administration were recorded for each plant. When a person became ill, the healing procedures used by Ibu Maria were observed and discussed with her.

2.2.4 Ecological analysis of the different land use units through tree diversity

In order to make the link between the resource management systems of the villagers and the forest environment, the tree diversity found in the different types of land-use areas was assessed. The following seven areas were studied: logged-over forest; fallows of 5, 15 and 30 years old; and three types of primary lowland forests: swamp forest, hill forest and the *kerangas* (Table 1). The focus group discussions, community maps and suggestions of the key informants enabled us to choose the study sites according to the different land and resource uses.

Data collection

For each land type, one plot enabled sampling of 0.2 ha of vegetation, using five small 20 m X 20 m subplots (Figure 5) per type (swamp, hill, *kerangas*, logged-over dipterocarp forest and the three age classes of fallows). Seven of these plots in the seven different land-use units were analyzed, which corresponds to a total area of 1.4 ha. Within the scope of another CoLUPSIA vegetation assessment in the swamp, hill and *kerangas* forests, 10 of these survey plots included

7 All scientific names of the collected medicinal plants and trees were verified using *The Plant List* (2010).

Table 1. Plot site description.

Land unit type	Local name	Mean altitude of plot sites (m)
Lowland swamp forest	*hutan rimba rawa*	75
Hill forest	*hutan rimba gunung*	300
Forest on sandy soil	*kerangas*	200
Logged-over forest	*hutan babas/sudah ditebang*	70
Fallows (5, 15 and 30 years old)	*bekas ladang*	70

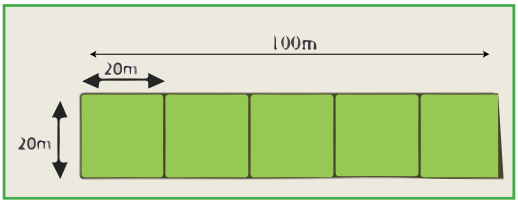

Figure 5. Setting of the 0.2 ha plots used in the fallows and logged-over forest.

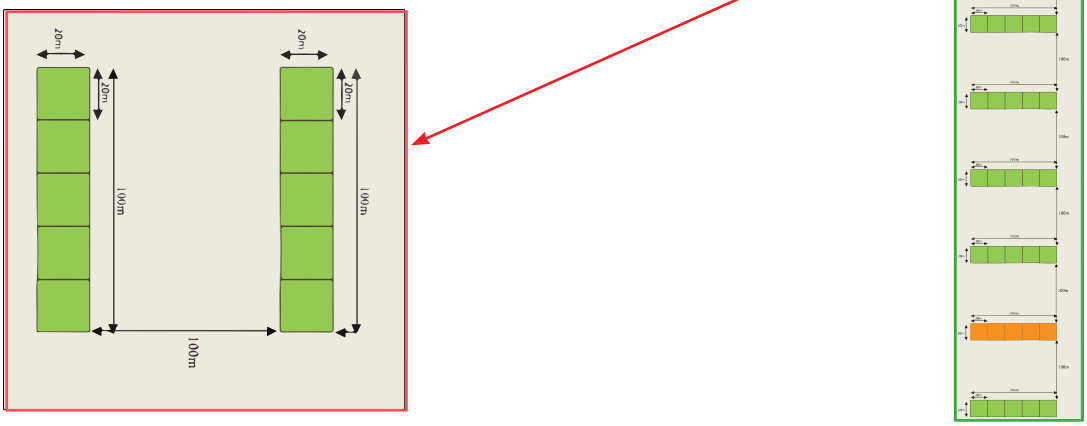

Figure 6. Zoom on 2 out of 10 plots laid in a row in the lowland hill forest as well as the *kerangas*. The orange plot symbolizes the plot which was randomly choosen for this study.

a total of 3 areas of 2 ha each. Between each of the 10 plots, a distance of 100 m was established (Figure 6). Out of these 10 plots, one data set of one plot was chosen randomly and used in this study, in order to compare the data from the swamp, hill and *kerangas* forests with the data sampled in the fallows and logged-over forest.

For each plot, leaf samples of each tree species were collected and their local name was recorded, which allowed scientific identification at CIFOR, Bogor. A field herbarium folder with dried leaves of each species was made to crosscheck every local name with the key informants in the village.

In each plot, the diameter at breast height (dbh) was measured 1.3 m from the ground or above trunk deformations, for each tree that had a diameter ≥ 10 cm. The dbh was measured using a diameter tape, which gives diameter values in centimetres. If the tree had a high buttress, ladders or lianas were used to climb the tree and measure the diameter above the buttress (Photos 3 and 4). As these are permanent plot sites, each tree was numbered with a metal plate. The point at which diameter measurement was taken was marked by painting the trunk with a white line (Photo 5).

Four local field assistants were hired. Bapak Endan and Bapak Ovit were excellent tree climbers and gathered the leaves for the specimen collection. Bapak Dobet was the most knowledgeable about tree species and Bapak Lombok helped with the establishment of the plots.

Photo 3. Bapak Endan and Lombok climb a tree with huge buttress for dbh measurement. (Photo by Edith Weihreter.)

Photo 4. Bapak Ovit climbs a liana to ensure dbh measurement above buttress. (Photo by Edith Weihreter.)

Photo 5. Number plates and white marks on sampled trees. (Photo by Edith Weihreter.)

Data analysis

- Overall species richness and distribution of dbh classes:
  - The total number of species per land unit is used as first indicator for overall species richness. In order to get an insight of the sizes of the trees in the different land units, the distribution of dbh was evaluated using the following six classes: 10–20cm, 20–40cm, 40–60cm, 60–80cm, 80–100cm, 100–185cm. These analyses were conducted using Microsoft Excel.
- The α-diversity value D using the Simpson Index (Simpson 1949):
  - The Simpson index λ is used to measure the strength of species' dominance for each vegetation type. λ has the following formula: $[\lambda = \sum n(n - 1)/N(N - 1)]$, where n is the total number of individuals of one species and N the total number of all individuals.
  - In order to represent the α-diversity[8] D found in each plot site, the formula $[D = 1 - \lambda]$ is applied, according to Sagar and Sharma (2012). The index D ranges from 0 to 1 and expresses the probability that two individuals randomly selected from a sample will belong to different species. If D = 0, there is no diversity, which means only one species is present, and if D = 1 the species' diversity is at its maximum.
- Importance value index (IVI):
  - IVI indicates the overall importance and dominance of a species in each plot site. It is calculated through summing the relative density (RDs) and the relative basal area (RBAs) of each species (Curtis and Cottam 1962) (see Table 2). It ranges from 0 to 200, and the larger the IVI, the more dominant a species is in the land unit. After calculations are completed, species are ranker from high to low IVI in order to compare the land units with each other.

2.3 Free listing of trees and medicinal plants

Data collection

In order to assess the knowledge about trees and medicinal plants of a broader spectrum of villagers, individual interviews were conducted. The people were asked to name 15 species of trees, to explain what kind of uses they had for them and where they usually found them. The same question was used to assess the

8 α-diversity refers to species diversity found on a local scale, here the plot sites, whereas β and γ-diversity refer to landscape and macro-scale (Whittaker et al. 2001)

Table 2. Calculations for the importance value index according to Curtis and Cottam (1962) and Hédl et al. (2009).

Relative density (RDs)	=	(Number of individuals of one species / total number of individuals) x 100
Relative basal area (RBAs)	=	(Total basal area for one species / total basal areas of all species) x 100 Where the individual tree basal area in m2 is: BAi = π(dbh/2)2 x 10 - 4
Importance value index (IVI)	=	RDs + RBAs

villagers' knowledge about medicinal plants, including the route of administration (Appendix 1). This approach provides us with an idea of what species is culturally important to a person (Borgatti and Halgin 1998) and what species the villagers know best or use generally most. The informants were randomly chosen among 10 men and 10 women. For each age class (< 30, 30–45, 45–60, >60 years old) 2 to 3 men as well as women were questioned, in order to represent all ages of the society.

Data analysis

The overall percentages of answers was calculated by summing the lists' lengths of each gender and topic group and dividing it by 150, which is the total number of possible answers (10 participants X 15 species each).

Using the program ANTROPAC (Borgatti, 1992) the difference in species quoted between the different gender and age groups was analyzed. ANTROPAC enables to calculate the Smith's index of salience (Smith S[9]). It highlights the psychologically or culturally important tree and medicinal plant species and differentiation in species choice and the degree of importance according to gender. Species with the greatest salience are those that respondents list the most often and tend to recall before other species (Borgatti and Halgin 1998). Smith S does not only put statistic weight on the rank of each species in the list, but also the overall length of each list (Balée 2010). Species that were named by at least two informants were considered and the 10 highest Smith S values for the men as well as the women lists analyzed were recorded.

9 For each species, Smith S = 1 - (Rs/Li), with Rs = rank of species on the list and Li = length of the respondent's list

3 Results

3.1 Activities, history and socioeconomic situation of Nanga Dua

The area has been inhabited for centuries, but the village was formally established in 1984, and currently has a population of 490 inhabitants. Due to an increased number of villagers, the traditional longhouse architecture was abandoned and people now live in individual houses, regrouped into one or more households (Photo 6). Access to the village is either by boat or through a former logging road by motorcycle. Travel time depends on rainfall. When it does not rain for a few days, most of the rivers and creeks become too low for navigation. When the rain is heavy the dust road becomes too muddy for motorcycling. Due to very high transportation costs[10], the inhabitants are relatively isolated. They rarely or never go to see a doctor for disease treatment or vaccination and rely mostly on traditional medicinal plant treatment.

Photo 6. Some houses of Nanga Dua. (Photo by Edith Weihreter.)

There are a few shops in the village with relatively expensive non-cultivated necessities such as soap, toothbrushes, petrol, etc. The village has a primary school with 75 children, aged from 6 to 13 years. From a socioeconomic survey conducted by the CoLUPSIA team in April 2012, it became evident that the educational level is generally very low and in many cases primary school is the only education that children receive.

Agriculture, fishing, hunting[11] and gathering is mainly done for subsidence. The villagers' agricultural system is based on annual swiddens. Traditional land tenure rights are family-based. New fields are opened every year using the slash-and-burn technique. Rotation is made on ancient fallows or on new soils that are cleared in primary forest. The detailed calendar of

		January	February	March	April	May	June	July	August	September	October	November	December
Swidden cultiavtion calendar	Rice harvesting												
	Clearing and cutting of new swidden site				Primary forest								
						Fallow 10 – 30 yrs old							
								Fallow 1 – 10 yrs old					
	Burning												
	Rice planting												
	Planting other plants												
	Weed control												
Other activities	Hunting												
	Gold-seeking												
	Rubber tree tapping	Dry days only						Dry season				Dry days only	
	Gathering firewood												
	Basketry												
	Gawai Dayak												

Figure 7. Calendar of swidden agriculture and other activities.

10 Petrol costs IDR 12,000/l, compared to IDR 4500/l in Jakarta. Travelling to Putussibau (next hospital) costs around IDR 1,000,000 IDR (~ € 86).

11 Men hunt using handmade rifles, and the gunpowder is made out of the wood of kayu tomau (*Syzygium cymosa*).

activities is given in Figure 7. Women help each other to clear the new fields in exchange for salary. Basketry is a frequent practice and people commonly use plaited baskets, bags, mats or fish traps (Appendix 2). Trading of these items is done among villagers.

Most income comes from gold mining, which is done throughout the year. It is a unstable source of money. Gold is exclusively extracted out of River Mentebah and forbidden on River Penungun and all creeks. Gold mining activity has largely destroyed the aquatic flora and fauna of River Mentebah, due to an increased amount of floating sediments (Photo 7). Mercury use to amalgamate the gold dust requires the consent of the people of the other villages close to the river, as locals living downstream fish and bathe in its water. Inhabitants of Nanga Dua use River Penungun for drinking, toileting, bathing and washing clothes.

Men gather *gaharu* in the forest, which is extracted from *Aquilaria microcarpa* (*gaharu bukit*) or *Aquilaria beccariana* (*gaharu pantai*) trees, to sell in the village or in nearby markets (Semangut or Mentebah). Due to time-consuming gold mining activities, only a few people grow and tap rubber trees. While women mostly work in the village, swiddens or gold-mining camps, men wander far out into the forest in order to hunt or gather *gaharu*. People commonly complained that the surrounding forests are "emptied" of animals, such as wild boar, birds or apes, and that prices for meat within the village steadily rise, as hunters have to walk further. All adult respondents agreed that when they were children, animals could be found in abundance close to the village, but now hunting pressure has drastically reduced their numbers.

3.2 Perception of the land use, landscape and species values

Focus group discussions

The villagers defined eight main types of land-use units (Figure 8) during the first meeting: primary swamp forest (*hutan rimba rawa*), primary hill forest (*hutan rimba gunung*), logged-over forest (*hutan babas*), "protected" forest (*hutan adat, tidak boleh ditebang*[12]), swidden (*ladang*), fallow (*bekas ladang*), rubber garden (*kebun karet*) and the rivers (*sungai*).

Hutan rimba is referred to as primary, "untouched", forest in English, although some trees might

Photo 7. River Penungun to the left and river Mentebah to the right, loaded with sediment. (Photo by Edith Weihreter.)

have been extracted by villagers 50 or more years ago. The primary swamp forest occupies small depressions at the foot of the hills, with a large number of small rivers and creeks. Thirty years ago, a Malaysian company selectively extracted trees out of the lowland forest, creating the logged-over or secondary forest and the earth road. Villagers also extract timber and wood on a much smaller scale for housing, mining camps or boat construction. Due to fear of erosion or because the soils are too nutrient poor for agriculture, villagers do not cut trees in certain areas. These "protected forests" correspond with zones covered by *kerangas* forests. Although the villagers seem not to include them as a distinctive land-use unit in their categorization of the landscapes, they recognize *kerangas* as a different forest type. Swiddens are agricultural fields cleared and planted with rice, vegetables, fruits and medicinal plants for one year, before a new field is opened. Fallows are old swiddens, which are left fallow for soil recovery for a certain amount of years. Once the farmers estimate that the soils are ready, which may take up to 30 years, fallows are converted to swiddens again or rubber gardens. The current rubber trees are still young, at around 1–15 years old. As rivers represent an important food (fish) and income (gold) source, they were also named as a main land-use type.

During the second meeting nine land-use categories (Figure 9) were registered. The list of important animal and plant products for each of these categories totaled 110 species, of which 74 were gathered in primary forest, 24 in the swiddens and 12 in fallows. Four different species of *gaharu* were, for example, named as marketable products (Appendix 3). In this section rubber was not mentioned by the villagers. The category containing the highest amount of species was: hunted wildlife (with 29 animals mentioned) followed by food and medicinal plants.

12 In English: forest you are not allowed to cut, according to traditional law (= *adat*)

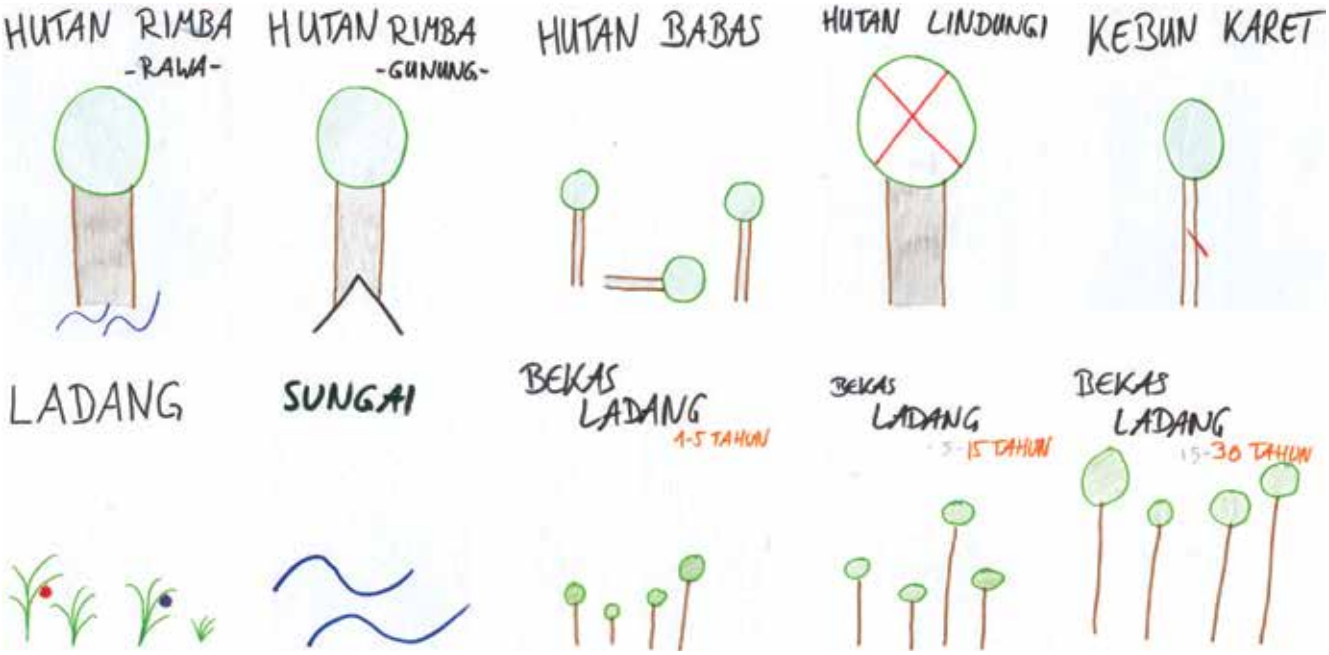

Figure 8. The eight land-use units established during the focus group discussion, cards used for the PDM. Here, fallows (*bekas ladang*) were differentiated according to their age (1–5, 5–15 or 15–30 years old).

Figure 9. The eight land-use categories established during the focus group discussion, cards used for the PDM.

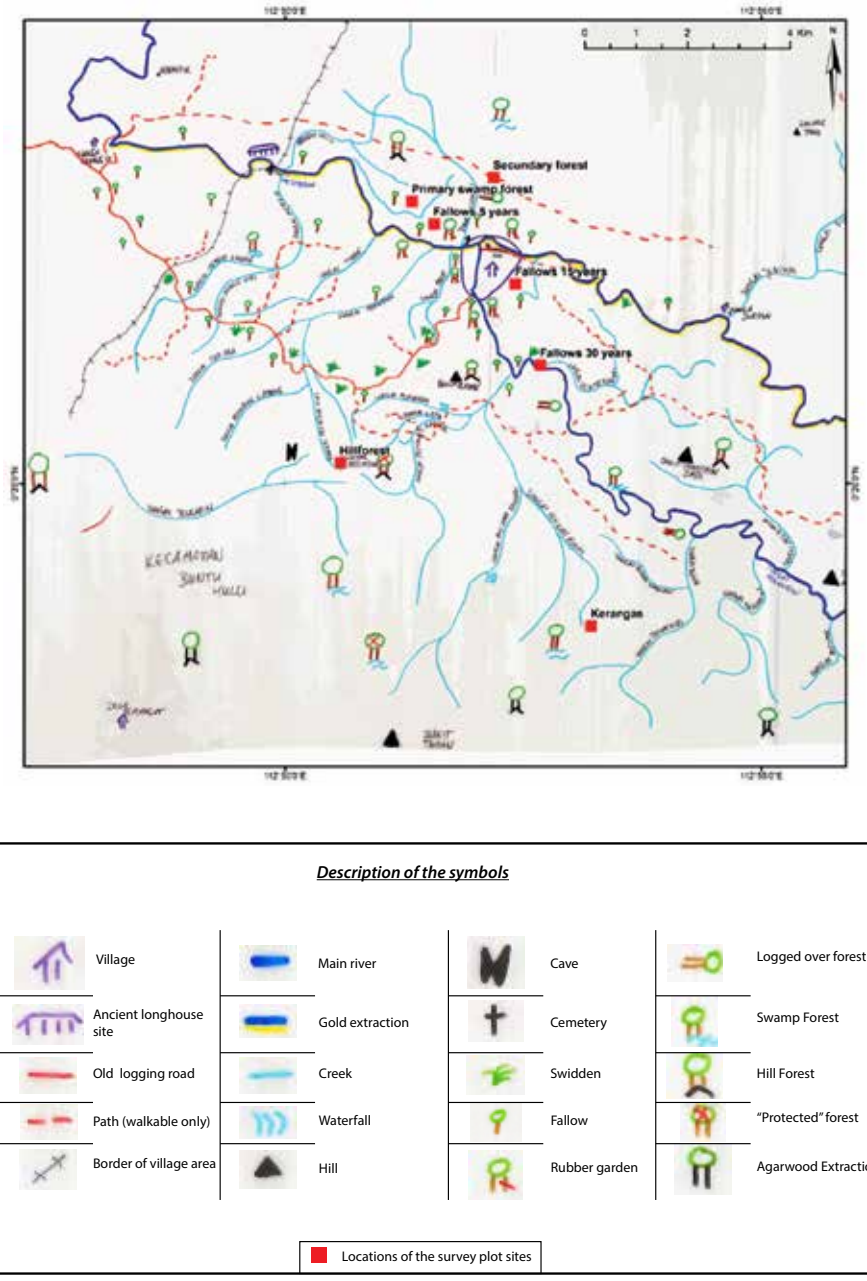

Figure 10. Map of the land types and land uses constructed by the men group.

Community landscape mapping

The men created a map that was more precise and correct in terms of distances and localizations then the women's map. The gap in territorial knowledge between men and women, highlighted through the participatory mapping process, reflects some of the realities of the women's world. Women do not have as much knowledge of the landscape as men as they spend more time in the village, while men wander far out into the forest, sometimes for months. This creates very different views of the environment.

The map established by the men (Figure 10) shows that the swiddens of this year were planted along the old logging road. The farthest field is a 3 hour walking distance (approximately 12 km) from the village, alongside the border of the village Nanga Payang area. This logging road is the only land connection to the district's road network, as it is the only path which is drivable by motorcycle. The main walking paths are included on the map; apart from these the forest has a dense network of small, temporary hunting paths. The fallows lie around the village and the two main rivers. The rubber gardens are close to the village and are easily accessible by boat. The territory has many small rivers and only some were incorporated into the map. Most of the area is occupied by hill forest. *Gaharu* is exclusively

gathered on Bukit Tuhan, the mountain range south of the territory, which contains mainly *Keranga* forests. It is accessible by boat and by walking through difficult and very steep terrain (1 or 2 days travel). The area contains one cave, inhabited by a small population (around 50 birds) of cave swiftlets (*Aerodramus fuciphagus*). The edible nests are not exploited by people of Nanga Dua, but exploitation rights are rented to people of Nanga Payang.

The red squares were added to the map later to indicate the location of the tree diversity survey plot sites.

PDM scoring exercices

Importance of the land types for use categories

Two graphs (Figure 11) represent the relative importance of the different land-use types for each land-use category, with respect to the data (Appendix 4) collected during the meetings. Generally, men tended to place either very large or very small amounts of pebbles on the land-use cards, while women distributed the pebbles more evenly. The importance men accorded to the different land-use types seems to be more contrasted. Both men and women expressed a preference using the pebbles for the hill forest, for all the use categories, except for fodder. Since it is forbidden to cut trees, the "protected" forest area falls into a less important category. The only use women had in this type of forest is for gathering medicinal plants and men used this forest for hunting. The rivers and swiddens were important for providing a food supply. Women found rubber gardens were also crucial in this category of use, while men negated this land type. Women seem also to have more use for swiddens, while men only thought of them as fodder and food sources, women gather fuelwood and medicines there.

A close-up look on the land-use category "medicinal plants" (Figure 12) reveals that women placed pebbles on the land types and men placed them

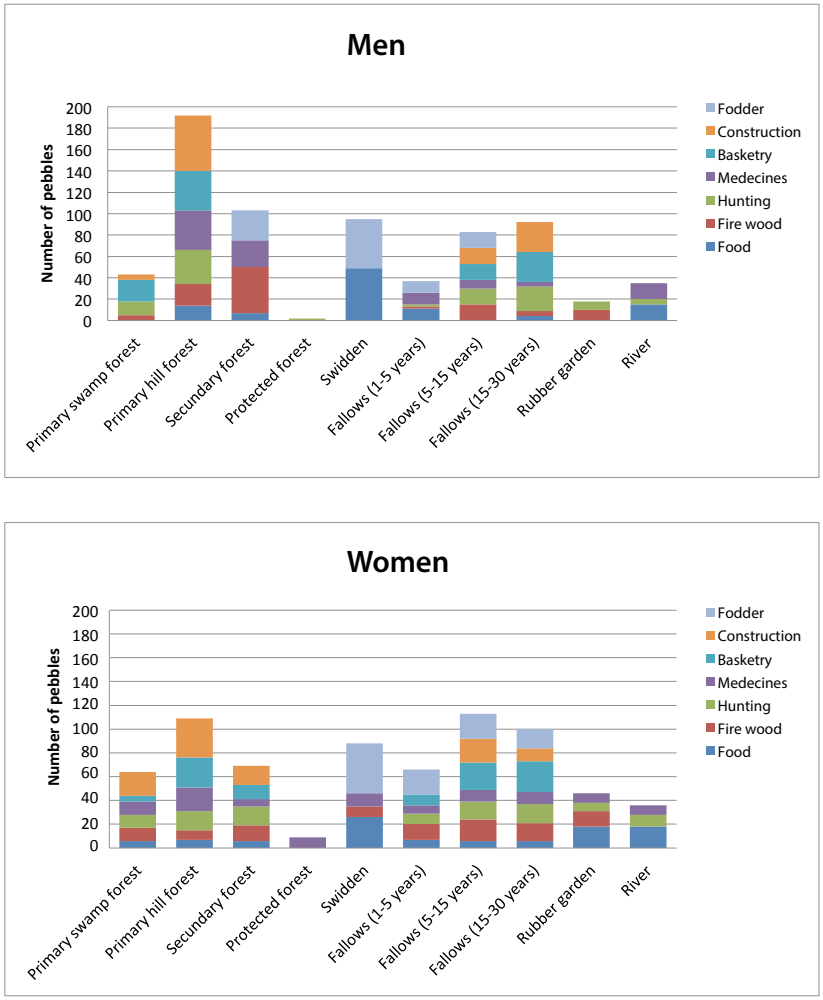

Figure 11. Importance of each land unit with regard to different use categories (men and women groups).

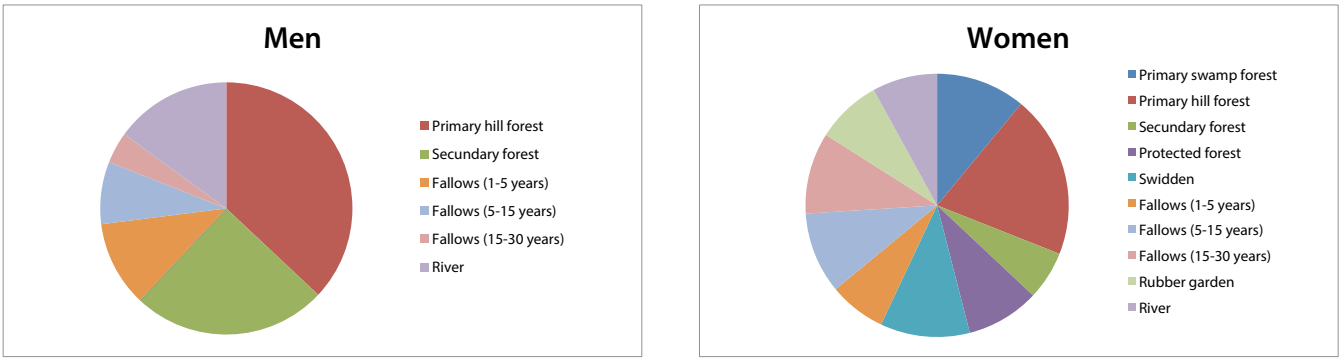

Figure 12. Importance of each land unit regarding medicinal plants (men and women).

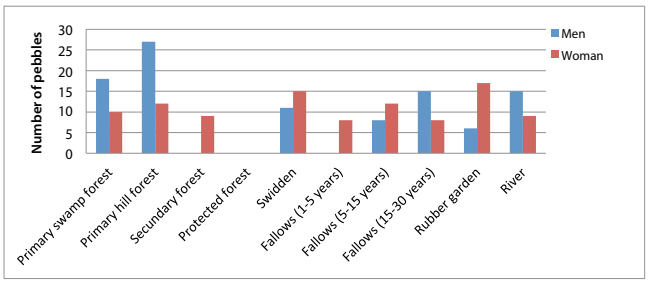

Figure 13. Importance of land-use types with regard to income.

on six different land types. Men argued that no medicinal plants are to be found in swamp forest, swiddens, rubber gardens and "protected" forests. Women recognized that medicinal plants are gathered in each land unit. It can be deduced that woman gather medicinal plants in more landscape units then men.

Income

While men placed a high value (Figure 13 and Appendix 5) on primary hill and swamp forest for their income, women found rubber gardens and swiddens more valuable. In contrast to women, men did not find secondary forests and fallows of 1–5 years old important for income. Both groups scored the "protected" forest as being not important to income.

Past–present–future

According to this PDM, there are perception changes over time (Figure 14 and Appendix 6). For the past and the present, men put a high number of pebbles on primary swamp and hill forests. They argued that their importance will drop, as these land types might disappear in the next 20 years. In the meantime, secondary forest and "protected" forests gain importance for the future. Men and women placed high scores on current rubber gardens, which seemed to have less importance in the past. Women argued that rubber gardens are crucial, as they can generate income and can be converted to swiddens. According to men, swiddens will lose their central role as food sources, as exploitable soils will be too far away from the village in the future.

3.3 Traditional medicinal plants and their uses

During this study 125 medicinal plants (Appendix 8) and 9 other types of remedies (Appendix 7) were recorded. The collection contains plants of 54 botanical families, of which 105 were identified to the species and 19 to the genus level. One plant remains unidentified. Ten plants that were given different names by the traditional healer, turned out to belong to 5 species only.

Medicinal uses for the plants collected were very broad. The plants could treat ailments such as stomach ache, headache, toothache, fever, and insect, snake or centipede bites; some were used in childbirth. The routes of administration and plant parts used varied. For 75 plants the leaves that contain the active ingredient, such as in tea made out of *kumis kucing* (*Orthosiphon aristatus*) leaves. The smoke of burned plant parts, for example the root of *Ilung asam* (*Schismatoglottis rupestris*) is used as a remedy "to chase Satan" out of the ill person or the house.

Beside the three key informants, only a few people could describe diseases in detail. Ibu Maria distinguished between, for example, three different types of headache. Plants were mostly used in combination; using one alone was rarely seen to be effective. For example, 12 different leaves were used

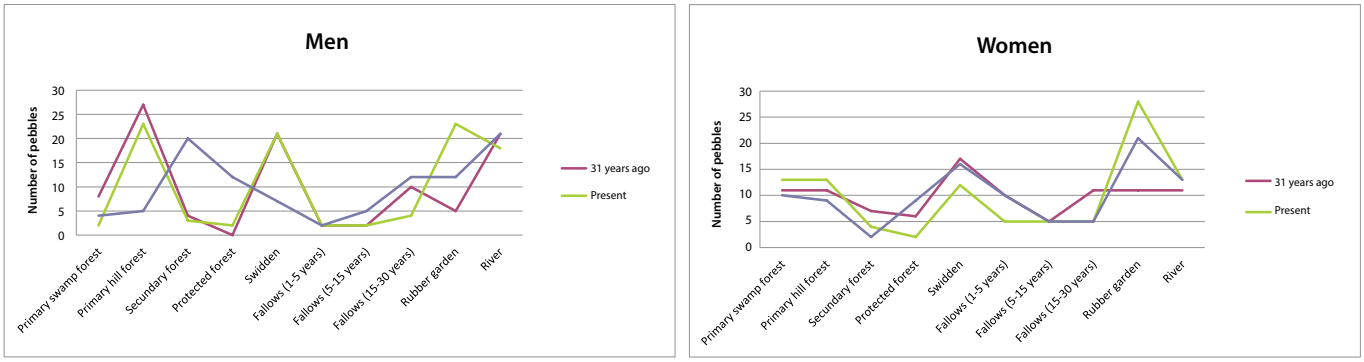

Figure 14. Change of perception in time, past–present–future (men and women groups).

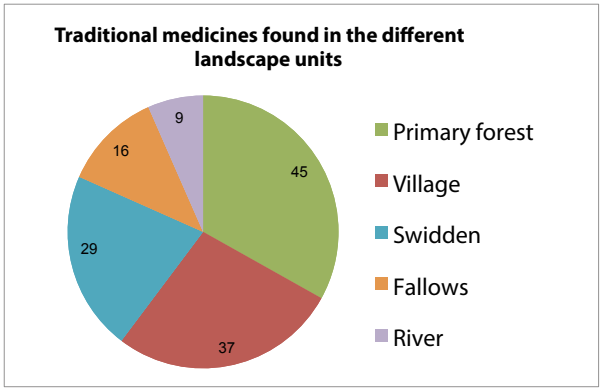

Figure 15. Proportions of the traditional medicines found in different landscape units.

to treat *meniali* abdominal pain (when the right side hurts). Some diseases require complex preparations and applications of plant mixtures that are the domain of specialists.

Out of the 136 natural medicines sampled, one third were collected in primary forest (Figure 15). Nearly half were collected in the immediate surroundings of the village and the swiddens. Some were found in the fallows and some on the riverbanks. This is not static data, as plants that are planted in the gardens may also be found in fallows. Furthermore, women grow plants that originate in the primary forest in their gardens or near their homes. Out of the 125 medicinal plants, only 38 were planted and 87 (nearly 70%) grew naturally in the wild.

3.4 Ecological analysis

The quantity and size (dbh) of trees in the different landscape units shows differences for each 0.2 ha plot (Table 3). The highest density of trees, having a dbh over 10 cm, is to be found in the young 5-year-old fallow (197 trees), followed by the *kerangas* forest (173 trees), the 15- year-old fallow (162 trees), the 30-year-old fallow (147 trees) and the secondary forest (130 trees). The lowest numbers of tree individuals are in the primary hill (103 trees) and swamp forests (99 trees). There is a difference of nearly 100 trees, between the young fallow and the primary swamp forest. Hill, swamp and secondary forests have relatively few small

Table 3. The dbh classes and the total amount of trees per land unit (in each plot of 20 x 100 m).

Land units	Dbh classes						Total number of trees/0.2 ha
	[10–20cm]	[20–40cm]	[40–60cm]	[60–80cm]	[80–100cm]	[100–185cm]	
5 year–old fallow	173	24					197
15 year-old fallow	99	62	1				162
30 year-old fallow	100	42	5				147
secondary forest	75	41	10	3		1	130
kerangas	107	58	7	1			173
hill forest	55	31	12	4	1		103
swamp forest	56	33	5	1	1	3	99

trees (dbh up to 20 cm) and the 5-year-old fallow has a large number of small trees. In contrast, big trees of over 60 cm of dbh are only found in the hill, swamp and secondary forest plots. The fallows and Kerangas have a higher amount of small trees, in larger quantities, whereas the primary hill and swamp forests have a smaller number of trees, but with some very large ones. The swamp forest contained some huge trees of nearly 2 m in dbh. The secondary forest, which was selectively logged over 30 years ago, has fewer individual trees than the 30-year-old fallow but has some large individual trees.

The *kerangas* are distinctive land types, which have sandy soils. The superficial roots are very obvious. The poverty of the soil is indicated by the presence of carnivorous plants such as *Nepenthes* spp. Poor and shallow soils do not allow the trees to grow tall and large, hence there is a high number of small trees in this area.

Table 4. Diversity index D = 1 - λ calculated through the Simpson index λ

Land unit	Total number of species	Diversity index D = 1 - λ
primary swamp forest	36	0.96
primary hill forest	36	0.92
kerangas	36	0.94
secondary forest	41	0.94
fallow 30 years	31	0.77
fallow 15 years	25	0.88
fallow 5 years	29	0.90

The Simpson index (Table 4, Appendix 9) shows that in terms of tree species richness, the swamp

Table 5. The 10 most salient trees and medicinal plants for women and men, according to their frequency (freq.) and their average rank (aver. rank) on the free lists.

Women_trees				Men_trees			
Local name	**Smith s**	**Freq.**	**Aver. Rank**	**Local name**	**Smith s**	**Freq.**	**Aver.Rank**
Nanka	0.33	6	7.67	*Benuah*	0.29	4	5.25
Mangga	0.28	4	5.5	*Mangga*	0.28	4	5.5
Tebedak	0.28	4	5.5	*Belian*	0.27	5	7.8
Pinang	0.21	3	5.33	*Durian*	0.27	3	2.67
Klotok	0.19	2	1.5	*Simpat_pinang*	0.25	3	3.33
Rotan	0.19	2	1.5	*Lensat*	0.23	3	4.33
Rambutan	0.17	2	3	*Tomau*	0.21	3	5.33
Leban	0.17	4	9.75	*Lengkeng*	0.19	3	6.33
Durian	0.17	3	7.67	*Empakan*	0.18	3	7
Tomau	0.17	3	7.67	*Embak*	0.17	3	6.67

Women_medicinal plants				Men_medicinal plants			
Local name	**Smith s**	**Freq.**	**Aver. Rank**	**Local name**	**Smith s**	**Freq.**	**Aver. Rank**
Sirih	0.29	5	5.4	*Juaran*	0.39	4	4.00
Jambu_biji	0.23	3	4.33	*Sabang*	0.37	3	1.33
Kunyit	0.19	3	5.33	*Kunyit*	0.35	4	5.50
Sabang	0.17	2	2.5	*Akar_kuning*	0.34	4	3.75
Juaran	0.17	3	7.33	*Entemu*	0.32	4	5.75
Tabar	0.16	2	4	*Tampal*	0.31	4	4.00
Bungur	0.15	2	4.5	*Kumis_kucing*	0.24	3	5.67
Parap	0.15	2	5	*Enke_hidup*	0.16	2	3.50
Serai	0.14	2	4.5	*Tangkai_hidup*	0.15	2	5.00
Salam	0.12	2	5.5	*Belaban_merah*	0.13	2	8.00

forest is close to the maximum, with D = 0.96, followed by the *kerangas* and logged-over forest (both D = 0.94). The hill forest has a D = 0.92, which is slightly higher than the 5-year-old fallows, where D = 0.90. The diversity index drops for older fallows: the 15-year-old fallow has a D of 0.88 and the 30-year-old has the lowest index at D= 0.77.

In terms of IVI, the *kerangas*, swamp and hill forests contain at least three species of the Dipterocarpaceae family, mainly of the genus *Shorea*, among their dominant species. They are not dominant in human-caused successional forests. The swamp forest can support trees that are dominant due to their huge basal area such as individuals of *Koompassia malaccensis* or *Alstonia angustiloba*. The pioneer species *Bellucia pentamera*, *Macaranga hosei* and *Ficus variegata* are dominant in all the fallows.

3.5 Free lists of trees and medicinal plants

The indexes of salience, Smith S, indicate differences in trees and medicinal plants cited by men and by women (Table 5). *Mangga*, *durian* and *tomau* were among the most prevalent and first mentioned trees for both groups. Three medicinal plants, *juaran*, *sabang* and *kunyit*, seemed to be important to the whole community. Nearly all of the people questioned listed 15 out of the 15 trees (93% of answers for the women and 96% for the men). Half of the named trees were used for their fruits and one third of them were used for house construction. The free lists of medicinal plants were hard to establish for most of the men who were surveyed. While women named 80% of the plants in the lists, men had shorter lists, with only 60% of answers. A small number of men displayed an in-depth knowledge of medicinal plants, their preparations and routes of administration.

4 Discussion

Overall, the lack of fluency in the local language and in Indonesian by the author was a barrier to the field research, especially at the beginning.

4.1 Gender-related observations

Central observations in this study were differences in perceptions between men and women. As observed in other Dayak communities (Gönner 2000; Mulyoutami et al. 2009), some tasks were exclusively the men's or the women's domain, although there was a large amount of common labor. Men were underrepresented in this study, especially during the focus group discussions and the survey of medicinal plants. First, they were mostly away during the 3-month study period and second because for me, as a women, contact with men was time consuming to organize and delicate to establish. Nevertheless, the results of the free lists and the PDM, combined with the villagers' opinions, imply that medicinal plant knowledge is generally more of a women's domain, even if some men had profound knowledge of it. According to Caniago and Siebert (1998), Dayak women in rural Kalimantan usually have deeper knowledge of medicinal plants, as it is they who mostly care for their children's health and manage their gardens.

4.2 Medicinal plant listing

Traditional medicine is an integral part of the health system in this area, for financial reasons, because of lack of alternatives and because of its efficiency. The relative isolation of Nanga Dua probably supports the use of medicinal plants and the perpetuation of this knowledge down the generations. The collection of medicinal plants gives us a first insight into this traditional custom. Meanwhile, comparing each sampled plant with bibliographic references, would deepen the analysis of the medicinal plants and the knowledge about them. For example *jambu air* (*Senna alata*), which is used to relieve 'itchy skin' has been proven to have antifungal properties according to Sule et al. (2011).

4.3 Participatory mapping

For the participatory mapping process, the map lacks accuracy and should be considered as a first draft that provides an overview of the area. The participants were unable to draw boundaries of the different land-use units. Furthermore, only four men and four women participants were present for the mapping procedure, and this does not represent the community as a whole. More GPS data from the field, with active participation of the local population would give a more reliable map (Bujang 2004). Maps are an important tool to empower people who rely on land established through customary institutions and local stakeholders should be included in spatial planning (Kurniawan and Hanafi 2004).

4.4 The free listing method

Due to lack of time, not all the trees and medicinal plants named in the free lists were sampled. This analysis is therefore based on local names and not on scientific names. It would have been more valuable from an ethnobotanic perspective to do a more detailed study. Instead of asking the informants to name trees and their uses, it would have been better to make a list for each use category, e.g. one list for tree species used for house construction (Quinlan 2005). Furthermore, as the salience index S takes into account the length of the lists, open listing (not restricted to 15 answers only) would have been more relevant. Moreover, data is generally statistically reliable counting from a minimum of 30 lists per topic (Borgatti and Halgin 1998).

In addition, it was observed that some respondents struggled to do this exercise. Indeed, people generally do not think theoretically about trees and medicinal plants. For instance, one 70-year-old woman could not list 15 medicinal plants while sitting in her house, but when she looked for plants for specific diseases or walks in the surrounding area she knew many plants and was consulted by the villagers because of her knowledge. Field interviews seem in this case to be more appropriate. Hence, the free listings approach is not a deep evaluation of the community's knowledge about tree and medicinal plant uses, but is seen as a first approach.

4.5 Ecological analysis

Vegetation cover in this area is mainly a forest mosaic of different types of vegetation, influenced to different degrees by human activities. In such a mosaic, especially for secondary regrowth, the problem of representativeness of the sampling is an issue (Wagner et al. 2000). A plot sample size of 0.2 ha appears large enough to characterize fallows, but it may not be statistically reliable in large forest areas. For the dipterocarp forests Ashton (1964) used plot sizes of 0.4 ha, but more recent studies sample 1 ha plots (Poulsen et al. 1996; Small et al. 2004). Some authors suggest use of much larger plots (Laumonier et al. 2010) and the CoLUPSIA project is establishing permanent plots of between 2 ha and 6 ha.

Due to lack of time, not all tree leaves were sampled, but only one per local name for each plot. The local classification does not always coincide with scientific classification. This led to a few mistakes, for example trees which had the same local name but different Latin names. For scientific correctness, each single tree should have been sampled.

The secondary forests and young fallows have high tree diversity indexes. The fact that forest disturbance for traditional slash-and-burn agriculture is done on a small-scale and in the immediate vicinity of primary forest, which serves as species reservoir (Mo et al. 2011), enables fast and tree-species-rich forest regeneration.

4.6 The *Kerangas*

The villagers did not include the *kerangas* as a distinctive land use in their categorization of the landscape, even if they did recognize this type of forest. This is because apart from *gaharu* gathering and sporadic hunting, the villagers do not use this forest type for agriculture. The *kerangas* forests are especially sensitive to disturbance, such as clear cutting or fire, as they grow on shallow, dry, sandy soils (Dennis 1999). According to Meijaard et al. (2005) the *kerangas* forest areas are unable to recover and produce any valuable vegetation after the trees have been cut. The villagers are aware of that, as they categorized this type of vegetation as forest that is protected from cutting through customary law. One other reason is that there were mostly women present during the focus group discussions about land uses. Women do not look for *gaharu* or hunt, so it might not seem an important land-use feature to them as they rarely enter the *kerangas*.

4.7 The role of vulnerable forestry resources

During my stay in the village and through the participatory surveys it became evident that the inhabitants of Nanga Dua Village use a broad variety of forest products on a daily basis. Rubber tree tapping is likely to become a more important resource in the future, once the trees are old enough. Local people seemed to be aware of the vulnerability of their forestry resources. The scoring exercises showed that primary forest was seen by local people as at risk of disappearing in the future and represents an important source of resources, such as food, handicrafts, and house and boat construction material. Primary swamp and hill forest play a crucial role as sources of income. As local people use medicinal plants to treat common ailments and illnesses, degradation of the forest may imply a loss of their healthcare options (Shanley and Luz 2003). This research highlights that the majority of medicinal plants originate from the primary forest, either through direct extraction or through selected planting of species gathered there. The fact that villagers observe that wild animals are becoming scarcer raises more questions. Wild animal resource management is not sustainable. A broad spectrum of species are hunted locally, some of which have lower populations and are protected by national law, such as the sun bear (*Helarctos malayanus*), which is classed as vulnerable on the IUCN Red List (Fredriksson et al. 2008) or the Sunda pangolin (*Manis javanica*), which is classed as endangered (Duckworth et al. 2008). It is important to study in detail these aspects of sustainable natural resource management and support the local community in order to ensure the lasting presence of wildlife. The scarcity of wildlife may be connected to the absence of fruit during the survey period. A stay of 3 months is not long enough to fully understand people's resource management issues, especially as it depends on seasonal rain variations.

5 Conclusion

This study brings new insights on a Dayak Mentebah community and the ways they perceive and use their environment.

The communities of Nanga Dua and neighboring villages are dependent on forestry resources. Despite the economic incomes earned through gold mining along rivers, people still rely on hunting and gathering; and on the fruits, vegetables and rice from their swiddens. Forest products are widely used for basketry, construction of houses or boats, fuelwood and food. The participatory surveys show that primary swamp and hill forest are important reservoirs of resources and that the people of Nanga Dua rely on them and know how to use them.

The traditional, consecutive land clearing for shifting cultivation in this area causes the formation of vegetation patches with different succession stages. These human-modified areas, which are mixtures of secondary regrowth and gardens are very rich biologically. Exploitation is on a small-scale and the swidden agriculture is embedded into the surrounding primary forest landscape, which explains the high diversity of tree species in the different land-use types. The secondary forest and young fallows have an important conservation value. Hill *kerangas* forests, where sporadic hunting and *gaharu* gathering is practiced, are protected from timber extraction by traditional law.

Traditional medicine remains an integral part of the health system in the area. Local people have remarkable knowledge of species and their uses as remedies. The relatively isolated location of the village probably sustains the traditional lifestyle. Meanwhile, socioeconomic, traditional and ecological settings are changing fast. People hope that the old logging road will be restored, which would give better access to the district's road network. Through this, access to better healthcare options and to other economic activities would become possible.

However, the opinions and needs of local people should be considered for any development project on their land. The rights to own and decide upon their ancestral lands have to be respected, in order to protect the rich cultural and natural heritage of the region.

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Appendices

Appendix 1. Two data sheet examples for the 60 free lists of species of medicinal plants and trees

Medicinal plants:

Gender/age informant: Bapak Simon (50 years)				
Local name	**Use**	**Plant part**	**Procedure**	**Location**
Pasak bumi	Fever	Leave	Drink tea	Forest/fallows
Akar kuning	Fever	Leave	Drink tea	Forest/fallows
Kayu semulang	Defecate blood, abdominal pain	Leave	Drink tea	Fallows
Kulit senkuang	Stomach ache	Leave	Drink tea	River
Rumput langau	Period too long	Leave	Rub on body	Village
Kenjin jawa	Abdominal pain	Fruit	Cook and eat	Forest
Rumput pelir kambing	Fever, stomach ache	Leave	Compress	Forest/fallows
Patampal	Itchy wound	Leave	Compress	Swidden
Jenung	Centipede bite	Leave	Compress	Swidden
Parapapi	Fever	Root	Drink tea	Fallows
Rumput badi kalui	Stomach ache	Leave	Compress	Swidden
Rumput sumpit hantu	Body ache	Leave	Compress	Forest
Rumput belanda	Wound	Leave	Compress	Village
Jambu air	Stomach ache	Leave	Drink tea	River
Bengkal	Fever, stomach ache	Leave	Drink tea	River

Trees:

Gender/age informant: Ibu Maria (48 years)		
Local name	**Use**	**Location**
Belian	House, boat construction	Forest
Benuah	House construction	Forest
Meranti	House construction	Forest
Simpak pinang	House construction	Forest
Pelaik	House construction	Forest
Durian	Fruit	Forest/Swidden
Tenkawang	Fruit	Forest
Sikup	Fruit	Fallows
Kempas	House construction	Forest
Bedaru	House construction	Forest
Linang	Fruit	Forest
Tapang	Honeybee tree	Forest
Kemarawang	House construction	Forest
Kayu garu	Oil	Forest
Damar	Sap	Forest

Appendix 2. Basketry

Some traditional basketry uses (Photos: E.Weihreter)

Ibu Tuman making a basket used for fishing

Different types of baskets

Mats used for drying rice in the sun

Ibu Sodak creates a hat, named Tangui, using peropok and rattant

A fish trap made out of rattan

Appendix 3. Important species for each use category

Use category	Important species	
	Local name	**Location**
Hunting	*Babi hutan*	Primary forest
Berburu	*Rusa*	Primary forest
	Kidjang	Primary forest
	Kancil	Primary forest
	Munsang	Primary forest
	Biawa	Primary forest
	Beruang	Primary forest
	Monyet kopuhan	Primary forest
	Monyet kopo	Primary forest
	Monyet kelasi	Primary forest
	Monyet kera	Primary forest
	Monyet empiau	Primary forest
	Getang prahu	Primary forest
	Mpisi	Primary forest
	Landak	Primary forest
	Lanki	Primary forest
	Berumtok	Primary forest
	Memar	Primary forest
	Enkuli	Primary forest
	Kubong	Primary forest
	Ribu	Primary forest
	Tengilin	Primary forest
	Poncin	Primary forest
	Tupai	Primary forest
	Burung tingan	Primary forest
	Burung tajak	Primary forest
	Burung totoh	Primary forest
	Burung kuko	Primary forest
	Didit	Primary forest
Basketry	*Perupuk*	Fallows
Anyaman	*Rassau*	Primary forest
	Kaseipu	Primary forest
	Rottan	Primary forest
	Enkodjak	Primary forest
	Sengang	Fallows
	Mujan	Primary forest
	Bamboo	Swidden

Use category	Important species	
	Local name	**Location**
Food	*Tebu*	Swidden
Makanan	*Padi*	Swidden
	Ubi jalar	Swidden
	Jagung	Swidden
	Ubi Rambat	Swidden
	Singkong (Ubi kayu)	Swidden
	Terong	Swidden
	Keladi	Swidden
	Mentimon	Swidden
	Cabe	Swidden
	Sawi	Swidden
	Gambas	Swidden
	Punjat	Swidden
	Jahe	Swidden
	Labu	Swidden
	Perengi	Swidden
	Durian	Swidden
	Pisang	Swidden
	Mangga	Swidden
Medicinal plants	*Sandu*	Primary forest
	Lukai	Primary forest
Tanaman obat	*Muar*	Primary forest
	Pata issao	Primary forest
	Senkai	Primary forest
	Onang-onang	Primary forest
	Sedeni akar	Primary forest
	Parapapi	Primary forest
	Akar kuning	Primary forest
	Ilung	Primary forest
	Situ utcin	Primary forest
	Akar perlulu	Primary forest
	Empilak merah	Primary forest
	Akar lakup	Fallows
	Tengedak merah	Primary forest
	Kayu mancut	Fallows
	Jenis rumput	Fallows

Use category	Important species	
	Local name	**Location**
Fire wood	*Lebatn*	Fallows
Kayu bakar	*Mehinai*	Fallows
	Mandin	Fallows
	Itap	Fallows
	Timau	Fallows
	Pelampai	Fallows
	Enkunit	Primary forest
	Kerecis	Primary forest
	Kumpang	Primary forest
	Ponjang	Primary forest
	Habai	Primary forest
	Tekujong	Primary forest
Fodder	*Selinkat*	Fallows
Makanan ternak	*Padi*	Swidden
	Jagung	Swidden
	Singkong	Swidden
Marketable products	*Gaharu*	Primary forest
	Gaharu ranci	Primary forest
Produk untuk dijual	*Gaharu buaya*	Primary forest
	Gaharu Ntamban	Primary forest
	Kayu badaru	Primary forest
	Kayu menuah	Primary forest
	Kayu Belian	Primary forest
	Kayu tenkawang	Primary forest
	Kayu menhirai	Primary forest
	Kayu buabuahan	Primary forest
Ornaments	*Bamboo*	Swidden
Hiasan, adat	*Rottan*	Primary forest
	Daun samir	Primary forest
	Daun kelapa	Primary forest
	Daun pinang	Primary forest
	Rassau	Primary forest
Construction	*Tekam*	Primary forest
Konstruksi	*Belian*	Primary forest
	Meranti	Primary forest
	Tomau	Primary forest
	Menuah	Primary forest

Appendix 4. Data sheet for the pdm: Importance of each land unit for the use categories

MEN	**Food** *Makanan*	**Fire wood** *Kayu bakar*	**Hunting** *Berburu*	**Medicines** *Obat-obatan*	**Basketry** *Anyaman*	**Construction** *Konstruksi*	**Fodder** *Makanan ternak*
Primary swamp forest *Hutan rimba rawa*	0	5	13	0	20	5	0
Primary hill forest *Hutan rimba gunung*	14	20	32	37	37	52	0
Secundary forest *Hutan babas*	7	43	0	25	0	0	28
Protected forest *Hutan adat*	0	0	2	0	0	0	0
Swidden *Ladang*	49	0	0	0	0	0	46
Fallows (1–5 years) *Bekas ladang*	11	2	2	11	0	0	11
Fallows (5–15 years) *Bekas ladang*	0	15	15	8	15	15	15
Fallows (15–30 years) *Bekas ladang*	4	5	23	4	28	28	0
Rubber garden *Kebun karet*	0	10	8	0	0	0	0
River *Sungai*	15	0	5	15	0	0	0
Total use per category	100	100	100	100	100	100	100

WOMEN	**Food** *Makanan*	**Fire wood** *Kayu bakar*	**Hunting** *Berburu*	**Medicines** *Obat-obatan*	**Basketry** *Anyaman*	**Construction** *Konstruksi*	**Fodder** *Makanan ternak*
Primary swamp forest *Hutan rimba rawa*	6	11	11	11	5	20	0
Primary hill forest *Hutan rimba gunung*	7	8	16	20	25	33	0
Secundary forest *Hutan babas*	6	13	16	6	12	16	0
Protected forest *Hutan adat*	0	0	0	9	0	0	0
Swidden *Ladang*	26	9	0	11	0	0	42
Fallows (1–5 years) *Bekas ladang*	7	13	9	7	9	0	21
Fallows (5–15 years) *Bekas ladang*	6	18	15	10	23	20	21
Fallows (15–30 years) *Bekas ladang*	6	15	16	10	26	11	16
Rubber garden *Kebun karet*	18	13	7	8	0	0	0
River *Sungai*	18	0	10	8	0	0	0
Total use per category	100	100	100	100	100	100	100

Appendix 5. Data sheet for the PDM: Source of income

	Total PDM			Important ressources	Price IDR	Euro
	Men	Women	Total			
Primary swamp forest *Hutan rimba rawa*	18	10	28	• *Gaharu/ gaharu buaya* (resin) • Plants for basketry: hats, baskets, traps etc. • Wood (e.g. tomau)	• 10,000–60,000/kg • 25,000–75,000/piece • 300,000–1,000,000/tree	• 0.8–5 • 2–6 • 24 - 80
Primary hill forest *Hutan rimba gunung*	27	12	39	• Wood (e.g. tekam) • Plants for basketry	• 300,000–1,000,000/tree • 25,000–75,000/piece	• 24–80 • 2–6
Secondary forest *Hutan babas*	0	9	9	• Wood (e.g. meranti)	• 300,000–1,000,000/tree	• 24–80
Protected forest *Hutan lindungi*	0	0	0	-	-	-
Swidden *Ladang*	11	15	26	• Rice and vegetables	• 5,000–12,000/kg	• 0,4–1
Fallows (1–5 years) *Bekas ladang*	0	8	8	• Vegetables	• 5,000/kg–12,000/kg	• 0.4–1
Fallows (5–15 years) *Bekas ladang*	8	12	20	• Firewood • Plants for basketry	• 5,000/basket • 25,000–75,000/piece	• 0.4
Fallows (15–30 years) *Bekas ladang*	15	8	23	• Wood (e.g. belantik) • Plants for basketry	• 300,000–1,000,000/tree • 25,000–75,000/piece	• 24–80 • 2–6
Rubber garden *Kebun karet*	6	17	23	• Rubber	• 5,000–10,000/kg	• 0.4–0,8
River *Sungai*	15	9	24	• Fish • Sandstone • Gold	• 30,000/kg • 8,000/m^3 • 500,000/g	• 2.4 • 0.7 • 42.6

Appendix 6. Data Sheet for the PDM: Past present future

MEN	**Present** *Sekarang*	**30 years ago** *30 tahun yang lalu*	**20 years from now** *20 tahun yang akan datang*
Primary swamp forest *Hutan rimba rawa*	2	8	4
Primary hill forest *Hutan rimba gunung*	23	27	5
Secondary forest *Hutan babas*	3	4	20
Protected forest *Hutan adat*	2	0	12
Swidden *Ladang*	21	21	7
Fallows (1–5 years) *Bekas ladang*	2	2	2
Fallows (5–15 years) *Bekas ladang*	2	2	5
Fallows (15–30 years) *Bekas ladang*	4	10	12
Rubber garden *Kebun karet*	23	5	12
River *Sungai*	18	21	21
Total use per category	100	100	100

WOMEN	**Present** *Sekarang*	**30 years ago** *30 tahun yang lalu*	**20 years from now** *20 tahun yang akan datang*
Primary swamp forest *Hutan rimba rawa*	13	11	10
Primary hill forest *Hutan rimba gunung*	13	11	9
Secondary forest *Hutan babas*	4	7	2
Protected forest *Hutan adat*	2	6	9
Swidden *Ladang*	12	17	16
Fallows (1-5 years) *Bekas ladang*	5	10	10
Fallows (5-15 years) *Bekas ladang*	5	5	5
Fallows (15-30 years) *Bekas ladang*	5	11	5
Rubber garden *Kebun karet*	28	11	21
River *Sungai*	13	11	13
Total use per category	100	100	100

Appendix 7. The nine remedies other then plants

Local name	Use	What part	Procedure
Kulat mangkut (*Auricularia* sp.)	Urinary pain	Mushroom	Eat
Kulat badung	Fever, malaria	Mushroom	Cook and rub against belly
Kulat pahunan	Chase Satan	Mushroom	Eat, drink tea or use smoke
Kujung tuntung	Chase Satan	Snail shell	Eat mixed with meat
Kapur	Toothache	Riversnail shell	Chew and spit out
Burung hiram	Nose bleeding	Birdsnest	Cook and make compress
Kancil (*Tragulus javanicus)*	Childgiving	Embryo	Eat
Senengir (*Cicadoidea* sp.)	Baby cries at late afternoon	Exoskeleton of cicada	Burn and let baby breath smoke
Burung tajak (*Bucerotidae* sp.)	Headache	Skull of bird, blackened in fire 	Rub with knife particles from the skull, mix with water and put on head

Appendix 8. List of the 125 medicinal plants, with their local name, scientific name, use, part used, route of administration, location and planting (N=not planted, Y=planted)

Local name	Family	Genus	Species	Author	Use	Plant part	Procedure	Location	Planted
Akar batuk ontis	Vitaceae	*Vitis*	sp.		Cough	Leave	Attach compress on throat	Primary forest/ fallows	N
Akar kepati	Rubiaceae	*Hemidiodea*	*atimifolia**	*Shum.*	Abdominal pain	Leave	Compress on belly or drink tea	Village	N
Akar kuning	Menispermaceae	*Fibraurea*	*tinctoria*	*Lour.*	Malaria, jaundice, rheumatic pains	Root	Boil in water and wash body	Primary forest	N
Akar leburlaling	Vitaceae	*Vitis*	*papillosa*	*Backer*	Fever	Root	Boil in water and wash body or mash and put on forehead	Garden	Y
Akar pujut	Orchidaceae	*Agrostophyllum*	sp.		Jaundice, fever	Leave	Boil in water and wash body	Primary forest	N
Akar punan	Vitaceae	*Ampelocissus*	*thyrsiflora*	*Planch*	Wound	Root	Compress on wound	Primary forest/ fallows	N
Akar rejan	Lamiaceae	*Leucas*	*lavandulifolia*	Sm.	Defecate blood	Root	Drink tea or eat	Village/ garden/ fallows	N
Anti	Apocynaceae	*Hoya*	*diversifolia**	*Bl.*	Fever, jaundice, stomach ache (bloating)	Whole plant	Compress on temples	Primary forest	N
Api	Rubiaceae	*Coptophyllum*	*fulvum*	*Bakh.f.*	Drop body heat	Leave	Compress	River	N
Badi kalui ♀	Amaranthaceae	*Amaranthus*	sp.		Nausea, stiffness, stomach ache	Root and leave	Boil in water and wash body	River	N
Banar	Smilacaceae	*Smilax*	*zeylanica*	*L.*	Mouth and throat infected	Root	Rinse mouth with tea	Fallows	N
"Baru bangung"	Iridaceae	*Eleutherine*	*bulbosa*	*Urb.*	Revive dead	Leave	Compress on forehead	Village	Y
Bawang moka	Compositae	*Ageratum*	*conyzoides*	*L.*	Urinating blood	Leave	Drink tea	Village	Y
Belaban	Myrtaceae	*Tristaniopsis*	*merguensis*	Ridl.	Fever	Leave	Drink tea	Primary forest	N
Belaban merah	Myrtaceae	*Tristaniopsis*	sp.		Stomach ache	Red bark	Drink tea	Primary forest	N
Bengkal air	Myrtaceae	*Syzygium*	sp.		Itchy skin	Leave	Boil in water and wash body	River	N
Bunga dewa	Compositae	*Gynura*	*japonica*	*Juel*	Lowering high blood pressure	Dried fruit	Drink tea	Village	Y
Bunga kambak	Malvaceae	*Hibiscus*	*rosa-sinensis*	*Linn.*	Fever	Leave	Compress	Garden	Y
Bungur	Polypodiaceae	*Platycerium*	*bifurcatum*	C.Chr.	Stomach ache	Leave	Drink tea	Village	N
Cikor	Zingiberaceae	*Kaempferia*	*galanga*	*L.*	Fever in children	Whole plant	Put compress on head	Village	Y
Daun belaian	Convolvulaceae	*Operculina*	*turpethum*	*Manso.*	Malaria, stomach ache in children	Leave	Moisten with hot water and put on head or drink tea	Garden	N
Dugan	Dryopteridaceae	*Tectaria*	*zeylanica*	*Sledge*	Wound inside the body	Fruit and leave	Eat and drink tea	Village	N
Enkabut	Phyllanthaceae	*Breynia*	*racemosa*	*Muell.Arg.*	Itching wound	Leave	Mash and put on wound	Fallows	N
Enklaiu	Apiaceae	*Trachyspermum*	*ammi*	*(L.) Sprague*	Jaundice	Whole plant	Cook and eat	Primary forest	N
Entatung	Meliaceae	*Azadirachta*	*indica*	Juss	Strabismus	Root tuber	Chew and spit on head of patient	Village/fallows	Y

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Appendix 8. continued

Local name	Family	Genus	Species	Author	Use	Plant part	Procedure	Location	Planted
Entepung buluk	Euphorbiaceae	*Mallotus*	*paniculatus*	*Muell.Arg.*	Stiffness from fever, shivering	Leave	Compress	Fallows	N
Entima	Rubiaceae	*Ophiorrhiza*	*sanguinea*	*Bl.*	Wound, fever	Leave	Mash or boil	Fallows	N
Ginseng ♀	Icacinaceae	*Stemonorus*	*scorpioides**	*Becc.*	Kidney disease, malaria	Root	Drink tea	Primary forest	N
Ginseng ♂	Icacinaceae	*Stemonorus*	*secundiflora**	*Bl.*	Kidney disease, malaria	Root	Drink tea	Primary forest	N
Ilung asam	Araceae	*Schismatoglottis*	*rupestris*	*Zoll.*	Chase satan	Root tuber	Boil in water and wash body	Primary forest	N
Ilung pagung	Flagellariaceae	*Flagellaria*	*indica*	*L.*	Body pain	Root	Drink tea	Primary forest	N
Itap labi-labi	Gentianaceae	*Fagraea*	*racemosa*	*Jack.*	Fever	Leave	Boil in water and wash body	Fallows	N
Jambu air (=*Serugan*)	Leguminosae	*Senna*	*alata*	*(L.) Roxb.*	Itchy skin	Leave	Boil in water and wash body	River	N
Jari	Compositae	*Sonchus*	*arvensis*	L.	Childbirth	Leave	Drink tea	River	N
Jerangan	Acoraceae	*Acorus*	*calamus*	*L.*	Stomach ache, nausea (in babies)	Root tuber	Eat or compress	Garden	Y
Jonong akar	Rhamnaceae	*Zizyphus*	*jujuba*	Lamk.	Insect, snake and centipede bites	White sap	Put on bite	Garden/Village	Y
Juaran bolang	Rubiaceae	*Ophiorrhiza*	sp.		Body pain from fever	Leave	Mash and put on body	Garden	Y
Juaran kuning	Euphorbiaceae	*Codiaeum*	sp.		Fever, drop body heat	Leave	Boil in water and wash body	Garden	Y
Juaran merah	Euphorbiaceae	*Codiaeum*	*variegatum*	*Juss*	Body pain and stiffness, fever	Leave	Compress	Garden	N
Juaran padi	Euphorbiaceae	*Codiaeum*	sp.		Fever, drop body heat	Leave	Boil in water and wash body	Garden	Y
Juaran tua	Apocynaceae	*Strophanthus*	sp.		Body pain	Leave	Compress	Garden	Y
Kankung	Compositae	*Austroeupatorium*	*inulifolium*	*Rob.*	Sleeplessness	Leave	Eat a lot	River	N
Kayu nadjam (=*Kunidin*)	Blechnaceae	*Stenochlaena*	*palustris*	*Bedd.*	Body pain	Leave	Cook and rub on body	Fallows	N
Kayu pata issau	Myrtaceae	*Eucalyptus*	deglupta	Bl.	?	Leave	?	Primary forest	N
Kayu suak	Sapindaceae	*Otophora*	*spectabilis*	*Bl.*	Fever	Leave	Boil in water and wash body	Primary forest/ fallows	N
Kekarut	Elaeocarpaceae	*Sloanea*	*javanica*	Ridl.	Chase satan off the house	Fruit	Burn and use smoke	Primary forest	N
Kemuntin	Melastomataceae	*Melastoma*	*malabathricum*	*L.*	Desinfect a bleeding wound, cholesterol, ♀ menstruation	Leave	Mash with hot water and put on wound, drink tea	Garden	N
Kenjin jawa	Leguminosae	*Archidendron*	*clypearia*	*Nielsen*	Nausea, stomach ache	Fruit	Compress or drink tea	Primary forest	N
Kibang	Compositae	*Acmella*	*alba*	*Jansen*	Swollen legs	Root	Cook and make compress	Village	Y
Kubung	Euphorbiaceae	*Macaranga*	*gigantea*	*Muell.Arg.*	Gingivitis in little children	Resin	Put resin on teethridge	Garden	N
Kumis kucing	Lamiaceae	*Orthosiphon*	*aristatus*	*(Blume) Miq*	Abdominal and low back pain	Leave	Drink tea	Garden	Y

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Appendix 8. continued

Local name	Family	Genus	Species	Author	Use	Plant part	Procedure	Location	Planted
Kunidin (=*Kayu nadjam*)	Blechnaceae	*Stenochlaena*	*palustris*	*Bedd.*	Blood disease	Leave	Drink tea	Fallows	N
Kunyit hitam	Zingiberaceae	*Curcuma*	sp.		Rheumatic pains	Root tuber	Drink tea	Village	Y
Kunyit merah	Zingiberaceae	*Curcuma*	*aeruginosa*	*Roxb.*	Fever	Leave	Eat or compress	Garden	Y
Kunyit putih	Zingiberaceae	*Curcuma*	sp.		Stomach ache, heartburn	Root tuber	Drink tea	Garden/Village	Y
Lada	Lauraceae	*Cinnamomum*	sp.		Chase satan in children and birth giving	Wood	Burn and use smoke	Primary forest	N
Lahiak	Poaceae	*Panicum*	sp.		♀ just finished childbirth, rheumatic pain	Leave	Mash and put on limbs	Garden	Y
Laluma sungai	Lamiaceae	*Scutellaria*	*discolor*	*Colebr.*	Abdominal pain, body pain	Root	Make tea or compress	Village	N
Leban	Lamiaceae	*Vitex*	*pinnata*	*L.*	Stomach ache	Leave	Compress on belly	Garden	N
Lengan	Rubiaceae	*Neonauclea*	*calycina*	*Merr.*	Stomach ache	Leave	Compress	Village/fallows	N
Lengat	Rubiaceae	*Dentella*	*repens*	*Forst.*	Stomach ache	Whole plant	Mash and put on belly	Village	N
Lensurai	Dipterocarpaceae	*Dipterocarpus*	sp.		Stomach ache, fever	Bud	Drink tea	Primary forest	N
Lukai	Annonaceae	*Goniothalamus*	sp.		Chase satan out of little children	Leave	Cook and eat	Primary forest	N
Mali-mali	Rubiaceae	*Oldenlandia*	*verticillata*	*L.*	Ulcer	Leave	Mash and put on ulcer	Fallows	N
Mambung (=*R. pelekambing*)	Compositae	*Blumea*	*lacera*	*DC.*	Headache, stomach ache, childbirth, hot body	Leave	Moisten and put on head or stomache	Garden	N
Mata ikan	Lamiaceae	*Callicarpa*	*candicans*	*L.*	Fever, nausea, wound	Leave	Drink tea or compress on wound	Primary forest	N
Mayagana	Polypodiaceae	*Platycerium*	*bifurcatum*	*C.Chr.*	Ear infection	Root and leave	Put compress with root on ear, mash leave with water pour in ear	Primary forest	N
Melimbing tujuk	Oxalidaceae	*Averrhoa*	*bilimbi*	*L.*	Blood disease	Fruit/dried leave	Eat fruit or drink tea with leave	Village	Y
Mengkudo	Rubiaceae	*Morinda*	*citrifolia*	*L.*	High blood pressure	Leave and fruit	Drink tea or eat	Village	Y
Mentemu	Zingiberaceae	*Curcuma*	*longa*	*L.*	Typhus, malaria	Fruit	Drink tea	Village	Y
Merumbun	Crassulaceae	*Bryophyllum*	*pinnatum*	*Oken*	Fever/Patient can't have children	Leave	Make cuts in leave and put on forehead/Mash with egg and water and drink before dinner	Village	Y
Mudan	Dilleniaceae	*Dillenia*	*eximia*	*Miq.*	Childbirth	Leave	Boil in water and wash body	Village	N
Muntan	Lycopodiaceae	*Lycopodium*	*cernuum*	*Linn.*	Wound	Leave	Mash and put on wound	Fallows	N
Ningon	Acanthaceae	*Strobilanthes*	*crispa**	*Bl.*	Cough/ stomach ache	Whole plant	Boil in water and wash body/ cook and put on belly	Village	N
Pahang raugn	Piperaceae	Piper	attenuatum	Miq.	Childbirth	Leave	Heat over fire and put on belly	Village/fallows	Y

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Appendix 8. continued

Local name	Family	Genus	Species	Author	Use	Plant part	Procedure	Location	Planted
Pakukele	Compositae	*Elephantopus*	*scaber*	*L.*	Nausea, fever, urinary pain	Root, leave	Make tea or compress with root, eat leave	Village	N
Pakumani	Leguminosae	*Crotalaria*	*incana*	*L.*	Lower back pain (lumbago), headache	Fruit	Rub fruit on forehead	Village	N
Palang burung	Apiaceae	*Eryngium*	*foetidum*	*L.*	Malaria	Leave	Mash and eat or drink tea	Garden	Y
Palau lombat	Orchidaceae	*Dendrobium*	sp.		Itchy skin	Leave	Boil in water and wash skin	Village	N
Pamo bensi	Marantaceae	*Phrynium*	*pubinerve*	*Bl.*	Defecate blood	Whole plant	Drink tea	Primary forest	N
Pamunkar	?				Tumor, nausea, urinary pain	Fruit	Cook and rub on body	Primary forest	N
Pandang uangi	Pandanacea	*Pandanus*	*amaryllifolius*	*Roxb.*	Kidney stone	Leave	Drink tea	Village	Y
Pang pahit	Cyperaceae	*Cyperus*	*difformis*	*L.*	Urinary pain	Leave	Drink tea	Village	N
Panjurong isi	Phyllanthaceae	*Phyllanthus*	*niruri*	*L.*	Wound	Whole plant	Mash and put on wound	Village	N
Parap ampar	Rubiaceae	*Argostemma*	*montamun*	*Bl.*	Tooth ache	Whole plant	Drink tea	Village	N
Parap ensilip ♂	Cyperaceae	*Fimbristylis*	*acuminata*	*Vahl.*	Nausea, stomach ache	Whole plant	Put compress on throat, drink tea	Village	N
Parap matu	Lamiaceae	Hyptis	capitata	Jacq.	?	Leave	?	Primary forest	N
Parap rasa	Compositae	*Cyanthillium*	*cinereum*	*Rob.*	Stomach ache	Whole plant	Cook and put on belly	Village	N
Parapapi	Plantaginaceae	*Plantago*	*major*	*L.*	Cold body, fever	Leave	Compress	River	N
Pasak bumi	Simaroubaceae	*Eurycoma*	*longifolia*	*Jack.*	Backhurt, fever, malaria	Root	Drink tea	Primary forest	N
Pasap mata hari	Compositae	*Ageratum*	*conyzoides*	*L.*	Headache	Leave	Put compress on forehead	Garden/ fallows	N
Pengensit	Leguminosae	*Senna*	*siamena*	*Lamk.*	Sore eyes	Leave, bark, fruit	Boil in water and wash eyes	Garden/ Primary forest	N
Petampal	Compositae	*Mikania*	*scandens*	*Willd.*	Fever	Leave	Boil in water and wash body	Village	Y
Piawas	Lauraceae	*Litsea*	*brachystachya**	*Boerl.*	Cough, sore throat	Leave	Mash and spit out	Primary forest/ fallows	N
Pingsan tabun	Phyllanthaceae	*Phyllanthus*	*pulcher*	*Wall.*	Fainting	Leave	Compress on body	Fallows	N
Pringat	Rosaceae	*Rubus*	*moluccanus**	*Kuntze*	Sore throat, cold/ tooth ache	Leave and stem	Drink tea/ chew leave on sick tooth	Garden	N
Purung haras	Leguminosae	*Arbus*	*precatorius*	*L.*	Baby cries	Fruit and leave	Mash and put on head	Village/fallows	Y
Rabun ayam	Compositae	*Synedrella*	*nodiflora*	*Gaernt.*	Eyes do not see well	Leave	Boil in water and wash eyes	Village/fallows	N
Ransak balun	Aspleniaceae	*Asplenium*	*nidus*	*L.*	Tumor, nausea, urinary pain	Leave	Cook and make compress	Primary forest	N
Rumput batu	Rubiaceae	*Oldenlandia*	*recurva*	Miq.	Fever	Root	Cook and make compress	Primary forest	N
Rumput langau	Apiaceae	*Centella*	*asiatica*	*(L.)Urb.*	Help the newborn to breath	Leave	Compress on head	Garden/Village	N

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Appendix 8. continued

Local name	Family	Genus	Species	Author	Use	Plant part	Procedure	Location	Planted
Rumput pelekambing (=*Mambung*)	Compositae	*Blumea*	*lacera*	*DC.*	Stomach ache	Leave	Compress	Garden/Village	Y
Sabang hijao (=*Sabang merah*)	Asparagaceae	*Cordyline*	*fruticosa*	*Chev.*	Fever	Leave	Compress	Village	Y
Sabang merah (=*Sabang hijao*)	Asparagaceae	*Cordyline*	*fruticosa*	*Chev.*	Fever, chase satan, headache, blood diseases	Leave	Mash and eat or drink tea	Garden	Y
Sandang	Rubiaceae	*Psychotria*	sp.		Pain in the ribs area, fever	Only white leaves	Cook and rub on body	Garden	N
Sanduk	Lauraceae	*Cinnamomum*	*kerangas*	*Kosterm.*	Chase satan, fever	Bark	Burn and use smoke	Primary forest/ fallows	N
Sarang kemutah	Acanthaceae	*Graptophyllum*	*pictum*	*(L)Griff*	Nausea	Whole plant	Eat or drink tea	River	N
Sarang semut	Picrodendraceae	*Austrobuxus*	*nitidus*	*Miq.*	High blood pressure, cancer, stroke	Dried tuber	Drink tea	Primary forest	N
Segah	Rubiaceae	*Streblosa*	*tortilis*	*Korth.*	Dizziness, nausea	Leave and root	Cook and make compress	Primary forest	N
Selasi	Passifloraceae	*Passiflora*	*foetida*	*L.*	Fever, jaundice	Leave and root	Eat, drink tea or wash body	Garden	N
Serai bangi	Graminae	*Andropogon*	*nardus*	*Linn.*	Fever	Whole plant	Boil in water and wash body	Village	Y
Serugan (=*Jambu air*)	Leguminosae	*Senna*	*alata*	*(L.) Roxb.*	Itchy skin, running nose	Dried leave	Smoke the leave	Village	N
Siloh	Orchidaceae	*Habenaria*	sp.		Sore and red eyes, nausea	Whole plant	Compress on eyes, drink tea	Primary forest	N
Siluh helang	Leguminosae	Inocarpus	fagifer	Fosberg	Sore throat/Pain in the legs	Leave	Drink tea/Mash and put on legs	Garden	N
Sudah kuku	Orchidaceae	*Dendrobium*	sp.		Ulcer, swollen skin	Whole plant	Cook and make compress	Primary forest	N
Surugan	Vitaceae	*Leea*	*angulata*	*Merr.*	Allergic reaction (also in cats and dogs)	Leave	Mash, wash skin with it (+soap)	Village	Y
Tabar	Costaceae	*Tapeinochilos*	*ananassae*	*K.Sch*	Sudden sickness, fever	Leave	Boil in water and wash body	Garden	N
Tarum buaya	Rubiaceae	*Oldenlandia*	*biflora*	*L.*	Stomach ache	Leave	Put on belly with leaves pointing to the back	Fallows	N
Tebu buah (=*Tebu merah*)	Poaceae	*Saccarum*	*officinarum*	*L.*	Body pain	Sap	Eat	Village	Y
Tebu lalin	Convolvulaceae	*Ipomoea*	*aquatica*	*Forssk.*	Fever	Leave	Boil in water and wash body	Garden	Y
Tebu merah (=*Tebu buah*)	Poaceae	*Saccarum*	*officinarum*	*L.*	Defecate/urinate blood	Sap	Eat	Village	Y
Tempilak merah	Leguminosae	*Bauhinia*	*acuminata*	*L.*	Fever in children	Whole plant	Drink tea	Village/fallows	Y
Tenkorokang	Leguminosae	*Abrus*	*precatorius*	*L.*	Throat infection	Root	Eat	Village	Y
Ubai	Myrtaceae	*Syzygium*	sp.		Childbirth	Leave	Eat (with meat)	Fallows	N
"X pussing"	Selaginellaceae	*Selaginella*	*uncinata*	*Spring*	Headache, dizziness, nausea	Whole plant	Compress on head	Primary forest	N

* it has not yet been determined whether the name is a synonym or has been accepted, according to *The Plant List* (2010)

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This study aims to introduce the natural resource uses of Dayak Mentebah people of the village Nanga Dua, West Kalimantan. It is part of the project CoLUPSIA that focuses on reinforcing small stakeholder's rights. Furthermore, ecological data are collected to support the protection of Indonesia's species rich and vulnerable tropical forests, threatened through high deforestation rates. The local people's perceptions about their environment and land uses were assessed using participatory survey techniques: focus group discussions, scoring exercises, free lists of species and participatory mapping. To further record the traditional practices a survey was conducted on medicinal plants. The ecological assessment was done through survey plots in different land use units, where tree diversity and diameter at breast height was measured. The inhabitants of Nanga Dua are dependent upon forest products for food, material for construction, basketry, etc. Medicinal plants are integral part of the health-care system. The traditional, shifting cultivation creates a diverse and mosaic-like patchwork of various types of forests, having different successional stages. Tree diversity in the land-use units was generally high, with the primary forest in immediate proximity acting as tree species reservoir.

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