People priorities and perceptions

Towards conservation partnership in Mamberamo

MANUEL BOISSIÈRE • NINING LISWANTI • MICHAEL PADMANABA • DOUGLAS SHEIL

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ABBREVIATIONS

BAPEDALDA	Badan Pengendalian Dampak Lingkungan Daerah (Regional Environment Impact Mitigation Agency)
BAPPEDA	Badan Perencanaan Pembangunan Daerah (Development Planning Board)
BKSDA	Balai Konservasi Sumber Daya Alam (Natural Resources Conservation Agency)
CBW	Commercial Belly Witdh
CI	Conservation International
CIFOR	Center for International Forestry Research
DAMR	Dewan Adat Mamberamo Raya (The Traditional Council of Mamberamo Raya)
FGD	Focus Group Discussion
GIS	Geographic Information System
GPS	Global Positioning System
LIPI	Lembaga Ilmu Pengetahuan Indonesia (The Indonesian Institute of Science)
LUVI	Local User's Value Index
MLA	Multidisciplinary Landscape Assessment
NGO	Non Governmental Organisation
NBC	National Broadcasting Company
PDM	Pebble Distribution Method
RAP	Rapid Assessment Program
UNCEN	Universitas Cenderawasih (The University of Cendrawasih)
UNIPA	Universitas Negeri Papua (The University of Papua)
YAPEMBRA	Yayasan Pembangunan Mamberamo Raya (Mamberamo Raya Development Foundation)
YALI	Yayasan Lingkungan Hidup Irian Jaya (Irian Jaya Environmental Foundation)

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EXECUTIVE SUMMARY

The Mamberamo watershed is recognized as one of New Guinea's most important area of undisturbed terrestrial ecosystems, which contains high levels of biodiversity, extensive areas of lowland swamp forests, and is draining around 8 million hectares of the main northern catchment of Papua. The Foja Mountain, with an exceptional biodiversity significance in a global context, even if uninhabited in its upper part, has also a high historical and cultural significance and will be of critical importance for conservation and for the future livelihoods of its inhabitants.

Conservation International (CI) Indonesia has launched several initiatives in the Mamberamo area since early 2000, targeting biodiversity conservation and sustainable environmental management. CI, in its commitment to these initiatives, has endeavoured to involve the local people in the decision-making processes concerning land use and natural resource conservation.

Since 2004 CI and CIFOR have used an original approach to study the local perceptions of natural resources, forest landscapes and biodiversity. The methods seek to establish, from a local perspective, what elements of 'biodiversity' are important to the communities on a landscape, environmental services and species levels, how much are they important, and for what reasons.

The first joined surveys revealed the importance and relevance of including local communities in the management of the future conservation area, because of their interest to protect their forests from encroachment and degradation. Local ownership and leadership systems are still strong in Mamberamo and any future activities needs to take them into consideration.

We contributed, at these early stages of our collaboration, to document a basic understanding about the needs, perceptions, knowledge and traditional values of the local communities, which could be used for lobbying to decision-makers.

Our research substantiates conservation efforts by indicating opportunities for and threats of biodiversity conservation (from a community perspective).
Our surveys also helped to strengthen community priorities and were pivotal in finally establishing a solid partnership between CI and the Mamberamo communities.

Because of the momentum developed during the first joined surveys, both CI and CIFOR were eager to further adapt the approach to more directly achieve conservation

outcomes in the watershed. In 2006, follow-up activities were developed to use the participatory maps as an instrument to engage local communities in a conservation agenda, based on their existing land management.

This book presents a general description of three study sites: Papasena, Kwerba and Kay villages booking order to compare three different situations, each village hosting different ethnic groups, topographies and challenges for biodiversity conservation. Activities included socio-economic surveys and GIS ground checks to improve the accuracy of participatory maps of the natural resources and of important landscape features. Participatory maps of land claims and land use were also drafted. Additional information was then collected on local activities related to biodiversity monitoring and control of the land and resources.

The results show that local communities, who depend on the river and the forest for their subsistence livelihoods, have a strong sense of land ownership and use gardens to mark their huge territories (between 1000 and 1500 km^2 per village), which they regularly patrol. They also have a strong awareness of the threats to their wild resources, and equally the need to maintain the watershed's services. Even if the population is low, the area coverage large, and the ethnic groups and livelihoods diverses, we observe similar or at least comparable ways to manage and control each society's territory, to identify and anticipate threats against their important resources. Local forms of resource monitoring can be observed in the villages areas, and the land use reflects existing ways of conserving the resources, for various reasons that can be useful for conservation purposes.

Based on these results, we recommend that the land-use maps and additional information concerning each community, local monitoring and control systems should be used to negotiate with local people the zoning of future conservation areas. Conservation management should also be designed to support existing systems in order to maintain balance in the face of outside intrusions. Rather than introducing new rules, which pay no heed to local cultures and traditions, the search should be for traditional (or at least locally-driven) rules and regulations that have managed to conserve this vast area, of near pristine forests, for generations.

Introduction

Photo by: M. Boissière

The Mamberamo watershed, in the western part of New Guinea Island, is recognized as one of New Guinea's most important area of undisturbed terrestrial ecosystems, which contain high levels of biodiversity (Richards et al. 2002; Polhemus and Allen 2007), extensive areas of lowland swamp forests (Johns et al 2007), and is draining around 8 million hectares of the main northern catchment of Papua (Frazier 2007; Beehler 2007a, b). About 90% of the Mamberamo watershed is dominated by lowland, swamp and natural mountain forests (Richards et al. 2002).

Several new species were found during a recent expedition in the Foja Mountains, which are part of the Mamberamo watershed. These mountains, with an exceptional biodiversity significance in a global context (Cyranoski 2006; Helgen 2007), even if uninhabited in its upper part (Hope 2007), have also a high historical and cultural significance and will be of critical importance for conservation and for the future livelihoods of its inhabitants (Burnett 2007).

Nevertheless, there are many other parts, in Mamberamo, which are still biologically poorly known and the majority of the plants encountered are not easily identified, due to scarcity of available database for Papua (CIFOR 2005; Takeuchi 2007). Local communities in Mamberamo (about 11,000 people) play an important role in the current condition of the watershed, as they depend on forest products, such as sago, and on cultivation of other crops for their livelihoods (Bemei and Watopa 2006).

However, as for most forested landscape in Indonesia, decrease of forest cover in Papua has accelerated since the 1997 economic crisis. Logging, mining, forest conversion into plantation, and infrastructure development such as dams and roads can be mentioned as major threats to biodiversity in Papua.

Conservation International (CI) was established in Papua in 1995. Its long-term goal is to promote people-based nature conservation and sustainable economic development through sustainable use of resources. To address this goal, CI's long-term strategy includes building local capacity in designing and implementing conservation and sustainable development.

Working with local communities, environmental NGOs and other conservation agencies, CI is building partnership to increase potential for more effective and sustainable conservation outcomes. In 2000, CI started conservation programs in the Mamberamo area and endeavoured to involve the local people in the decision-making processes concerning land use and natural resource conservation. Collaboration was developed between CI and the Center for International Forestry Research (CIFOR) in 2004 to use a multidisciplinary approach to define what matters for local people in terms of biodiversity and natural resources in these forested landscapes. The survey revealed a strong sense of ownership concerning a vast territory, which includes the

Foja Mountains; a strong commitment to guard specific areas in the landscape and to maintain key resources, but also species with less tangible values.

This book refers to joined activities in Mamberamo developed by CIFOR and CI in 2006. The results of the previous survey were revisited, and creative ways to utilize them were explored, as CI is working to adapt the approach to specific conservation objectives. We present here the main findings from our survey (socio-economic data and mapping) and discuss how such information can be used by Conservation International (CI) to achieve conservation in Mamberamo, by considering the local perspectives on land management.

This book addresses the following issues important to better integrate local management of the natural resources to conservation needs in Mamberamo: to what extend can we use local land use to achieve conservation in Mamberamo, with the participation of the local communities? What tools, adaptations to the former CIFOR approach, could be developed to achieve such purpose? What elements of comparison can we observe between these three different societies, each having deferent (even if comparable) livelihoods, and living in different parts of this huge watershed: the hills, the lowland and the swamps.

1.1 A brief history of CIFOR activities in Mamberamo

Between May and September 2004, in collaboration with the CI Indonesia Papua Program and the Indonesian Institute of Science (*LIPI*), CIFOR trained 20 participants in Multidisciplinary Landscape Assessment (MLA) in Papua. The participants were from: the provincial government offices of the Regional Environmental Impact Mitigation Agency (*BAPEDALDA*) and the Natural Resources Conservation Agency (*BKSDA*) in Jayapura; the University of Cenderawasih (*Uncen*) and the University of Papua (*Unipa*); and CI. The results were reported in a document provided by CIFOR in 2005, with contributions from the different trainees and trainers. The training was divided into three main activities: a conceptual approach to the set of methods proposed by MLA; a biodiversity survey in Mamberamo, where the approach was tested in two villages, Papasena I and Kwerba; and an analysis phase at CIFOR Headquarter to teach the trainees how to use the results of the data they had collected previously.

Apart from the capacity building objective of the 2004 activity, we achieved and documented a basic understanding of the needs, perceptions, knowledge and traditional values of the local communities. The survey also helped to build trust between CI and the local communities as well as to give the participants new insights into the importance of the local point of view on natural resource management.

The MLA has proven to be a relevant diagnostic tool that can help anticipate issues and problems in the future. It substantiates conservation efforts with solid reasoning and indicates opportunities and threats (from a community perspective), and what is needed in order to achieve long-lasting conservation on the ground such as maintaining forest functions for the community, and maintaining important economic species.

Because the MLA, implemented during 2004, was developing momentum, both CI and CIFOR agreed to further adapt the methods to help CI achieve conservation outcomes in partnership with local communities. The 2004 MLA methods were the "blue-print for the 2006 MLA". The methods have been adapted to answer specific questions in order to prepare for the involvement of local stakeholders in the CI conservation initiatives in Mamberamo.

As part of this new set of activities, a kick-off workshop was held in Jayapura in May 2006. Twenty seven participants attended the workshop from various institutions: The Development Planning Board of Sarmi Regency (*BAPPEDA*) and the Forestry Agency of Sarmi Regency (*Dinas Kehutanan Kabupaten*), *BKSDA*, *BAPEDALDA*, lecturers from *Uncen* and *Unipa*, a local NGO (*Yayasan Pembangunan Mamberamo Raya - YAPEMBRA*), the Traditional Council of Mamberamo Raya (*Dewan Adat Mamberamo Raya / DAMR*), staff from *LIPI* and CI Papua, previous MLA participants and CIFOR.

The main goal of the workshop was to bring together different stakeholders, at the provincial, district and local levels. It recognized the specific needs of each stakeholder, and proposed adaptations of the methods and new activities related to conservation. A list of activities was proposed as a result of the group discussions. Based on these recommendations, CI and CIFOR continued to prepare action plan activities for the survey.

1.2 Context: CI position and initiatives in Mamberamo, and the Foja Expedition

In 2005, after the MLA training activities in MBC, CI prepared an expedition to the Foja Mountains; one of these mountains borders the Mamberamo watershed. Local communities claim that these mountains are their traditional sacred lands and outsiders must obtain local authorization to enter the area. The 2005 expedition involved local communities from Kwerba, Biological Research Centre of *LIPI*, *Uncen*, *Unipa*, the *BKSDA* and international experts from Australia and the USA. Many new species of plants and animals were discovered during the expedition (de Fretes 2006). The good participation of local villagers was a result of the strong relationship built during the 2004 MLA activities, where mutual understanding and a better comprehension of the local

perception of the Foja Mountains, the natural resources, the local priorities in terms of development, anticipation of threats, and local interest in biodiversity conservation were obtained. The international media coverage of the expedition and its discoveries (NBC 2006[1]) made local and national governments, conservation institutions and donors more interested in developing activities in this area. It also helped to gain local support for the conservation programmes.

1.3 2006 survey: what's new?

The main objectives of the new set of activities were to revisit the results of the 2004 MLA, to explore creative ways to utilize them and to improve CI capacity in adapting MLA methods to specific conservation objectives. We also aimed to build a common understanding of the landscape, between local communities and scientists, as well as to encourage discussion about the conservation of natural resources and sustainable development priorities, based on the participatory map. Ultimately, we planned to provide a set of tools that could be used for negotiations on community-based natural resource allocation, conservation and for land use planning.

This action-plan included follow-up activities in the two former villages (Kwerba and Papasena I), focusing on conservation aspects and testing the adapted MLA tools at a new site (Kay Village).
Three major activities were carried out in all three villages:

1. **The socio-economic survey**, which covered information on the collection and sale of natural resource, and scoring exercises for commercial and rare[2] plants and/or animals. In addition, we updated village demography, the prices of trade goods as well as family and clan (*marga*) significance in relation to land-ownership. We considered that the knowledge of the traditional institutions, the relationship between the different families, clans, languages, and the rules on land tenure should be the basis for discussion and negotiation on land use in Mamberamo.

2. **The Global Positioning System (GPS) ground check**, based on previous and new participatory mapping, included important sites based on local people's perceptions (rivers, sacred places, hunting areas, etc.). The results from the ground check activities and discussions with villagers will be used for potential zoning activities in the future protected area based on the actual land use and the local priorities.

[1] See 'Lost World' of wildlife found in Indonesia (http://www.msnbc.msn.com/id/11114156/).

[2] The term "rare" is used here to define resources that are hard to obtain, according to the villagers, because of their difficult access (e.g. high in the trees) or because of over-harvesting (there is no scientific data to support this information).

3. **Local activities related to monitoring** (hereinafter we use "Local Monitoring" to refer this activity) of plants and animals. We studied the possible existing local monitoring in each village, for resources that could have economic value and/ or that could be threatened or rare. Monitoring is defined here as the regular assessment of important resources over a certain period of time, the control exerted by local communities over their habitats, and the identification of threats. Even if this monitoring part was not developed as a core activity, it brought valuable information about the local people's behaviours and traditional rules.

In Kay Village, where no MLA-related activity had previously been developed, we added three more activities, which were considered important for the adapted set of methods:

4. **Participatory mapping of landscapes and resources**, which included information on natural resources, special sites and local perceptions, is important for the local community.

5. **The socio-economic survey** of the village history and the cultural background of land use, included a household questionnaire and interviews with key informants.

6. **Scoring exercises** (Pebble Distribution Method - PDM) were used to quantify the importance of forest products (plant and animal species) and landscape units per use category.

The core activity focused on the mapping exercise and the information collected during the ground checks. Rivers, swamp lakes and special places were checked during field surveys, and on the occasion, information was added on local monitoring, land types and important resources. We believed that each element of the study was necessary to understand the overall situation in each of the three villages. The maps cannot stand alone; they need to be linked to the socio-economic data, to the traditional system of land tenure, and to the use and monitoring of specific important natural resources. The good integration of the different aspects of our approach and the inter-disciplinary nature of the methods used are a guarantee of the results validity. Of these aspects and results none can be isolated from the other.

In this report, we try to show how the different elements of our research are interconnected, how the interpretation of the results depend on this integration to propose recommendations for biodiversity conservation in Mamberamo. We first briefly describe the methods used during the survey. Each chapter is based on each village visited. We discuss the results from the socio-economic survey, the participatory mapping and the local monitoring. Then we discuss the way CI could use these results and maps in the conservation of Mamberamo.

Methods

Photo by: N. Liswanti

2.1 Assessing the local perceptions: a brief overview of the methods

This set of methods have been developed by CIFOR to "… *define priorities that reflect local considerations and can inform a wide range of processes, from the revision of 'good practice' in forest harvest management to local land use decisions and international forestry and conservation policy*" (Sheil *et al.* 2003)[3] . They are based on a complementary approach to more classical biodiversity assessments, biophysical studies or rapid assessment programmes, by emphasising the local point of view on natural resources and forest landscapes. Most studies on forest typology use land types as the principal unit of assessment. We believe that local communities should apply their own representation systems to the various land types of a common landscape, which may differ from those of the scientific community. To bring these different perceptions together, it is important to work on the local classification and importance of lands in order to measure the biodiversity.

As originally formulated, the approach aimed to inform decision-makers about what is important to local people in terms of forest landscape, environmental services and resources management, and the complex relationships local people have with forests. The approach combines technical analysis and assessment of local priorities', and is rooted in social (anthropology, ethnobotany and socio-economics) and natural sciences (ecology, botany, pedology, geography).

During the surveys, two different teams worked in collaboration: a village team and a field team. The first step was to explain to the villagers the objectives of the survey and to obtain their approval and support. Then the two teams, with the villagers, produced a map of the landscape that shows the rivers, culturally important sites and places where the main resources are found. Some aspects of the approach (e.g. joint mapping) are primarily intended to build communication and understanding with the communities (i.e. to facilitate the process rather than to be seen as results).

The village team used a range of methods (see Table 1), which included household questionnaires, focus group discussions (FGD) and interviews. Information was gathered from the head of each household on socio-economic aspects (demography, level of education, main sources of income and livelihood) and cultural aspects. The questionnaires also collected basic information on local views of threats to biodiversity, people's perspectives on natural resource management and conservation, and on land tenure.

[3] See also http://www.cifor.cgiar.org/mla/

During our survey, scoring exercises included assessments of the importance of the land and forest types, and the species of plants and animals for each use category, as defined by the community. The scores and the explanations given by them were used for the development of a dialogue with the community and to gain a better understanding of local priorities (Sheil and Liswanti 2006, Sassen and Jum 2007).

The surveys conducted by the field team used plots in each land and forest type, identified by the villagers, to collect information on the sites' uses and history, as well as to record all plants (botanical specimens were collected) and their uses. The two teams worked in close collaboration, with a daily meeting to discuss progress and unexpected results or difficulties.

2.2 Adaptation of the methods to obtain conservation outputs

The new set of MLA activities was designed specifically to address biodiversity conservation concerns. We developed a new set of activities (Table 1) in relation to community mapping and land use strategies for each of the chosen sites. Below is a brief description of the new activities.

Table 1. Data collection activities used in the village-based survey

Objective	Activities and target group
Village description/perspective of land use	Interview with the village head only
Cultural background of land use	Interview with the traditional leader only
Demography	Household survey (census) and documentation obtained from the village head
Price of traded goods	Interview with shop keepers
Household survey (included questionnaires regarding problems and aspirations, with comments on needs and solutions)	Interview with the head of the household
The collection and sale of natural resources	Interview with 3–5 key informants
Settlement history and land use	Interview with the village head and traditional leader
Disasters and important events	Interview with the village head and traditional leader
Identification of land and forest types	Community meeting (with mapping exercise)
Identification of natural resource	Community meeting

Objective	Activities and target group
Scoring the importance of landscape units	FGD. Women/men, old/young separate
Scoring the economically most important species per use category	FGD. Women/men, old/young separate

Source: Sheil *et al*. 2003

2.3 Site selection

A number of possible villages were identified, with arguments for and against each of them. Three villages (Papasena 1[4], Kwerba and Kay) were then chosen by CI and CIFOR, according to the information on each location and different criteria (Map 1):

Map 1. Site area in Mamberamo watershed

[4] Papasena 1, 2 and 3 are used only to introduce the three separate villages. Otherwise Papasena refers to the whole territory.

- *The location of the previous* (2004) *MLA surveys*: we decided to take the opportunity to conduct follow-up activities in the same area as the 2004 survey. We designed a new set of activities that would capitalize on the data already collected and worked on the lessons learned.
- *Strategic area for conservation*: Kay is located on the edge of the Tariku River (also called the Rouffaer River), in the swamp area of the watershed. The location completed the information we had on villages situated in the foothills of Mount Foja (Kwerba), and in the lowlands (Papasena). Kwerba and Kay have also been targeted by potential infrastructure projects (roads) that would cross their territory, a zone of almost pristine forests. This makes the two locations sensitive for conservation and development. Papasena is located at the center of the Mamberamo Watershed, not far from the mouth of the Tariku River in Mamberamo.
- *Agreement from local community to host our activities*: Baso Village, upstream from Papasena on the Mamberamo River, was considered a potential site for our activities, but we were unable to obtain support from the entire community. We thus shifted to Kay, where the local people welcomed us. The site was suggested by Sonny Weriko, a local traditional leader for the Rouffaer region (including Sikari, Rouffaer and Iribima) living in Dabra.

We already had a large amount of data for Papasena 1 and Kwerba from the 2004 survey. The follow up survey for these two villages took only nine days per village. In Kay we spent three weeks collecting basic information as no data had ever been collected there before. We also had to develop participatory mapping during the first steps. Table 2 gives an overview of the new activities and methods for each location.

2.3.1 Socio-economic survey

In the three villages, we introduced the survey (background, objectives, etc.) as well as the team members, during a community meeting. Socio-economic data collection was concerned mainly with natural resources that were important sources of income for the communities. The socio-economic work focused on two issues:

First, we collected general information on the history of the villages, the demography (household surveys), the economics (number of shops in the villages, prices of goods), cultural background, land use, the collection of forest products, regulations and taboos. Structured interviews were conducted with the village heads and customary leaders, as well as other key informants.

Table 2. New activities developed in Kwerba and Papasena 1 (the former MLA sites) and Kay (the new location)

Activities	Details	Adaptation from MLA methods	Site location
1. Socio-economic survey	Interviews with the village head/ customary leader and villagers on demography, household survey, history of the village, inventory of the village (number of shops/ cooperatives/means of transport)	Socio-economic aspects through a series of interviews	Kay
2. An inventory of clan and ethnic groups	1. Information on the meaning of clan and ethnic group according to the local community 2. Database on customary land rights (*hak ulayat*) of each clan/ family 3. Interviews regarding boundaries within villages	Socio-economic methods through a series of interviews and household surveys	Kwerba, Papasena 1, Kay
3. Participatory mapping of natural resources and landscapes	Community meetings, group discussions and interviews regarding landscapes (forest and other land types), natural resources and special sites	Participatory map	Kay
4. Land use and identification of species with economic potential based on the participatory map	1. Ground check based on initial stage of the survey. Preliminary data collected through FGD, interviews and community meetings 2. Zoning according to traditional systems or local perceptions 3. GPS points for rivers/ tributaries/important sites and natural resources defined during participatory mapping	We used the participatory map developed during the MLA 2004 for Kwerba and Papasena 1 and developed a new participatory map for Kay	Kwerba, Papasena 1, Kay

Activities	Details	Adaptation from MLA methods	Site location
5. Important natural resources for local people	Group discussion (FGD), PDM 10 (the most important species for local people), PDM 6 (important forest and land types for local people)	Using part of the scoring exercises	Kay
6. Study of local biodiversity monitoring	1. Scoring exercise (PDM) for economically valuable and endangered species and plant collection. Important fauna habitats identified on the participatory map 2. FGD (based on results from mapping and PDM) to define the category of uses for certain species 3. Local monitoring of the status of a certain species, the territorial control and the identification of threats	Modified MLA data sheets (information on site description, GPS points, distance from village, site history, forest type and number of species)	Kwerba, Papasena 1, Kay

Second, we worked on the ethnic and lineage division of each village. We believed it was important to better understand how the different families, clans and lineages were organized, and what the implications were, in terms of land tenure, natural resource management, sharing of knowledge/awareness/control, and biodiversity monitoring. This information helped also to prepare the ground check for the participatory maps, to select informants to go into the field with us, and to better understand the complexity of the issues related to land use.

2.3.2 Scoring exercises

Scoring exercises were undertaken in FGD meetings (Figure 1). When possible, four groups of villagers, based on gender and age (old men, old women, young men and young women), were formed, with four to eight people in each group and facilitated by a researcher. These exercises addressed issues of the importance of "forest and other land types", "source of useful products", the important "species per use category" (in Kay) and the important "economic and/or rare species" (in all villages). With input from local community, we defined "rare species" as resources (plants and animals) that are "rarely" harvested because situated in rugged places with very limited access or because recently less available in the forest and other land types.

2.3.3 Participatory mapping

Using previous (and new for Kay) resources and landscape participatory maps, we worked with the community to produce a land use map that could serve as a base for the zoning of future protected areas. The technical steps of the elaboration of these maps are described in Annex 1.

Before going to the field, we had a discussion with a group of people/informants to:

- prepare maps of the area we were going to survey;
- check names and position of main rivers and tributaries as well as other special sites (lakes, sacred places, etc.);
- check where people usually cultivate their land and go fishing and/or hunting crocodiles;
- check the farthest point people go from the village to hunt game and collect forest products;
- discuss traditional zoning and ask how they divide their land for certain uses;
- ask which clan owned which land, not to raise the issue of boundaries but to select informants who could help describe the area we were going to survey; and
- select a few informants from each landowner's clan where the survey was going to be carried out.

Photo by: M. Boissière

Figure 1. A scoring exercise with a group of men in Kay Village

In the field we checked names and the position of main rivers, tributaries, lakes, islands and sacred places, using GPS. In addition, the position of some other important places such as sago gardens (wild or planted), old villages and clan boundaries were taken. During these surveys much more information was collected about the history of each site, the ecological knowledge of the informants, the monitoring/control exerted over these areas, etc.

All points collected from the field were checked again in the villages with the socio-economic team and local informants, resulting in discussions on the position of rivers, islands and limits, and on a new map, with the corrections validated by the villagers. There were then more discussions concerned with the actual land use, according to the villagers and based on these maps. We also tried to propose a gradient on land use by the local people, which could be useful for further discussion on possible biodiversity conservation zoning with all concerned stakeholders.

In the different sites we considered that land use, the perceptions of each part of the territory, and the knowledge of the different features of the landscape, strongly depend on the land tenure, i.e. how the different clans claim different parts of the region. It was important to continuously explain to the local community that the purpose of the

clan area map was not to identify boundaries but more to emphasize how the area is used and managed. Knowing each clan area was also useful when identifying the right informants for our field surveys. With this in mind we prepared a map, with the villagers, of the different clans and their areas (see Box 1 for a definition of clan and ethnic groups). This map was not given back to the villagers, as it could have caused conflicts, in a place where boundaries, land rights and resource management are still sensitive and subject to conflicts. The clan map is a non-official tool, which is useful for our understanding of the situation, and for our analysis and interpretation of the land use. We also produced a land use map, an interpretation of the actual level of management of the territory. This gives a general picture of land use, made at a certain time, which shows how far villagers go/travel for their different activities.

Box 1. Clans and ethnic groups in Mamberamo

A characteristic of the population of Mamberamo is the high diversity and complexity of groups in the region, where a number of different languages are spoken in one single village. A distinction is made between two general divisions of the society: **suku** and **marga**. All the communities in Mamberamo commonly use these two Indonesian terms, with more or less the same meaning.
Suku represents the ethnic groups. People from the same suku share the same language, the same myths, origins, and group of ancestors.
Marga represents the clan. Several clans are represented in one ethnic group. Members of one clan have the same origin and ancestor.

2.3.4 Local monitoring

In addition we looked for evidence of local biodiversity monitoring for either economically valuable plants and animals or threatened/rare species. Questionnaires and informal discussions were prepared for this purpose, together with more direct observations during our field trips. Originally our purpose was to design, together with the communities, simple biodiversity monitoring. But we decided to study the local monitoring systems, present in each village, which could support future biodiversity conservation.

Kwerba Survey

Photo by: N. Liswanti

Kwerba was chosen by CI as a pilot village for long-term activity development for the "Mamberamo Biodiversity Conservation Corridor" in Papua. Since our last visit in 2004, significant changes have occurred in Kwerba. Kwerba used to be a traditional village[5] but with continuous effort during the last 20 years and support from CI Papua, it was officially appointed as a new village (*Desa*) in November 2006.

To support conservation planning in this area, CI established a "conservation post" managed by a Mamberamo Field Officer (MFO) and provided a motorized boat in 2005. With support from CI, the local community has developed village regulations, including for the use of the motorized boat. The MFO helped with the preparation of the MLA 2006 survey and informed the villagers about this new set of activities. In addition CI hired two local youths, who have knowledge of plants and animals, to implement CI's conservation programme in Kwerba.

One important result from the 2004 survey was the community map. This shows the distribution of existing natural resources and special sites that Kwerba people consider important for their livelihoods. Based on the survey results, the local people had expected to use the map to keep their traditional area safe from any extractive activities, conducted by the local government or outsiders that would disturb their natural resources.

3.1 A village in the Foja Foothills

3.1.1 Geography and history

Administratively Kwerba Village belongs to the District (*Kecamatan*) of Mamberamo Tengah (Middle Mamberamo) in Sarmi Regency (*Kabupaten*). Kwerba is located on a sharp bend of the Wiri River, a tributary of the Mamberamo River. This is a mountainous region and the village, at 80 m above sea level, is surrounded by steep hills. To reach the village during the dry season, motorized boats can only reach the mouth of the Wiri River, and it takes an additional half an hour to walk a narrow muddy forest path. A small stream with clean water (Buerak River) runs along side the village. Another source of clean water (preferred for drinking water) is a well in a rocky cliff wall, at the far side of the airstrip.

Kwerba village is surrounded by agricultural areas, primary hill forests and secondary forests[6]. The latter is usually caused either by landslides (scattered along the riverbank) or by human activities (around the village). Some areas, belonging to the Maner and Haciwa clans, are covered by flat primary lowland forest.

[5] A *Desa* (village) has an official administrative status under a *Kecamatan* (district). When it has no recognized status, it is called *Kampung* (traditional village). A *Kampung* is usually under the authority of a *Desa*.
[6] In Annex 2 we provide a brief analysis of the vegetation of Mamberamo.

Unlike Kay and, to a lesser extent, Papasena, it is common for people in Kwerba to plant sago for food. Some lakes are found scattered in the wider territory, with abundant resources including crocodiles. The nearest lake from the village is Lake Hehetem, which is about three hours walk to the north-west.

3.1.2 The population of Kwerba

The population of Kwerba in 2004 was a total of 354 people in 44 households. In a territory estimated at 1100 km^2 (see chapter 6.1.6), population density is around 0.32 persons per km^2, far below the figure at the province level (5.66 persons per km^2, according to BPS Papua 2002). Some 35 houses[7], made of poles with bark strip walls and rooves of sago palm leaves, standing on stilts, line the airstrip. The literacy rate is around 50% and the village has an unofficial elementary school, run by a volunteer. The closest secondary school is in Kasonaweja District and the closest university is in Jayapura. However, only a few people have continued on to higher education and a university degree.

The languages spoken in this area are diverse. Most of the villagers can speak Indonesian, but the different clans in Kwerba speak a language called 'Kwerba'[8], used mainly by the people living in a small village called Hanem[9] Hamlet during the old times. There are now several ethnic groups in the village, who have different languages and traditions (Table 3).

Table 3. The ethnic groups of Kwerba

Original ethnic group	Claimed ethnic group	Clan
Kwerba	Amih	Maner
Kwerba	Kwerba	Tawane
Kwerba	Orawa	Haciwa
Kwerba	Burmeso	Meop
Kwerba	Kwerba	Karawata
Burmeso	Burmeso	Abiasit*
Burmeso	Burmeso	Tasti*
Kawera	Kawera	Bilasi**
Orawa	Orawa	Kho***

* This clan's origin is Burmeso Village, ** This clan's origin is Kasonaweja District, *** This clan's origin is Marina Valen Village

[7] It is common in Kwerba, as well as in many other villages in Indonesia, for several families to live in the same house. During the 2006 survey, we found that the number of households had significantly increased. Updated demographic data for 2006 are available at CI Jayapura.

[8] http://www.ethnologue.com/show_language.asp?code=xwr

[9] We were unable to date when Kwerba people lived in Hanem, probably during the 19th century.

Table 3 shows the clans in Kwerba that claim they currently belong to different ethnic groups. According to local informants, these main clans were Hanem, situated between the Ani and Kanang rivers, where they had stayed for a long period. Because of frequent wars among the different ethnic groups, the Kwerba clans dispersed and left the Ani River. The Maner moved to the Wiri River owned by the Amih ethnic group, the Haciwa moved to the Tabiri River owned by the Orawa ethnic group, and the Meop moved to the Piari River owned by the Burmeso. Later, each new settled clan claimed to belong to their host ethnic group.

3.1.3 Local livelihoods

Most villagers in Kwerba believe that their current life is better than in the past, when they were nomadic[10]. Up until the present, the Kwerba people have been highly dependent on forest resources (hunting and gathering[11]) such as wild pig (*Sus scrofa*, *see Figure 2*), cassowary (*Casuarius unappendiculatus*), ground kangaroo (*Dorcopsis hageni*) and tree kangaroo (*Dendrolagus inustus*). The villagers now grow sago (*Metroxylon sagu*, the staple food), coconut (*Cocos nucifera*), Areca nut (*Areca catechu*), cacao (*Theobroma cacao*), red Pandanus (*Pandanus conoideus*), banana (*Musa* sp.), papaya (*Carica papaya*), cassava (*Manihot utillisima*), sweet potato (*Ipomoea batatas*), pumpkin (Family Cucurbitaceae), pineapple (*Ananas comusus*).

Rivers and lakes provide important resources (second in importance to forest resources) such as crocodiles (*Crocodylus novaeguineae* and *C. porosus*) and fishes: *ikan*[12] *sembilang*[13] (Family Ariidae), carp (*Cyprinus carpio*), *mujair* (*Oreochromis sp*.) and *lele dumbo* (*Clarias* sp.), etc.

Crocodiles and birds of paradise (*Paradisaea minor* and *Seleucidis melanoleucus*) are now difficult to find in the village area because of over-harvesting or difficult access. To maintain these animal resources collection is limited and permission from the landowner is required when looking for them in another clan's area (see 3.4 *Local Monitoring*).

[10] When a war broke out with the Burmeso (probably during the 19th century), the Kwerba people kept moving their settlement from one place to another – a list of more than 15 locations was given by the head of the village, they then moved to the mouth of the Tabiri River. This was where they were living when outsiders arrived in the 1960s (probably missionaries). In 1972, the village was relocated to the mouth of the Wiri River and in 1974 the village moved again to its present location in anticipation of the construction of an airstrip at Tacewaram (the flat area of the present day) in Kwerba. RBMU (Regions Beyond Missionary Union), an American missionary group, built the airstrip in 1975 (CIFOR, 2005).

[11] The animals (mammals and birds) were directly identified from field guides by the informants during the fieldwork (see Behler *et al*. 2001 and Flannery 1995)

[12] *Ikan* is the Indonesian term for fish

[13] This is one of several species of catfish commonly found in the Mamberamo area. Its bladder is an important source of income for the local community.

The villagers also have an alternative source of income from selling mats (made from Pandanus leaves), *matoa* (*Pometia pinnata*) and orchids (Family Orchidaceae). A few people work as teachers or sell goods such as handicrafts, soap, sugar, batteries, salt and cigarettes.

Photo by: M. Padmanaba

Figure 2. Local communities consider wild pig to be an important resource

The people of Kwerba still highly respect taboos (traditional regulations/restrictions), which ultimately help them to protect their natural resources. However, although villagers know that fishing with poison (e.g. *Derris elliptica*) causes environmental degradation, they continue to use this technique for fishing.

3.2 Socio-economic survey

3.2.1 Survey of the clans

From the 2004 survey, there was some confusion about the term 'clan'. Therefore, in the 2006 survey we gathered information to obtain a clearer definition of this term. In many discussions, the young people (under 40 years old) often used the ethnic group term to refer to a clan. Only the older generation gave sufficient information to explain the meaning of clan. The definition of clan is presented in Box 1.

Clans are classified into two groups: the main (local) clans and the outsiders. The main clans include: Maner, Haciwa, Karawata, Tawane and Meop; while the outsiders, who come from other villages but live permanently in Kwerba include: Abiasit, Bilasi, Kho and Tasti. Each clan has its own leader except for the Karawata whose leader passed away in early 2006 and nobody has replaced him yet. Within the Kwerba territory, the main clans own a major tributary of the Mamberamo River. Nevertheless, the outsiders are not necessarily excluded from the control of the tributaries. They usually live in the village because they married a member of one of the main clans and have permission to collect and hunt resources in the areas belonging to their new clan (Table 4).

Table 4. The distribution of clans, tributaries and landowners in Kwerba

Clans	Tributaries (including boundaries)	Main landowner
Maner	Tabiri River – Mowam River – Wiri River – Siri River	Maner
Haciwa	Watab River – Tabiri River	Haciwa
Karawata	Mayau River	Karawata
Tawane	Mayau River – Ani River – Kanang River	Tawane
Meop	Arisi River – Not River	Meop
Abiasit*	Wiri River	Maner
Bilasi*	Arisi River – Not River	Meop
Kho*	Arisi River - Mayau River – Ani River – Kanang River	Meop
Tasti*	Arisi River – Not River	Meop

* These clans are given land use rights to collect forest products in areas belonging to other clans.

3.2.2 Natural resource for cash income

Information on the collection of natural resource for cash income was obtained from interviews and FGD with the different clans in the village. In general they identified many forest products that were usually collected or hunted for daily consumption and for sale. From that list, we asked each clan to select the ten most important plants and/or animals (Table 5). The collection of forest products depends on certain conditions, i.e. availability (near the village), risk (high in the canopy), accessibility (location, topography and transportation) and potential market.

Table 5. A summary of the natural resources collected by each clan in Kwerba

Indonesian and/or in English/scientific name	Collected by clan	Season	Price (Rp[14])	Note
Ikan sembilang / catfish (Family Ariidae)	All clans	Any time	50-80,000/kg	The bladder of the catfish
Lele dumbo / catfish (*Clarias* sp.)	One clan	Any time	50,000/fish	Fresh (sold to Kasonaweja)
Mujair (*Oreochromis* sp.)	One clan	Any time	50,000/fish	Fresh (sold to Kasonaweja)
Cendrawasih / bird of paradise (*Paradisaea minor)*	Five clans	Any time	80-100,000 /animal	Sold as ornemental stuffed animals
Kasuari / cassowary (*Casuarius unappendiculatus)*	All clans	During fruit season	25-50,000/piece	Sold fresh/ smoked
Maleo (*Talegalla jobiensis)*	Four clans	Any time	30,000/animal	Sold fresh/to bake
Mambruk / crowned pigeon (*Goura victoria)*	One clan	Any time	No information available	Sold fresh/ smoked
Babi / wild pig (*Sus scrofa)*	All clans	Any time	20,000/piece	Sold fresh/ smoked
Buaya / crocodile *(Crocodylus porosus, C. novaeguineae)*	Three clans	Any time	14-16,000/inch	crocodile skins
Kanguru tanah / ground kangaroo (*Dorcopsis hageni)*	All clans	Any time	10-15,000/piece	Sold fresh/ smoked
Kanguru pohon / tree kangaroo (*Dendrolagus inustus)*	All clans	Any time	15,000/piece	Sold fresh/ smoked
Anggrek / orchids (*Dendrobium* spp.)	One clan	Any time	250,000/plant	When they visit the forests or by order

[14] Rp = Rupiah (IDR), the Indonesian currency

Indonesian and/or in English/scientific name	Collected by clan	Season	Price (Rp[14])	Note
Buah merah / red Pandanus (*Pandanus conoideus)*	One clan	Any time	20-30,000/mat	Sold as mats
Melinjo / gnetum (*Gnetum gnemon*)	Three clans	Any time	2,000/heap	Fruit
Sagu / sago (*Metroxylon sagu)*	Six clans	Depend on age of sago (10-12 years)	100,000/bag	Sold to Kasonaweja

Table 5 shows that more animals are hunted than plants. Five animals are considered more important than other species by all clans. Sago is important for six clans and still abundant in Kwerba. One clan may consider certain species of plant or animal as important when other clans do not. For example, orchids are only important for the Meop.

3.2.3 Commercial and rare species

Table 6 shows the information on species that matter to local people in terms of commercial use and rare species.

In Kwerba, men and women have different perceptions of how to determine plants and animals that have market value for their livelihoods. Commercial species refers to plants or animals that could quickly generate money, according to the women's group, and/or can be sold at a high price, according to the men's group. Table 6 shows the five most important plants and animals for commercial use. Red Pandanus (LUVI = 13.32), sago (12.75) and gnetum (10.42) are important because they can generate quick cash income as they are still abundant in the village area. The *matoa* tree (4.61) and orchids (3.35) are considered less important species. Matoa is difficult to find in the village area, but abundant in the forest. Some people collect orchids (e.g. *Dendrobium* spp.), which are easily found in the mountain forest. However, they only collect orchids when there is an order from people in Jayapura or the district.

Table 6. Commercial species by two groups of women and two groups of men in Kwerba Village

	Indonesian and/or local / English name	Scientific name	Average LUVIx100
Plant	*Buah merah* (*kacir*) / red Pandanus	*Pandanus conoideus*	13.32
	Sagu (*namok*) / sago	*Metroxylon sagu*	12.75
	Melinjo (*wac*) / gnetum	*Gnetum gnemon*	10.42
	Matoa (*hiber*)	*Pometia pinnata*	4.61
	Anggrek (*ehib-ehib*) / orchids	*Dendrobium* spp.	3.35
Animal	*Ikan sembilang* (*akunet*) / catfish	Family Ariidae	6.09
	Babi (*cipic*) / wild pig	*Sus scrofa*	5.82
	Kanguru tanah (*hower*) / ground kangaroo	*Dorcopsis hageni*	5.21
	Kasuari (*kamah*) / cassowary	*Casuarius unappendiculatus*	4.76
	Kanguru pohon (*habuak*) / tree kangaroo	*Dendrolagus inustus*	4.20

The most economically important animal is the *ikan sembilang* (6.09) for its bladder (Figure 3). Other animals such as wild pig (5.82), ground kangaroo (5.21), cassowary (4.76) and tree kangaroo (4.20) are also considered important commercial products because they are easy to catch and are still abundant around the village.

Table 7 shows the rare species identified by the local people. Plants are abundant in the village area (Wiri, Mowam and Siri rivers); only animals are considered rare.

Table 7. Rare animal species in Kwerba village

Indonesian and/or local / English name	Scientific name	Average LUVIx100
Buaya (*cidam*) / crocodiles	*Crocodylus novaeguineae* and *C. porosus*	28.75
Cendrawasih (*kacy*) / bird of paradise	*Paradisea minor*	21.25
Kasuari (*kamah*) / cassowary	*Casuarius unappendiculatus*	7.50
Kanguru tanah (*hower*) / ground kangaroo	*Dorcopsis hageni*	7.50

Crocodiles and birds of paradise also have a trade potential, i.e. bird of paradise and most parts of the crocodile (skin, teeth, meat, eggs, fat and genitals) are used as commercial products. But these animals have become difficult to hunt because of over-harvesting or difficult access. Unlike in Papasena and Kay, people in Kwerba think the cassowary and ground kangaroo are rare species. Even though the villagers hunt these animals for daily consumption, since 2000 they have become difficult to find near the village, but are still abundant along other tributaries within the Kwerba territory.

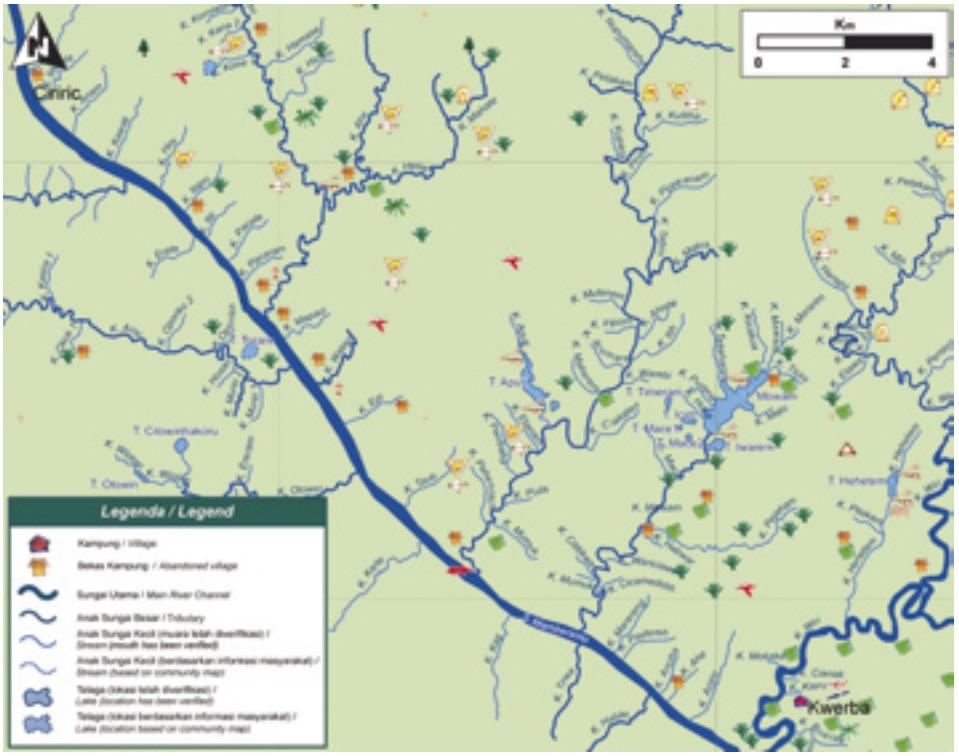
Photo by: M. Padmanaba

Figure 3. Kwerba people consider *ikan sembilang's* bladder to be an important commercial product

3.3 Participatory mapping

This activity was a follow-up from the MLA 2004 study. From the 2004 participatory map we generated three different maps: a geo-referenced natural resources distribution map, clan map and land use map.

Natural resources map (Map 2): Although local knowledge on natural resources was very impressive, the 2004 map needed to be modified after a ground check activity. Many people in the village (men, women, old and young) from different clans were involved in editing the map. As each tributary belongs to a specific clan, members of the clan were the most knowledgeable about that particular area. The natural resources are broadly distributed along the different rivers from the mouth to the upstream area of the river. The location of certain resources is easily recognized (crocodile, pig, cassowary, resin tree / *Agathis sp.*, eaglewood / *Aquilaria* sp., gardens, cemetery). Sago gardens are everywhere, and sago has become one of the most important resources.



Map 2. A portion of the natural resources map of Kwerba Village

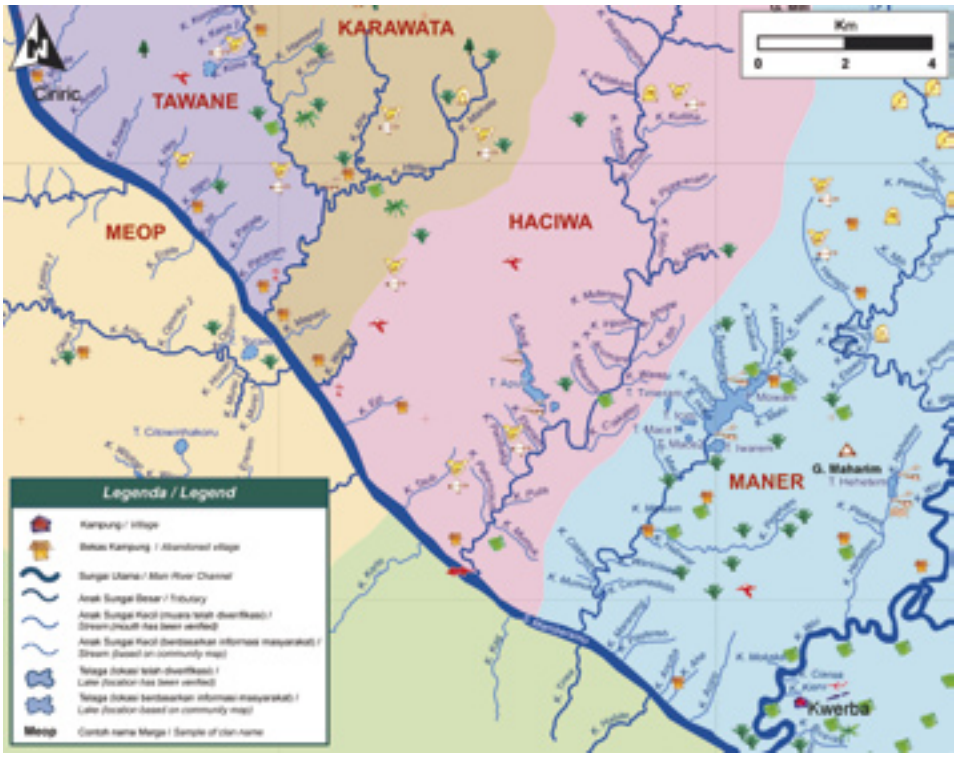
It is not only their staple food but they also use it to mark their territories. Swift caves are located in the upper area of the Wiri River but local people do not collect the nests as access from the village is difficult, even though the nests have an economic potential. They recognize that eaglewood and the resin tree are important hilly species with high economic value, but they are less interested in collecting these species because of the lack of a market. ost gardens are situated along the three rivers that belong to the Maner clan (Mowam, Wiri and Siri rivers). A few small gardens have, however, been established in other river areas as a source of food when they go hunting or are on patrol.

Lakes and rivers (e.g. Tabiri and Mowam) are other important landscapes as people still go there for hunting crocodiles and fishing. They need to travel by canoe or to walk to reach these resources.

Clan map (Map 3): This map shows the distribution of the Kwerba clan areas according to the villagers. During the map-making process, we talked carefully to the community about mapping the boundaries and limits of the clans, because it was a sensitive issue in the previous MLA activity. Nevertheless, it was necessary to obtain information on clan areas for a ground check activity as well. Most heads of clans and the older people were involved in the making of this map.

They checked their clan borders under the supervision of the *Ondoafi*[15]. Each clan is responsible for managing its resources. The leader allows them to establish gardens in the village area and to plant vegetables and fruits.

Map 3 also shows the distribution of clan areas in the Kwerba territory. All clans have access to the Mamberamo River:



Map 3. A portion of the clan map of Kwerba Village

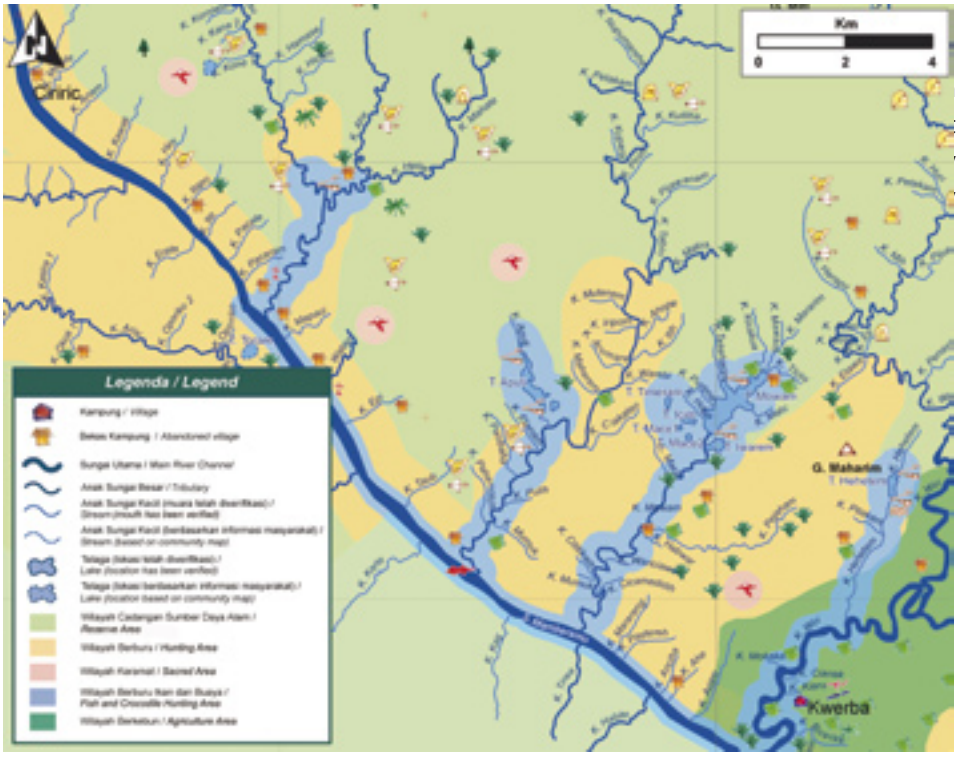
[15] Ondoafi is a specific term used in the Sentani District (http://www.bakti.org/index.php?section=163&lang=en). Ondoafi means a customary leader and people in the Mamberamo region have adopted the term.

- **The Maner clan:** This clan occupies more than 50% of the total area in Kwerba, including three rivers along the Mamberamo River (Siri, Wiri and Mowam rivers). This clan used to live in a home range from the mouth of the Wiri and Mowam rivers to the upper part of each river. This is shown by the distribution of 17 old abandoned villages along these rivers where they have planted sago, banana, coconut and fruits.

  In 1971, the Maner and other clans decided to move their village to the side of the Wiri River, in the Maner's territory. All clans living there were allowed to freely collect forest products for their own consumption.

  The collection of commercial products such as sago, crocodile, cockatoo and the bird of paradise is allowed only after permission is granted, and on the condition that the landowner receives a half share of the products collected. Collecting and hunting other products such as cassowary, ground and tree kangaroo, fishes, wild pig, freshwater turtle (*Pelochelys cantori* and *Elseya novaeguineae*), matoa, gnetum and rattan (*Calamus sp.*) is free anytime.
- **The Haciwa clan:** Only one abandoned village can be found close to the mouth of the Tabiri River. Several gardens are scattered along the river, but for their daily subsistence, they have gardens in the Maner area near Kwerba Village.
- **The Karawata clan:** The Karawata's area is the smallest of the clan areas; however, there is only one family in this clan. In early 2006, the landowner of this area passed away and the area now belongs to his children.
- **The Tawane clan:** The area is very important as all clans originally come from the hamlet of Hanem, located near the Ani River (see 3.2.1 Survey of the clans). This is why all clans still have access to this area for collecting forest products although they already have their own territories. The intersection of the Kwamah and Kwamawe rivers is an important hunting area for the Haciwa, Meop and Tawane clans.
  The Tawane clan also collects forest products in the Karawata's area (Mayau River) because these clans lived together in Hanem Hamlet a long time ago. Thirteen old abandoned villages with sago plantations can be found in this clan's area. They usually collect the sago when visiting these places.
- **The Meop clan:** This is the only clan whose area is located on the left side of the Mamberamo River. This clan has an important place for hunting, called Tadio/Keretasan forest. It is accessible only on foot from the mouth of the Piari River. The area is a rich source of various animals such as wild pig, ground kangaroo, cassowary, crocodile, turtle, fishes, *maleo* and bird of paradise.

Land use map (Map 4): Based on information from each clan and discussions with the older villagers, clan leaders and traditional leaders (*kepala suku*), the Kwerba territory is generally shared according to different land uses:



Map 4. A portion of the land use map of Kwerba Village

In Kwerba, crocodile hunting areas are situated along the Mamberamo, Siri, Wiri, Mowam, Tabiri and Mayau rivers. Several lakes are also important for hunting crocodile (i.e. Lake Hehetem, Aputi and Mowam). According to the villagers, the best places for hunting are along the riverbanks. Fishing is usually undertaken near the settlements.

2. **Reserve Areas (less intensive use for game)**
   The Kwerba people maintain more than 50% of their total area strictly as a reserve for natural resources. The main reason for this is difficult access. In addition, people want to protect their resources from over-harvesting and to keep some areas for the future. Most of this mountainous/hilly area is covered by primary forest with limited access. According to local people, plants and animals are still abundant in this area.

3. **Agricultural Areas**
   Agricultural areas are mostly located near the Wiri River not far from the village. Each clan has a small area to use for agriculture. The *Ondoafi* gives the right to use the land to villagers who need it.

Usually villagers also plant mixed crops in their clan areas which they harvest when they visit the area for hunting or patrolling.

4. **Sacred Areas**

The villagers believe that their ancestors inhabit these areas in the form of certain plants and animals. The sacred areas are scattered around the territory, near the main tributaries. If someone trespasses, it brings bad luck.

The following are some examples of sacred areas:

- The Kone 1 River: there is a sacred pool which people are prohibited from looking at if they pass nearby.
- The Lake Aputi: everybody has to talk quietly when near the lake.
- The Hanem and Amohu rivers: local people believe that the hot water pond (*mepopok*), mineral water pond (*pikaka*) and salt-water pond (*harig*), found in these rivers are all inhabited by their ancestors.
- The upstream area of the Watap River: people are not allowed to cut bamboo.
- The upstream area of the Pim River: people are forbidden to call or mention two birds: the *kokora* (*Pitta erythrogaster*) and *kwakar* (owl).
- The upstream area of the Mar and Besway rivers: people are banned from cutting the *mocian tree* to avoid *akure*[16] disease.
- The upstream area of the Acipu, Wiri, Tabiri and Kanang rivers: according to villagers, there is a crocodile that protects these places. People have to be very careful if their canoe or boat is passing these rivers. Many accidents have happened already.

3.4 Local monitoring

3.4.1 Local control of the territory

The Kwerba territory includes five major tributaries along the Mamberamo River (see Table 4). Each tributary belongs to a major clan in Kwerba (Maner, Haciwa, Karawata, Tawane and Meop) and each clan has their own land. In general the territory of each clan is limited by mountains, rivers, sago gardens or other specific features easy to identify.

All clans collect forest products but are not allowed to do so in an extensive area for a long period. For certain resources such as sago, bird of paradise and crocodile, they still need permission from the landowners.

[16] According to local belief, akure is a disease that occurs when people cut or touch the Mocian tree. This tree is similar to the nanihaya tree (Family Apocynaceae), a small tree, located in mountain forest. The main symptom is the body becomes stiff. It is believed that nobody can survive from this disease. Actually, there is no record of recent attacks of akure and it is thought to have only occured along time ago.

In 2000 the rules were changed when YALI (*Yayasan Lingkungan Hidup Irian Jaya*, a local environmental conservation NGO) and the Traditional Council of Mamberamo Raya asked people to follow new rules concerning land tenure. Now collectors have to give 50% of the forest product to the landowner to avoid conflict among clans.

There are three types of traditional ownership in Kwerba:
1) Individual ownership (*cinya hama*) is individuals who own specific areas such as forest, a small river or lake.
2) Joint ownership (*nimya hama*) is shared ownership between two or more people from the same clan.
3) Right of use (*coonemoter/conanamotera*) is the right given to individuals who are not the landowner.

Each clan controls its own territory, usually a few members patrol and stay on the upstream river area for two to four months. During the patrol, they usually collect forest products and hunt. This sort of monitoring is important to prevent trespassing.

3.4.2 Natural resources control

In order to control their natural resources, villagers use two types of prohibition in certain areas, called *Titir* and *Arach*. These prohibitions help them to maintain their resources. *Titir* is an area where people are not allowed to hunt animals. They keep this area as a reserve for game because of its difficult access. In addition, this area is considered a sacred place. *Arach* is an area in which hunting is forbidden for specific reasons, i.e. mourning. The area is closed temporarily and then opened again after the mourning period.

Usually, villagers hunt in their clan area, and look for animals from the mouth of each main tributary. Some rules are applied to hunting as well:
1. Hunting limits are fixed to protect animals from over hunting.
2. The use of certain animals (e.g. cassowary, crocodile, maleo and snake) is not allowed; where villagers believe these animals might be the reincarnation of their ancestors.
3. The use of forest products in sacred areas is not allowed, for cultural reasons (fear of the ancestors).

Villagers are trying to maintain some important species, which could have an economic value and/or that could be threatened, e.g. crocodiles and birds of paradise.

There are two types of crocodile which are usually collected: black crocodile/fresh water crocodile (*Crocodylus novaeguineae*) and yellow crocodile/sea crocodile (*C. porosus*). Businessmen living in Jayapura have collected these species since the 1970s, and some companies i.e. PT. Bintandjai and PT. Bintang Mas started to collect them in the 1980s. Crocodiles were not sold but traded during that period. Villagers could catch 5-10 crocodiles in one night and exchange them for cigarettes or clothes. According to them, the crocodile started to be traded in the 1990s and there has been a good market in Jayapura since 1992.

People recognized that crocodiles could be found easily along the Mamberamo, Siri and Mayau rivers, and in Lake Hehetem and Mowam. Even those from other places (Sorong, Biak and Serui) also hunt crocodiles in these areas. Hunters prefer to look for crocodiles at night, when there is no apparent moon, in clear water, or during the dry season when crocodiles are visible on the riverside. However, since 2001 the Kwerba people have found that it is difficult to catch crocodiles in these areas. It can now take several days before they can catch one and exceptional to catch more than one crocodile in one day. For most villagers, hunting crocodiles consumes much time and efforts and the number of crocodile they could harvest recently is not worthed if compared to the logistic they should prepare.

Villagers try to control the population of crocodiles in some places where they are still abundant, mostly in some lakes such as Hehetem, Aputi, Mowam, Iwarem, Otowiri and Wacawah. Crocodiles are also found on rivers such as the Siri and Mayau. Some rules are emphasized to control the crocodile resource. For example: collecting crocodile eggs is only allowed in a few existing nests and only crocodiles between 12 – 20 inches CBW may be hunted for their skin (Box 2).

Box 2. Commercial Belly Width (CBW) for crocodiles

CBW is defined rather technically as the "width of a crocodile skin on which at least the two outer longitudinal rows of raised scutes posterior to the nuchal shield are present and is the distance across the belly between the outer edges of the outer scutes in the third tranverse scale row behind the nucal shield, outer in all cases meaning furthest from the middorsal line" (http://faolex.fao.org/docs/texts/png51637.doc). See also Van Jaarsveldt (1987). The skin from the back of the crocodile is not measured. It is only a partial circumference. In Indonesia, CBW should be comprised between 12 and 20 inches (Keputusan Menteri Kehutanan 2827/Kpts-II/2002).

The villagers have a good knowledge on important resources including birds of paradise in their area, but they only collect two species (*Paradisaea minor* and *Seleucidis melanoleucus*), because of their potential market in the district and in Jayapura. According to the villagers, the population of these two species is also decreasing in the forests near the village. These birds are actually still abundant in the upper part of all main rivers within Kwerba but the very limited access to reach those areas are the major obstacle for people to collect the resource.

Papasena Survey

Photo by: M. Boissière

As in Kwerba, the MLA 2004 survey in Papasena implemented a series of activities during a one-month stay in the village. The 2004 MLA results form an interesting input in the discussion of local communities and conservation issues. It shows that local people still rely on the forest for their livelihoods and that for most of the categories of use and values the forest remains the most significant location.

Based on these results, the MLA 2006 survey explored the possibility of there being natural resources from the forest that could be commercially developed as an alternative source of income for local people. This included local monitoring of valuable resources. The results show that the local community considers sago (*Metroxylon sagu*, see Figure 4) and *matoa* (*Pometia pinnata*) as well as crocodile (two species: freshwater and saltwater, *Crocodylus novaeguineae* and *C. porosus* respectively) and *ikan sembilang* (Family Ariidae), as the most important plants and animals for trading.

Photo by: M. Boissière

Figure 4. A woman processing sago, a staple food in Papasena

After the 2004 survey, villagers in Papasena had two expectations: 1) to use the MLA results (especially the resource map) as a basis for discussing land conflicts with other villages around; and 2) to use the map to prove their rights over their resources to any outsider who comes to exploit the surrounding natural resources. The new improved MLA 2006 survey maps were also developed with local participation, and can now be used in discussions concerning land use planning and conservation.

4.1 The lowland village

4.1.1 Geography and history

Since the early 1970s, Papasena has been an officially recognized village under the District of Mamberamo Hulu in the Regency of Sarmi. The old village was situated at the mouth of the Daude River (a tributary of the Mamberamo River) and the villagers were all Christians of the Evangelical Christian Church (*Gereja Kristen Injili - GKI*). In 1972 a priest from the Indonesia Evangelical Church (*Gereja Injili di Indonesia - GIDI*) helped the community to construct an airstrip in a new settlement on the banks of the Daude River, which is now known as Papasena 1. A part of the community followed this new church. Later in 1973 people living in the old settlement built a new village located on the banks of the Beri River which was recognized as Papasena 2. In 1988 due to internal conflict concerning women among the old people of the Dude clan in Papasena 1, a third village, Papasena 3, was established without any official village status. From Papasena 2, a group of five households moved upstream in 2002 due to a religious conflict (they are 7th Day Adventists). Relationships among the three villages are still strong, but conflicts concerning resource use, especially crocodile hunting, occur occasionally.

Papasena 1 is situated in swampy lowland between Jayawijaya and the Foja Mountains. It is a flat area of plain and swamp forests, with the first hills some kilometers north of the village. Its elevation is 70 m above sea level. During the wet season (when the Daude River floods) Papasena 1 can be reached by motorized boat. During the dry season, however, boats can only reach the mouth of the Daude River.

Most of the houses and the communal buildings, such as the church, community centre, community health care centre (*puskesmas*)[17] and elementary school were built alongside the airstrip. The other houses are scattered widely around this central airstrip, in small groups of 3-4 houses surrounded by shrubs and small trees. CI built a conservation post in 2005 (see Figure 5) and recruited several local youths as staff for implementing conservation activities (*Penggerak Kader Konservasi - PKK*) in order to keep CI's priorities in line with local needs and provide the community with regular updates on CI's programmes. CI also donated a boat engine and a chainsaw to support local needs.

[17] The local government gave this facility to the villagers but unfortunately, the medicine was always in short supply and the medical aide representative subsequently left the village two years ago. Since then, this building has not been maintained properly and is now in bad condition.

4.1.2 The population of Papasena

The populations of more than 500 people live in 82 households. In a territory estimated at 1700 km^2 (see chapter 6.1.6), population density is around 0.36 persons per km^2, not far from the figure in Kwerba. It has significantly increased during the last two years though the number of households has remained the same. In the MLA 2004 survey, it was reported that there were 377 people in Papasena. Young couples and their children mostly live with their parents, as housing has become a major problem. It is now common to find two or more households living in the same house in Papasena. For this reason, the district government has begun a house-construction programme.

Photo by: M. Boissière

Figure 5. CI built a conservation post in Papasena in 2005

There are seven main clans of six ethnic groups in the village: Kawena and Dikibak (Batero ethnic group), Khu (Kawijta ethnic group), Dawrije (Werebo ethnic group), Dude 1 (Kwaketai ethnic group), Dude 2 (Warudargo ethnic group) and Ewey (Pokorijta ethnic group) who are also the main landowners in Papasena 1. Batero, Kawijta and Werebo are the main ethnic groups in Papasena. In addition, there are several minor clans in Papasena: Baidoba, Treido, Kusa, Maner, Kowi, Sambari, Kep-kep and Pikeri. Each ethnic group in Papasena has its own language, but three main ethnic groups (Kawijta, Werebo and Kwaketai) have adopted one common language, i.e. the Kawijta language. According to the customary leader, the other groups also use Kawijta for daily conversation in Papasena.

4.1.3 Local livelihoods

In Papasena, the staple foods are sago (cultivated and wild), bananas (*Musa* sp.), sweet potatoes (*Ipomoea batatas*), cassava (*Manihot utillisima*) and some green vegetables. Sago grows best in swampy areas and four or five bags of sago can be extracted from one tree, which is enough to feed a family for several months. Apart from these planted crops, people in Papasena rely on forest products; fruits, leaves and a variety of game: ground kangaroo (*Dorcopsis hageni*), tree kangaroo (*Dendrolagus inustus*), cuscus (*Spilocuscus maculatus*), rat (*Peroryctes raffrayana*), wild pig (*Sus scrofa*), cassowary (*Casuarius unappendiculatus*) and other birds, because the forest is still very close to the village and in very good condition.

Because of the landscape and the proximity of the Mamberamo River, fishing and hunting crocodiles plays an important role in Papasena livelihoods especially as a source of income. Several techniques are used for fishing: hook, net, poison, etc. Different varieties of fishes e.g. *ikan sembilang*, carp (*Cyprinus carpio*) and *mujair* (*Oreochromis* sp.) are caught on the Mamberamo River and its tributaries.

Some villagers collect the swim bladders of *ikan sembilang*, which are sold to collectors coming to the village, mostly from the District of Dabra and Jayapura. According to local informants, the bladders are exported to Hong Kong for medicine. The price of one kilogram of dried bladder varies between Rp 70,000 – Rp 100,000. Crocodiles are an important source of protein as well as cash income (see Figure 6). The juvenile animals and skins are sold to collectors in the district and to ranchers and/or trading companies in Jayapura. Traded skins are subject to a minimum (12 inches) and maximum (20 inches) size-limit (see Box 2), with an average price of Rp 20,000 per inch. For villagers, it is a chance to earn money and it encourages them to continue hunting crocodile and *ikan sembilang*. Even now, as the trading company's activities are decreasing, people can still find collectors and traders in the district and Iri Island to whom they can sell the crocodile skin and *ikan sembilang* bladders.

In Papasena land tenure is not only applied to forests but also to rivers and wildlife management. According to the elders, this started in 2000, when YALI and DAMR introduced new rules concerning land tenure. Each part of the territory is therefore 'owned' by a clan, but anyone is allowed to undertake subsistence activities (gardening, fishing or hunting for food) anywhere without restriction. People can also hunt anywhere they want as long as they recognize the landowner's rights and do not go into sacred areas. When dealing with extraction for commercial purposes, land rights are a more sensitive issue requiring clear authorization beforehand. Only commercial extractive activities require permission from landlords from different clans. Therefore,

crocodile hunting remains a major cause of conflict between the different villages, each arguing that it has exclusive rights to this activity, Papasena 1 because of its traditional land rights and Papasena 2 and 3 because of their proximity to the main river. Each clan owns areas often delimited by small rivers. For example, the Kwaketai ethnic group owns land along the Beri River, the Werebo along the Oire River and the Pokhorijta along the Daude River. Access to these territories is free for everybody, but land rights are kept by the main groups. Sago planting is constrained by land rights, but there are no precise rules for other kinds of gardens (mixed crop gardens), according to the villagers.

Photo by: M. Boissière

Figure 6. Crocodile skin is an economically important product

4.2 Socio-economic survey

4.2.1 Forest products for cash income

From the FGD and interviews with key informants, plant species such as sago, *masohi* (*Cryptocarya massoy*), gnetum (*Gnetum gnemon*) and *matoa* were identified as the forest resources most frequently collected by the people of Papasena. There are no specific seasons, except for *matoa*, which has two fruiting seasons: April and December.

People use plants, such as sago and *matoa* from the forest to meet their daily needs, and also to sell, mostly to villagers.

The most hunted species are crocodile, *ikan sembilang*, carp and *mujair*, wild pig, cassowary, ground kangaroo and tree kangaroo and several species of bird (cockatoos, hornbills, pigeons, parrots, and birds of paradise). Hunting crocodiles during the dry season, when water in most lakes (especially Lake Pougda), rivers and tributaries is lower, is relatively easy. Mammals and birds are found in huge numbers everywhere, mainly during the fruit season, while fishes including *ikan sembilang* can be caught anytime in all lakes, rivers and tributaries. The people of Papasena use animal resources both for daily consumption and for sale.

4.2.2 Commercial and rare species

Two scoring exercises adapted from MLA methods were implemented during focus group discussions with two groups of men and women. The discussions focused on plants and animals important for trading, which are now rarely found by villagers. Table 8 shows that sago scored much higher than other commercial species as it is the main food for most people. In addition, crocodile and *ikan sembilang* are also considered important commercial resources.

Table 8. Commercial species in Papasena

	Indonesian and/or local / English name	Scientific name	Average LUVIx100
Plant	*Sagu* (*pii*) / sago	*Metroxylon sagu*	19.44
	Matoa (*poki*)	*Pometia pinnata*	6.38
	Melinjo (*tourah*) / gnetum	*Gnetum gnemon*	3.53
	Pinang (*tia*) / Areca nut	*Areca catechu*	3.17
	Siri hutan (*pakari awirug*) / betel	*Piper betle*	1.46
Animal	*Buaya* (*pay*) / crocodile	*Crocodylus* sp.	7.74
	Ikan sembilang (*tari*) / catfish	Family Ariidae	6.42
	Babi (*iig*) / wild pig	*Sus scrofa*	4.04
	Kasuari (*khu*) / cassowary	*Casuarius unappendiculatus*	3.55
	Ikan mas / carp	*Cyprinus carpio*	3.24

It is interesting to see that local people also believe that some products, such as sago, *matoa*, gnetum, crocodile and wild pig are rare. The crocodiles are the second rarest species in this area after birds of paradise (see Table 9) as it has been over hunted, mainly since companies looking for animal skins came to the region in the 1970s.

Table 9. Rare species in Papasena

	Indonesian and/or local / English name	Scientific name	Average LUVIx100
Plants	*Sagu* (*pii*) / sago	*Metroxylon sagu*	5.88
	Matoa (*poki*)	*Pometia pinnata*	3.25
	Melinjo (*tourah*) / gnetum	*Gnetum gnemon*	1.88
	Sukun (*kwa*) / breadfruit	*Artocarpus altilis*	1.50
Animals	*Cendrawasih* (*dii*) / birds of paradise	Family Paradisaeidae	26.38
	Buaya (*paij*) / crocodile	*Crocodylus* sp.	20.00
	Nuri / parrots	Family Psittacidae	5.00
	Babi (*iig*) / wild pig	*Sus scrofa*	4.00
	Kakatua putih (*wii*) / sulphur-crested cockatoo	*Cacatua galerita*	2.88

This demand for crocodile skins has led the local people of Papasena and other villages to put more effort into crocodile hunting. Birds of paradise are considered the rarest animal as they were frequently caught alive for their high price and have now become difficult to find. Other birds such as parrots and cockatoos (see Figure 7) have also become rare since they are often hunted for their meat and the juvenile animals are taken for sale. As some resources are no longer easy to find a rule has been issued by the village head and the *Ondoafi*[18].

4.3 Participatory mapping

The main aim of this activity was to improve the participatory map developed during the MLA survey in 2004 by conducting a field survey using GPS to verify the main information given by the community. Combined with information obtained during FGD, the results from the ground check were analysed using Geographic Information System (GIS) software to create three new maps: a geo-referenced natural resources distribution map, clan map and land use map (see Annex 1 for more information on the methods).

[18] A definition of the term 'Ondoafi' has been given in footnote 10 on page 26.

Photo by: D. Sheil

Figure 7. Cockatoos are often captured for sale

Natural resources distribution map (Map 5): We can see from Map 5 that, in general, all information on the MLA 2004 map is still relevant; however, this improved map is now more accurate. Some changes were noted in the field concerning, for example, the names of some places. For instance, a river near Papasena 3 was identified as the Tawrig River on the map, but during the ground check the key informant said it was actually the Tarbo River.

This might have happened because the former informant was not the owner of this particular area. The shape of some parts of the main rivers and lakes such as Kakug and Puarite looked different compared to the 2004 map. This may have been caused by river or water flow dynamics. Having been verified and formalised, the shape and position of most features such as villages, old abandoned villages, rivers, tributaries and lakes are now more accurate. The map can now be used for further discussion concerning clan areas and traditional land use. Important resources for example plants, animals, rivers,

tributaries and lakes, which have been drawn on the map covering village areas, are mostly situated in the northern part of main river channels. However, less information on resources appears in the mountainous terrain, possibly because the area is difficult to access.

Map 5. A portion of the natural resources distribution map of Papasena Village

Clan map (Map 6): This map is based on the natural resources distribution map and shows areas claimed by the different Papasena clans. However, clan areas were not geo-referenced and only based on information collected during discussions with representatives, including the *Ondoafies* – Apolos Dude (Papasena 1) and Timotius Kawena (Papasena 2) - in the villages (see Table 10).

Overall, there are two different things on the clan map of Papasena that do not appear on the maps of the two other study villages. First, there is one clan whose area is separated in two different places, in hilly terrain and on the bank of the main river channel. This enables the clan, i.e. Dude 1, to access the Taritatu River, the main channel where most villagers hunt/fish crocodile and *ikan sembilang*.

Map 6. A portion of the clan map of Papasena Village

Table 10. Areas of the seven dominant clans in Papasena

Clan	Claimed Areas
Dawrije	Ari River - Dawig River - Siri River
Khu	Ari River- Beri River
Ewey	The mouth of Daude River - Arpu River- Lake Poipu– Lake Toraru
Kawena	Beri River at the mouth of Kware River - Foja Mountains
Dude 1	The mouth of Beri River - Kuare River - Daude River
Dude 2	Oire River - Tarbo River
Dikibak	Bare River - Arue River

Second, there is one clan (Kawena) who lives outside its traditional territory i.e. in the Ewey clan area around the Taritatu River. According to our informants, Kawena people used to live in mountainous terrain in the northern part of Papasena village. Due to conflict, the remaining Kawena people moved downstream and married local people in the Papasena area. Up till now, they live on the banks of the Beri River and have access to the main river for fishing and hunting crocodile.

The Dawrije was the first clan to settle in this area, and have retained their original land ownership, which is mostly covered by secondary swamp forest and secondary lowland forest. Though most of them have moved and now live in Papasena, two Dawrije settlements with a few houses can still be found in Werebo near the mouth of the Soaki River and on Ari Island on the Mamberamo River. Abandoned villages of the Papasena people can be found at the mouth of the Wariso River, which separates Papasena from Sikari Village and where people have planted fruit trees. This shows that the clan members are maintaining a regular presence in their traditional lands.

Most Khu clan areas are dominated by primary swamp forest. The mouth of the Tikari River is an important hunting area, as are areas in and around lakes Puarite and Kakug, particularly for fishing and hunting crocodiles. Dawrije clan members are allowed to take natural resources from these areas as these two clans are related.

The Ewey clan has laid claim to the location of Papasena 1 and 2, where most crops are cultivated. Primary lowland forest is the major vegetation type. A few natural gaps and old gardens occur along the banks of the Daude River. In addition, some important plants: sago, gnetum, *matoa*, *masohi* and rattan; and animals such as: pig, cassowary, maleo and ground kangaroo were recorded in this area. Potential sites for fishing and hunting crocodiles have been identified on some lakes: Toraru, Augtai, Pougda, Pokobi and Tajakre; and on the Daude River.

Dude 1 clan areas are situated in two different sites: a small part in the southern area of the Taritatu River and a bigger part upstream on the Daude River (upper part of the Arpu River). This small area, including lakes Wariste and Warigku, is a primary swamp forest, which has fishing and crocodile hunting potential. The bigger part is mostly covered by primary lowland forest with some small gardens along the Beri River. Dude clan members used to live in Papasena 1 until an internal conflict separated them into two clans, i.e. Dude 1 and Dude 2. Dude 1 remained in Papasena 1 while the Dude 2 moved to the banks of the Oire River. This has led to the establishment of a new settlement, Papasena 3, which is still administratively dependent on Papasena 1. According to our key informants, people in Papasena 3 want to form a new official village.

Primary swamp forest seems to dominate the area claimed by Dude 2. Most of their areas are used for hunting (wild pig, cassowary, kangaroo and several kinds of birds). There are small gardens around the village and potential areas for fishing and crocodile hunting on lakes Treta and Dauri.

Almost all areas claimed by the Dikibak are covered by primary swamp forest. One place close to the mouth of the Arue River, is a popular fishing and crocodile hunting area. A

permanent hut has been built there and sago planted for those who stay overnight.

The biggest, and the farthest area, belongs to the Kawena clan who mostly live in Papasena 2. It is covered by primary lowland, then hill forest from the mouth of the Kware River up to the Foja Mountains and thus mainly defined as sacred areas. On the clan map, there is insufficient information concerning the Kawena clan area in the mountains. The Kawena clan limits are marked with dashed lines on the map.

Land use map (Map 7): This map is also based on the natural resources distribution map and describes land use areas which can be categorized as crop growing, hunting, fishing, sacred places and areas which are less intensively used. These categories show how local people use their land to meet their daily needs. Among all land uses, crop growing is the most limited, mostly around the villages, where people plant sago, banana, sweet potato, cassava, coconut, red Pandanus and vegetables for food. No crops are planted in the southern areas of the Taritatu River, which is covered by swamp. The information on this map is not geo-referenced and only obtained from discussions in the village.

Map 7. A portion of the land use map of Papasena Village

Gardens and forests around the village provide other resources important for local needs such as wood for building boats, house construction, firewood and medicine. Some small gardens have been cultivated outside the village along the banks of the rivers and even the upper reaches of the rivers. They are an important food supply for villagers when hunting and patrolling.

Hunting areas are defined as the areas where people regularly go to catch game (pig, kangaroo, cassowary and other birds, etc.) both for food and sale. They start from the Soaki River, a tributary of the upper Mamberamo River and go up until the upper part of the Arue River, a tributary of the Taritatu River. Although people hunt close to the village, they also spend one day hunting and collecting non-timber forest products and come back to the village the same evening. Sometimes they walk further and spend a night in the forest. They also regularly hunt until the upper part of the tributaries in small groups of 3 – 5 people and spend a couple of weeks or even one month in the forest, build a hut, cultivate small gardens and hunt. They do this actually to mark and control their territory. During our field activities we found many animal footprints and heard animals, indicating they were still plentiful around the village and people did not need to go far to catch them.

We considered areas for fishing and hunting crocodiles to be different from 'hunting areas' because of the different land type. In addition, fishes (especially *ikan sembilang*) and crocodile are specific resources, which people consider important based on our scoring exercises. Areas for these activities include the Taritatu River and almost all lakes around it. Groups of 2 – 4 people usually hunt crocodile at night, mostly during the dry season (July – August). During daylight, they earn additional income by fishing in the same area. They go fishing anytime particularly for catfish because of its highly-priced bladder.

People of Papasena, especially the members of the Ewey Clan, are allowed to extend their area for fishing and crocodile hunting into the Pakuja Village territory. This is most probably because they are related. On the map we gave this extended fishing and crocodile hunting area a different mark.

Another land use category is the sacred area, which is situated in the mountainous terrain north of the village. Everyone must ask permission from their ancestors' spirits and carry out a little ritual, led by a local guide, before passing it. This is believed to avoid bad luck or being disturbed by the spirits. The lower part of the sacred area overlaps with the hunting area in some places. According to informants, there are still a lot of important resources in this area but since it is located in rugged terrain, almost nobody goes there. Only a few people sometimes hunt animals while conducting

territory control (see 4.4.1 Local control of the territory). There is also a piece of land in the northern part of this sacred area (owned by the Kawena) for which there is no available information on the natural resources. The map we brought with us to the field did not include that particular area.

We consider the area, which is not included in any of these categories to be the less intensive use area. It refers to the area only occasionally used for planting crops and hunting and on a less intensive scale. This area is from the upper part of the Oire River to the west until the upper part of the Arue River.

4.4 Local monitoring

4.4.1 Local control of the territory

In order to defend and safe guard their customary lands, each clan regularly sends a group to patrol and stay in the area for a period of two to four weeks. If needed, they stay longer, up to three months in the upper reaches of the rivers. When they meet outsiders, they ask the purpose of their visit and the resources they are looking for. The Dikibak clan have a permanent guard at the mouth of the Arue River to protect their natural resources. No specific equipment is used only common tools for hunting and gardening such as a machete, knife, torches and bow and arrows.

Land tenure is a sensitive issue and may lead to conflict among local people as there is still no official rule. These issues were more flexible before YALI activities, when people were free to collect forest products without any strict land rights. Because each clan's responsibility was emphasized by YALI, as a way to control the depleting natural resources, tensions arose. The elders now regret the changes made by YALI, but the younger generations believe that more profit can now be made from the natural resources.

4.4.2 Natural resources control

In general, natural resources are still abundant in Papasena. People hunt within a couple of hours walk from the village. Recently, however, people catch fewer of some important species such as crocodiles and *ikan sembilang* than they could several years ago. The villagers believe that the decline coincides with the arrival of outsiders, who came to the village to trade in these species.

People have a simple way of informally monitoring the number of catfishes as they fish. They do this by putting a net across a lake for example and leaving it for a night and can compare the yields they get over time. Our informants suggest that people do the same for other fishes. To monitor crocodile availability, the easiest way is to observe the number and the size of footprints found in the soft ground around the river. This is much easier when the river is low. Crocodiles can also be detected and monitored directly at night using a torch as their eyes reflect the light.

Those who catch crocodiles and sell them must pay a certain amount to the *Ondoafi keret*[19] and the landowner. Among the clans, the leaders have agreed to close certain lakes for crocodile hunting, to give the animals a chance to breed naturally, without any disturbance. There is no definite length of time for such closures. They may be for several years or until the leaders think the availability of crocodile in the lakes is sufficient to meet their needs.

[19] Apart from Ondoafi in general, specifically in Papasena, people also use the term Ondoafi keret who is a clan leader, mainly responsible for looking after the forest inside the clan area.

Kay Survey

Photo by: M. Boissière

Kay is a new location for CI activities. This location was decided with a former agreement from the local community, and the traditional leader Sonny Weriko. Initially, the survey was planned for Baso/Fuaw Villages, in Mamberamo Hulu District. The decision to shift from Baso/Fuaw to Kay was taken because we could not obtain full approval from the Baso and Fuaw communities. Equally no agreement was reached with the leaders of Baso and Fuaw during meetings in Dabra. The villagers were worried that if CI built a conservation area in their territory they would be prevented from hunting and collecting important forest products for their livelihoods. The team did not want to begin new activities under these conditions. After obtaining a formal agreement with Sonny Weriko, one of our team members went to Kay to explain the aims of our study and to confirm the villagers' agreement to host us during our three-week survey. Then, the rest of the team followed.

5.1 The swamp village

5.1.1 Geography and history

The village is situated on the banks of the Tariku River, in swampy lowland. The traditional territory of Kay is different from the two other case studies. It follows the Tariku River for 80 km, forming a band of about 10 km wide on each side of the river. The local communities are almost totally dependent on the environmental services provided by the river system and the surrounding swamps. The only access to their different settlements, in the middle of this 1,300 km^2 territory, is by boat (Kay's airstrip is in bad repair). The territory is flat and occasionally flooded (during the rainy season) near the river, but north of the river, after a few kilometres of swamp, there are hills and low mountains.

The first villagers were from two distinct clans: Weriko and Krakuko, both from the Torweja ethnic group (see Table 11). They moved from Sikari, Burmeso and Marina Valen to the Tariku area (near the mouth of the Deido River). Outsiders (probably missionaries and traders) came to the region in the 1950s and regrouped the different communities into one single village at the mouth of the Oi River. Then in 1992 an airstrip was built on the actual location of Kay 1 and the communities moved there. The different villages started to convert to Christianity in 1968. From the time they moved to Kay 1, seasonal floods regularly threatened the village and destroyed the gardens. For these reasons, when the government looked for a location for the district, a higher site was chosen. The reason for moving to Kay 2 was because of regular flooding.

Three settlements can be found near Kay:
- Kay 1: the main (and first) village (*Desa*) of the region.
- Kay 2 (or Bakaije): a part of Kay population moved to a new location, situated on the banks of the Oi River.
- Kay District[20]: a new district town/village is currently being built (started in 2003) upstream from the Akru River, on solid ground, which is safe from floods. From Kay 1, the district town/village can be reached by small boat on the Akru River during the rainy season (when the river is high enough) and by foot (about 6 km) during the dry season.

5.1.2 The population of Kay 1

The village consists of 26 households (163 inhabitants)[21]. There used to be more villagers but, in 2006 some moved to a new location upstream to build a new district village. With a best estimation of the territory of 1300 km^2 (see chapter 6.1.6), the population density in Kay is around 0.13 persons per km^2, about three times less than Kwerba or Papasena. This is the area of lowest population density among the three villages. A primary school was built in Kay 1 in 2001 but at the time of the survey there was no teacher.

Table 11 shows the different groups of Kay, according to the ethnic and clan. From this table we can see that the main clans represented in Kay belong to the Torweja ethnic group, which was the first ethnic group in the region. The Kwersa is second, although they are now the majority in Kay 1 (most of the Torweja have moved to the district and Haya). In Kay there are two local languages spoken: Torweja and Kwersa, following the two main ethnic groups represented in the village. The Wekerig is an ethnic group living in an enclave inside Kay territory, Kosware village, but administratively depends on Haya Village. Kosware Village is located on a peninsula on the Tariku Riverside, downstream from Kay.

Table 11. Main divisions of ethnic groups and clans in Kay

	Ethnic groups (suku)	Clan (marga)
1	Kwersa	Foruo, Kwersa, Tiasa
2	Torweja	Fikeri, Kaesa, Kasitai, Kosugo, Krakuko, Tebeiko, Ton, Totow, Weriko
3	Wekerig	Kano

[20] This is the base of the district government.
[21] Although we conducted some household surveys and community meetings in the district, and had some discussions with villagers from Kay 2, our main activities took place in Kay 1.

The distribution of the different clans in Kay territory can be seen on Map 9 (see 5.3 Participatory mapping). From this map, even though there is no official limitation of formal territories between each clan and village, we can gain a general idea of how the different clans are exerting control over the length of the Tariku River and its tributaries. Later we used this map to discuss the participatory mapping of the resources and the land-use map.

Roughly we can see that the Kay territory is divided into two parts: from Kay 1, upstream on the Tariku River, the groups speaking the Kwersa language are dominant; downstream, until the mouth of the Tariku flowing into the Mamberamo River, the Torweja groups are dominant. This division of the territory not only influences the land use (rich crocodile lakes are more numerous upstream, but bigger downstream), but also the knowledge of the resources, of the different features of the landscape, and of course of the stories, in each part of the territory.

5.1.3 Local livelihoods

The main vegetation, around Kay 1 village, is mostly wild sago palm (*Metroxylon sagu*). Unlike the other sites, sago in Kay is rarely planted as it grows naturally in the swamp along the Tariku River. Huge portions of forest are uniformly made of sago. Villagers also have mixed crop gardens, sweet potatoes (*Ipomoea batatas*), *taro* (*Colocasia esculenta*), and fruits trees, for example red Pandanus (*Pandanus conoideus*), papaya (*Carica papaya*), jackfruit (*Artocarpus heterophyllus*), banana (*Musa* sp.), mango (*Mangifera indica*) and breadfruit (*Artocarpus altilis*). But the gardens are often victims of regular floods that destroy them. Therefore, villagers do not rely on these crops for their livelihoods, but more on sago, which is important, with livestock (chickens and domesticated pigs), fishes (catfish, carp, etc.), crocodiles (*Crocodylus porosus* and *C. novaeguinae*) and game (birds, wild pigs and cassowaries).

For these reasons, gardens are not situated close to the village, but are opened on the different islands of the main river. In the village, houses in general occupy the available land, and some fruit trees are found dispersed around the settlement. The gardens on the islands have two main functions: they are a source of food when travelling along the river (about 80 km long) and are the best way to mark a territory and confirm land rights. We will see below that the control and monitoring that the villagers exert over their important territory is what counts (see 5.4. Local monitoring). But the gardens are ephemerals, islands appear and disappear with the floods due to river dynamics, and because the soil is made of clay, without any stones. Usually, on these islands villagers also keep some domesticated animals (pigs and chickens).

Photo by: N. Liswanti

Figure 8. Local people use red Pandanus as seasonal food

There is only one shop in the village where basic goods can be purchased (rice, cooking oil, dried fish, salt, sugar, tea, coffee, etc.). The owner buys the products from company boats (e.g. PT. Bintang Mas) and from a Kaso police officer who regularly comes to the village.

5.2 Socio-economic survey

Following this quick overview of the Kay geography and people, socio-economic information was collected in and around the village (Kay 2 and District).

5.2.1 The importance of land types

This scoring exercise was conducted in Kay for the first time, and because the villagers were busy preparing for the Christmas events, it was difficult to find enough informants for the PDM activities. The women were more confused and reluctant to participate in the exercises than the men.

Table 12 shows that for all use categories, the forest is the most important place, followed by main rivers and then swamp lakes. This is because the main resources for livelihoods (food, construction, etc.) and for cash (crocodile, catfish, etc.) are found in these three land categories. The sacred places, abandoned villages, swamps and islands were given a low score because people rarely go there. For sacred places, they need to perform specific rituals before any visit.

The lowest score was the village because people only stay there, but when they have to look for food or marketable products, they go outside the village. Even gardens are rare near the village, as they are mostly located on the islands on the Tariku River. The islands were also given a low score because they are only used for gardens and pig husbandry, but mixed-crop gardens are often flooded and therefore do not represent the main source of food in the village (people rely more on wild sago, and fishes).

Table 12. Mean importance of land types per category of use as scored by two groups of men and one group of women

Land types	All	Food	Medicine	Light construction	Heavy construction	Boat	Tools	Firewood	Basketry	Ornemental/ritual	Marketable items	Hunting function	Place for hunting	Recreation	Future
Forest	16.0	12.7	15.7	18.7	20	21.3	16.3	15.0	15.3	19.0	13.7	16.3	17.0	8.0	17.3
Village	5.0	7.0	10.3	6.0	6.7	4.7	7.0	8.7	5.7	4.0	5.3	10.0	5.7	14.3	6.3
Abandoned village	6.0	6.0	6.0	6.0	5.0	8.0	7.3	4.3	6.3	7.7	6.7	9.0	4.7	11.3	7.3
Garden	8.0	10.7	8.0	5.7	6.7	3.7	6.7	13.0	6.3	9.3	8.7	7.3	9.0	3.3	7.0
Old garden	7.0	6.3	6.7	8.7	7.3	9.0	7.3	11.3	6.3	7.3	7.0	10.7	6.7	2.0	5.7
Mountain	7.0	5.3	6.0	4.7	6.7	5.3	9.0	4.7	5.3	10.7	6.3	5.7	5.0	3.7	5.0
Sacred place	6.0	2.3	2.7	2.0	3.7	0.7	3.0	1.0	1.3	1.0	3.3	2.0	5.3	1.0	4.0
Swamp	6.0	4.3	5.7	3.7	5.0	2.7	7.7	2.0	10.7	8.7	3.0	2.7	7.7	1.3	2.7
Lake	12.0	15.0	10.3	8.0	6.3	6.3	8.0	5.7	4.0	4.0	16.7	8.0	10.7	8.3	14.3
Island	6.0	8.0	5.0	8.7	6.3	7.3	8.3	10.3	11.0	7.0	8.0	7.7	9.7	21.0	7.7
Small river	8.0	8.7	11.0	11.3	10.3	13.7	7.7	9.3	14.3	9.3	8.3	8.0	10.0	4.7	7.3
Main river	14.0	13.7	12.7	16.7	16.0	17.3	11.7	14.7	13.3	12.0	13.0	12.7	8.7	21.0	15.3
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

When we consider each category of the table individually, the forest is the most important for all except three categories: food, because the lakes and rivers provide some important food (fishes and crocodile) for the villagers; marketable products, because the lakes are the main place to look for crocodiles; and recreation because children like to play on sandy beaches on the riverside, and because of the presence of

wild sugar cane (*Saccharum spontaneum*) that they use to play with. Adults enjoy the riverside too to relax. The forest is the most important land type for future generations, as it provides the most important resources for villagers. For the boat category, the river is second after the forest. This is because important trees for making boats grow near the river, or have fallen on the riverside, and then it is easier to transport the boat to the river when it is finished. The river is also important for firewood as a lot of deadwood is carried by the river, and is easy to collect from there. The lake is the third important land type (see Figure 9).

The forests, rivers and lakes are the places where most of the village activities take place. They represent the main locations, where land tenure is sensitive, and where landlords strictly exert control over their resources (see 5.4 Local monitoring). The village was also given a high score, as it is important for medicinal products, because many medicinal plants grow (naturally or planted) near the settlements.

5.2.2 Importance of the forest per use category

Villagers identified an important number of forest types, for which they recognize specific ecological features. Swamp forest represents the main forest type in Kay territory, but accessible only during the dry season. The mountain forest is located in the north of the territory, on the upper part of Oi River, and between Kay and Sikari. Secondary forests occur near the villages in old regrowth forests where villagers collect timber and firewood, or following natural disasters such as landslides.

Lake forests participate in the dynamics of swamp lakes, progressively closing them. The villagers think of the riparian forest as two types, both grow on the riversides, but not directly in the water. One type of riparian forest is made up of large areas of sago, important on the Tariku River, and the other type has no sago areas. The rattan forest is thought of as forest on solid ground (but muddy and regularly flooded) where wild pigs and cassowaries are abundant. This forest type is marked by the importance and diversity of palms. We found one near Kay District.

With all categories of use considered together, the most important forest is riparian, followed by secondary (Table 13). Near the river people can find game and timber for house construction, huts and canoes. Secondary forest is important because it is close to their gardens, a lot of small and useful trees are found there. The third most important forest type is in the mountains, as the best quality timber can be found there, and it is the habitat of many animals. Swamp and rattan forests have low scores because their access is difficult.

Photo by: M. Boissière

Figure 9. The swamp lake is an important land type

Table 13. Mean importance of forest types per category of use as scored by two groups of men in Kay

Forest types	All	Food	Medicine	Light construction	Heavy construction	Boat	Tools	Firewood	Basketry	Ornemental/ ritual	Marketable items	Hunting function	Hunting place	Recreation	Future
Swamp forest	7.0	5.0	6.0	10.0	9.5	9.0	6.0	6.5	2.5	7.0	6.5	7.5	7.5	12.0	7.5
Mountain forest	15.0	13.0	26.0	13.5	19.5	21.5	29.0	18.5	24.0	21.5	18.5	20.0	20.0	18.0	21.0
Secondary forest	17.0	8.5	9.5	17.5	16.0	10.5	7.0	17.5	5.5	7.5	8.5	9.5	7.0	11.0	6.0
Lake forest	13.0	14.5	22.5	11.5	10.5	14.0	13.5	17.0	13.5	12.0	24.0	13.5	14.5	17.5	16.0
Riparian forest	**28.0**	28.5	22.0	25.0	18.0	26.0	26.0	24.5	29.5	18.5	19.5	18.0	21.5	23.5	19.5
Rattan forest	7.0	9.5	7.0	8.5	12.0	8.5	4.5	5.5	17.0	16.0	8.0	14.5	12.0	8.0	11.5
Sago forest	14.0	21.0	7.0	14.0	14.5	10.5	14.0	10.5	8.0	17.5	15.0	17.0	17.5	10.0	18.5
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

If we consider each category of use individually, riparian and mountain forests are the most important for each category except for marketable items which are found mostly in the lake-forests. Riparian forests are the most important for food, because villagers fish with nets near the riverside, for many animal resources, and because of the presence of sago. For food, sago forests are the second most important, followed by lake forest. Mountain forests are considered the most important place for timber for heavy construction because of the presence of valuable species for construction (e.g. resin trees), even though, in general, villagers look for wood for construction in more accessible places. Mountain forest is also the most important forest for the future, followed by riparian forest, because of all the services it provides, and the elders often ask their children to take special care of these forests. They are considered reserves, because of their difficult access.

The results for marketable products were not surprising, as lake forests (where crocodiles are most numerous) were first, followed by riparian forest. Villagers do not think of the lake by itself, but also the surrounding forest. Animals are largely available in the forests situated on the riverside. In lake forests, there are a lot of foods for fishes from the trees, and fishes are then eaten by crocodiles, which are a valuable resource. In the forest near the lakes, a lot of holes in the wood host valuable birds, such as parrots.

5.2.3 Natural resources for cash income

Many natural resources have been identified by the villagers, which are regularly collected or hunted. For some of resources, information on the prices they could be sold for was available.

Table 14. Natural resources in Kay

No	Indonesian and/or English/scientific name	Season	Price (Rp)
1	*Buaya* / crocodile (*Crocodylus porosus, C. novaeguinae*)	In genereal, any time during the dry season, and at night during any season	20-21,000/inch of skin
2	*Mambruk* / crowned pigeon (*Goura victoria*)	Anytime	50,000/animal
3	Fishes*	More plentiful during dry season, when butterflies are available	i.e. bladder of catfish= 50-100,000/kg

No	Indonesian and/or English/scientific name	Season	Price (Rp)
4	*Cendrawasih* / Bird of paradise (Family Paradisaeidae)	When trees are fruiting during the wet season	250-500,000/animal
5	*Sagu* / Sago (*Metroxylon sagu)*	Anytime when it starts to flower in no particular season	50,000/bag of starch
6	*Lao-lao* / ground kangaroo (*Dorcopsis hageni*)	Anytime	15-20,000/animal
7	*Kasuari* / cassowary (*Casuarius unappendiculatus*)	When trees are fruiting during the wet season	3-4,500,000/animal
8	*Babi* / wild pig (*Sus scrofa)*	When trees are fruiting during the wet season	3-5,000,000/animal
9	*Matoa* (*Pometia pinnata)*	Anytime as it fruits, regularly throughout the year	5-6,000/heap of fruit
10	*Kura-kura* / freshwater turtle (*Pelochelys cantori and Elseya novaeguineae*)	Dry season	10,000/animal
11	*Merbau* / iron wood (*Intsia bijuga)*	Anytime	10,000/m^2
12	*Buah merah* / red Pandanus (*Pandanus conoideus)*	Seasonal, once a year (September)	300-500,000/litre of oil

*including catfish, carp, mujair (*Oreochromis* sp.), tawes (Family Cyprinidae), gabus: gudgeon (Family Eleotridae) or gobies (Family Gobiidae).

Table 14 shows a selection of natural resources harvested by the villagers. Examples of important resources for the people in Kay can be seen in Figure 10. In Annex 5 we provide a complete list of commercial products.

Photo by: M. Boissière

Figure 10. Freshwater turtles are hunted mainly during the dry season

5.2.4 Most important species

Only the men followed the scoring exercises for the important species (Table 15). The socio-economic team tried to collect information from the women, but it was a difficult task, as almost no woman actively participates in hunting and associated activities. Two more possible reasons for their shyness may have been that they had probably never been interviewed by outsiders before, and it may have been their first experience of sharing their perceptions about land features and resources. The results presented below are from the men's groups only.

Table 15. Top 10 plants in Kay Village, scored by two groups of men

No.	Indonesian and/or local/English name	Scientific name	LUVIx100
1	*Sagu* (*fii*) / sago	*Metroxylon sagu*	5.49
2	*Merbau* (*tokou*) / iron wood	*Intsia bijuga*	3.29
3	(*kay*)	*Calophyllum peekelii*	2.71
4	*Matoa* (*ceeri*)	*Pometia pinnata*	2.35
5	*Melinjo* (*sura*) / gnetum	*Gnetum gnemon*	2.31
6	*Sabo*	*Ficus polyantha*	1.74
7	*Jambu hutan* (*tagki*) / wild guava	*Syzygium* sp.	1.32
8	*Sukun* (*kwa*) / bread fruit	*Artocarpus altilis*	1.10
9	*Kayu merah* (*babe*)	*Calophyllum* sp.	1.04
10	*Buah merah* (*oosi*) / red Pandanus	*Pandanus conoideus*	0.90

From the different categories of use, and after applying the LUVI index (see 2. Methods), sago came first as it represents the staple crop in Kay. Both sago and breadfruit are important foods. Sago is also considered important for construction, because its leaves are the main roofing material. Its importance value for construction is comparable to iron wood (important for making tables) and *Calophyllum* sp., a strong wood used for all kinds of construction and tools. Sago starch can also be sold, making it a valuable product. Some fruit trees also scored high (matoa, wild guava, and red Pandanus) because they play an important part in the local diet, even though they are seasonal.

Not surprisingly, the best scores for animals were for crocodiles, cassowaries, wild pigs and *ikan sembilang*, as they are the main resources for food and cash (Table 16). Crowned pigeon is also hunted for food, to make tools (arrows) and to be sold (but less important than parrots for this last use). Crocodiles, monitor lizards and snakes are also used for medicine.

Table 16. Top 10 animals in Kay Village, scored by two groups of men

No.	Indonesian and or / local/English name	Scientific name	LUVIx100
1	*Buaya* (*feija*) / crocodile	*Crocodylus novaeguineae*	2.54
2	*Kasuari* (*kuu*) / cassowary	*Casuarius unappendiculatus*	2.47
3	*Babi* (*iig*) / wild pig	*Sus scrofa*	2.33
4	*Ikan Sembilang* (*ceri*) / catfish	Family Ariidae	1.14
5	*Mambruk* (*tobi*) / crowned pigeon	*Goura victoria*	0.86

No.	Indonesian and or / local/English name	Scientific name	LUVIx100
6	*Nuri merah* (*ouwi*) / parrot	Family Psittacidae	0.51
7	*Soa-soa* (*kwisi*) / monitor lizard	*Varanus* sp.	0.50
8	*Lao-lao* (*suu*) / ground kangaroo	*Dorcopsis hageni*	0.48
9	*Kura-kura* (*furuferi*) / freshwater turtle	*Pelochelys cantori and Elseya novaeguineae*	0.45
10	*Cendrawasih* (*diyaa*) / birds of paradise	Family Paradisaeidae	0.44

5.2.5 Commercial and rare species

Two additional exercises were added to the regular MLA scoring exercises: we first scored the important species for commercial use, according to the villagers, and then the rare species. Table 17 presents the plant and animal species which have or could have a market value, according to our informants.

These species could be selected for monitoring, if the villagers want to develop their extraction for cash earning. In Table 17, there are two plant categories are scored: plants that are, or could be, sold for food (sago, gnetum, red Pandanus, matoa), and those sold as timber (iron wood).

Iron wood has a high potential for logging, and villagers have already thought about it for future business activities. At the district office, we saw a note on prices per cubic meter for future logging companies that may be interested in the resource. Sago is everywhere, and its monitoring is less an issue, as long as the demography is low. But *matoa* could be threatened in the long term, because of harvesting techniques (see 5.4 Local monitoring).

Table 17. Commercial species in Kay Village, scored by two groups of men

	Indonesian and/or local/English name	Scientific name	LUVIx100
Plant	*Sagu* (*fii*) / sago	*Metroxylon sagu*	6.41
	Matoa (*ceeri*)	*Pometia pinnata*	4.92
	Melinjo (*sura*) / gnetum	*Gnetum gnemon*	2.41
	Merbau (*tokou*) / iron wood	*Intsia bijuga*	2.37
	Buah merah (*oosi*) / red Pandanus	*Pandanus conoideus*	1.85

	Indonesian and/or local/English name	Scientific name	LUVIx100
Animal	*Buaya* (*feija*) / crocodile	*Crocodylus novaeguineae*	5.65
	Ikan Sembilang (*ceri*) / catfish	Family Ariidae	5.05
	Babi (*iig*) / wild pig	*Sus scrofa*	3.16
	Cendrawasih (*diyaa*) / birds of paradise	Family Paradisaeidae	2.93
	Kakatua putih (*wiya*) / sulphur-crested cockatoo	*Cacatua galerita*	2.89

The most important animals with an economic potential are the crocodile, for its skin, and the *ikan sembilang* for its valuable bladder, sold as medicine in Singapore or Hong Kong as told by local people in Papasena. Then birds of paradise and parrots represent important economic resources as ornaments, although the hunting of birds of paradise is forbidden in Indonesia.

Table 18 shows the rare species identified by the villagers. From the plant categories, two species were identified: an orchid and a tree valuable for its timber.

Table 18. Rare species in Kay Village

	Indonesian and/or local/English name	Scientific name	LUVIx100
Plant	*Masohi*	*Cryptocarya massoy*	12.00
	Vanili hutan / wild vanilla	*Vanilla* sp.	8.00
Animal	*Cendrawasih* / birds of paradise (*diya*)	Family Paradisaeidae	30.00
	Buaya / crocodile (*feija*)	*Crocodylus novaeguineae*	25.00
	Ikan Sembilang / catfish (*ceri*)	Family Ariidae	25.00

The three animals identified have also a potential for commercial use. Local people acknowledge that it is difficult to hunt or capture these species (e.g. the crocodiles and catfishes have been over harvested; the birds of paradise are, in places, difficult to access), but also recognise their economic values. These species should therefore be the target of monitoring activities to assess and control populations over time.

5.3 Participatory mapping

The making of the maps is described in Annex 1. Similarly to Papasena and Kwerba, three maps were produced in Kay. The participatory map of the natural resources in Kay

had to be done from scratch, because no activity was carried out in Kay in 2004. The participatory map was made at the same time as the ground check. It was an iterative process with the map only being finalized at the end of the survey. A lot of modifications were made after each ground check. The original participatory maps drawn in the village had more mistakes than in the case of Kwerba and Papasena (where only a few river names were changed after a ground check). This is probably because the swampy landscape around Kay can quickly change including the course of the main river.

Natural resources map (Map 8): The first steps during community meetings showed that the women were less responsive than the men. It was difficult to make them share their knowledge of the different elements of the landscape, because of the language and because this activity seemed too confusing for them. They had difficulty in communicating their knowledge of the rivers, the resources and the lake names. The group was also dominated by a woman from Papasena who had moved to Kay even though she knew few if any of the Kwersa and Torweja names. We, therefore, failed to catch the women's points of view in Kay.

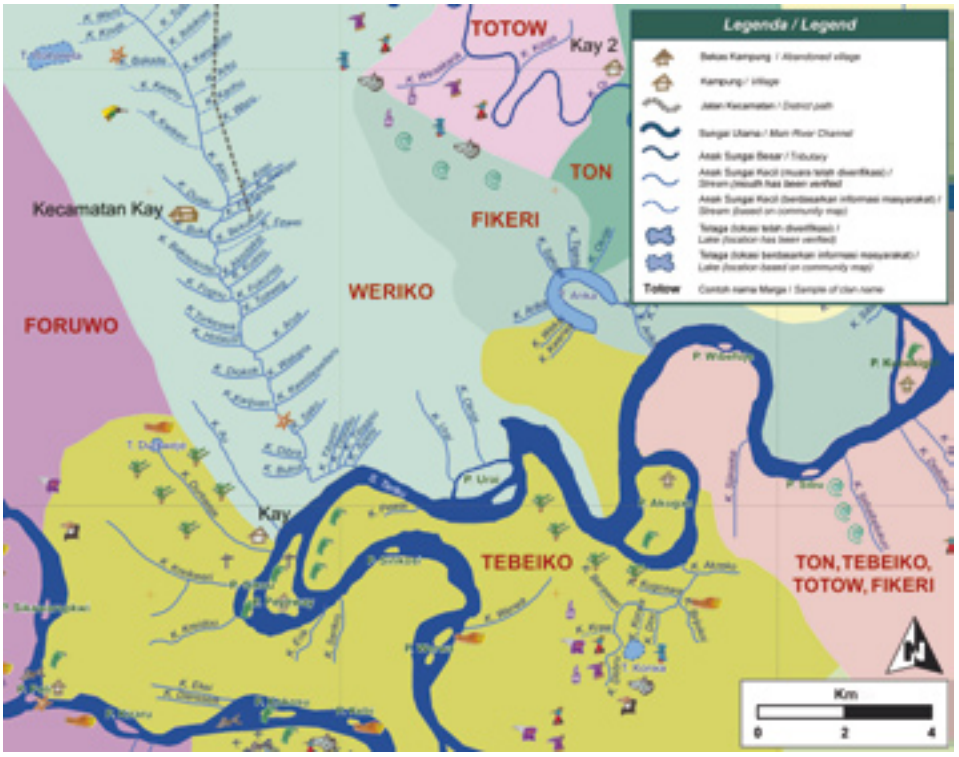
Map 8. A portion of the natural resources map of Kay Village

After a combined map was prepared, we checked each element of the landscape with two groups of informants, using GPS and direct observation. Coming back to the village, each correction and change was discussed with the local informants until we prepared a clean version of the maps. The knowledge of the natural resources is high at each point of the Tariku River, even if the amount of resources recognized is limited (crocodiles, fishes, pigs, cassowaries, crowned pigeons, *maleo*, hornbills, sago forest, rattan forests, gardens, cemetery, resin tree forest, rivers, etc.). Usually the knowledge of natural resources concentrates near the different rivers, and depends on the access to the resource. One important feature of the landscape was the rattan forests, swampy forests with a lot of Arecaceae, where pigs and cassowaries are abundant during the dry season.

Wild sago is everywhere, and for this reason it was difficult for the villagers to draw the main places where it can be found. We found that the main gardens were on the small islands on the main river. The map shows an extensive use of the territory, but in a narrow band along the Tariku River. If the same map was made during the dry season, we would probably have a larger band, but the problem of access remains important and the results would be unlikely to change significantly. The villagers often travel by canoe in some parts of their territory, but it is also possible to walk in other parts during the dry season. They often hunt during the fruit season.

Clan map (Map 9): This map shows a general repartition of the territory according to the two main languages: Kwersa upstream from Kay, until Abare Island (near the Bareri River), and Torweja downstream from Kay until the confluence of the Tariku River with the Mamberamo/Taritatu River. Most of the clans have access to the main river, with two exceptions:

- The clans whose territories are on the Oi River, and live in Haya, do not have access to the Tariku River. These are the Krakuko, Totow, Ton and Fikeri who all speak the Torweja language.
- The Kaesa clan (also Torweja) used to have a bigger territory on the edge of the Poli 1 River. A large part of this territory was ceded to Deido Village when the different districts were set up in Mamberamo.



Map 9. A portion of the clan map of Kay Village

All the other clans have access to the Tariku because of the importance of the fish and crocodile resources there. The Tariku River is the place where all the swamp lakes are formed, and where the main islands can be found. This is then an important source for local incomes and livelihoods. The economy of the region is based on the main river richness in natural products. Controlling this richness is therefore the principal challenge for the people of Kay. The inequality between the sizes of each clan's territory does not seem to cause any dispute or problem within the community, but this is one more reason not to use this specific map for any negotiation process. The natural resources look regularly and equally distributed among the different clans, with important areas of game (mainly pigs and cassowaries), crocodiles and fishes in each area.

Land use map (Map 10): This map was the most difficult to complete, because land use depends essentially on access to the resources, which can be a problem in an area of swamps highly subject to seasonal flooding. Access varies according to the season. The map was completed during the wet season, which may limit the amplitude of land use. Even though we had several meetings with the Kay community, to discuss the

surface of their territory that is actually being used, whatever the season, we ended up with a number of areas of different uses. We had to find the link between the different areas to give a more general overview of the situation. The main use of the territory is concentrated near the main rivers: Tariku, Oi, Soi, Bekai, Poli and Akru; and the main swamp lakes: Korwate, Babe, Arika, Foriberi, Sibido, Kihai (only accessible by foot) and Karija.

Map 10. A portion of the land use map of Kay Village

The mixed crop gardens are located on the main islands of the Tariku River. The hunting zones are around the Poli and Kwisija swamp lakes, and close to the main rivers: Soi, Akru, Debru, Bekai and the upper part of the Tariku River. Hunting areas can be found in each clan's territory. Usually, villagers use their canoes to access the tributaries and the lakes and when the water is too low to use canoes they walk. They look for game as far as they can or until they find cassowaries or pigs on their way. Because of the richness of the area in wild animals, they usually do not have to go too far. Another zone was delimited between the main tributaries, of less intensive use; villagers occasionally go there to hunt or to look for other forest products, when access is possible (seasonally)

and when resources are getting scarce near the main rivers. Villagers consider such areas as reserves for game, because of their difficult access.

Fishing and crocodile hunting take place mainly on the Tariku River and its tributaries: Sorude and Soi rivers and in the main swamp lakes: Iyako, Korwate, Krwe and Cerifisa. But the Kay people usually fish not far from their settlements, as this resource is still very abundant.

Photo by: M. Boissière

Figure 11. The local people collect coal for cooking

Some special places have also been identified in the area of the Weriko clan, where villagers collect coal (see Figure 11) for cooking. In the upper reaches of the Akru River, the coal shows on the surface, and is regularly collected by the landowners (a small track has been managed to access to the resource). Another place identified for its coal was on the Oi River, which the villagers from Kay 2 mainly manage, but we were not able to obtain further information about this.

The sacred places have a different distribution from Papasena and Kwerba. In Kay area they are usually found in the upper reaches of the main rivers (e.g. Bekai, Oi, Soi, Orupo, Kivari, Titabi, Sorude) or in remote places near swamp lakes (e.g. Iyako, Korwate, Babe, Kihai). These areas are difficult to access, and villagers avoid hunting or fishing there. Informants told stories about these areas during the ground check and interviews at

the village, to explain the reason for the status of the sacred areas. Some examples show the diversity of situations for which an area becomes sacred:

- On the Bakaite River (a tributary of Akru River), there is a sacred mountain, where outsiders can go only if they are accompanied by local people. It is believed that two brothers from Sikari left some soil there and the soil miraculously became a mountain.
- Anyone who enters the sacred area near Babe Swamp lake, without asking permission from the spirits may cause a tempest, will catch no animal, and may even disappear.
- On the Oi River, there was an old village called Kokom. It was a big village, until somebody saw a ghost a long time ago. Then, all the villagers moved away, and the place was considered sacred, with only a cemetery remaining.
- In some other places (Lake Kihai or the Orupo River) it is believed that giant crocodiles or snakes protect these places from intruders.

Villagers have a good knowledge of their overall territory, including the condition of the resources, and even river dynamics. They keep an eye on intruders, outsiders and villagers from different clans entering their territory. This knowledge can be considered a form of monitoring.

5.4 Local monitoring

Monitoring is often linked to patrolling. Villagers in Kay, Papasena and Kwerba often patrol their territories. In Kay, if we only think of the natural resources that are important for livelihoods, there are sufficient crocodile, fish and game within easy reach of the village. There is no need to hunt far from the village. But, in fact, villagers go for days along the river, to the limits of their territory to look for food and economic resources. The main reason is actually to mark their territory by hunting, building huts on the riverside and maintaining their gardens on the small islands. The gardens on the islands all along the Tariku River are visible to everyone travelling on the river. When a villager wants to open a garden in a forest, he usually marks the place with two sticks cross-tied together (see Figure 12). This way, he makes sure that nobody else will make a garden at this precise location. The important and precise knowledge that villagers have of each part of their land, the names of each river, each lake and even each piece of forest on the riverside (all the territory is divided into smaller areas, named by each land owner) shows how sensitive the issue of land tenure is, and how well this huge territory of about 1,300 km^2 is guarded.

Photo by: M. Boissière

Figure 12. Two sticks cross-tied together are used to mark a future garden location

An important way to monitor a territory is therefore to exert a regular control over it. Local people in Kay give extra protection to specific parts of the area, where important resources can be found. These specific areas can be the mouth of an important tributary of the Tariku River, or a swamp lake where crocodiles, sago and fishes are abundant. During our survey, we identified nine special places where local community control is higher: lakes Arika and Sujawiso, and the mouth of the Soi, Oi, Bekai, Deido, Poli, Bareri and Poli 2 rivers.

For each of these places an individual, representative of the clan who owns the land, stays permanently there to patrol and to control who comes, for what reason, and what they are collecting. Sometimes two areas can be under the responsibility of one single person. These guardians, whose charge is hereditary, are called *Ijabait*, or land owners. When an outsider trespasses, he will have to pay a fine accordingly.

Apart from the control exerted over their territory, villagers monitor their important and valuable resources regularly. There is no special monitoring for important plants for the local livelihoods, such as sago, because it is readily available, mainly growing naturally on the riverbanks, and people can collect sago wherever they stay. Usually, they build a small hut on the side of the river, in a sago forest, and eat wild sago as they fish and hunt. Iron wood is still abundant, but it is being used for the construction of the new district and to build churches. The amount of *matoa*, famous for its fruit, has also declined because of over-harvesting. The way it is harvested (by cutting the trunk of the tree, when the fruit is too high) is largely responsible for its decline. The wood is often used to make planks and canoes.

Photo by: M. Boissière

Figure 13. The local people monitor crocodile population by using torch light at night

The villagers monitor two important animals: the crocodile and *ikan sembilang*. The crocodile population has been in decline since the 80s, according to our informants. In the early 80s, villagers could catch 10-15 crocodiles a day, but now they can only catch less than three in the dry season. Villagers try to protect the crocodile population by forbidding hunting in specific places where crocodiles have been over-harvested. During the wet season or when travelling at night, people use torches to assess the importance and size of the crocodile population (see Figure 13). The reflection of

the crocodile's eyes in the light helps when counting them and the intensity of the brightness indicates the size of the crocodile. In this way, villagers can gauge the condition of the population. During the day, the travellers can identify crocodile tracks on the sandy riverbanks.

Crocodiles are more numerous in the swamp lakes, where fishes are also abundant and the water is quiet. During the night, the crocodiles leave the lake to hunt in the small tributaries. It is of course much easier to find them using paddles than a motorized canoe. This kind of monitoring can also be found in Papasena and Kwerba. Kay also has restrictions for hunting crocodiles according to the location (each lake belongs to a clan) and the size (see Box 2).

The *ikan sembilang* population, according to the villagers, is also decreasing. They are no longer catching as many as they use to with their nets. *Ikan sembilang*, found in deep and moving water, have been over-fished because of their bladders, which are sold for approximately Rp 50,000 and 100,000 per kg in the local and provincial market respectively. In addition, in 2000 an outsider from Sulawesi (Haruna) introduced small *lele dumbo* fish (*Clarias* sp.) into the upper reaches of the Tariku River. These fish eat the eggs of the catfish and can breed rapidly in the main river.

To keep an important reserve of crocodiles and fishes, some swamp lakes are closed and access forbidden. This was the case for certain lakes in the area of the Tebeiko Clan: on lakes Tiba and Iyako for example, no hunting or fishing has been allowed since 1996. According to the villagers, this is to reserve stock, but from our ground checks it looks like these areas are not accessible (no river to reach them), or are in sacred places, haunted by giant snakes or crocodiles, for example. Birds of paradise are never monitored, as people do not look for them as they are rare in swampy areas.

On a more general level, villagers know also the dynamics of the river. When using canoes, they know the dangerous places (rapids, whirlpools, tree trunks, sand banks) and how to deal with them, and the proper time to go (after a big rain, during the daylight), at least in their own clan's territory. The elders have an important knowledge of the formation of the swamp lakes. For example, one of our informants explained that, when he was young (about 50 years ago), the swamp lake Sujawiso was a part of the Oi River, until the river moved, and it became a lake. He believes that the small river that joins the lake to the Tariku River is receding, but another river might develop and keep the connection. Another example was given for Lake Babe, when our informant, who had not been there for years, was surprised by the small size of the lake, possibly due to an increase in tree cover. We were also told that some years ago, in front of

the Arika River mouth, there was an island that has now completely disappeared. This knowledge can be considered a monitoring activity, as the villagers are well aware of the transformations of this changing landscape. They always know how many loops there are in the river before they reach a specific place, even if these loops change from time to time.

Towards conservation partnership in Mamberamo

Photo by: M. Boissière

In this book we show how the results from our survey can directly address conservation issues in the Mamberamo Biodiversity Corridor, and how local people's participation is possible in that domain, when there are clear signs of local control over the resources, and of monitoring of each village's territory. Even if the term "conservation" is not used by the villagers, we have shown that a sense of conservation exist, in many parts of Mamberamo, generally associated to the use local people want to have of the resources (for sell, for their livelihoods, or for spiritual), or to strong sense of land rights. The following is a discussion of the main results and a presentation of the recommendations that have emerged from our survey.

6.1 Conservation in Mamberamo using multidisciplinary assessment

The following discussion is an attempt to compare the different case studies of the 2006 survey, and to analyse the changes since 2004 for Papasena and Kwerba villages. We take into consideration the way local people monitor their resources, and how the maps can inform about land use and land tenure.

6.1.1 Changes from 2004 survey

For the two villages, Kwerba and Papasena, the 2006 survey was the second visit using the MLA approach. The main change we observed was an increase in population in each village, due to recent births, and some of the villagers may not have been in the village during the demographic survey in 2004. The landscape around the villages has not changed considerably since our last visit, and the condition of the vegetation remains the same. According to the villagers, some resources are depleting (crocodiles, catfishes), but this was already the case in 2004.

CI has built a conservation post in the two villages, which ultimately serve as meeting halls for the villagers. The permanent presence of CI staff in the villages has built some local awareness about conservation, but also a perception of how the village should be developed and what the role of CI should be in that development. The Foja expedition has made the communities more aware of the benefits and recognition they can expect in terms of notoriety and more direct incomes, and has increased their interest in CI activities in Mamberamo. We could see the villagers were proud of the interest the outside world had in the richness and diversity of their natural resources.

6.1.2 Moving to Kay

Thanks to the support of Sonny Weriko (traditional leader), the Kay villagers welcomed us, and actively and enthusiastically participated in the different activities we proposed. However, there were important differences between Kay and the two other villages.

Kay women found it difficult to participate in our activities because:
- o They were particularly shy with outsiders;
- o Very few women in Kay spoke Indonesian;
- o They found it difficult to understand our objectives and the information we required, and
- o They had little knowledge of the trade in wild animal products as this is conducted by the men.

However, in general the villagers in Kay were more aware of the importance of conserving their territory than the villagers from the other two villages, particularly as the regency had plans to build a road into their district.

6.1.3 Three similar local ways to monitoring

One important similarity among the three villages is the presence of very comparable ways of monitoring and strong control of their huge territories (between 1,000 to 1,700 km^2) and natural resources. All three villages have their gardens situated near the village to meet their daily needs, and near the rivers dispersed all around their territories, to provide food when patrolling or hunting. Gardens are also used to mark their territories. In Kay food is also found in wild sago forests on the riverbanks.

In Kay territorial control is different to the other two villages. A guard belonging to each landowner clan is permanently posted at the mouth of important rivers, or beside big swamp lakes to control those entering and for what reason. In Papasena and Kwerba the different clan members guarding their territories are replaced every few months.

Monitoring also concerns regular assessment of resources. People from each village have similar ways of assessing important resources, such as crocodiles (with a torch at night or during the dry season) or *ikan sembilang* (with a net). This expertise could be valuable when planning joint conservation activities, using the local skills to assess the availability of key resources. Local knowledge of the river dynamics also shows how well this complex ecosystem is understood by the villagers; assessment and anticipation of the changes in this ecosystem could be built on the local knowledge, in collaboration with scientists.

6.1.4 Comparison between societies and livelihoods

The different clans in Papasena share their territories in a slightly different way to the other two villages. In Papasena, the clan areas are dotted all around the village. Some clans have two areas under their responsibility, and others have split into two clans. In Kwerba and Kay, the clan areas are more uniform, regularly shared within the territory. These differences can be explained by the history of each society, how they arrived in the current villages, how they interact with each other, and the alliances built among the different clans. One common factor in Papasena and Kwerba was the activities of a local NGO (YALI), which has influenced the rules regarding land tenure and land use, transforming the traditional system into a more constrained system.

These societies, although living in a similar environment, the lowland part of a same catchment (Boissière and Purwanto 2007), have slightly different livelihoods. In Kwerba, villagers depend mainly on planted sago and wild meat from the forest for their livelihoods. They occasionally catch crocodiles and fishes, but these do not represent their main source of food, more an additional source of cash income. In Papasena, the situation is intermediary, with the presence of both planted and wild sago, and villagers strongly depend on river products (crocodiles and fishes) and on regular visits to the forest (looking for pigs, cassowaries, etc.) for their livelihoods. In Kay, most of the sago is wild and abundant near the Tariku River, and fishes and crocodiles represent the main sources of income as well as food. They occasionally hunt for meat in the forest during the dry season, or when they are travelling. During the wet season, the main transportation in Kay is by boat, while walking in the forest is still possible in Papasena and Kwerba. For the three villages, mixed-crop gardens only provide additional food, as sago remains the staple crop.

From the survey on economic resources, we crosschecked the resources that have an economic potential and are difficult to collect (rare or difficult to access), see Table 19.

Table 19 is not an exhaustive list, but gives a good idea of the resources that are actually traded (e.g. with outsiders: crocodiles, *ikan sembilang* bladders, iron wood, etc.; and locally: wild pigs, cassowaries, sago, *matoa*, etc.), and the ones that could be traded if a market network existed (e.g. kangaroo, parrots, birds of paradise, orchids, red Pandanus, etc.). It also shows that villagers are aware of the scarcity of certain resources.

Table 19. Economic and rare species in Kwerba, Papasena and Kay

Species (English)	Economic value			Rare and/or difficult to access		
	Kwerba	Papasena	Kay	Kwerba	Papasena	Kay
Cassowary	x	x		x		
Wild pig	x	x	x		x	
Ground kangaroo	x			x		
Tree kangaroo	x					
Birds of paradise			x	x	x	x
Parrots			x		x	
Catfish (*ikan sembilang*)	x	x	x			x
Crocodile		x	x	x	x	x
Carp		x				
Sago	x	x	x		x	
Gnetum	x	x	x		x	
Orchids	x					
Red Pandanus	x		x			
Matoa	x	x	x		x	
Areca nut		x				
Betel		x				
Iron wood			x			

6.1.5 Mapping exercise

The mapping exercise shows that knowledge is not equitably shared within the society of each village, and among the different villages. In general the men have knowledge of the landscape features located far from their village, but the women know more about the resources and land types situated in the direct vicinity of the village and the gardens. Men more often go patrolling or hunting far away, for days or weeks, and when women accompany them, they often stay at the camp, near the river.

When ground checking the information obtained during the community meetings in the village, we observed different situations among the three villages. In Kwerba and Papasena, there were very few mistakes in the names and location of the different

rivers, tributaries and lakes. In Kay after each ground-check we had to work again with the villagers to correct the location of the different rivers and islands. The different topography of the three villages is most certainly responsible for this situation. Kwerba is situated in foothills and mountain areas and Papasena is located in a mixed landscape of foothills, swampy lowlands and hills. While the Kay territory is dominated by swampy lowlands. The main river (Tariku) in Kay territory is also very dynamic, regularly changing its course in short periods (important changes can be observed in one or two years). Unlike Kwerba and Papasena the Kay landscape is constantly changing, making the accurate location of all landmarks near impossible. However, the Kay villagers' knowledge of each river, island and lake remains important.

From the analysis of the land use maps, we observed a gradient in each map, centred on the villages in Kwerba and Papasena, and on the Tariku River in Kay, with a more intensive use close to the settlements or to the main river (crocodile hunting, fishing and gardens), and a less intensive use (hunting area and reserve) as we moved away from these areas to reach an area of minimal use in the mountains (sacred areas). This last category covers a large territory in Papasena, and more scattered areas in Kwerba and Kay, influenced by the history of each community (in Papasena some of the community come from the mountains). This gradation in land use intensity is of great value to any conservation and development project, which could be based on the existing land use to make more effective any attempt to conserve biodiversity in the region.

6.1.6 Extracting numbers from the maps: interests, cautious and limitations

The participatory maps have been developed based on GIS and information from local communities. Our references included Landsat images from 2005 as well as from 1999 and 2002. Map preparation is described in annex 1.

Area boundaries are not always precise, and this leads to uncertainties in the maps and especially in the areas of the local territories. Uncertainties derive from various sources. Though many reference points used to draw boundaries were field checked with GPS, and could be fixed with certainty, some other sites (such as the source of rivers) can only be inferred from the images and may differ (i.e. they may be much longer). Though boundaries falling on larger rivers are clear and unambiguous, some features are less certain. In many cases the reference points use are widely spaced and the shape of the boundary in between may be convex of concave: thus adding or subtracting large areas of territory. In some cases references points are lacking over large regions and there is no

clarity on the boundary: for example in much of northern part of Papasena (drawn with dash-points to indicate uncertainty). These uncertainties are greatest when considered in terms of certain landuses such as sacred areas, which are localised features with no clear boundary—based on our work with the communities we adopted a 250m no-go zone for these features but this remains arbitary and the 'true edge' would better be viewed as 'fuzzy' in any case.

The maps are a mixture of precise and less precise (our conservative 'best guess') information. We used information from local people during interviews and participatory mapping process to guide our best guess of where boundaries should be placed. We can estimate resulting areas and our confidence on these by comparing our estimated maximum (largest) and minimum (smallest) area based on well-defined features. Table 20 shows the best choice for these calculations, with the estimation of the errors. It will be noted that our best guess areas are close to the minimum (smaller areas occur only with a prevalence of concave boundaries), while geographic limits suggest the area could be as much as double these estimates.

Table 20. Estimated total area (Km^2) of the 3 study village territories

	Best estimate Km^2	Smallest Km^2	Largest Km^2	Min Minus %	Max Add %
Kwerba	1100	922	1969	16	95
Papasena	1700	1298	2265	24	57
Kay	1300	1073	2572	17	115

The variability of area in Kwerba is less important than in the two other villages. Most of Kay territory is covered by flat lowlands and information on the features limiting them are scarce leading to less certainty in the boundary.

6.2 Building from the survey to engage local communities into conservation

Conservation in Mamberamo: general

Mamberamo watershed has great potential for conservation. The different surveys (RAP, MLA, Social Feasibility Study – SFS and Sustainable Use Option Plan - SUOP) have shown the richness, in terms of biodiversity and extraordinary landscapes, still protected

by the relative isolation of the region. But the situation is rapidly changing, with new development projects and increasing means of communication with the regency and the provincial capital. Building conservation in Mamberamo clearly needs the support and the direct involvement of the local communities in the design of the area to be protected, in its management, and in the decisions that need to be made. The solution is local, at the village level: each society specificity, priorities, interest, organization, and history need to be taken into account. Regular discussions, negotiations need to be conducted locally, village after village.

For resources valuable for trading and rare or difficult to collect, there is ground for further research and collaboration. For many of these resources (e.g. crocodiles, catfishes, orchids) villagers use regular monitoring, as they travel, and a tight control on who is trying to collect them, and for what reasons. The presence of an effective local monitoring and an awareness of the availability of the natural resources are valuable for conservation.

A more anthropological survey is necessary

More social and anthropological surveys of the communities in the watershed, in light of the high social diversity we observed, would be valuable. New Guinea has the highest language diversity in the world, and the Mamberamo region may have the highest number of languages for the entire island[22]. Different languages mean different origins, histories, traditions, and behaviours. In a single village, we counted at least two or three different languages. This exceptional situation leads to complex power relationships, alliances and territory sharing. Such information can help CI to better understand the local social organization and to decrypt the different individual agendas. By extension, it will help to identify who to deal with, and how, in the frame of a conservation programme. Cultural diversity influences the way local communities consider their relationships with the outside world, with the administration at the district, regency and provincial levels, and the way they act. When building conservation in these three village areas, the different local behaviours and specificities require careful consideration.

How should the maps be used for conservation?

Data obtained from the field were analysed and used as basic information for map improvement. The maps (and all important and accurate information on them) might be used in negotiation processes, for example for land use planning. These maps are not a final result, they are merely 'drafts', even in their final shape. They are a basis for discussion, negotiation and a way to share a common vision of the territory. They could be used in the process of designing new areas for conservation, based on the way local

[22] Languages and Ethnic Groups of Papua Province, SIL Ethnologue. Http://www.ethnologue.com/show-country.asp?name=IDP

communities use their land. These maps were developed during the wet season; the information collected reflects this situation. If the same survey was conducted again during the dry season, more especially in the case of Kay, where the level of water in the swamps determines the access to certain resources, the resulting maps would be slightly different.

The clan map shows how the different clans share their territory. This issue is sensitive and may lead to conflicts if the communities perceive this map as an official recognition of their rights. These clan maps were made for the sole purpose of our analysis and report. They should not be used for any other purpose than research, as they have no legal value.

The MLA follow-up activities

The methods were reduced and adapted to respond to CI questions and priorities in Mamberamo, with emphasis on the participatory maps developed during the 2004 survey. The new set of activities has proven to be an efficient way to better understand the local communities, their social organization, and the way they use and control their territories. This survey was designed to test the adapted MLA in three villages of Mamberamo. We recommend CI use this approach in other strategic villages of the biodiversity corridor.

MLA and the communities' perceptions of the river

The Mamberamo, Taritatu and Tariku rivers dominate the landscape of this major watershed. The villages are located near these main rivers, as they provide important resources for the local livelihoods. An MLA survey specifically focussed on the communities' perceptions of the river, of the events that change it, the floods, the landslides, the dynamics of the lakes, the islands and the seasons. Some preliminary studies were initiated during the watershed assessment organized by CI in 2007, in collaboration with CIFOR, but there should be more emphasised on water/river perceptions when conducting future research.

A follow up with different tools

Based on the maps prepared during the survey, and on all the information collected on the history, economy, demography, and social organization; different tools could be used to discuss these results with the villagers and develop possible scenarios on how to reach each stakeholder's expectations. The Future Scenario methods, developed by CIFOR, could be a relevant tool to follow up the information collected (Wollenberg et al 2000).

The need for a follow up of the monitoring survey: the watershed

An important observation from our surveys was the local monitoring found in each village. Local people have ways to control and protect their territories and resources, by patrolling and permanently guarding some specific areas and resources. These systems and activities have great potential for conservation. Prior to our survey, we believed that the sacred areas were the main opportunity for joint conservation. With the local monitoring and protection measures it would be feasible to develop active conservation across the whole landscape. Instead of bringing new rules to the villagers to protect their environment, it would be wise to use the existing ones. For that purpose, more research needs to be conducted of the whole Mamberamo corridor, to look for similar situations in other communities of the region. New activities could examine these control strategies and understand to what extent local monitoring and protection practices, such as permanent guards and patrols of important resource areas, control of visiting outsiders (including other clans) and regulations governing the hunting and collection of rare resources or resources in decline, are still active and relevant to the local concern and to conservation targets. What internal and external factors influence these practices? How can they be integrated into a broader community-based management scheme?

Developing local capacity in documenting rules concerning natural resource management

There was an expressed need by the local communities to document and develop village rules, that would fix basic rules within the village entity (*Desa*), and the relations with outsiders (government at district, regency and provincial levels, companies, businessmen, scientists, NGOs, etc.). Training on how to integrate some of the data collected during our survey, into these village rules, would help to formalize and build awareness of important conservation issues.

The need to monitor the impact of CI activities on local behaviour

We recommend that CI try to monitor the impact of its activities on local people, in terms of their awareness of threats to biodiversity, of their interest in conservation, and of their expectations for the future development of their village (status, building, health, education, etc.). A better understanding of the driving forces that modify the local behaviours would help CI to develop their conservation strategies in the region.

The need to involve the local government more directly in conservation activities

We recommend that the local government be included more in future activities in Mamberamo. During our recent survey, some government staff at the provincial level joined the team (*BAPPEDALDA* and *BKSDA*), but no regency staff were involved,

although some participated in the initial workshop we organized in Jayapura. Involving the local government in field activities is indeed a sensitive issue, as we never know how the local people will deal with or react to their presence. However, their presence is necessary when it comes to land use planning, for example, zoning of protected areas. Decisions on land use are made at the regency level (building new roads, granting forest concession, etc.) Training of local government staff could be a way to involve them in conservation activities.

Conclusion

Photo by: M. Boissière

Mamberamo watershed is of major importance to conservation priorities, not only for its rich, and still understudied, biodiversity, but also for the cultural richness of the local communities.

Building effective conservation in Mamberamo, deciding which lands/areas need to be strictly protected, and which can be used to support local livelihoods, can only be successful if all the different local perceptions and needs are taken into account. The solution is not global, at the watershed level, but local, in the different villages, dealing with the different groups in each village, considering each different agenda and priority.

In this book, we have provided evidences of strong local concerns related to the use of each local territory, the future of the important resources of Mamberamo, and the necessary protection needed. In each of the villages, local people keep an eye on their richness, on their rights, and regularly monitor their resources and habitats. They are aware of the potential threats against them, and even if this is to use, exploit their own natural resources, it is obvious that a strong sense of conservation, strengthened by the mistrust expressed against outsiders, exists in Mamberamo. This sense could provide the basis for an important and essential collaboration between villagers, conservationists and decision-makers for the protection of this fragile watershed.

The approach developed by CIFOR has proven to be a strong and efficient tool to capture the local point of view, the local perceptions on landscape and natural resources, and the local priorities in terms of development, land use and land tenure. For this new set of activities in Mamberamo, the methods have been adapted to more directly answer conservation issues, as defined during the Jayapura workshop. Using the maps, by combining ground check and information collected from local people, helps to understand the different ways local communities use and manage their territory, and how to build a basis for more collaboration between local people and conservation NGOs. The survey in Mamberamo has also provided new information about how local people exert a monitoring on the important resources and habitats, how they address the potential threats on these, and how similar dynamics can be observed in each of the villages.

This approach needs to be extended and developed in other areas of the Mamberamo watershed, as a support for conservation needs. More capacity building is necessary for conservation and local government staff so they may use these methods to help build awareness among the local communities of the threats to their environment and by extension their way of life.

Understanding the biophysical factors (ecology, watershed dynamics and vegetation typology) that play a major role in the high biodiversity of the Mamberamo is of paramount importance if the area is to be conserved. Equally, understanding the local communities and involving them in any decisions to be made regarding their traditional territories is also a prerequisite to any attempt to protect this huge area.

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Annex 1. The making of participatory maps during MLA activities in Mamberamo

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The community map was compiled to provide information about the distribution of existing natural resources, clan areas and traditional land use areas, from a community's perspective. All information on the maps was provided by the local people. In addition, its accuracy was improved, using GIS and GPS technology, for wider purposes.

Generally the maps were compiled through the following processes (Figure 1):

1. Base map preparation
2. Data collection
3. Data processing
4. Cartographic
5. Quality control

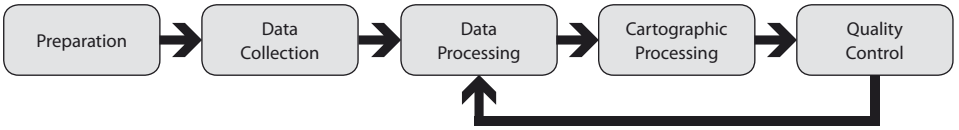
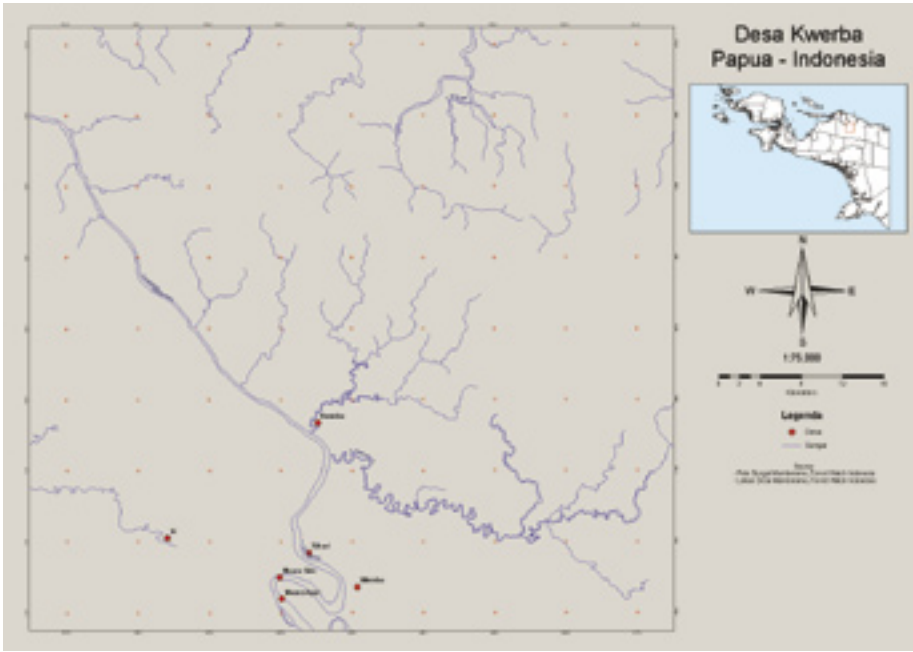


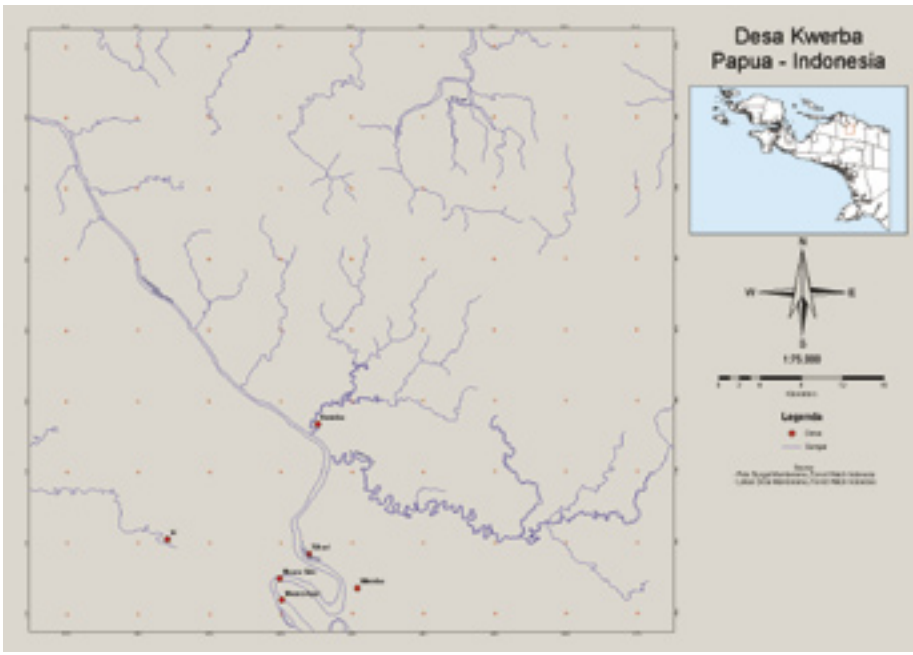
Figure 1. Flow diagram of the participatory mapping process

1. Base map preparation

The main purpose of this phase was to prepare preliminary data that would be used as basic information in the data collection phase. In this phase we collected and compiled suitable information on the main rivers in the three villages, obtained from Forest Watch Indonesia (FWI). This 1:75.000 scale map was used by the community to describe their perspectives of the natural resources by drawing them on the map. Landsat satellite images were used to identify the landscape in the study area for the years 1999, 2002, and 2005. The 2005 dataset represents the latest condition of the area and the other maps (2002 or 1999 image) were used as a backup if an area in the 2005 image was not clear, for instance because of cloud cover. Figure 2 shows the base map and satellite map for Kwerba Village.



(a)



(b)

Figure 2. Example of Kwerba base map (a) and Kwerba satellite map (b)

2. Data collection

In this phase, with local informants and some basic maps, we began to collect and check information about the distribution of natural resources, including location names around the village, at forks of main tributaries and road intersections. We also collected information about the distribution of clan areas and traditional land use, to better understand how the local people manage their territory. This phase involved almost all the inhabitants of the three villages (see Sheil *et al.* 2003, for Mapping meeting constructions). In this study, we prepared a geo-referenced base map to guide the community in recognizing their area and to help maintain the quality of the spatial information.

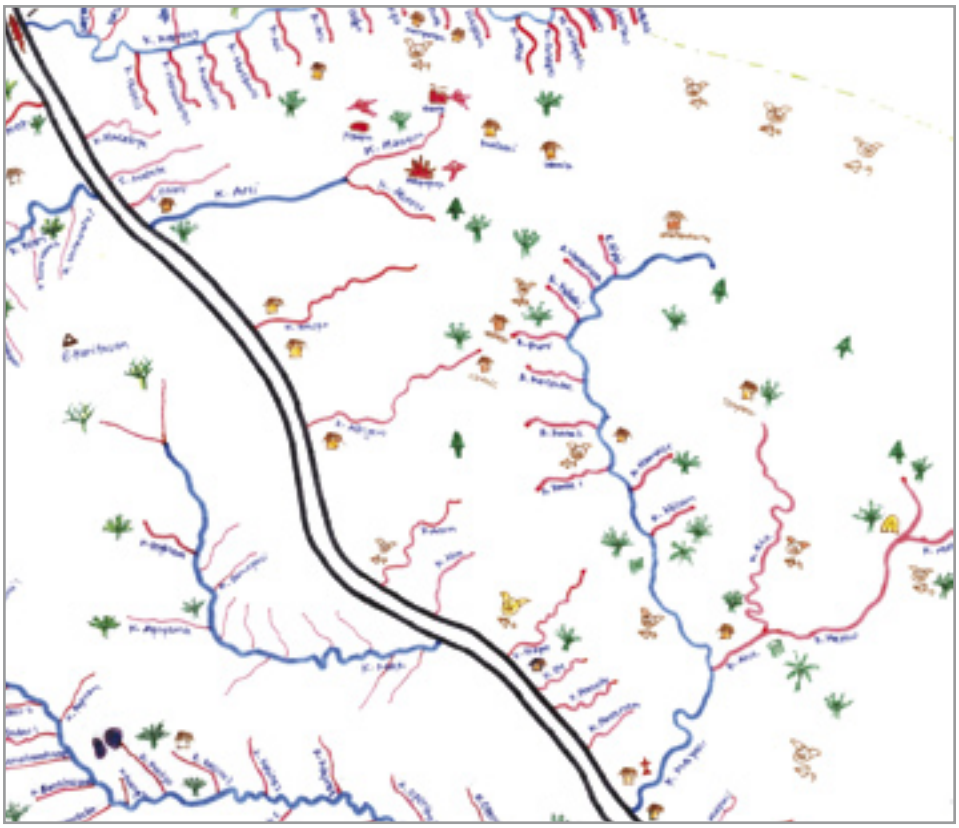


Figure 3. Information collected from the community, drawn on a sketch map

To improve spatial accuracy of the maps, field checks were carried out using GPS. Field checks were applied to several features including the village location, old abandoned

villages, the mouth of rivers and tributaries, lakes, islands, gardens and important places (sacred places, hunting areas, etc.).

Outputs of this phase are:
- A sketch map that contains community information about the distribution of natural resources, traditional land use and clan areas (see Figure 3);
- GPS field check data; and
- Interview results.

3. Data processing

In this phase, previous data collected was processed into GIS data. Information on the sketch map included: a) geo-referencing; b) digitizing all features on the map; and c) the data was then adjusted based on the field check data and on available data sets, with better spatial accuracy, such as Landsat satellite imagery.

Geo-referencing

This process is intended to register all features on the sketch map so they will be bounded to a coordinate. Geo-referencing is done by scanning the sketch map into a digital format and then registering sample points into its true coordinates using an available dataset (Landsat satellite data). Sample points are topographic features easily identified on both sketch map and Landsat images such as the mouth of a river. The process of geo-referencing can be seen in Figure 4 and 5.

Digitizing

Digitizing is a process that converts a geo-referenced scanned map into a GIS vector format. This process was undertaken by registering all segments of the features' coordinates (including point, line and area features) into the GIS database. Then, each feature is bounded by an attribute to give more information on specific features such as name, type, etc.

The digitizing process can be done using two approaches i.e. exact digitizing and relative digitizing. The exact digitizing is applied to features with reliable position information such as main rivers which can be seen on Landsat images or features with coordinate information from GPS field data. Some data do not contain reliable positions and depend on relative positions given by the community. For instance, the community may provide information on a natural resource available between two rivers. This particular information is then digitized based on their relative position to other references which have reliable positions.

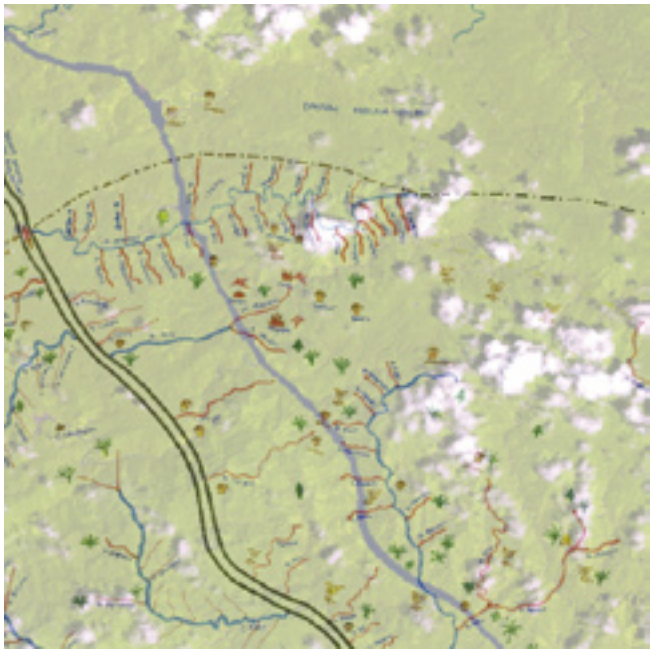


Figure 4. Sketch map overlaid on Landsat image before the geo-referencing process

Figure 5. After the geo-referencing process

Figure 6. Landsat image before the digitizing process

Figure 7. After exact digitizing process. Each feature is bounded to one attribute

Figure 8. Original sketch map

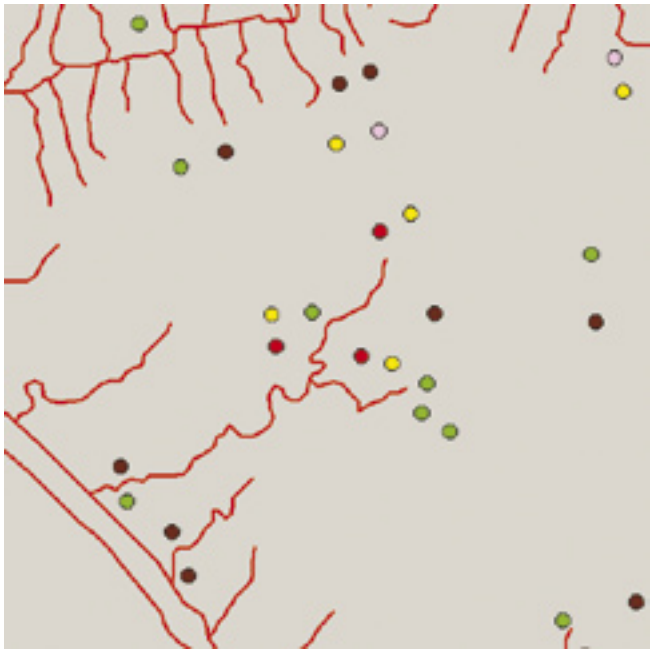


Figure 9. Digitized data using a relative approach

Adjustment

Data and information from the community were collected using simple methods (sketch map by the community representatives) which might therefore have significant errors and need to be adjusted. To improve the accuracy, field check datasets and other supporting available datasets (Landsat satellite images) were also used during the adjustment process. Landsat satellite images have a 30 metre resolution so that the adjustment process can only be applied to visible features on the Landsat image (bigger than 30 metres) such as main rivers, islands and lakes. Smaller features cannot be adjusted, and so will have a lower level of accuracy compared to the others.

The outputs of this data processing phase are GIS datasets covering topographical features and several themes in the three villages:

- Lakes
- Rivers
- Islands
- Villages
- Sacred places
- The distribution of plant and animal resources
- Land use (hunting areas, gardens, etc.)
- Clan areas

4. Cartographic

The main purpose of this phase was to create communicative maps that visualize community information with reasonable accuracy. After completing the cartographic process, GIS data from the previous phase was transformed to 1:75000 scale maps on A0 size map paper (Figure 12).

The original symbols were used so that the maps produced from this process would be similar to the original sketch map but with improved accuracy and additional cartographic components such as a grid, magnetic north sign, scale, etc. These components will not only help the user visualize the relative positions of the features but will also show the position of important information closer to the real location.

(a)

(b)

Figure 10. Before adjustment (a) and after adjustment (b)

Figure 11. Participatory map after cartographic process

Since the data contains different levels of accuracy (i.e. river and lake data), hence, different symbols for each level of accuracy was used. This approach will help the user to distinguish, which data is more reliable and which is not, so the information on the maps can be used in the right way.

5. Quality control

To maintain output quality, several aspects needed to be checked:

- Information accuracy
  The correctness and completeness of the information presented on the maps, including place names and spelling. This process was conducted by comparing a map with the original data source including the sketch maps, GPS field check data and interview results. When a difference was found between data sources and maps, the related data on the map was then corrected.
- Spatial accuracy
  The accuracy of a feature's location was compared to the original data source. When these differed to the original data source, they were corrected.
- Details
  Both information and spatial accuracy such as overlapping labels or symbols were checked and adjusted manually.

(a)

(b)

Figure 12. Map before Quality Control (a) and Map after Quality Control (b)

Annex 2. Summary of commercial products of Kwerba Village

No.	Name in Indonesian and/or in English/(Scientific name)	Season	Price (Rp)	Note
1	*Ayam hutan* / wild chicken (*Talegalla jobiensis*)	Any time	30,000/animal 5,000/egg	Sold fresh/to bake Chicken egg
2	*Babi* / wild pig (*Sus scrofa*)	When trees are fruiting	25-50,000/piece 300,000/animal	Sold fresh/smoked Sold alive
3	*Buaya* / crocodile (*Crocodylus porosus* and *C. novaeguineae*)	Any time	15-27,000/inch 10-20,000/animal 500,000/piece	Skin crocodile Sold fresh/smoked Genital crocodile
4	*Cendrawasih* / birds of paradise (Family Paradisaeidae)	Any time	100-500,000/animal	Sold as offseted animal
5	*Ikan mas* / carp (*Cyprinus* sp.)	Any time	30-50,000/animal	Sold fresh
6	*Ikan sembilang* / catfish (Family Ariidae)	Any time	50-80,000/kg 5-10,000/animal	The bladder of catfish Sold fresh/smoked
7	*Kakatua putih* / sulphur-crested cockatoo (*Cacatua galerita*)	Any time	250-300,000/animal	Adult animal
8	*Kanguru pohon* / tree kangaroo (*Dendrolagus inustus*)	Any time	10-15,000/piece	Sold fresh/smoked
9	*Kanguru tanah* / ground kangaroo (*Dorcopsis hageni*)	Any time	10-15,000/piece	Sold fresh/smoked
10	*Kasuari* / cassowary (*Casuarius unappendiculatus*)	Any time	10-15,000/piece 300,000/animal	Sold fresh/smoked Sold alive
11	*Kus-kus* / cus-cus (*Spilocuscus* sp., Fam. Phalangeridae)	Any time	5-20,000/animal	Sold fresh/smoked
12	*Mambruk* / crowned pigeon (*Goura victoria*)	Any time	50-100,000/animal	Sold alive
13	*Nuri hijau* / parrot (Family Psittacidae)	Any time	100,000/animal	Sold alive
14	*Nuri merah* / parrot (Family Psittacidae)	Any time	150-200,000/animal	Sold alive

No.	Name in Indonesian and/or in English/(Scientific name)	Season	Price (Rp)	Note
15	*Kura-kura* / freshwater turtle (*Pelochelys cantori* and *Elseya novaeguineae*)	Any time	10,000/animal	Sold alive
16	*Anggrek* / orchids (Dendrobium spp.)	Any time	150-250,000/plant	When they visit the forest or by order
17	*Buah merah* / red Pandanus (*Pandanus conoideus*)	Any time	20-30,000/mat	Sold as 'mat'
18	*Damar* / resin tree (*Vatica rassak*)	Any time	5-10,000/piece	Sold as 'resin'
19	*Daun paku* / fern (*Diplazium esculentum*)	Any time	2,000/bunch	Leaf
20	*Daun tikar* / Pandanus tree (*Pandanus* sp.)	Any time	15-50,000/mat	Sold as 'mat'
21	*Gaharu* / eaglewood (*Aquillaria* sp.)	Any time	150,000/ons	Second grade
22	*Melinjo* / gnetum (*Gnetum gnemon*)	Any time	1-2,000/heap 20,000/bag	Fruit
23	*Matoa* (*Pometia pinnata*)	Any time	2-10,000/heap	Fruit
24	*Sagu* / sago (*Metroxylon sagu*)	Depend on age of sago (10-12years)	50-100,000/bag	Sold to Kasonaweja

Annex 3. Summary of commercial products of Papasena Village

No.	Name in Indonesian and/or in English/(scientific name)	Season	Price (Rp)
1	*Asam* (*Tamarindus indica*)	Anytime	2,000/heap of fruit
2	*Ayam hutan* (*Talegalla* sp.)	When trees are fruiting	10 - 50,000/animal
3	*Babi* / wild pig (*Sus scrofa*)	Anytime, mainly when trees are fruiting	200,000 - 1 million/animal 10 - 30,000/piece of meat 5 - 20,000/piece of tooth
4	*Belut* (*Anguilla* sp., *fam. Anguillidae*)	Anytime	10 - 15,000/animal
5	*Buah merah kuning* / red Pandanus (*Pandanus* sp.)	Seasonal, 3 times a year	5,000 - 10,000/piece of fruit 500,000/lt of oil
6	*Buah merah merah* / red Pandanus (*Pandanus conoideus*)	Seasonal, 3 times a year	5 - 20,000/piece of fruit
7	*Buah tinta* (*Syzygium* sp.)	Seasonal, twice a year	1 - 3,000/heap of fruit
8	*Buaya* / crocodile (*Crocodylus porosus* and *C. novaeguineae*)	Anytime, mainly during dry season	20 - 22,000/inch of skin 3 - 5,000/piece of meat 50,000/piece of tooth 500 - 700,000/head of animal 100,000/lt of oil 30 - 100,000/piece of genital 10,000/piece of bile
9	*Merpati hutan* / imperial pigeon (Family Columbidae)	When trees are fruiting	100 - 200,000/animal (alive) 8,000/piece of meat
10	*Rangkong* / hornbill (*Rhyticeros plicatus*)	When trees are fruiting (mainly fig)	100 - 350,000/animal (alive)
11	*Nuri merah* / parrot (Family Psittcidae)	When it is flower season	100 - 200,000/animal (alive)
12	*Cendrawasih* / birds of paradise (Family Paradisaeidae)	When trees are fruiting	500,000/animal (dead) 1,000,000/animal (alive)
13	*Jambu hutan* (*Syzygium* sp.)	Seasonal, twice a year	1,000/heap of fruits
14	*Melinjo* / gnetum (*Gnetum gnemon*)	Anytime	10 - 20,000/heap of fruits
15	*Ikan mas* / carp (*Cyprinus* sp.)	Anytime, mainly during dry season	5 - 10,000/bunch of fishes
16	*Ikan mujair* (*Oreochromis* sp.)	Anytime	5 - 10,000/bunch of fishes
17	*Ikan sembilang* / catfish (Family Ariidae)	Anytime, mainly during dry season	60 - 70,000/kg bladder 3 - 10,000/animal meat
18	*Ikan tawes* (Family Cyprinidae)	Anytime	2 – 5,000/bunch of fishes
19	*Jambu air* (*Syzygium* sp.)	Seasonal, twice a year	1,000/heap of fruits
20	*Kakatua putih* / sulphur-crested cockatoo (*Cacatua galerita*)	When trees are fruiting (mainly *matoa*)	300 - 500,000/animal (alive)
21	*Kakatua raja* / king cockatoo (*Probosciger atterimus*)	When trees are fruiting	300 - 400,000/animal (alive)

No.	Name in Indonesian and/or in English/(scientific name)	Season	Price (Rp)
22	*Kanguru pohon* / tree kangaroo (*Dendrolagus inustus*)	Anytime	50 - 100,000/animal meat
23	*Kasuari* / cassowary (*Casuarius unappendiculatus*)	When trees are fruiting	50,000/body feather 10,000/nail 2 – 3,000,000/animal meat 40 – 50,000/piece of thigh meat
24	*Kura-kura* / freshwater turtle (*Pelochelys cantori* and *Elseya novaeguineae*)	Anytime, mainly during dry season	10 - 50,000/animal meat
25	*Kus-kus* / cus-cus (*Spilocuscus* sp. Fam. Phalangeridae)	When trees are fruiting	50 – 100,000/animal meat
26	*Kanguru tanah* / ground kangaroo (*Dorcopsis hageni*)	Anytime	50 – 100,000/animal meat 10 - 20,000/piece of thigh meat
27	*Lele dumbo* / catfish (*Clarias* sp.)	Anytime	5 - 10,000/animal meat
28	*Mambruk* / crowned pigeon (*Goura victoria*)	When trees are fruiting	50 - 300,000/animal meat
29	*Matoa* (*Pometia pinnata*)	Seasonal, once a year	5 - 10,000/heap of fruit
30	*Nibung hutan* (*Gulubia costata*)	Anytime	50,000/stump
31	*Nuri hijau* / parrot (Family Psittacidae)	Anytime	50,000/animal (alive)
32	*Pinang* / areca nut (*Areca catechu*)	Anytime	15 – 20,000/bundle of fruit 1 – 5,000/heap of fruit
33	*Sagu* / sago (*Metroxylon sagu*)	Anytime	50 - 100,000/sack
34	*Sukun* / breadfruit (*Artocarpus altilis*)	Seasonal, 3 - 4 times a year	1 - 5,000/heap of fruit
35	*Tikus tanah* (Family Muridae)	Anytime	10 – 20,000/animal meat
36	*Udang* / freshwater shrimp	Seasonal, in dry season	10rb-20rb
37	*Ular hijau* (*Chondropython* sp., *Fam. Boaidae*)	Anytime	500,000/animal (alive)

Annex 4. Summary commercial products of Kay Village

No	Name in Indonesian and/or in English/(Scientific name)	Season	Price (Rp)
1	*Ayam hutan* (*Talegalla* sp.)	Anytime, mainly when trees are fruiting	40 - 50,000/animal
2	*Babi* / wild pig (*Sus scrofa*)	Anytime	3 - 5,000,000/animal 20,000/piece of meat
3	*Buah merah* / red Pandanus (*Pandanus conoideus*)	Seasonal, twice a year	300 - 500,000/lt oil 20-50,000/piece of fruit
4	*Buah tinta* (*Syzygium* sp.)		1,000/piece of fruit
5	*Buaya* / crocodile (*Crocodylus porosus* and *C. novaeguineae*)	Anytime but more in dry season	20,000/inch of skin
6	*Cedrawasih* / birds of paradise (Family Paradisaeidae)	when the fruits it like are ripe	200 - 500,000/animal
7	*Ikan sembilang* / catfish (Family Ariidae)	Anytime	70 - 120,000/kg dried bladder 30-50,000/animal
8	*Jeruk hutan* (*Citrus* sp.)	Seasonal, once a year	3,000/piece of fruit
9	*Kakatua hijau* / cockatoo (Family Psittacidae)	Anytime	100 - 150,000/animal
10	*Kakatua putih* / sulphur-crested cockatoo (*Cacatua galerita*)	when trees are fruiting (especially *matoa*)	300 - 400,000/animal
11	*Kasuari* / cassowary (*Casuarius unappendiculatus*)	Anytime, mainly when trees are fruiting	20,000/piece of meat 500,000 - 4,000,000/animal
12	*Kayu koro* (*Ficus* sp.)	Anytime	2.5 - 3,000,000/ton of wood
13	*Kayu merah* (*Homalium foetidum*)	Anytime	2,500,000/ton of wood
14	*Kayu susu* (*Alstonia scholaris*)	Anytime	300,000/m3 of wood
15	*Kura-kura* / freshwater turtle (*Pelochelys cantori* and *Elseya novaeguineae*)	Anytime in the daylight	20 - 50,000/animal
16	*Lao-lao* / ground kangaroo (*Dorcopsis hageni*)	Anytime	15 - 20,000/animal
17	*Lele dumbo* / catfish (*Clarias* sp.)	Anytime	10 - 15,000/animal
18	*Mambruk* / crowned pigeon (*Goura victoria*)	when trees are fruiting (especially fig and iron wood)	50 - 150,000/animal
19	*Masohi* (*Cryptocarya massoy*)	Anytime	400,000/sack of bark 70,000/bottle
20	*Matoa* (*Pometia pinnata*)	when in fruit, regularly throughout the year	5 - 6,000/heap of fruit

No	Name in Indonesian and/or in English/(Scientific name)	Season	Price (Rp)
21	*Melinjo* / Gnetum (*Gnetum gnemon*)	Anytime	1 - 5,000/bunch of leaf 60 - 100,000/piece of noken bag
22	*Merbau* / iron wood (*Intsia bijuga*)	Anytime	300,000/m^3 of wood
23	*Merpati hutan* / imperial pigeon (Family Columbidae)	when trees are fruiting	30 - 40,000/animal
24	*Nuri* / parrots (Family Psittacidae)	when trees are fruiting	150 - 300,000/animal
25	*Rotan* / rattan (*Calamus* sp. and *Daemonorops* sp.)	Anytime	120 - 140,000/pairs
26	*Sagu* / sago (*Metroxylon sagu*)	Anytime	50,000/bag of starch
27	*Ubi hutan* (*Bioscorea pentapylla* and *B. hispida*)		5,000/piece of fruit
28	*Sukun* / bread fruit (*Artocarpus altilis*)	when in fruit	2,000/piece of fruit
29	*Ulat sagu* (*Rhynchophorus ferrugineus*, Fam. Curculionidae)*	Anytime	5,000/heap
30	*Vanili hutan* / wild vanilla (*Vanilla* sp.)		1,000,000/kg

*www.infopapua.com

Annex 5. Plant list species of Kwerba, Papasena and Kay Villages

No.	Genus & Species	Family	Life Form	Site		
				Kwerba	Papasena	Kay
Note: Bt.: Big tree, St.: Small tree, Mt.: Medium tree, Sh.: Shrub, Tp.: Tree palm, Pa.: Pandan, Cl.P: Climbing palm, Li.: Liana, Hb.: Herb						
Table 1: List of plants species found in swamp forest						
1	*Aphanamixis* cf. *polystachya* (Wall.) R.N. Parker	Meliaceae	Mt.	-	x	x
2	*Ardisia lurida* Blume	Myrsinaceae	St.	-	x	x
3	*Barringtonia acutangul*a (L.) Gaertn.	Lecythidaceae	St.	x	x	x
4	*Barringtonia racemosa* (L.) Spreng.	Lecythidaceae	St.	-	x	x
5	*Bischoffia javanica* Blume	Bischoffiaceae	Mt.	x	x	x
6	*Campnosperma auriculatum* Hook.f.	Anacardiaceae	Mt.	x	x	x
7	*Campnosperma brevipetiolata* Volken	Anacardiaceae	Mt.	-	x	x
8	*Carallia brachiata* (Lour.) Merr.	Rhizophoraceae	Mt.	x	x	x
9	*Cerbera floribunda* K. Sch.	Apocynaceae	Mt.	x	x	x
10	*Crateva religiosa* Forster.f.	Capparaceae	St.	-	x	x
11	*Dillenia papuana* Martell.	Dilleniaceae	Bt.	x	x	x
12	*Dracontomelon dao (Blanco) Merr. & Rolfe*	Anacardiaceae	Mt.	x	x	x
13	*Elaeocarpus sphaericus (*Gaertn.) K. Schum.	Elaeocarpaceae	Mt.	x	x	x
14	*Endospermum moluccanum* (Teijsm. & Binnend) Kurz.	Euphorbiaceae	Mt.	x	x	x
15	*Garcinia hollrungii* Lauterb.	Clusiaceae	Mt.	-	x	x
16	*Garcinia latissima* Miq.	Clusiaceae	St.	x	x	-
17	*Gonocaryum littorale* (Bl.) Sleumer	Icacinaceae	St.	x	x	x
18	*Gymnacranthera paniculata* (A.DC.) Warb.	Myristicaceae	St.	x	x	x

No.	Genus & Species	Family	Life Form	Site		
				Kwerba	Papasena	Kay
Note: Bt.: Big tree, St.: Small tree, Mt.: Medium tree, Sh.: Shrub, Tp.: Tree palm, Pa.: Pandan, Cl.P: Climbing palm, Li.: Liana, Hb.: Herb						
19	*Horsfieldia irya* (Gaertn.) Warb.	Myristicaceae	St.	x	x	x
20	*Myristica fatua* Houtt.	Myristicaceae	Mt.	x	x	x
21	*Myristica holrungii* Warb.	Myristicaceae	Mt.	x	x	x
22	*Myristica subalulata* Miq.	Myristicaceae	Mt.	x	x	-
23	*Neonauclea chalmersii* Merrill	Rubiaceae	St.	-	x	x
24	*Nauclea orientalis* L.	Rubiaceae	Mt.	x	x	x
25	*Neonauclea versteghii* Merrill & Perry	Rubiaceae	Mt.	x	x	x
26	*Pisonia longirostris* Teijsm. et Binnend.	Nyctaginaceae	St.	x	x	x
27	*Planchonia papuana* Kunth.	Lecythidaceae	Mt.	x	x	x
28	*Rhus taitensis* Guill.	Anacardiaceae	Mt.	-	x	x
29	*Syzygium malaccense* (L.) Merr. & Perry	Myrtaceae	Mt.	x	x	x
30	*Syzygium* sp. 1	Myrtaceae	Mt.	x	x	-
31	*Syzygium* sp. 2	Myrtaceae	Mt.	x	-	-
32	*Teijsmanniodendron aherianum* (Merr.) Bakh.	Verbenaceae	St.	-	x	x
33	*Terminalia microcarpa* Decne	Combretaceae	Mt.	x	x	-
34	*Terminalia sepicana* Diels.	Combretaceae	Mt.	x	-	-
35	*Timonius sp.*	Rubiaceae	Mt.	x	-	x
Table 1b: Ten dominant plants species found in swamp forest						
1	*Barringtonia acutangul*a (L.) Gaertn.	Lecythidaceae	St.	x	x	x
2	*Calophyllum* sp.	Clusiaceae	St.	-	x	x
3	*Crataeva* cf. *religiosa* Ainslie	Capparaceae	St.	-	x	x

No.	Genus & Species	Family	Life Form	Site		
				Kwerba	Papasena	Kay
Note: Bt.: Big tree, St.: Small tree, Mt.: Medium tree, Sh.: Shrub, Tp.: Tree palm, Pa.: Pandan, Cl.P: Climbing palm, Li.: Liana, Hb.: Herb						
4	*Dillenia papuana* Martelli	Dilleniaceae	Bt.	x	x	x
5	*Hibiscus tiliaceus* L.	Malvaceae	St.	x	x	x
6	*Mitragyna speciosa* Korth.	Rubiaceae	Mt.	-	x	x
7	*Neonauclea chalmersii* Merrill	Rubiaceae	St.	-	x	x
8	*Neonauclea versteghii* Merrill & Perry	Rubiaceae	Mt.	x	x	x
9	*Pandanus lauterbachii* K. Sch. & Warb.	Pandanaceae	Pa.	x	x	-
10	*Syzygium* sp.	Myrtaceae	Mt.	-	x	x
Table 2: List of plants species found in secondary forest						
1	*Abroma augusta* Linn.f.	Sterculiaceae	Sh.	-	x	x
2	*Alphitonia incana* (Roxb.) Teijsm. & Binn. ex Kure	Rhamnaceae	Mt.	x	x	-
3	*Anthocephalus chinensis* Hassk.	Rubiaceae	Bt.	x	x	-
4	*Artocarpus altilis* (Parkinson) Fosberg.	Moraceae	Bt.	x	x	x
5	*Artocarpus vrieseanus* Miq.	Moraceae	Mt	x	x	-
6	*Campnosperma auriculatum* Hook.f.	Anacardiaceae	Mt	x	x	x
7	*Cananga odorata* (Lam.) Hook.f. & Thoms.	Annonaceae	Mt.	x	x	x
8	*Althaffia pleiostigma* Warb.	Tiliaceae	Mt.	x	x	x
9	*Dracontomelon dao (Blanco) Merr. & Rolfe*	Anacardiaceae	Mt.	x	x	x
10	*Endospermum labios* Schodde	Euphorbiaceae	Mt	x	-	-
11	*Endospermum moluccanum* (Teijsm. & Binnend.) Kurz	Euphorbiaceae	Mt.	x	x	x
12	*Fagraea racemosa* Jack ex Wall.	Loganiaceae	St.	x	x	-
13	*Ficus congesta* Roxb.	Moraceae	St.	x	x	x

No.	Genus & Species	Family	Life Form	Site		
				Kwerba	Papasena	Kay
Note: Bt.: Big tree, St.: Small tree, Mt.: Medium tree, Sh.: Shrub, Tp.: Tree palm, Pa.: Pandan, Cl.P: Climbing palm, Li.: Liana, Hb.: Herb						
14	*Ficus dammaropsis* Diels.	Moraceae	St.	x	-	-
15	*Ficus minahasae* Miq.	Moraceae	St.	x	-	-
16	*Ficus miquellii* King	Moraceae	St.	x	x	-
17	*Ficus ruficaulis* Merr.	Moraceae	St.	x	-	-
18	*Ficus variegata* Blume	Moraceae	Mt	x	-	-
19	*Gastonia spectabilis* (Harms.) Philipson	Araliaceae	Mt.	x	x	x
20	*Geunsia* sp.	Verbenaceae	St.	x	x	-
21	*Glochidion novoguineense* K. Sch.	Euphorbiaceae	St.	x	x	x
22	*Glochidion philippicum* (Cav.) C.B. Roxb.	Euphorbiaceae	Mt.	x	x	x
23	*Glochidion* sp.	Euphorbiaceae	St.	x	x	x
24	*Hibiscus tiliaceus* L.	Malvaceae	St.	x	x	x
25	*Homalanthus novoguinensis* K. Schum.	Euphorbiaceae	Mt	x	-	x
26	*Leea indica* (Burm.f.) Merr.	Leeaceae	Sh.	x	x	x
27	*Macaranga aleuritoides* F. Muell.	Euphorbiaceae	St.	x	x	-
28	*Macaranga fimbriata* S. Moore	Euphorbiaceae	St.	x	x	-
29	*Macaranga mappa* (L.) Muell. Arg.	Euphorbiaceae	St.	x	x	-
30	*Macaranga quadriglandulosa* Warb.	Euphorbiaceae	St.	x	x	-
31	*Macaranga tanarius* (L.) Muell. Arg.	Euphorbiaceae	St.	x	x	-
32	*Mallotus floribundus* Muell. Arg.	Euphorbiaceae	St.	x	-	-
33	*Nauclea orientalis* L.	Rubiaceae	Mt.	x	x	x
34	*Neonauclea versteghii* Merrill & Perry	Rubiaceae	Mt.	x	x	x

No.	Genus & Species	Family	Life Form	Site		
				Kwerba	Papasena	Kay
Note: Bt.: Big tree, St.: Small tree, Mt.: Medium tree, Sh.: Shrub, Tp.: Tree palm, Pa.: Pandan, Cl.P: Climbing palm, Li.: Liana, Hb.: Herb						
35	*Osmoxylon palmatum* (Lamk.) Philipson	Araliaceae	St.	x	x	-
36	*Pandanus* sp.	Pandanaceae	Pa.	x	x	x
37	*Paraserianthes falcataria* (Jack) Nielsen	Fabaceae	Bt.	x	x	-
38	*Planchonia papuana* Kunth.	Lecythidaceae	Mt.	x	x	x
39	*Pterocarpus indicus* Willd.	Fabaceae	Bt.	x	x	-
40	*Trema orientalis* L.	Ulmaceae	Mt	x	x	-
Table 2b: Ten dominant plants species found in secondary forest						
1	*Alphitonia incana* (Roxb.) Teijsm. & Binn. ex Kure	Rhamnaceae	Mt.	x	x	-
2	*Cassia alata* L.	Fabaceae	Sh.	x	x	x
3	*Commersonia batramia* (L.) Merrill	Sterculiaceae	Sh.	x	x	-
4	*Ficus miquellii* King	Moraceae	St.	x	x	-
5	*Glochidion novoguineense* K. Sch.	Euphorbiaceae	St.	x	x	x
6	*Glochidion philippicum* (Cav.) C.B. Roxb.	Euphorbiaceae	Mt.	x	x	x
7	*Kleinhovia hospita* L.	Sterculiaceae	Mt.	x	x	x
8	*Macaranga fimbriata* S. Moore	Euphorbiaceae	St.	x	x	-
9	*Macaranga mappa* (L.) Muell. Arg.	Euphorbiaceae	St.	x	x	-
10	*Macaranga quadriglandulosa* Warb.	Euphorbiaceae	St.	x	x	-
Table 3: List of plants species found in primary flat lowland forest						
1	*Aglaia sylvestris* (M. Roem.) Merr.	Meliaceae	Mt.	x	x	-
2	*Alchornea rugosa* Muell. Arg.	Euphorbiaceae	St.	x	x	-
3	*Alseodaphne* sp.	Lauraceae	Mt.	x	x	x

No.	Genus & Species	Family	Life Form	Site		
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4	*Alstonia scholaris* (L.) R. Br.	Apocynaceae	Bt.	x	x	x
5	*Antiaris toxicaria* (Pers.) Lesch.	Moraceae	Mt.	x	x	-
6	*Antidesma orientale* J.J. Smith	Euphorbiaceae	St.	x	x	-
7	*Aphanamixis polystachya* (Wall.) R.N. Parker	Meliaceae	Mt.	-	x	x
8	*Aporosa brassii* Mansfield	Euphorbiaceae	St.	x	x	-
9	*Aporosa laxiflora* Pax. & Hoffm.	Euphorbiaceae	St.	x	x	x
10	*Archidendron aruense* (Warb.) de Wit.	Fabaceae	St.	x	x	-
11	*Ardisia lurida* Blume	Myrsinaceae	St.	-	x	x
12	*Ardisia* sp.	Myrsinaceae	Mt.	x	-	-
13	*Artocarpus* sp.	Moraceae	Mt.	-	x	x
14	*Artocarpus vrieseanus* Miq.	Moraceae	Mt.	x	x	-
15	*Beilschmiedia acutifolia* Teschn.	Lauraceae	St.	x	x	-
16	*Beilschmiedia archboldiana* C.K. Allen	Lauraceae	Mt.	x	x	-
17	*Beilschmiedia* cf. *myrmecophylla* Kosterm.	Lauraceae	Mt.	x	x	-
18	*Beilschmiedia gemmiflora* (Bl.) Kosterm.	Lauraceae	Mt.	x	-	-
19	*Bennetiodendron leprosipes* Merrill	Flacourtiaceae	Mt.	x	x	-
20	*Bischoffia javanica* Blume	Euphorbiaceae	Mt.	x	x	x
21	*Buchanania macrocarpa* Laut.	Anacardiaceae	Mt.	x	x	x
22	*Campnosperma auriculatum* Hook.f.	Anacardiaceae	Mt.	x	x	x
23	*Canarium hirsutum* Willd.	Burseraceae	Mt.	x	x	x
24	*Canarium indicum* Willd.	Burseraceae	Mt.	x	-	-

No.	Genus & Species	Family	Life Form	Site		
				Kwerba	Papasena	Kay
Note: Bt.: Big tree, St.: Small tree, Mt.: Medium tree, Sh.: Shrub, Tp.: Tree palm, Pa.: Pandan, Cl.P: Climbing palm, Li.: Liana, Hb.: Herb						
25	*Canarium maluense* Lauterb.	Burseraceae	Mt.	x	x	-
26	*Canarium oleosum* (Lamk.) Engl.	Burseraceae	Mt.	x	x	-
27	*Canarium sylvestre* Gaertn.	Burseraceae	Mt.	x	-	-
28	*Carallia brachiata* (Lour.) Merr.	Rhizophoraceae	Mt.	x	x	x
29	*Caryota rhumpiana* Mart. *var. novoguineensis*	Arecaceae	Tp.	x	x	x
30	*Celtis paniculata* Planch.	Tiliaceae	Mt.	x	x	-
31	*Celtis philippinensis* Blanco	Ulmaceae	Bt.	x	x	x
32	*Cerbera floribunda* K. Sch.	Apocynaceae	Mt.	x	x	x
33	*Chisocheton ceramicus* (Miq.) C.DC.	Meliaceae	St.	x	x	x
34	*Sandoricum koetjape* Merrill	Meliaceae	Mt.	x	x	x
35	*Chisocheton lasiocarpus* (Miq.) Valeton	Meliaceae	St.	x	-	-
36	*Chisocheton sapindus* Stevens.	Meliaceae	St.	x	-	-
37	*Chisocheton stellatus* Stevens	Meliaceae	St.	x	-	-
38	*Cinnamomum culitlawan* (L.) Kosterm.	Lauraceae	Mt.	x	x	-
39	*Cinnamomum* sp.	Lauraceae	St.	x	-	-
40	*Citronella suaveolens* (Bl.) Howard	Icacinaceae	Mt.	x	-	-
41	*Cleistanthus myrianthus* (Hassk.) Kurz.	Euphorbiaceae	St.	x	-	-
42	*Crudia papuana* Kosterm.	Fabaceae	Mt.	x	x	-
43	*Cryptocarya densiflora* Blume	Lauraceae	Mt.	x	x	-
44	*Cryptocarya idenburgensis* Merr.	Lauraceae	St.	x	-	-
45	*Cryptocarya infectoria* (Blume) Miquel	Lauraceae	St.	x	-	-

No.	Genus & Species	Family	Life Form	Site		
				Kwerba	Papasena	Kay
Note: Bt.: Big tree, St.: Small tree, Mt.: Medium tree, Sh.: Shrub, Tp.: Tree palm, Pa.: Pandan, Cl.P: Climbing palm, Li.: Liana, Hb.: Herb						
46	*Cryptocarya laevigata* F. Vill.	Lauraceae	Mt.	x	x	x
47	*Cryptocarya massoy* (Oken.) Kosterm.	Lauraceae	Mt.	x	x	-
48	*Cryptocarya* sp.	Lauraceae	Mt.	x	-	-
49	*Cryptocarya verrucosa* Teschn.	Lauraceae	St.			
50	*Dillenia papuana* Martelli	Dilleniaceae	Bt.	x	x	x
51	*Diospyros buxifolia* (Bl.) Hiern.	Ebenaceae	St.	x	-	-
52	*Diospyros discolor* Willd.	Ebenaceae	Mt.	x	-	-
53	*Diospyros herbacea* A. Cunn. & Benth.	Ebenaceae	St.	-	x	x
54	*Dracontomelon dao* (Blanco) Merr. & Rolfe	Anacardiaceae	Mt.	x	x	x
55	*Drypetes celebica* (Boerl.& Koord.) Pax & Hoffm.	Euphorbiaceae	Mt.	x	x	-
56	*Drypetes longifolia* (Bl.) Pax. & Hoffm.	Euphorbiaceae	Mt.	x	x	-
57	*Dysoxylum arborescens* Miq.	Meliaceae	Mt.	x	x	-
58	*Dysoxylum arnoldianum* K. Schum	Meliaceae	Mt.	x	-	-
59	*Dysoxylum excelsum* Blume	Meliaceae	Mt.	x	x	-
60	*Dysoxylum parasiticum* (Osbeck.) Kosterm.	Meliaceae	Mt.	x	-	-
61	*Elaeocarpus nouhysii* Koord.	Elaeocarpaceae	Mt.	x	-	-
62	*Elaeocarpus sphaericus* (Gaertn.) K. Schum.	Elaeocarpaceae	Mt.	x	x	x
63	*Endiandra acuminata* White & Francis	Lauraceae	Mt.	x	x	-
64	*Endiandra alleniana* C.T. White	Lauraceae	Mt.	x	-	-
65	*Endiandra euadenia* (Bl.) Kosterm.	Lauraceae	Mt.	x	-	-
66	*Endospermum moluccanum* (Teijsm. & Binnend) Kurz.	Euphorbiaceae	Mt.	x	x	x

No.	Genus & Species	Family	Life Form	Site		
				Kwerba	Papasena	Kay
Note: Bt.: Big tree, St.: Small tree, Mt.: Medium tree, Sh.: Shrub, Tp.: Tree palm, Pa.: Pandan, Cl.P: Climbing palm, Li.: Liana, Hb.: Herb						
67	*Engelhardia rigida* Blume	Juglandaceae	Mt.	x	-	-
68	*Fagraea racemosa* Jack ex Wall.	Loganiaceae	St.	x	x	-
69	*Firminia papuana* Mildbr.	Sterculiaceae	Mt.	x	-	-
70	*Garcinia dulcis* Kurz.	Clusiaceae	St.	x	-	-
71	*Garcinia hollrungii* Lauterb.	Clusiaceae	Mt.	-	x	x
72	*Garcinia latissima* Miq.	Clusiaceae	St.	x	x	-
73	*Garcinia riedelliana* Pierre	Clusiaceae	St.	x	-	-
74	*Gnetum gnemon* L.	Gnetaceae	Mt.	x	x	x
75	*Gonocaryum littorale* (Bl.) Sleumer	Icacinaceae	St.	x	x	x
76	*Gulubia costata* (Becc.) Becc.	Arecaceae	Tp.	x	x	x
77	*Gymnacranthera paniculata* (A.DC.) Warb.	Myristicaceae	St.	x	x	x
78	*Haplolobus floribundus* (K. Sch.) H.J. Lam	Burseraceae	Mt.	x	x	-
79	*Haplolobus lanceolatus* H.J. Lam ex Leenh.	Burseraceae	Mt.	x	-	-
80	*Haplolobus moluccanus* (Leenh.) H.J. Lam	Burseraceae	Mt.	x	x	-
81	*Homalium foetidum* (Roxb.) Bth.	Flacourtiaceae	Mt.	x	x	-
82	*Horsfieldia helwingii* (Warb.) Warb.	Myristicaceae	St.	x	x	-
83	*Horsfieldia irya* (Gaertn.) Warb.	Myristicaceae	St.	x	x	x
84	*Horsfieldia sylvestris* (Houtt.) Warb.	Myristicaceae	Mt.	x	x	x
85	*Hydriastele microspodik* (Becc.) Burr.	Arecaceae	Tp.	x	x	x
86	*Intsia bijuga* (Colebrooke) O. Kuntze	Fabaceae	Bt.	x	x	x
87	*Intsia palembanica* Miq.	Fabaceae	Bt.	x	x	-

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88	*Lithocarpus* sp.	Fagaceae	Mt.	x	x	-
89	*Litsea forstenii* (Blume) Boerl.	Lauraceae	St.	x	x	x
90	*Macaranga fallacina* Pax. & Hoffm.	Euphorbiaceae	St.	x	-	-
91	*Macaranga tessellata* Gage	Euphorbiaceae	St.	x	-	-
92	*Mallotus moritzianus* Muell. Arg.	Euphorbiaceae	St.	x	-	-
93	*Maniltoa plurijuga* Merr. & Perry	Fabaceae	Mt.	-	x	x
94	*Maniltoa psilogyne* Harms.	Fabaceae	Mt.	x	x	x
95	*Maniltoa rosea* (K. Schum.) Meuwen	Fabaceae	Mt.	x	x	-
96	*Maniltoa schefferi* K. Schum	Fabaceae	Bt.	x	x	x
97	*Mastixiodendron pachyclados* (K. Schum.) Melchior	Rubiaceae	Mt.	x	x	x
98	*Medusanthera laxiflora* (Miers.) Howard.	Icacinaceae	St.	x	x	x
99	*Metroxylon sagu* Rottb.	Arecaceae	Tp.	x	x	x
100	*Mischocarpus longifolius* Radlk.	Sapindaceae	St.	x	-	-
101	*Myristica fatua* Houtt.	Myristicaceae	Mt.	x	x	x
102	*Myristica hollrungii* Warb.	Myristicaceae	Mt.	x	x	x
103	*Myristica lepidota* Bl.	Myristicaceae	Mt.	x	-	-
104	*Myristica subalulata* Miq.	Myristicaceae	Mt.	x	x	-
105	*Myristica sulcata* Warb.	Myristicaceae	Mt.	x	-	-
106	*Neoscortechinia forbesii* (Hook.f.) Pax. & Hoffm.	Euphorbiaceae	Mt.	x	x	-
107	*Neubergia corymbosa* (A. Gray) Leenh.	Loganiaceae	St.	x	x	x
108	*Orania* cf. *brassii* Burret	Arecaceae	Tp.	-	x	-

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109	*Osmelia philippina* (Turcz.) Benth.	Flacourtiaceae	Mt.	x	-	-
110	*Palaquium erythrospermum* Lam.	Sapotaceae	Mt.	x	-	-
111	*Paraserianthes falcataria* (Jack) Nielsen	Fabaceae	Bt.	x	x	-
112	*Paratocarpus venenosus* Becc.	Moraceae	Bt.	x	x	-
113	*Pimeleodendron amboinicum* Hassk.	Euphorbiaceae	Mt.	x	x	x
114	*Pisonia longirostris* Teijsm. et Binnend.	Nyctaginaceae	St.	x	x	x
115	*Pittosporum sinuatum* Bl.	Pittosporaceae	Sh.	x	x	-
116	*Pometia pinnata* J.R. & G. Forster.	Sapindaceae	Bt.	x	x	x
117	*Pouteria chartacea* (F.v. Mueller) Baehni	Sapotaceae	Bt.	x	-	-
118	*Pouteria duclitan* (Blanco) Baehni syn.	Sapotaceae	Mt.	x	x	-
119	*Pouteria firma* (Miq.) Baehni	Sapotaceae	Mt.	x	-	-
120	*Pouteria linggensis* (Burck) Baehni	Sapotaceae	Mt.	x	-	-
121	*Pouteria macropoda* (H.J. Lam) Baehni	Sapotaceae	Bt.	x	-	-
122	*Prainea papuana* Becc.	Moraceae	Mt.	x	x	x
123	*Pseudobotrys cauliflora* (Pulle) Sleumer	Icacinaceae	Mt.	x	x	x
124	*Pterocarpus indicus* Willd.	Fabaceae	Bt.	x	x	-
125	*Pterocymbium beccarii* K. Schum	Sterculiaceae	Bt.	x	x	-
126	*Pterygota horsfiedlii* (R. Br.) Kosterm.	Sterculiaceae	Bt.	x	x	-
127	*Quasia indica* (Gaertn.) Noot.	Simaroubaceae	St.	x	-	-
128	*Rhopaloblaste brassii* H.E. Moore	Arecaceae	Tp.	x	x	x
129	*Rhus taitensis* Guill.	Anacardiaceae	Mt.	-	x	x

No.	Genus & Species	Family	Life Form	Site		
				Kwerba	Papasena	Kay
Note: Bt.: Big tree, St.: Small tree, Mt.: Medium tree, Sh.: Shrub, Tp.: Tree palm, Pa.: Pandan, Cl.P: Climbing palm, Li.: Liana, Hb.: Herb						
130	*Rhyticaryum oleraceum* Becc.	Icacinaceae	St.	-	x	-
131	*Saurauia* sp.	Actinidiaceae	St.	x	x	-
132	*Semecarpus aruensis* Engl.	Anacardiaceae	St.	x	x	x
133	*Semecarpus forstenii* Blume	Anacardiaceae	St.	x	-	-
134	*Sloanea aberans* (Brandis) A.C. Smith	Elaeocarpaceae	Mt.	x	-	-
135	*Sloanea sogorensis* Beck.f.	Elaeocarpaceae	Mt.	x	-	-
136	*Spondias dulcis* Forst.	Anacardiaceae	Mt.	x	x	x
137	*Stemonurus ammui* (Kaneh.) Sleumer	Icacinaceae	Mt.	x	x	-
138	*Sterculia shillinghawi* F.v. Muell.	Sterculiaceae	Mt.	x	x	-
139	*Syzygium buettnerianum* (K. Schum.) Niedenzu	Myrtaceae	Mt.	x	-	-
140	*Syzygium burapensis* T.G. Hartley	Myrtaceae	Mt.	x	x	-
141	*Syzygium decipiens* (Koord. & Val.) Merr. & Perry	Myrtaceae	Mt.	x	x	-
142	*Syzygium furfuraceum* Merr. & Perry	Myrtaceae	Mt.	x	-	-
143	*Syzygium geniocalyx* Merr. & Perry	Myrtaceae	St.	x	x	-
144	*Syzygium leptoneurum* Diels.	Myrtaceae	Mt.	x	x	-
145	*Syzygium longipes* (Warb.) Merr. & Perry	Myrtaceae	St.	-	x	x
146	*Syzygium nutans* (K. Schum.) Merr. & Perry	Myrtaceae	Mt.	-	x	x
147	*Syzygium papuasica* Merr. & Perry	Myrtaceae	Mt.	x	-	-
148	*Syzygium* sp.	Myrtaceae	Mt.	-	x	x
149	*Syzygium tierneyana* (F. Muell.) T.G. Hartley & Perry	Myrtaceae	Mt.	x	x	-
150	*Syzygium trinerve* (Ridley) Merr. & Perry	Myrtaceae	Mt.	x	x	x

No.	Genus & Species	Family	Life Form	Site		
				Kwerba	Papasena	Kay
Note: Bt.: Big tree, St.: Small tree, Mt.: Medium tree, Sh.: Shrub, Tp.: Tree palm, Pa.: Pandan, Cl.P: Climbing palm, Li.: Liana, Hb.: Herb						
151	*Syzygium verstegii* Lauterb.	Myrtaceae	Mt.	x	x	-
152	*Teijsmanniodendron bogoriense* Koord.	Verbenaceae	Mt.	x	x	-
153	*Teisjmanniodendron hollrungii* (Warb.) Kosterm.	Verbenaceae	Mt.	x	x	-
154	*Terminalia brassii* Exell.	Combretaceae	Bt.	-	x	x
155	*Terminalia complanata* K. Schum.	Combretaceae	Bt.	x	-	-
156	*Terminalia koernbachii* Warb.	Combretaceae	Mt.	x	-	-
157	*Terminalia microcarpa* Decne	Combretaceae	Mt.	x	x	-
158	*Terminalia rubiginosa* K. Schum.	Combretaceae	Bt.	x	x	x
159	*Terminalia steensiana* Exell.	Combretaceae	Bt.	x	x	-
160	*Timonius romeri* Val.	Rubiaceae	St.	x	x	-
161	*Timonius rufescens* Boerl.	Rubiaceae	St.	-	x	x
162	*Trichadenia philippinensis* Merr.	Flacourtiaceae	Mt.	x	-	-
163	*Vatica rassak* (Korth.) Blume	Dipterocarpaceae	Bt.	x	x	-
164	*Xanthophyllum papuanum* Whitmore & Meijden	Polygalaceae	Bt.	x	x	x
165	*Zizyphus angustifolius* (Miq.) Hatusima ex Steenis	Rhamnaceae	St.	x	x	x
Table 3b: Ten dominant plants species found in primary flat lowland forest						
1	*Pometia pinnata* J.R. & G. Forster.	Sapindaceae	Bt.	x	x	x
2	*Intsia palembanica* Miq.	Fabaceae	Bt.	x	x	-
3	*Celtis philippinensis* Blanco	Ulmaceae	Bt.	x	x	x
4	*Canarium maluense* Lauterb.	Burseraceae	Mt	x	x	-
5	*Teijsmanniodendron bogoriense* Koord.	Verbenaceae	Mt.	x	x	-

No.	Genus & Species	Family	Life Form	Site		
				Kwerba	Papasena	Kay
Note: Bt.: Big tree, St.: Small tree, Mt.: Medium tree, Sh.: Shrub, Tp.: Tree palm, Pa.: Pandan, Cl.P: Climbing palm, Li.: Liana, Hb.: Herb						
6	*Homalium foetidum* (Roxb.) Bth.	Flacourtiaceae	Mt.	x	x	-
7	*Prainea papuana* Becc.	Moraceae	Mt.	x	x	x
8	*Gnetum gnemon* L.	Gnetaceae	Mt.	x	x	x
9	*Mastixiodendron pachyclados* (K. Schum.) Melchior	Rubiaceae	Mt.	x	x	x
10	*Pimeleodendron amboinicum* Hassk.	Euphorbiaceae	Mt.	x	x	x
Table 4: List of plants species found in ridge primary forest						
1	*Acioa heterophylla* (Scorb.) Kosterm.	Chrysobalanaceae	Mt.	x	x	-
2	*Actinodaphne procera* (Bl.) Nees	Lauraceae	Mt.	x	x	-
3	*Aglaia cucullata* (Roxb.) Pellegr.	Meliaceae	Mt.	x	x	-
4	*Aglaia edulis* (Roxb.) Wall.	Meliaceae	Mt.	x	x	-
5	*Aglaia lowii* (Wight.) Salanha ex Ramamorthy	Meliaceae	Mt.	x	x	-
6	*Aglaia sapindina* (F. & M.) Harms.	Meliaceae	Mt.	x	x	-
7	*Aglaia sylvestris* (M. Roem.) Merr.	Meliaceae	Mt.	x	x	-
8	*Alchornea rugosa* Muell. Arg.	Euphorbiaceae	St.	x	x	-
9	*Alseodaphne* sp.	Lauraceae	Mt.	x	x	x
10	*Anisoptera thurifera* (Blanco) Bl. ssp. *polyandra* (Bl.) P.S. Ashton	Dipterocarpaceae	Bt.	x	x	x
11	*Antiaris toxicaria* (Pers.) Lesch.	Moraceae	Mt.	x	x	-
12	*Antidesma orientale* J.J. Smith	Elaeocarpaceae	St.	x	x	-
13	*Aporosa brassii* Mansfield	Euphorbiaceae	St.	x	x	-
14	*Aporosa laxiflora* Pax. & Hoffm.	Euphorbiaceae	St.	x	x	x
15	*Aporosa papuana* Pax. & Hoffm.	Euphorbiaceae	St.	x	x	-

No.	Genus & Species	Family	Life Form	Site		
				Kwerba	Papasena	Kay
Note: Bt.: Big tree, St.: Small tree, Mt.: Medium tree, Sh.: Shrub, Tp.: Tree palm, Pa.: Pandan, Cl.P: Climbing palm, Li.: Liana, Hb.: Herb						
16	*Archidendron aruense* (Warb.) de Wit.	Fabaceae	St.	-	x	-
17	*Ardisia lurida* Blume	Myrsinaceae	St.	-	x	x
18	*Ardisia* sp. 1	Myrsinaceae	St.	x	x	x
19	*Ardisia* sp. 2	Myrsinaceae	St.	-	-	x
20	*Artocarpus incisus* (Thunb.) L.f.	Moraceae	Mt.	-	x	x
21	*Artocarpus sepicanus* Diels	Moraceae	Mt.	x	-	-
22	*Artocarpus* sp. 1	Moraceae	Mt.	-	x	x
23	*Artocarpus teysmannii* Miq.	Moraceae	Mt.	-	x	x
24	*Artocarpus vrieseanus* Miq.	Moraceae	Mt.	x	x	-
25	*Astronia papetaria* Blume	Melastomataceae	Mt.	x	-	-
26	*Baccaurea* sp.	Euphorbiaceae	St.	x	-	-
27	*Beilschmiedia archboldiana* C.K. Allen	Lauraceae	Mt.	x	x	-
28	*Beilschmiedia myrmecophylla* Kosterm.	Lauraceae	Mt.	x	x	-
29	*Beilschmiedia* sp.	Lauraceae	Mt.	x	x	-
30	*Bennetiodendron leprosipes* Merrill	Flacourtiaceae	Mt.	x	x	-
31	*Blumeodendron tokbrai* (Bl.) Kurz	Euphorbiaceae	Mt.	x	x	-
32	*Calophyllum papuanum* Lautb.	Clusiaceae	Mt.	x	x	-
33	*Calophyllum peekeelii* Lour.	Clusiaceae	Mt.	x	x	-
34	*Calophyllum soulatri* Burm.f.	Clusiaceae	Mt.	x	x	x
35	*Canarium hirsutum* Willd.	Burseraceae	Mt.	x	x	x
36	*Canarium indicum* Willd.	Burseraceae	Mt.	x	-	-

No.	Genus & Species	Family	Life Form	Site		
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Note: Bt.: Big tree, St.: Small tree, Mt.: Medium tree, Sh.: Shrub, Tp.: Tree palm, Pa.: Pandan, Cl.P: Climbing palm, Li.: Liana, Hb.: Herb						
37	*Canarium maluense* Lauterb.	Burseraceae	Mt.	x	x	-
38	*Canarium oleosum* (Lamk.) Engl.	Burseraceae	Mt.	x	x	-
39	*Canarium sylvestre* Gaertn.	Burseraceae	Mt.	x	-	-
40	*Carallia brachiata* (Lour.) Merr.	Rhizophoraceae	Mt.	x	x	x
41	*Casearia papuana* Sleumer	Flacourtiaceae	St.	x	-	-
42	*Celtis paniculata* Planch.	Ulmaceae	Mt.	x	x	-
43	*Celtis philippinensis* Blanco	Ulmaceae	Bt.	x	x	x
44	*Chionanthus oxycarpus* (Lingels) Kiew	Oleaceae	St.	x	-	-
45	*Chionanthus sessiliflorus* (Hensch.) Kiew	Oleaceae	St.	x	x	-
46	*Chisocheton ceramicus* (Miq.) C.DC.	Meliaceae	St.	x	x	x
47	*Chisocheton lasiocarpus* (Miq.) Valeton	Meliaceae	St.	x	-	-
48	*Chisocheton sapindus* Stevens	Meliaceae	St.	x	-	-
49	*Chisocheton stellatus* Stevens	Meliaceae	St.	x	-	-
50	*Chrysophyllum roxburghii* G. Don	Sapotaceae	Mt.	x	-	-
51	*Cinnamomum culitlawan* (L.) Kosterm.	Lauraceae	Mt.	x	x	-
52	*Cinnamomum* sp.	Lauraceae	St.	x	-	-
53	*Citronella suaveolens* (Bl.) Howard	Icacinaceae	Mt.	x	-	-
54	*Cleistanthus myrianthus* (Hassk.) Kurz	Euphorbiaceae	St.	x	-	-
55	*Cryptocarya densiflora* Blume	Lauraceae	Mt.	x	x	-
56	*Cryptocarya idenburgensis* Merr.	Lauraceae	St.	x	-	-
57	*Cryptocarya kamahar* Teschn.	Lauraceae	Mt.	x	x	-

No.	Genus & Species	Family	Life Form	Site		
				Kwerba	Papasena	Kay
Note: Bt.: Big tree, St.: Small tree, Mt.: Medium tree, Sh.: Shrub, Tp.: Tree palm, Pa.: Pandan, Cl.P: Climbing palm, Li.: Liana, Hb.: Herb						
58	*Cryptocarya laevigata* F. Vill.	Lauraceae	Mt.	x	x	x
59	*Cryptocarya massoy* (Oken) Kosterm.	Lauraceae	Mt.	x	x	-
60	*Cryptocarya palmerensis* Allen	Lauraceae	Mt.	x	-	-
61	*Cryptocarya* sp.	Lauraceae	St.	x	-	-
62	*Cryptocarya verrucosa* Teschn.	Lauraceae	St.			
63	*Cryptocarya zollingeriana* Miq.	Lauraceae	Mt.			
64	*Diospyros buxifolia* (Bl.) Hiern.	Ebenaceae	St.	x	-	-
65	*Diospyros discolor* Willd.	Ebenaceae	Mt.	x	-	-
66	*Diospyros ferrea* (Willd.) Bakh.	Ebenaceae	St.	x	-	-
67	*Diospyros herbacea* A. Cunn. & Benth.	Ebenaceae	St.	-	x	x
68	*Diospyros* sp.	Ebenaceae	Mt.	x	-	-
69	*Diospyros ulo* Merr.	Ebenaceae	Mt.	x	-	-
70	*Drypetes celebica* (Boerl.& Koord.) Pax & Hoffm.	Euphorbiaceae	Mt.	x	x	-
71	*Drypetes longifolia* (Bl.) Pax. & Hoffm.	Euphorbiaceae	Mt.	x	x	-
72	*Drypetes* sp.	Euphorbiaceae	Mt.	x	-	-
73	*Duabunga moluccana* Blume	Sonneratiaceae	St.	x	x	-
74	*Dyctyoneura acuminata* Blume	Sapindaceae	St.	x	x	-
75	*Dysoxylum arborescens* Miq.	Meliaceae	Mt.	x	x	-
76	*Dysoxylum excelsum* Blume	Meliaceae	Mt.	x	x	-
77	*Dysoxylum hexandrum* Merr.	Meliaceae	Mt.	x	-	-
78	*Dysoxylum pettigrewianum* F.M. Bailey	Meliaceae	Mt.	x	-	-

No.	Genus & Species	Family	Life Form	Site		
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Note: Bt.: Big tree, St.: Small tree, Mt.: Medium tree, Sh.: Shrub, Tp.: Tree palm, Pa.: Pandan, Cl.P: Climbing palm, Li.: Liana, Hb.: Herb						
79	*Dysoxylum variabile* Harms.	Meliaceae	Mt.	x	-	-
80	*Elaeocarpus nouhysii* Koord.	Elaeocarpaceae	Mt.	x	-	-
81	*Elaeocarpus sphaericus* (Gaertn.) K. Schum.	Elaeocarpaceae	Mt.	x	x	x
82	*Elaeocarpus stipularis* Blume	Elaeocarpaceae	Mt.	x	-	-
83	*Elattostachys zippeliana* Radlk.	Sapindaceae	St.	x	-	-
84	*Endiandra acuminata* White & Francis	Lauraceae	Mt.	x	x	-
85	*Endiandra alleniana* C.T. White	Lauraceae	Mt.	x	-	-
86	*Endiandra euadenia* (Bl.) Kosterm.	Lauraceae	Mt.	x	-	-
87	*Fagraea racemosa* Jack ex Wall.	Loganiaceae	St.	x	x	-
88	*Firminia papuana* Mildbr.	Sterculiaceae	Mt.	x	-	-
89	*Garcinia hollrungii* Lauterb.	Clusiaceae	Mt.	-	x	x
90	*Garcinia riedeliana* Pierre	Clusiaceae	St.	x	-	-
91	*Gmelina moluccana* (Bl.) Backer	Verbenaceae	Mt.	x	-	-
92	*Gnetum gnemon* L.	Gnetaceae	Mt.	x	x	x
93	*Gonocaryum filiforme* Scheff.	Icacinaceae	Mt.	x	-	-
94	*Gonocaryum littorale* (Bl.) Sleumer	Icacinaceae	St.	x	x	x
95	*Gymnacranthera paniculata* (A.DC.) Warb.	Myrsiticaceae	St.	x	x	x
96	*Haplolobus floribundus* (K. Sch.) H.J. Lam	Burseraceae	Mt.	x	x	-
97	*Haplolobus moluccanus* (Leenh.) H.J. Lam	Burseraceae	Mt.	x	x	-
98	*Helicia* sp.	Proteaceae	Mt.	x	-	-
99	*Homalium foetidum* (Roxb.) Bth.	Flacourtiaceae	Mt.	x	x	-

No.	Genus & Species	Family	Life Form	Site		
				Kwerba	Papasena	Kay
Note: Bt.: Big tree, St.: Small tree, Mt.: Medium tree, Sh.: Shrub, Tp.: Tree palm, Pa.: Pandan, Cl.P: Climbing palm, Li.: Liana, Hb.: Herb						
100	*Hopea novoguineensis* Slooten	Dipterocarpaceae	Mt.	x	x	-
101	*Horsfieldia helwingii* (Warb.) Warb.	Myrsiticaceae	St.	x	x	-
102	*Horsfieldia irya* (Gaertn.) Warb.	Myrsiticaceae	St.	x	x	x
103	*Horsfieldia kostermansii* J. Sinclair	Myrsiticaceae	Mt.	x	-	-
104	*Horsfieldia sylvestris* (Houtt.) Warb.	Myrsiticaceae	Mt.	x	x	x
105	*Intsia bijuga* (Colebrooke) O. Kuntze	Fabaceae	Bt.	x	x	x
106	*Intsia palembanica* Miq.	Fabaceae	Bt.	x	x	-
107	*Jagera pseudorhus* (A. Rich.) Radlk.	Sapindaceae	St.	x	-	-
108	*Lithocarpus celebicus* (Miq.) Rehd.	Fagaceae	Mt.	x	-	-
109	*Lithocarpus* sp.	Fagaceae	Mt.	x	x	-
110	*Lithocarpus vinkii* Soepadmo	Fagaceae	Mt.	x	-	-
111	*Litsea forstenii* (Blume) Boerl.	Lauraceae	St.	x	x	x
112	*Litsea* sp.	Lauraceae	Mt.	-	-	x
113	*Litsea timoriana* Span.	Lauraceae	Mt.	x	-	-
114	*Mallotus moritzianus* Muell. Arg.	Euphorbiaceae	St.	x	-	-
115	*Mangifera minor* Blume	Anacardiaceae	Mt.	x	-	-
116	*Maniltoa plurijuga* Merr. & Perry	Fabaceae	Mt.	-	x	x
117	*Maniltoa psilogyne* Harms.	Fabaceae	Mt.	x	x	x
118	*Maniltoa rosea* (K. Schum.) Meuwen	Fabaceae	St.	x	x	-
119	*Maniltoa schefferi* K. Schum	Fabaceae	Bt.	x	x	x
120	*Maranthes corymbosa* Blume	Chrysobalanaceae	Bt.	x	x	-

No.	Genus & Species	Family	Life Form	Site		
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121	*Mastixiodendron pachyclados* (K. Schum.) Melchior	Rubiaceae	Mt.	x	x	x
122	*Medusanthera laxiflora* (Miers.) Howard	Icacinaceae	St.	x	x	x
123	*Memecylon edule* Roxb.	Melastomataceae	St.	x	-	-
124	*Memecylon* sp.	Melastomataceae	St.	x	-	-
125	*Microcos ceramensis* Burr.	Tiliaceae	St.	x	-	-
126	*Mischocarpus longifolius* Radlk.	Sapindaceae	St.	x	-	-
127	*Myristica fatua* Houtt.	Myrsiticaceae	Mt.	x	x	x
128	*Myristica hollrungii* Warb.	Myrsiticaceae	Mt.	x	x	x
129	*Myristica lancifolia* Poirret	Myrsiticaceae	St.	x	-	-
130	*Myristica lepidota* Bl.	Myrsiticaceae	Mt.	x	-	-
131	*Myristica subalulata* Miq.	Myrsiticaceae	Mt.	x	x	-
132	*Myristica sulcata* Warb.	Myrsiticaceae	Mt.	x	-	-
133	*Nenauclea acuminata* Rids.	Rubiaceae	Mt.	x	-	-
134	*Nauclea orientalis* L.	Rubiaceae	Mt.	x	x	-
135	*Neoscortechinia forbesii* (Hook.f.) Pax. & Hoffm.	Euphorbiaceae	Mt.	x	x	-
136	*Nephelium* sp.	Sapindaceae	Mt.	x	-	-
137	*Osmelia philippina* (Turcz.) Benth.	Flacourtiaceae	Mt.	x	-	-
138	*Palaquium erythrospermum* Lam.	Sapotaceae	Mt.	x	-	-
139	*Palaquium warburgianum* Schltr.	Sapindaceae	Bt.	x	-	-
140	*Paraserianthes falcataria* (Jack) Nielsen	Fabaceae	Bt.	x	x	-
141	*Parastemon versteghii* Merr. & Perry	Chrysobalanaceae	Mt.	x	x	-

No.	Genus & Species	Family	Life Form	Site		
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Note: Bt.: Big tree, St.: Small tree, Mt.: Medium tree, Sh.: Shrub, Tp.: Tree palm, Pa.: Pandan, Cl.P: Climbing palm, Li.: Liana, Hb.: Herb						
142	*Paratocarpus venenosus* Becc.	Moraceae	Bt.	x	x	-
143	*Parinari nonda* (F.v.M.) Benth.	Chrysobalanaceae	Mt.	x	x	-
144	*Parinari papuana* C.T. White	Chrysobalanaceae	*Mt.	x	-	-
145	*Pertusadina multifolia* (Havil.) Ridsd.	Rubiaceae	Mt.	x	-	-
146	*Phoebe cuneata* Blume	Lauraceae	Bt.	x	x	x
147	*Pimeleodendron amboinicum* Hassk.	Euphorbiaceae	Mt.	x	x	x
148	*Pittosporum sinuatum* Bl.	Pittosporaceae	Sh.	x	x	-
149	*Platea excelsa* Blume	Icacinaceae	Mt.	x	-	-
150	*Podocarpus neriifolius* D. Don ex Lamk.	Podocarpaceae	Mt.	x	-	-
151	*Pometia pinnata* J.R. & G. Forster.	Sapindaceae	Bt.	x	x	x
152	*Pouteria chartacea* (F.v. Mueller) Baehni	Sapotaceae	Bt.	x	-	-
153	*Pouteria duclitan* (Blanco) Baehni	Sapotaceae	Mt.	x	x	-
154	*Pouteria firma* (Miq.) Baehni	Sapotaceae	Mt.	x	-	-
155	*Prainea papuana* Becc.	Moraceae	Mt.	x	x	x
156	*Prunus arborea* (Bl.) Kalkm.	Rosaceae	Mt.	x	x	-
157	*Pternandra coerulescens* Jack	Melastomataceae	Mt.	x	x	x
158	*Pterocarpus indicus* Willd.	Fabaceae	Bt.	x	x	-
159	*Pterocymbium beccarii* K. Schum.	Sterculiaceae	Bt.	x	x	-
160	*Pterygota horsfieldii* (R. Br.) Kosterm.	Sterculiaceae	Bt.	x	x	-
161	*Ptychopyxis chrysantha* (Schum.) Airy Shaw	Euphorbiaceae	Mt.	x	x	-
162	*Quasia indica* (Gaertn.) Noot.	Sapotaceae	St.	x	-	-

No.	Genus & Species	Family	Life Form	Site		
				Kwerba	Papasena	Kay
Note: Bt.: Big tree, St.: Small tree, Mt.: Medium tree, Sh.: Shrub, Tp.: Tree palm, Pa.: Pandan, Cl.P: Climbing palm, Li.: Liana, Hb.: Herb						
163	*Ryparosa javanica* (Blume) Kurz. ex Koord. & Valeton	Flacourtiaceae	St.	x	-	-
164	*Sandoricum koetjape* Merrill	Meliaceae	Mt.	x	x	x
165	*Sloanea aberans* (Brandis) A.C. Smith	Elaeocarpaceae	Mt.	x	-	-
166	*Sloanea paradisearum* F. & M.	Elaeocarpaceae	Mt.	x	x	-
167	*Sloanea sogerensis* Beck.f.	Elaeocarpaceae	Mt.	x	-	-
168	*Spondias dulcis* Forst.	Anacardiaceae	Mt.	x	x	x
169	*Stemonurus ammui* (Kaneh.) Sleumer	Icacinaceae	Mt.	x	x	-
170	*Stemonurus monticolus* Sleumer	Icacinaceae	Mt.	x	x	-
171	*Sterculia macrophylla* Vent.	Sterculiaceae	Mt.	x	x	-
172	*Sterculia shillinghawi* F.v. Muell.	Sterculiaceae	Mt.	x	x	-
173	*Syzygium decipiens* (Koord. & Val.) Merr. & Perry	Myrtaceae	Mt.	x	x	-
174	*Syzygium geniocalyx* Merr. & Perry	Myrtaceae	St.	x	x	-
175	*Syzygium leptoneurum* Diels	Myrtaceae	Mt.	x	x	-
176	*Syzygium longipes* (Warb.) Merr. & Perry	Myrtaceae	St.	-	x	x
177	*Syzygium nutans* (K. Schum.) Merr. & Perry	Myrtaceae	Mt.	-	x	x
178	*Syzygium rosaceum* Diels.	Myrtaceae	Mt.	x	x	-
179	*Syzygium* sp. 1	Myrtaceae	Mt.	x	x	-
180	*Syzygium* sp. 2	Myrtaceae	Mt.	x	-	-
181	*Syzygium* sp. 3	Myrtaceae	Mt.	x	x	-
182	*Syzygium* sp. 4	Myrtaceae	Mt.	-	x	x
183	*Syzygium trinerve (*Ridley) Merr. & Perry	Myrtaceae	Mt.	x	x	x

No.	Genus & Species	Family	Life Form	Site		
				Kwerba	Papasena	Kay
Note: Bt.: Big tree, St.: Small tree, Mt.: Medium tree, Sh.: Shrub, Tp.: Tree palm, Pa.: Pandan, Cl.P: Climbing palm, Li.: Liana, Hb.: Herb						
184	*Syzygium verstegii* Lauterb.	Myrtaceae	Mt.	x	x	-
185	*Teijsmanniodendron bogoriense* Koord.	Verbenaceae	Mt.	x	x	-
186	*Teijsmanniodendron hollrungii* (Warb.) Kosterm.	Verbenaceae	Mt.	x	x	-
187	*Terminalia complanata* K. Schum.	Combretaceae	Mt.	x	-	-
188	*Terminalia kaernbachii* Warb.	Combretaceae	Mt.	x	-	-
189	*Terminalia microcarpa* Decne	Combretaceae	Mt.	x	x	-
190	*Terminalia rubiginosa* K. Schum.	Combretaceae	Mt.	x	x	x
191	*Terminalia sepicana* Diels	Combretaceae	Mt.	x	-	-
192	*Ternstroemia cherry* (F.M. Bailey) Merr.	Theaceae	St.	x	-	-
193	*Tetractomia obovata* Merr.	Rutaceae	Mt.	x	-	-
194	*Timonius sp.*	Rubiaceae	Mt.	x	-	x
195	*Timonius novoguineensis* Warb.	Rubiaceae	St.	x	-	-
196	*Timonius romeri* Val.	Rubiaceae	St.	x	x	-
197	*Timonius rufescens* Boerl.	Rubiaceae	St.	-	x	x
198	*Toxotrophis ilicifolia* Vid.	Moraceae	Mt.	x	-	-
199	*Trichadenia philippinensis* Merr.	Flacourtiaceae	Mt.	x	-	-
200	*Vatica rassak* (Korth.) Blume	Dipterocarpaceae	Bt.	x	x	-
201	*Vavaea bantamensis* Koord. & Merr.	Meliaceae	Mt.	x	-	-
202	*Xanthophyllum papuanum* Whitmore ex Meijden	Polygalaceae	Bt.	x	x	x
203	*Xanthophyllum suberosum* C.T. White	Polygalaceae	Mt.	x	-	-
204	*Xanthophyllum tenuipetalum* Meijden	Polygalaceae	St.	x	-	-

No.	Genus & Species	Family	Life Form	Site		
				Kwerba	Papasena	Kay
Note: Bt.: Big tree, St.: Small tree, Mt.: Medium tree, Sh.: Shrub, Tp.: Tree palm, Pa.: Pandan, Cl.P: Climbing palm, Li.: Liana, Hb.: Herb						
205	*Zizyphus angustifolius* (Miq.) Hatusima ex Steenis	Rhamnaceae	St.	x	x	x
Table 4b: Ten dominant plants species found in ridge primary forest						
1	*Anisoptera thurifera* (Blanco) Bl.	Dipterocarpaceae	Bt.	x	x	x
2	*Homalium foetidum* (Roxb.) Bth.	Flacourtiaceae	Mt.	x	x	-
3	*Hopea novoguineensis* Slooten	Dipterocarpaceae	Mt.	x	x	-
4	*Intsia palembanica* Miq.	Fabaceae	Bt.	x	x	-
5	*Myristica hollrungii* Warb.	Myristicaceae	Mt.	x	x	x
6	*Pimeleodendron amboinicum* Hassk.	Euphorbiaceae	Mt.	x	x	x
7	*Pometia pinnata* J.R. & G. Forster.	Sapindaceae	Bt.	x	x	x
8	*Prainea papuana* Becc.	Moraceae	Mt.	x	x	x
9	*Pterygota horsfieldii* (R. Br.) Kosterm.	Sterculiaceae	Bt.	x	x	-
10	*Sterculia shilinghawi* F.v. Muell.	Sterculiaceae	Mt.	x	x	-
Table 5: List of plants species found in Damar forest						
1	*Acioa heterophylla* (Scorb.) Kosterm.	Chrysobalanaceae	Mt.	x	x	-
2	*Actinodaphne procera* (Bl.) Nees	Lauraceae	Mt.	x	x	-
3	*Aglaia cucullata* (Roxb.) Pellegr.	Meliaceae	Mt.	x	x	-
4	*Aglaia edulis* (Roxb.) Wall.	Meliaceae	Mt.	x	x	-
5	*Aglaia lowii* (Wight.) Salanha ex Ramamorthy	Meliaceae	Mt.	x	x	-
6	*Aglaia sapindina* (F. & M.) Harms.	Meliaceae	Mt.	x	x	-
7	*Aglaia sylvestris* (M. Roem.) Merr.	Meliaceae	Mt.	x	x	-
8	*Alchornea rugosa* Muell. Arg.	Euphorbiaceae	St.	x	x	-

No.	Genus & Species	Family	Life Form	Site		
				Kwerba	Papasena	Kay
Note: Bt.: Big tree, St.: Small tree, Mt.: Medium tree, Sh.: Shrub, Tp.: Tree palm, Pa.: Pandan, Cl.P: Climbing palm, Li.: Liana, Hb.: Herb						
9	*Alseodaphne* sp.	Lauraceae	Mt.	x	x	x
10	*Anisoptera thurifera* (Blanco) Bl.	Dipterocarpaceae	Bt.	x	x	x
11	*Antiaris toxicaria* (Pers.) Lesch.	Moraceae	Mt.	x	x	-
12	*Antidesma orientale* J.J. Smith	Elaeocarpaceae	St.	x	x	-
13	*Aporosa brassii* Mansfield	Euphorbiaceae	St.	x	x	-
14	*Aporosa laxiflora* Pax. & Hoffm.	Euphorbiaceae	St.	x	x	x
15	*Aporosa papuana* Pax. & Hoffm.	Euphorbiaceae	St.	x	x	-
16	*Beilschmiedia archboldiana* C.K. Allen	Lauraceae	Mt.	x	x	-
17	*Beilschmiedia myrmecophylla* Kosterm.	Lauraceae	Mt.	x	x	-
18	*Beilschmiedia* sp.	Lauraceae	Mt.	x	x	-
19	*Bennetiodendron leprosipes* Merrill	Flacourtiaceae	Mt.	x	x	-
20	*Blumeodendron tokbrai* (Bl.) Kurz	Euphorbiaceae	Mt.	x	x	-
21	*Calophyllum peekeelii* Lour.	Clusiaceae	Mt.	x	x	-
22	*Calophyllum soulatri* Burm.f.	Clusiaceae	Mt.	x	x	x
23	*Canarium hirsutum* Willd.	Burseraceae	Mt.	x	x	x
24	*Canarium indicum* Willd.	Burseraceae	Mt.	x	-	-
25	*Canarium maluense* Lauterb.	Burseraceae	Mt.	x	x	-
26	*Canarium oleosum* (Lamk.) Engl.	Burseraceae	Mt.	x	x	-
27	*Canarium sylvestre* Gaertn.	Burseraceae	Mt.	x	-	-
28	*Celtis philippinensis* Blanco	Ulmaceae	Bt.	x	x	x
29	*Drypetes celebica* (Boerl.& Koord.) Pax & Hoffm.	Euphorbiaceae	Mt.	x	x	-

No.	Genus & Species	Family	Life Form	Site		
				Kwerba	Papasena	Kay
Note: Bt.: Big tree, St.: Small tree, Mt.: Medium tree, Sh.: Shrub, Tp.: Tree palm, Pa.: Pandan, Cl.P: Climbing palm, Li.: Liana, Hb.: Herb						
30	*Drypetes longifolia* (Bl.) Pax & Hoffm.	Euphorbiaceae	Mt.	x	x	-
31	*Endiandra acuminata* White & Francis	Lauraceae	Mt.	x	x	-
32	*Endiandra alleniana* C.T. White	Lauraceae	Mt.	x	-	-
33	*Endiandra euadenia* (Bl.) Kosterm.	Lauraceae	Mt.	x	-	-
34	*Engelhardia rigida* Blume	Juglandaceae	Mt.	x	-	-
35	*Fagraea racemosa* Jack ex Wall.	Loganiaceae	St.	x	x	-
36	*Firminia papuana* Mildbr.	Sterculiaceae	Mt.	x	-	-
37	*Homalium foetidum* (Roxb.) Bth.	Flacourtiaceae	Mt.	x	x	-
38	*Hopea novoguineensis* Slooten	Dipterocarpaceae	Mt.	x	x	-
39	*Intsia palembanica* Miq.	Fabaceae	Bt.	x	x	-
40	*Maranthes corymbosa* Blume	Chrysobalanaceae	Bt.	x	x	-
41	*Myristica hollrungii* Warb.	Myristicaceae	Mt.	x	x	x
42	*Parastemon versteghii* Merr. & Perry	Chrysobalanaceae	Mt	x	x	-
43	*Pimeleodendron amboinicum* Hassk.	Euphorbiaceae	Mt.	x	x	x
44	*Pometia pinnata* J.R. & G. Forster.	Sapindaceae	Bt.	x	x	x
45	*Pouteria duclitan* (Blanco) Baehni	Sapotaceae	Mt.	x	x	-
46	*Pouteria firma* (Miq.) Baehni	Sapotaceae	Mt.	x	-	-
47	*Prainea papuana* Becc.	Moraceae	Mt.	x	x	x
48	*Prunus arborea* (Bl.) Kalkm.	Rosaceae	Mt.	x	x	-
49	*Prunus schlechteri* (Koehne) Kalkmn.	Rosaceae	Mt.	x	-	-
50	*Pternandra coerulescens* Jack	Melastomataceae	Mt.	x	x	x

No.	Genus & Species	Family	Life Form	Site		
				Kwerba	Papasena	Kay
Note: Bt.: Big tree, St.: Small tree, Mt.: Medium tree, Sh.: Shrub, Tp.: Tree palm, Pa.: Pandan, Cl.P: Climbing palm, Li.: Liana, Hb.: Herb						
51	*Pterocarpus indicus* Willd.	Fabaceae	Bt.	x	x	-
52	*Pterocymbium beccarii* K. Schum.	Sterculiaceae	Bt.	x	x	-
53	*Pterygota horsfieldii* (R. Br.) Kosterm.	Sterculiaceae	Bt.	x	x	-
54	*Ptychopyxis chrysantha* (Schum.) Airy Shaw	Euphorbiaceae	Mt.	x	x	-
55	*Sloanea sogorensis* Beck.f.	Elaeocarpaceae	Mt.	x	-	-
56	*Stemonurus ammui* (Kaneh) Sleumer	Icacinaceae	Mt.	x	x	-
67	*Sterculia shillinghawi* F.v. Muell.	Sterculiaceae	Mt.	x	x	-
68	*Xanthophyllum papuanum* Whitmore ex Meijden	Polygalaceae	Bt.	x	x	x
69	*Xanthophyllum suberosum* C.T. White	Polygalaceae	Mt.	x	-	-
70	*Xanthophyllum tenuipetalum* Meijden	Polygalaceae	St.	x	-	-
71	*Zizyphus angustifolius* (Miq.) Hatusima ex Steenis	Rhamnaceae	St.	x	x	x
Tabel 5b : Ten dominant plants species found in Damar forest						
1	*Intsia palembanica* Miq.	Fabaceae	Bt.	x	x	-
2	*Pometia pinnata* J.R. & G. Forster.	Sapindaceae	Bt.	x	x	x
3	*Sloanea aberans* (Brandis) A.C. Sm.	Elaeocarpaceae	Mt.	x	-	-
4	*Celtis philippinensis* Blanco	Ulmaceae	Bt.	x	x	x
5	*Canarium maluense* Lauterb.	Burseraceae	Mt	x	x	-
6	*Teijsmanniodendron bogoriense* Koord.	Verbenaceae	Mt.	x	x	-
7	*Pterygota horsfieldii* (R. Br.) Kosterm.	Sterculiaceae	Bt.	x	x	-
8	*Pimeleodendron amboinicum* Hassk.	Euphorbiaceae	Mt.	x	x	x
9	*Firminia papuana* Mildbr.	Sterculiaceae	Mt.	x	-	-

No.	Genus & Species	Family	Life Form	Site		
				Kwerba	Papasena	Kay
Note: Bt.: Big tree, St.: Small tree, Mt.: Medium tree, Sh.: Shrub, Tp.: Tree palm, Pa.: Pandan, Cl.P: Climbing palm, Li.: Liana, Hb.: Herb						
10	*Elaeocarpus nouhysii* Koord.	Elaeocarpaceae	Mt.	x	-	-

Table 6: List of plants species found in sago forest

1	*Planchonia papuana* Kunth.	Lecythidaceae	Mt.	x	x	x
2	*Bischoffia javanica* Blume	Euphorbiaceae	Mt.	x	x	x
3	*Nauclea orientalis* L.	Rubiaceae	Mt.	x	x	x
4	*Neonauclea forsterii* (Seem. ex Havil.) Merr.	Rubiaceae	Mt.	-	x	x
5	*Terminalia microcarpa* Decne	Combretaceae	Mt.	x	x	-
6	*Terminalia sepicana* Diels	Combretaceae	Mt.	x	-	-
7	*Tabernaemontana aurantiaca* Gaud.	Combretaceae	St.	x	x	-
8	*Myristica fatua* Houtt.	Myristicaceae	Mt.	x	x	x
9	*Horsfieldia irya* (Gaertn.) Warb.	Myristicaceae	St.	x	x	x
10	*Garcinia hollrungii* Lauterb.	Clusiaceae	Mt.	-	x	x
11	*Garcinia latissima* Miq.	Clusiaceae	St.	x	x	-
12	*Cerbera floribunda* K. Sch.	Apocynaceae	Mt.	x	x	x
13	*Morinda citrifolia* L.	Rubiaceae	St.	x	x	x
14	*Sandoricum koetjape* Merrill	Meliaceae	Mt.	x	x	x
15	*Syzygium* sp.	Myrtaceae	Mt.	-	x	x
16	*Syzygium* sp.	Myrtaceae	Mt.	-	x	x
17	*Syzygium* sp.	Myrtaceae	Mt.	-	x	x
18	*Allophyllus cobbe* (L.) Rauesch.	Sapindaceae	Sh.	-	x	x
19	*Intsia bijuga* (Colebrooke) O. Kuntze	Fabaceae	Bt.	x	x	x

No.	Genus & Species	Family	Life Form	Site		
				Kwerba	Papasena	Kay
Note: Bt.: Big tree, St.: Small tree, Mt.: Medium tree, Sh.: Shrub, Tp.: Tree palm, Pa.: Pandan, Cl.P: Climbing palm, Li.: Liana, Hb.: Herb						
20	*Dillenia papuana* Martell.	Dilleniaceae	Bt.	x	x	x
21	*Dillenia* cf. *quercifolia* (C.T. White & Francis ex Lane-Poole) Hoogl.	Dilleniaceae	Sh.	x	x	x
22	*Alstonia scholaris* (L.) R. Br.	Apocynaceae	Bt.	x	x	x
23	*Octomeles sumatrana* Miq.	Datiscaceae	Bt.	x	x	x
24	*Endospermum moluccanum* (Teijsm. & Binnend) Kurz.	Euphorbiaceae	Mt.	x	x	x
25	*Elaeocarpus*	Elaeocarpaceae		x	-	-
26	*Ficus* sp.	Moraceae	St.	-	x	x
27	*Cananga odorata* (Lam.) Hook.f. & Thoms.	Annonaceae	Mt.	x	x	x
28	*Dendrolobium umbellatum* (L.) Benth.	Fabaceae	St.	x	x	x
29	*Buchanania* sp.	Anacardiaceae	Mt.	x	x	-
30	*Pisonia longirostris* Teijsm. et Binnend.	Nyctaginaceae	St.	x	x	x
31	*Barringtonia acutangul*a (L.) Gaertn.	Lecythidaceae	St.			
32	*Campnosperma auriculatum* Hook.f.	Anacardiaceae	Mt.	x	x	x
33	*Gymnacranthera paniculata* (A.DC.) Warb.	Myristicaceae	St.	x	x	x
34	*Horsfieldia sylvestris* (Houtt.) Warb.	Myristicaceae	Mt.	x	x	x
35	*Chisocheton sp.*	Meliaceae	St.	-	x	x
36	*Aglaia* sp.	Meliaceae	Mt.	x	x	-
Table 6b: Ten dominant plants species found in sago forest						
1	*Planchonia papuana* Kunth.	Lecythidaceae	Mt.	x	x	x
2	*Terminalia brassii* Exell.	Combretaceae	Bt.	-	x	x
3	*Nauclea orientalis* L.	Rubiaceae	Mt.	x	x	x

No.	Genus & Species	Family	Life Form	Site		
				Kwerba	Papasena	Kay
Note: Bt.: Big tree, St.: Small tree, Mt.: Medium tree, Sh.: Shrub, Tp.: Tree palm, Pa.: Pandan, Cl.P: Climbing palm, Li.: Liana, Hb.: Herb						
4	*Neonauclea versteghii* Merrill & Perry	Rubiaceae	Mt.	x	x	x
5	*Boschoffia javanica* Blume	Euphorbiaceae	Mt.	-	x	x
6	*Horsfieldia irya* (Gaertn.) Warb.	Myristicaceae	St.	x	x	x
7	*Octomeles sumatrana* Miq.	Datiscaceae	Bt.	x	x	x
8	*Tabernaemontana aurantiaca* Gaud.	Apocynaceae		x	x	-
9	*Intsia bijuga* (Colebrooke) O. Kuntze	Fabaceae	Bt.	x	x	x
10	*Garcinia latissima* Miq.	Clusiaceae	St.	x	x	-
Table 7: List of plants species found in riparian forest						
1	*Aglaia* sp.	Meliaceae	St.	x	x	x
2	*Anthocephalus chinensis* Hassk.	Rubiaceae	Bt.	x	x	-
3	*Aphanamixis polystachya (Wall.) R.N. Parker*	Meliaceae	Mt	-	-	x
4	*Artocarpus altilis* (Parkinson) Fosberg.	Moraceae	Bt.	x	x	x
5	*Campnosperma auriculatum* Hook.f.	Anacardiaceae	Mt.	x	x	x
6	*Cananga odorata* (Lam.) Hook.f. & Thoms.	Annonaceae	Mt.	x	x	x
7	*Chionanthus ramiflorus* Roxb.	Oleaceae	Mt.	x	x	x
8	*Decaspermum sp.*	Myrtaceae	Sh.	x	x	-
9	*Dendrolobium umbellatum* (L.) Benth.	Fabaceae	St.	x	x	x
10	*Dillenia papuana* Martell.	Dilleniaceae	Bt.	x	x	x
11	*Dillenia* cf. *quercifolia* (C.T. White & Francis ex Lane-Poole) Hoogl.	Dilleniaceae	Sh.	x	x	x
12	*Dillenia castanaefolia (Miq.) Dur. & Jack*	Dilleniaceae	Sh.	x	x	-
13	*Dracontomelon dao (Blanco) Merr. & Rolfe*	Anacardiaceae	Mt.	x	x	x

No.	Genus & Species	Family	Life Form	Site		
				Kwerba	Papasena	Kay
Note: Bt.: Big tree, St.: Small tree, Mt.: Medium tree, Sh.: Shrub, Tp.: Tree palm, Pa.: Pandan, Cl.P: Climbing palm, Li.: Liana, Hb.: Herb						
14	*Duabunga moluccana* Blume	Sonneratiaceae	St.	x	x	-
15	*Dysoxylum arborescens* Miq.	Meliaceae	Mt.	x	x	-
16	*Elaeocarpus sphaericus* (Gaertn.) K. Schum.	Elaeocarpaceae	Mt.	x	x	x
17	*Endospermum moluccanum* (Teijsm. & Binnend) Kurz.	Euphorbiaceae	Mt.	x	x	x
18	*Euodia elleryana* F.Muell.	Rutaceae	Mt.	-	x	x
19	*Ficus dammaropsis* Diels.	Moraceae	St.	x	-	-
20	*Ficus* sp.1	Moraceae	St.	x	x	x
21	*Ficus* sp.2	Moraceae	St.	-	-	x
22	*Garcinia* sp.	Clusiaceae	St.	-	-	x
23	*Glochidion* cf. *philippicum* (Cav.) C.B. Roxb.	Euphorbiaceae	Mt.	x	x	x
24	*Hibiscus tiliaceus* L.	Malvaceae	Mt.	x	x	x
25	*Jagera pseudorhus* (A. Rich.) Radlk.	Sapindaceae	St.	x	-	-
26	*Kleinhovia hospita* L.	Sterculiaceae	Mt.	x	x	x
27	*Leea* sp.	Leeaceae	Sh.	x	x	-
28	*Nauclea orientalis* L.	Rubiaceae	Mt.	x	x	x
29	*Neonauclea versteghii* Merrill & Perry	Rubiaceae	Mt.	x	x	x
30	*Octomeles sumatrana* Miq.	Datiscaceae	Bt.	x	x	x
31	*Osmoxylon palmatum* (Lamk.) Philipson	Araliaceae	St.	x	x	-
32	*Paraserianthes falcataria* (Jack) Nielsen	Fabaceae	Bt.	x	x	-
33	*Planchonia papuana* Kunth.	Lecythidaceae	Mt.	x	x	x
34	*Premna corymbosa* Rottl. & Willd.	Verbenaceae	St.	x	x	-

No.	Genus & Species	Family	Life Form	Site		
				Kwerba	Papasena	Kay
Note: Bt.: Big tree, St.: Small tree, Mt.: Medium tree, Sh.: Shrub, Tp.: Tree palm, Pa.: Pandan, Cl.P: Climbing palm, Li.: Liana, Hb.: Herb						
35	*Schefflera* sp.	Araliaceae	Sh.	-	x	x
36	*Syzygium* sp.	Myrtaceae	Mt.	-	x	x
37	*Teijsmanniodendron aherianum* (Merr.) Bakh.	Verbenaceae	St.	-	x	x
38	*Terminalia brassii* Exell.	Combretaceae	Bt.	-	x	x
39	*Terminalia microcarpa* Decne	Combretaceae	Mt.	x	x	-
40	*Timonius sp.*	Rubiaceae	Mt.	-	x	x
41	*Vitex quinata* Druce	Verbenaceae	Mt.	-	x	x
Table 7b: Ten dominant plants species found in riparian forest						
1	*Nauclea orientalis* L.	Rubiaceae	Mt.	x	x	x
2	*Neonauclea versteghii* Merrill & Perry	Rubiaceae	Mt.	x	x	x
3	*Planchonia papuana* Kunth.	Lecythidaceae	Mt.	x	x	x
4	*Dillenia* cf. *quercifolia* (C.T. White & Francis ex Lane-Poole) Hoogl.	Dilleniaceae	Sh.	x	x	x
5	*Teijsmanniodendron aherianum* (Merr.) Bakh.	Verbenaceae	St.	-	x	x
6	*Premna corymbosa* Rottl. & Willd.	Verbenaceae	St.	x	x	-
7	*Dendrolobium umbellatum* (L.) Benth.	Fabaceae	St.	x	x	x
8	*Ficus* sp.	Moraceae	St.	-	x	x
9	*Terminalia* cf. *brassii* Exell.	Combretaceae	Bt.	-	x	x
10	*Hibiscus tiliaceus* L.	Malvaceae	St.	x	x	x
Table 8: List of plants species found in succession forest						
1	*Saccharum spontaneum* L.	Poaceae	Herb	x	x	x
2	*Timonius sp.*	Rubiaceae	Mt.	-	x	x

No.	Genus & Species	Family	Life Form	Site		
				Kwerba	Papasena	Kay
Note: Bt.: Big tree, St.: Small tree, Mt.: Medium tree, Sh.: Shrub, Tp.: Tree palm, Pa.: Pandan, Cl.P: Climbing palm, Li.: Liana, Hb.: Herb						
3	*Althaffia pleiostigma* Warb.	Tiliaceae	Mt.	x	x	x
4	*Nauclea orientalis* L.	Rubiaceae	Mt.	x	x	x
5	*Neonauclea versteghii* Merrill & Perry	Rubiaceae	Mt.	x	x	x
6	*Artocarpus altilis* (Parkinson) Fosberg.	Moraceae	Bt.	x	x	x
7	*Terminalia brassii* Exell.	Combretaceae	Bt.	-	x	x
8	*Planchonia papuana* Kunth.	Lecythidaceae	Mt.	x	x	x
9	*Hibiscus tiliaceus* L.	Malvaceae	Mt.	x	x	x
10	*Octomeles sumatrana* Miq.	Datiscaceae	Bt.	x	x	x
11	*Ficus* sp.	Moraceae	St.	-	x	x
12	*Mitragyna speciosa* Korth.	Rubiaceae	Mt.	-	x	x
13	*Barringtonia acutangul*a (L.) Gaertn.	Lecythidaceae	St.	x	x	x
14	*Euodia elleryana* F. Muell.	Rutaceae	Mt.	-	x	x
Table 8b: Ten dominant plants species found in succession forest						
1	*Saccharum spontaneum* L.	Poaceae	Herb	x	x	x
2	*Timonius sp.*	Rubiaceae	Mt.	-	x	x
3	*Althaffia pleiostigma* Warb.	Tiliaceae	Mt.	x	x	x
4	*Nauclea orientalis* L.	Rubiaceae	Mt.	x	x	x
5	*Neonauclea versteghii* Merrill & Perry	Rubiaceae	Mt.	x	x	x
6	*Artocarpus altilis* (Parkinson) Fosberg.	Moraceae	Bt.	x	x	x
7	*Terminalia brassii* Exell.	Combretaceae	Bt.	-	x	x
8	*Planchonia papuana* Kunth.	Lecythidaceae	Mt.	x	x	x

No.	Genus & Species	Family	Life Form	Site		
				Kwerba	Papasena	Kay
Note: Bt.: Big tree, St.: Small tree, Mt.: Medium tree, Sh.: Shrub, Tp.: Tree palm, Pa.: Pandan, Cl.P: Climbing palm, Li.: Liana, Hb.: Herb						
9	*Hibiscus tiliaceus* L.	Malvaceae	Mt.	x	x	x

Table 9: List of plants species found in rattan forest

1	*Alseodaphne* sp.	Lauraceae	Mt.	x	x	x
2	*Alstonia scholaris* (L.) R. Br.	Apocynaceae	Bt.	x	x	x
3	*Anisoptera thurifera* (Blanco) Bl.	Dipterocarpaceae	Bt.	x	x	x
4	*Areca macrocalyx* Zipp.	Arecaceae	Tp.	x	x	-
5	*Buchanania sessilifolia* Blume	Anacardiaceae	Mt.	x	x	x
6	*Calamus hollrungii* Becc.	Arecaceae	Cl.P	x	x	x
7	*Calamus warbughii* K. Schum.	Arecaceae	Cl.P	x	x	x
8	*Calophyllum* sp.	Clusiaceae	Mt.	-	x	x
9	*Campnosperma auriculatum* Hook.f.	Anacardiaceae	Mt.	x	x	x
10	*Caryota rumphiana* Mart.	Arecaceae	Tp.	x	x	x
11	*Cryptocarya* sp. 1	Lauraceae	Mt.	x	x	-
12	*Cryptocarya* sp. 2	Lauraceae	St.	x	x	-
13	*Dracontomelon dao (Blanco) Merr. & Rolfe*	Anacardiaceae	Mt.	x	x	x
14	*Fagraea racemosa* Jack ex Wall.	Loganiaceae	St.	x	x	-
15	*Gnetum gnemon* L.	Gnetaceae	Mt.	x	x	x
16	*Gonocaryum littorale* (Bl.) Sleumer	Icacinaceae	St.	x	x	x
17	*Gulubia costata* (Becc.) Becc.	Arecaceae	Tp.	x	x	x
18	*Gymnacranthera paniculata* (A.DC.) Warb.	Myristicaceae	St.	x	x	x
19	*Horsfieldia irya* (Gaertn.) Warb.	Myristicaceae	St.	x	x	x

No.	Genus & Species	Family	Life Form	Site		
				Kwerba	Papasena	Kay
Note: Bt.: Big tree, St.: Small tree, Mt.: Medium tree, Sh.: Shrub, Tp.: Tree palm, Pa.: Pandan, Cl.P: Climbing palm, Li.: Liana, Hb.: Herb						
20	*Horsfieldia sylvestris* (Houtt.) Warb.	Myristicaceae	Mt.	x	x	x
21	*Korthalsia brassii* Burrett	Arecaceae	Cl.P	-	x	x
22	*Licuala* sp.	Arecaceae	Tp.	x	x	x
23	*Litsea* sp. 2	Lauraceae	Mt.	x	x	-
24	*Litsea* sp.1	Lauraceae	Mt.	-	x	x
25	*Mastixiodendron pachyclados* (K. Schum.) Melchior	Rubiaceae	Mt.	x	x	x
26	*Medusanthera laxiflora* (Miers.) Howard	Icacinaceae	St.	x	x	x
27	*Metroxylon sagu* Rottb.	Arecaceae	Mt.	x	x	x
28	*Myristica fatua* Houtt.	Myristicaceae	Mt.	x	x	x
29	*Myristica lancifolia* Poirret	Myristicaceae	St.	x	-	-
30	*Nauclea orientalis* L.	Rubiaceae	Mt.	x	x	x
31	*Neoscortechinia forbesii* (Hook.f.) Pax. & Hoffm.	Euphorbiaceae	Mt.	x	x	-
32	*Neubergia corymbosa* (A. Gray) Leenh.	Loganiaceae	St.	x	x	x
33	*Paraserianthes falcataria* (Jack) Nielsen	Fabaceae	Bt.	x	x	-
34	*Pimeleodendron amboinicum* Hassk.	Euphorbiaceae	Mt.	x	x	x
35	*Pometia pinnata* J.R. & G. Forster.	Sapindaceae	Bt.	x	x	x
36	*Prainea papuana* Becc.	Moraceae	Mt.	x	x	x
37	*Rhopaloblaste brassii* H.E. Moore	Arecaceae	Tp.	x	x	x
38	*Sterculia* sp.	Sterculiaceae	Mt.	x	-	-
39	*Syzygium* sp.	Myrtaceae	Mt.	-	x	x
40	*Tabernaemontana aurantiaca* Gaud.	Apocynaceae	St.	x	x	-

No.	Genus & Species	Family	Life Form	Site		
				Kwerba	Papasena	Kay
Note: Bt.: Big tree, St.: Small tree, Mt.: Medium tree, Sh.: Shrub, Tp.: Tree palm, Pa.: Pandan, Cl.P: Climbing palm, Li.: Liana, Hb.: Herb						
41	*Terminalia brassii* Exell.	Combretaceae	Bt.	-	x	x
Table 9b: Ten dominant plants species found in rattan forest						
1	*Alseodaphne* sp.	Lauraceae	Mt.	x	x	x
2	*Campnosperma auriculatum* Hook.f.	Anacardiaceae	Mt.	x	x	x
3	*Gnetum gnemon* L.	Gnetaceae	Mt.	x	x	x
4	*Horsfieldia irya* (Gaertn.) Warb.	Myristicaceae	St.	x	x	x
5	*Mastixiodendron pachyclados* (K. Schum.) Melchior	Rubiaceae	Mt.	x	x	x
6	*Metroxylon sagu* Rottb.	Arecaceae	Tp.	x	x	x
7	*Neubergia corymbosa* (A. Gray) Leenh.	Loganiaceae	St.	x	x	x
8	*Pimeleodendron amboinicum* Hassk.	Euphorbiaceae	Mt.	x	x	x
9	*Rhopaloblaste brassii* H.E. Moore	Arecaceae	Tp.	x	x	x
10	*Tabernaemontana aurantiaca* Gaud.	Apocynaceae	St.	x	x	-
Table 10 : List of plants species found at the garden of all villages						
1	*Abelmoschus manihot* (L.) Medik.	Malvaceae	Sh.	x	-	-
2	*Abelmoschus moschatus* Medik.	Malvaceae	Sh.	x	x	-
3	*Acalypha siamensis* Oliv.	Euphorbiaceae	Sh.	-	-	-
4	*Acorus calamus* L.	Zingiberaceae	Herb	x	-	x
5	*Allamanda catharica* L.	Apocynaceae	Li.	x	x	-
6	*Alpinia galanga* (L.) Swartz	Zingiberaceae	Herb.	x	x	x
7	*Ananas comoscus* (L.) Merr.	Brommeliaceae	Herb.	x	x	x
8	*Annona muricata* L.	Annonaceae	St.	x	x	x

No.	Genus & Species	Family	Life Form	Site		
				Kwerba	Papasena	Kay
Note: Bt.: Big tree, St.: Small tree, Mt.: Medium tree, Sh.: Shrub, Tp.: Tree palm, Pa.: Pandan, Cl.P: Climbing palm, Li.: Liana, Hb.: Herb						
9	*Arachis hypogaea* L.	Fabaceae	Herb.	x	x	x
10	*Areca catechu* L.	Arecaceae	Tp.	x	x	x
11	*Artocarpus altilis* (Parkinson) Fosberg	Moraceae	Bt.	x	x	x
12	*Artocarpus altilis* (Parkinson) Fosberg.	Moraceae	Bt	x	x	x
13	*Artocarpus integer* (Thunb.) Merr.	Moraceae	Mt.	x	x	x
14	*Averrhoa carambola* L.	Oxalidaceae	St.	x	x	-
15	*Bambusa* sp.	Poaceae	Bamboo	x	x	x
16	*Belamcanda chinensis* (L.) DC.	Liliaceae	Herb	x	x	-
17	*Bougainvillea spectabilis* Willd.	Nyctaginaceae	Wl.	x	x	-
18	*Caladium bicolor* (W. Ait.) Vent.	Araceae	Herb.	x	x	x
19	*Calocasia esculenta* (L.) Schott.	Araceae	Herb	x	x	x
20	*Capsicum frutescens* Linn.	Solanaceae	Sh.	x	x	x
21	*Carica papaya* L.	Caricaceae	St.	x	x	x
22	*Citrus nobilis* Lour.	Rutaceae	Li.	x	x	x
23	*Clerodendrum paniculatum* L.	Verbenaceae	Sh.	x	x	x
24	*Cocos nucifera* L.	Arecaceae	Tp.	x	x	x
25	*Codiaeum variegatum* (L.) Bl.	Euphorbiaceae	Sh.	x	x	x
26	*Coffea robusta* Linden	Rubiaceae	Sh.	x	x	x
27	*Cosmos caudatus* H.B.K.	Asteraceae	Sh.	x	x	-
28	*Curcuma domestica* Sw.	Zingiberaceae	Herb.	x	x	x
29	*Cymbopogon nardus* Rendle	Poaceae	Herb.	x	x	-

No.	Genus & Species	Family	Life Form	Site		
				Kwerba	Papasena	Kay
Note: Bt.: Big tree, St.: Small tree, Mt.: Medium tree, Sh.: Shrub, Tp.: Tree palm, Pa.: Pandan, Cl.P: Climbing palm, Li.: Liana, Hb.: Herb						
30	*Duranta erecta* L.	Verbenaceae	Sh.	x	x	-
31	*Gardenia jasminioides* Ellis	Rubiaceae	St.	x	x	-
32	*Gendarussa vulgaris* Nees	Acanthaceae	Sh.	x	x	x
33	*Hibiscus rosa-sinensis* L.	Malvaceae	Sh.	x	x	-
34	*Ipomoea aquatica* Forst.	Convolvulaceae	Herb.	x	x	x
35	*Ipomoea batatas* (L.) L.	Convolvulaceae	Cr. Herb.	x	x	x
36	*Jatropha curcas* L.	Euphorbiaceae	Sh.	x	x	-
37	*Mangifera indica* L.	Anacardiaceae	Mt.	x	x	x
38	*Manihot esculenta* Crantz.	Euphorbiaceae	Sh.	x	x	x
39	*Morinda citrifolia* L.	Rubiaceae	St.	x	x	x
40	*Musa* spp.	Musaceae	Herb.	x	x	x
41	*Orthosiphon stamineus* Benth.	Lamiaceae	Herb.	x	x	x
42	*Pandanus conoideus* de Vriese	Pandanaceae	Pa.	x	x	x
43	*Pangium edule* Reinw.	Flacourtiaceae	Bt.	x	-	-
44	*Pedilanthus tithymaloides* Poit.	Euphorbiaceae	Succulen	x	x	x
45	*Phacelophyrynium maximum* (Bl.) K. Schum.	Maranthaceae	Herb.	x	-	-
46	*Piper betle* L.	Piperaceae	Li.	x	x	x
47	*Plectranthus scutellaroides* (L.) R. Br.	Lamiaceae	Herb.	x	x	x
48	*Pometia pinnata* J.R. & G. Forster.	Sapindaceae	Bt.	x	x	x
49	*Psydium guajava* L.	Myrtaceae	St.	x	x	x
50	*Saccharum officinarum* L.	Poaceae	Sh.	x	x	x

No.	Genus & Species	Family	Life Form	Site		
				Kwerba	Papasena	Kay
Note: Bt.: Big tree, St.: Small tree, Mt.: Medium tree, Sh.: Shrub, Tp.: Tree palm, Pa.: Pandan, Cl.P: Climbing palm, Li.: Liana, Hb.: Herb						
51	*Salacca zalacca* (J. Gaertner) Voss ex Vilmorin	Arecaceae	Palm	x	-	-
52	*Spondias cytherea* Sonn.	Anacardiaceae	Mt.	x	x	x
53	*Syzygium aqueum* (Burm.f.) Alston	Myrtaceae	Mt.	x	x	x
54	*Tagetes erecta* L.	Asteraceae	Sh.	x	x	-
55	*Theobroma cacao* L.	Sterculiaceae	Sh.	x	x	x
56	*Vigna unguiculata* (L.) Walp.	Fabaceae	Li.	x	x	-
57	*Vinca rosea* L.	Apocynaceae	Sh.	x	x	-
58	*Xanthosoma sagittifolium* Schott.	Araceae	Herb.	x	x	x
59	*Zea mays* L.	Poaceae	Herb.	x	x	x
60	*Zingiber officinalis* Rosc.	Zingiberaceae	Herb.	x	x	x

Conservation International Indonesia has launched several initiatives in the Mamberamo area since early 2000, targeting biodiversity conservation and sustainable environmental management, as well as facilitating the development of the "Mamberamo Biodiversity Corridor". The Mamberamo watershed is noted as Papua's most important area of undisturbed terrestrial ecosystems, which contain high levels of biodiversity. Since 2004 CI and CIFOR have collaborated to adapt and apply an interdisciplinary approach to the study of local perceptions of natural resources, forest landscapes and biodiversity, including local priorities for their management. The 2004 survey revealed a strong sense of ownership of this vast territory, a strong commitment to guard specific areas in the landscape and to maintain key resources, but also species with less tangible values.

This report refers to the follow-up activities in Mamberamo developed by CIFOR and CI in 2006. The new activities included additional socio-economic surveys in three villages. The accuracy of the participatory maps of the natural resources and important landscape features were improved using GPS ground checks. Participatory maps of territorial land claims and land use by clans were also drafted. Additional information was then collected on local biodiversity monitoring and control of the land and resources. The results show that local communities with village territories of between 1000 and 1700 km^2 per village which they regularly patrol, have a strong awareness of the threats to their wild resources, and equally the need to maintain the watershed's services.

Based on these results, we recommend that the land-use maps should be used to negotiate with local people the zoning of future conservation areas. Conservation management should also be designed to support existing systems in order to maintain balance in the face of outside intrusions and to survey strategic villages the length of the Mamberamo Biodiversity Corridor. Rather than introducing new rules, which pay no heed to local cultures and traditions, the search should be for traditional rules and regulations that have managed to conserve this vast area, of near pristine forests, for generations.

Gordon and Betty MOORE FOUNDATION
CIFOR
CONSERVATION INTERNATIONAL