THE DIVERSITY OF CONSERVATION: EXPLORING NARRATIVES, RELATIONSHIPS AND ECOSYSTEM SERVICES IN MELANESIAN MARKET-BASED BIODIVERSITY CONSERVATION

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Dedication

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Abstract

Papua New Guinea (PNG) is a biodiversity hotspot with large carbon pools making it a target of international conservation efforts. Protection of biodiversity in this Pacific island nation requires conservationists to work with customary landowners, whose land rights are ensured in the constitution. New projects using market-based conservation have recently been attempted in PNG. Landowners welcome direct payments from conservationists but conservationists and landowners have contrasting cultural perspectives. This dissertation examines the perspectives of landowners and conservationists in a market-based project. The first chapter describes Wanang village and the development of Wanang Conservation, the first project in PNG to use direct payments for conservation. The second chapter explores the multiple meanings of conservation to villagers. Conservation is discussed in terms of ancestral resource protection, material benefits, exchange relationships, political leadership, and as a connection to ancestors. These narratives demonstrate that the diverse roles conservation plays at Wanang are far more complex than simple biodiversity protection. In the third chapter, villagers' and conservationists' interests in ecosystem services and how these interests align are discussed through an examination of the bundling of carbon storage, hunted game, useful plants, and forest spirits in mature and recently disturbed forests. Villagers' interests in hunting, forest spirits, and plants used for tools, medicine, food, and rituals, align with conservationists' interests in carbon storage in mature forests. The fourth chapter examines the complexity of using economic incentives in Melanesia. Conservationists use economic discourse to explain how the project functions and how

they appeal to villagers as rational, self-interested, economic actors. However, villagers see incentives as part of an exchange relationship with moral obligations that extend beyond the transaction. The parties are able to build a relationship around the idea of material exchange, although they understand it differently. This dissertation demonstrates the complexity, unintended consequenses, and difficulty of sustaining payments for ecosystem services in PNG. Villagers have multiple interests and expectations of conservation and a different understanding of how projects function than do conservationists. Despite these differences, villagers and conservationists can find common ground to work together, yet the work is never finished, as continuous renegotiations are necessary. Future research should examine the role of social relationships, incentives, and ancestors in the sustainability of the direct payments model.

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Acronyms

BRC	New Guinea Binatang Research Center
BRG	Bismark-Ramu Group
CRI	Christensen Research Institute
CTFS	Center for Tropical Forest Science
DEC	Department of Environment and Conservation
FMA	Forest Management Agreement
ICAD	Integrated Conservation and Development
ILG	Incorporated Landowner Group
NGO	Non-governmental organization
PES	Payments for ecosystem services
PNG	Papua New Guinea
PNGFA	Papua New Guinea Forest Authority
PNGFRI	Papua New Guinea Forest Research Institute
PTC	Parataxonomist Training Center
REDD/REDD+	Reduced Emissions from Deforestation and Degradation
RH	Rimbunan Hijau
SPRS	Swire PNG Rainforest Study
VDT	Village Development Trust
WWF	World Wildlife Fund
WCA	Wildlife Conservation Area

Introduction

The field of conservation biology has produced a number of strategies to the global biodiversity crisis (Mace 2014). First, fortress conservation aimed to separate people and nature with government owned protected areas that excluded people. Then community-based conservation promised to conserve biodiversity by suiting the needs of the local people. Most recently, market-based conservation aims to use market forces to protect biodiversity.

This so called 'new conservation' includes incentive based conservation efforts such as payments for ecosystem services (PES) and direct payments for conservation. PES is argued to be institutionally simpler and more cost-effective than community-based conservation or integrating conservation and economic development (Ferraro and Simpson 2002, Ferraro 2011). In addition, potential access to new market-based funding sources for conservation is appealing. Using market approaches to maximize benefits at minimal cost through voluntary transactions also appears to create win-win situations and remove political conflicts that have long plagued conservation (Igoe and Brockington 2007). Reducing emissions from deforestation and degradation (REDD+) is a global initiative that has embraced the PES approach, offering to reward tropical forest landowners for carbon sequestration on their land.

The Pacific island of New Guinea is a biodiversity hotspot and has been the target of international conservation efforts (Melick et al. 2012). The nation of Papua New Guinea on the eastern half of New Guinea has moved through different conservation

strategies and is now facing implementation of REDD+. The creation of protected areas in PNG has been hindered by lack of government owned land, inalienable indigenous land rights, and limited government capacity (Melick et al. 2012). Community-based conservation in PNG has also been unsuccessful in persuading landowners, with distinct cultural expectations including material wealth, to establish protected areas (West 2006). Market-based conservation appears well suited to provide landowners with desired material benefits (Novotny 2010).

However, the social, ecological, economic and political complexity of conservation issues does not fit into any one panacea, including PES (Berkes 2007). Complexity and tradeoffs are unavoidable in conservation and need to be explicitly examined at multiple scales and in different systems (Hirsch et al. 2010). Complexity is manifest in or across local, national, or global levels and in ecological, cultural, or political systems. Additionally, win-win narratives, by making tradeoffs invisible, create unrealistic expectations of all benefit and no loss (McShane et al. 2011).

Potential REDD+ complexities and tradeoffs include stalled efforts to reduce emissions in developed countries, displacement of deforestation to other areas, and loss of land access among those with insecure land tenure (Hirsch et al. 2010). The impacts of REDD+ policy have the potential to be great and far reaching, prompting the need to better understand PES projects.

Papua New Guinea was a leader in REDD+ policy development, contains expansive tropical forests, and has constitutionally secure land tenure making it a target for REDD+ activity, but PES in the PNG context has not been tested. This research is an

investigation into the first use of direct payments for conservation in Papua New Guinea at Wanang Conservation. This dissertation complicates the simplified depiction of direct payments for conservation through an exploration of the local context and linkages between the local and global actors. I used an ethnographic approach to gain a comprehensive understanding of the project. My research topics developed organically as informants taught me about their interests, concerns, and challenges.

The dissertation does not follow a traditional integrated format but rather each chapter can be read as a stand-alone investigation into a related topic. Chapter one, "The Wanang and how they chose conservation", provides a detailed history of the development of Wanang Conservation and its functioning during the period of my fieldwork. Wanang Conservation was not a project planned to test the use of direct payments for conservation, rather it developed gradually through partnerships between indigenous landowners and conservationists. Therefore, it is important to understand the unique history, culture, and politics surrounding the project. Despite its uniqueness, Wanang Conservation can serve as a case study to inform conservation elsewhere in Melanesia as many of its challenges will be illustrative of pervasive issues in PNG.

In chapter two, "Much more than biodiversity protection: The meanings of rainforest conservation among the people of Wanang, Papua New Guinea", I examine the multiple meanings of conservation to Wanang villagers. Although the project could be explained in simple economic terms, to villagers there were many separate and related ways to talk about conservation. In this chapter, I explore this diversity in the meanings of conservation: (1) conservation protecting resources passed on from ancestors, (2)

conservation as a source of material benefits, (3) conservation as part of a reciprocal relationship with conservationists, (4) conservation as a means to gain and exercise political power, and (5) conservation as part of a reciprocal relationship with ancestors.

In chapter three, "Ecosystem service bundling: an interdisciplinary examination of forest carbon storage and local forest benefits in Papua New Guinea", I contrast Melanesian landowner and Western conservationist perspectives on ecosystem services. Landowners were concerned with hunting success, forest spirits, and plants used for food, fuel, medicine, tools, construction material, and rituals. Conservationists and REDD+ practitioners were concerned with carbon, as well as biodiversity. I examined the distribution of these services across mature and recently disturbed forests. I found that hunting success, plants used as tools, medicine and food, forest spirits, and carbon storage were better provisioned by mature forests, while fuel was better provided by recently disturbed forests.

In chapter four, "Market-based conservation in a Melanesian context: How do direct payments for conservation in Papua New Guinea meet contrasting expectations of landowners and conservationists?" I examine the relationship between Western conservationists and Melanesian landowners. Western conservationists saw the relationship as one of mutual self-interest and used economic principles of costs and benefits to judge the project. Melanesian landowners, on the other hand, saw the relationship as one of moral obligation. These different perspectives led to divergent expectations, misunderstandings, and conflict. I discuss how landowners and conservationists worked around these differences.

This dissertation contributes to understanding the use of market-based conservation in Papua New Guinea. The complexity of Melanesian conservation, with its heterogeniuos groups, need to provide development, and cultural institutions, is not simplified by incentives, but incentives can be an important part of the conservation toolkit. A pragmatic approach, possibly using aspects of both market-based conservation and community-based conservation, may be necessary to fit the needs of the problem at hand.

Future research should continue to examine the use of incentives in PNG to improve our understanding of their merits and their unintended consequences. The importance of social relationships, connections to ancestors, and incentives to landowner satisfaction and long term sustainability of Melanesian conservation projects should be further investigated to identify the prevalence of the findings of this case study. Future expansion of REDD+ in PNG may provide opportunity to examine this topic across multiple projects.

Chapter 1: The Wanang and how they chose conservation

Introduction

In 2000, a group of Wanang villagers in the lowland rainforest of Papua New Guinea signed a conservation deed prohibiting commercial logging of their customary land. The villagers originally worked with Bismark Ramu Group (BRG), an environmental and community empowerment non-governmental organization, to develop the deed, and later worked with biologists from the New Guinea Binatang Research Center (BRC) to bring development to their village. Day to day conservation experiences for most Wanang villagers involve community work, conservation rules, cash payments, social relationships, and biological research employment. I will examine the social and historical background behind how Wanang made the remarkable decision to resist the promised windfall that comes with resource extraction and came to be the first village in Papua New Guinea to receive direct payments for conservation.

Conservation is not a new endeavor in Papua New Guinea, and many landowners have worked with conservationists. For example, the Gimi, the Maisin, the Elauru, and the Kamiali each participated in Integrated Conservation and Development projects in the 1990's (Barker 2008, Halvaksz 2006,Wagner 2002, West 2006). In each of these projects, landowners formed social relationships with conservationists that they thought would bring development through market activity. Each project was challenged and ultimately failed when conservation could not meet villagers' expectations and inequalities among heterogeneous landowner groups fueled opposition. Similar issues

will be explored in the case of Wanang Conservation, as well as the significance of direct payments.

Methods

My research is based on ten months of participant observation in Wanang and with biologists at BRC from 2010 to 2012. I conducted 34 formal semi-structured interviews with Wanang villagers, conservationists from Bismark Ramu Group, biologists and parabiologists from BRC, and donors. In addition, I completed household questionnaires and hunting surveys with 51 households in Wanang and the surrounding logging villages of Palimul, Manimagi, Wagai, and Tiklik (see Appendix 5 for sample questionnaire and appendix 6 for sample hunting survey). I conducted ethnobotanical surveys and reviewed various documents such as proposals, reports, budgets, and public media about the project. My interactions with villagers were conducted in Melanesian Pidgin, or *Tok Pisin*. I used discourse analysis to piece together the development of the project and describe the functioning of the project during the period of my fieldwork from 2010 through 2012. Names of villagers and conservationists have been altered to protect their identities. However, Filip Damen, the village leader and initiator of conservation, is identified with his consent.

Wanang Village

Wanang village is located at -5.231136 latitude, 145.182095 longitude in the middle Ramu River basin in Madang province, Papua New Guinea (Figure 1.1). The village is located on a tributary of the Sogeram River upstream of the confluence of the Sogeram and Wanang Rivers. The mixed evergreen hill forests of Wanang receive 3,500

mm of rainfall annually with a mean monthly temperature of 26 degrees Celsius (Anderson-Teixeira et al. 2014).

The population of the village was 223 people in 2012. The people live in two hamlets: Wanang hamlet, on the banks of the river, and in Pikas Paia hamlet, on the ridgetop northwest of the river. There are additional villages and hamlets nearby with familial ties to Wanang: Munge to the south, and Manimagi and Kokel to the northeast, Palimul to the east, and Wagai and Tiklik to the northwest (Figure 1.2).

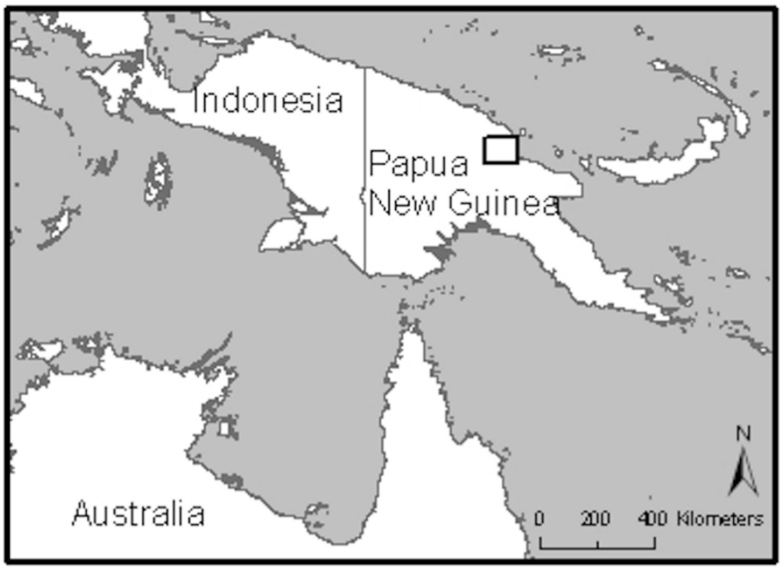

Figure 1.1: Study area in Madang province, Papua New Guinea.

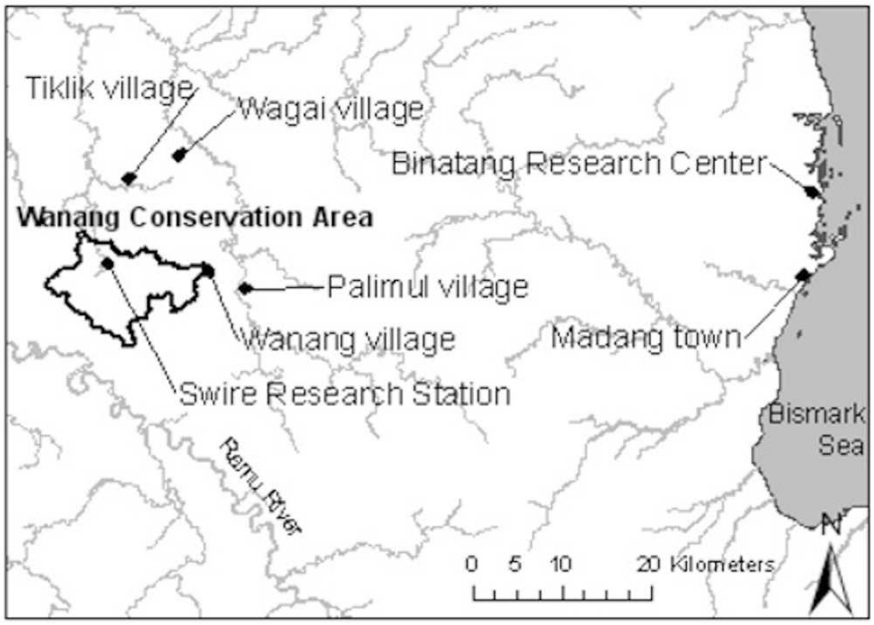

Figure 1.2: Study area in Madang province: Wanang Conservation in black outline and the location of Swire Research Station, nearby villages, and New Guinea Binatang Research Center in Nagada Harbor.

History

The Ramu River was first observed by a Westerner, Freiherr von Schleinitz, in 1886, and first explored in 1896 by botanist Dr. Carl Lauterbach (Kasprus 1973, Sullivan 2010). The first missions, the Catholic Missions of Alexishafen, were established on the Ramu in 1933 at Atembe and Annaberg, 60 km to the northwest of Wanang (Kasprus 1973). The Wanang were first gathered together by Catholic missionaries prior to 1970, at Masla, a few kilometers west of their current location. Previously, Wanang people had lived semi-nomadic lives in kin groups on their customary land. After a number of elders died at Masla, the place was abandoned, as was custom. Death was a sign that *sanguma*, or sorcery, was in the area, which caused people to desert the settlement for safety and move to another location. In the late 1980s, after some time living dispersed on their separate territories, the lineages gathered again at Kokel, a few km northeast of Wanang,

at a Church of Christ mission. The church school was the first formal education many villagers experienced. After a few years at Kokel, two elder men died, the settlement dispersed, and the mission departed. Around the same time, news came of a road that was to extend from Madang town across the Ramu River and into the mountain range above owned by Simbai people. The road passed through Wanang customary land and the area now known as Wanang village. Some villagers moved to Wanang in the late 1990s, anticipating the connection to development that the road would provide and Simbai settlers also relocated to Wanang when the road was being constructed. A dirt track was cleared but quickly deteriorated due to unstable terrain, heavy rainfall, and lack of maintenance. The road failed to provide the motorized connection to town the people desired, but they remained, in the area using the road as a footpath, while others settled subsequently. The occupied land includes portions of territories belonging to two lineages: one from Wanang and one from a neighboring village with marriage ties to Wanang. Villagers have not shown interest in relocation, despite the deaths of elder men, which traditionally motivated relocation.

Economy

Villagers practice subsistence-based adaptive strategies, consisting of slash and burn horticulture, hunting, and gathering (see chapter 4). Men and women adhere to a sexual division of labor. They have different roles and work cooperatively to provide for their families. For example, to make annual garden plots roughly one hectare in size, women cut the understory layer of the forest while men cut the large canopy trees. After

allowing the debris to dry for several weeks women make and burn piles of organic matter. Men later use felled logs to erect fences that keep pigs out of the garden plot. Women save seeds and collect cuttings and tubers from previous gardens of taro, banana, yam, potato, cassava, corn, and sugar cane. Men dig holes with sticks and women plant in them. Women alsoweed gardens, harvest, and prepare food. Garden preparation work is largely completed in the dry season from August to November, although villagers report seasonal timing becoming less predictable. Men and women will also work cooperatively to harvest starch from semi-wild sago palm (*Metroxylon sagu*), but the Wanang are not as dependent on this resource as populations closer to the Ramu River (Kasprus 1973, Sullivan 2010).

Figure 1.3 Wanang men digging holes in a recently cleared and burned garden, into which women plant tubers.

Families hunt and gather together. The man leads the way with his dogs and his bow and arrow at the ready. The woman follows behind collecting edible greens and carrying game the man obtains along the way in a netbag, which she or another women has made of tree bark (*Gnetum)*. Pig is the preferred game, but wallaby, bandicoot, cassowary, and other birds are also commonly hunted. Women, and occasionally men, will dig through large megapode nests of decomposing forest debris to collect eggs. Young animals, such as pigs or cassowaries, may be captured alive on these hunting excursions and women are responsible for rearing and feeding them back in the village. Men and women will also pound rotenone, a fish poison, out of *Derris* plants to capture fish in streams. Women gather and shape the *Derris* roots and stems into bundles and the men beat the toxin into the water until the stunned fish rise to the surface, where they are collected by men and children.

Language and Society

The people speak Maghu, part of the Sogeram subgroup of South Adelbert Range branch of the Madang group in the Proto Trans New Guinea family (Pawley 2012, Daniels 2010, see appendix 1 for glossary). Maghu itself has not been studied, but it is thought to be a dialect of Aci or Aisi, spoken by neighboring villages to the northwest (Wade 1993, D. Daniels 2012, pers. comm.). The area and people are referred to as Galisakan in government documents and on maps. However, villagers explain this is a misnomer as Galisakang is the name of but one lineage recorded by a patrol officer in colonial times.

People live in nuclear family homes of two to fourteen people. Some men have

two or three wives, each of whom ran separate adjacent households. Children are most frequently biological but are also gifted among families and adopted. Extended families often live in close proximity with their houses grouped together. Men remain on their customary land after marriage, while women move to the customary land of her husband. Elders report that sister exchange was a common practice during their youth, in which two men from different clans marry each other's sister, tying the clans together. Sister exchange is further detailed by Sullivan (2010: 28). This practice has given way to optative marriage, or marriage by choice. Marriage and childbirth are followed by large ceremonial exchanges in which the woman's clan is given gifts of pig, food, money, and fabric.

Land Tenure

Wanang villagers claim large tracts of customary land, aand the population density is very low, with 5.2 people per square kilometer in 2000 (NRI 2010). In the Wanang area, kin-groups that pass down customary land from one generation to the next consist of 10-30 people who trace their male decent line to a common ancestor. Women have land use rights to their husband's and father's land, which are not passed on to their children, who receive land rights from the father.

Wanang lineages (*sakang)* include Alkapke, Numucar, Girosakang (also known as Katam), Igasakang, Wanasakang, Kai, Kambasakang (also known as Galisakang), Kaipsakang, Angasakang, and Igumana. Although not definitive, one villager explained the relation of the lineages to wider clans this way: Igumana, Igasakang, Wanasakang, Kaipsakang, Girosakang, Inimucar, and Banasakang are part of Masala; Galisakang is

part of Kungi; and Kimkatam is part of Alkapke. In addition to the landowners, 44 settlers, mostly Simbai, now reside in Wanang to access development benefits of the road and now conservation. Villagers now refer to themselves as the Wanang community, which includes landowners and settlers.

Lineal land is held under customary landownership ensured by the PNG constitution, with no possibility of formal sale and purchase, but there are provisions to allow groups to register as Incorporated Landowner Groups (ILG) to enter into contracts for industrial resource extraction (Weiner and Glaskin 2007). By definition, customary land boundaries are unclear, but landowners' descriptions and mapping of territory delineations suggest each Wanang lineage claims 1,000 - 3,000 hectares. Villagers explained that prior to colonization their ancestors did not tolerate trespassing on their land and would attack non-kin intruders with bows and arrows. Violent conflicts over land use along the Ramu River in the 1930s and 1940s are described by Kasprus (1973). These practices have stopped but there remains an obligatory need to obtain the permission from landowners prior to using their land or resources. Villagers are now often suspicious of unauthorized use of their land as they no longer reside on or monitor a large portion of the area.

Land use rights are based on ancestry, social relations, and past use, with such claims being dynamic and often supported by recalling of ancestor stories. This is illustrated by two examples: Thomas returning to claim his customary land by reestablishing social relations, and the retelling of ancestor stories to establish land rights related to planning for an oil palm plantation near the Ramu River.

In 2008, a man called Thomas moved to Wanang for the first time to reclaim customary land. His grandfather had left the area during WWII and settled in Korog, near Madang, but had told Thomas about their Wanang land. While abesent, other men looked after his lineal land and they had to show him where it was located. Thomas and his family were not immediately integrated into the community but were treated with suspicion. His cousins and their families prepared a homecoming party and exchanged chickens and garden food to demonstrate their relationship to him. They agreed to divide the land between logging and conservation while sharing the benefits. Thomas's family gave a pig and garden food to village elders to thank them for looking after his land (figure 1.4).

Figure 1.4 Thomas and the Igumana lineage presented a pig and garden food to Wanang big men to thank them for looking after their land in their absence.

In the second example, Jeff, a Ramu man, was planning for an oil palm plantation and believed the land in question belonged to his lineage but heard it might be part of Wanang Conservation. When the question of land tenure arose, he traveled to Wanang with his kinsmen to settle the issue. A meeting was held to settle the claim. All parties recalled that a woman named Koomaybung resided on this land more than three generations prior, and that her name is associated with this piece of land. She was the daughter of the Alkapke lineage (in conservation), but whose child did she have? After five hours of deliberations and faint recollections, it was decided that she first had a baby girl with an Inumucar man but the child died and was burned in a fire. She lived on Inumucar land but then joined Inuminabul, Jeff's lineage. She had surviving Inuminabul children, who then used this piece of land and believed it was their own. However, women cannot pass on land and it was decided that the land belonged to Inumucar.

Exchange

In Melanesian societies, such as Wanang, exchange relations are an important moral concern and a source of identity (Strathern 1988). Melanesians do not regard themselves as independent actors, but are part of a kin network in which they share moral obligations through exchange (Sahlins 1972, Strathern 1988, see chapter 4). These exchanges can be small, such as a tobacco leaf between sisters, or large, such as an orchestrated exchange of pigs, fabric, and money between two villages connected through marriage.

One large exchange took place between Wanang and the nearby village of Musak. Musak invited Wanang for three concurrent exchanges to return their indebtedness to

Wanang for men assisting a Musak man when he fell ill, for children birthed to Musak by a woman from Wanang, and for a past marriage with a long over due brideprice. Wanang gathered pigs, lengths of fabric, and money to present to Musak, who hosted Wanang for two days and gave similar gifts of pigs, fabric, money, and garden vegetables. There was an all night performance by Wanang villagers (Tok Pisin: *singsing*). Neither group acquired much in material wealth in the exchange but the exchange re-affirmed the ties between the two villages. Maintaining and establishing harmonious relationships through exchange is of utmost importance to villagers, as many hardships are attributed to conflict, such as illnesses or unsuccessful hunting excursions. Indeed, to maintain harmony after the land dispute between Inumucar and Inuminabul lineages, even though Jeff (Inuminabul) was not the rightful landowner, he was offered monetary compensation for his the failure of his palm oil project.

Religion

Each lineage has a totemic animal or plant and an associated ancestor story. For example, there is an ant clan, a water clan, a sugarcane clan, and a megapode clan. Examples of ancestor stories are provided in appendix 2. People report loss of much of their ancestral stories and knowledge. Many villagers claimed ignorance and referred me to more knowledgeable elders when asked about their origins and ancestors. Wanang is tied to the Ramu River through a history of migrations and ancestor stories. Sullivan (2010) and Kasprus (1973) also found that the Ramu River had cosmological significance for villagers living elsewhere in the Ramu basin.

Villagers have been exposed to Christianity including Catholicism, Seventh Day

Adventism, and Church of Christ, but few report regular practice. At times villagers used the biblical story of Adam and Eve to explain their origin or talked about the big man in the sky.

The Wanang often refer to forest spirits (*masalai)* inhabiting their customary land (see chapter 3). *Masalai* help the Wanang to be successful hunters and provide forest resources for them, but *masalai* can also make people sick when displeased. Logging or other activity can disturb and anger *masalai*, or cause *masalai* to vacate an area so that the landowner will lose its cooperation and power (see also Wood 2004). Some men, typically elders, are knowledgeable about working with *masalai* as skilled hunters. Other men have lost this knowledge and depend on dogs for success. Men also explain that logging is bad for dogs because they cannot follow a trail in disturbed forests with felled trees. Traditionally, forest areas inhabited by *masalai* were forbidden to non-kin. These particular places were respected. Villagers rely on the *masalai* spirits, who are their ancestors, as it was ancestors who passed the forest on to villagers and ancestor cooperation is still viewed as necessary for successful use of forest resources.

According to villagers, the afterlife, where the ancestors live, is a place of abundance and wealth. One young woman told me that after death, we go to a place underground, where "there is plenty of canned fish and rice [that the dead] will send … to Mama to eat." Benefitting from the dead is desirable but requires secret knowledge. Missionary Aloys Kasprus (1973) recorded beliefs from 1936 to 1943 in the Ramu Basin about ancestors turning into spirits who looked like white men. Westerners were therefore thought to be ancestors, or to hold the secrets of exchange with them. These

beliefs resulted in the cargo cults of the 1950s (Lawrence 1964). Cargo cults consisted of villagers practicing elaborate rituals imitating Western religious or economic activities in hopes of gaining access to material goods from their ancestors, who were believed to have returned in the form of white men or to be in contact with white men possessing material wealth (Lawrence 1964). Specific cargo cult practices varied widely, but all asserted the belief that certain ritual activities would produce material wealth. Wanang villagers described participating in cargo activities in the past resembling Catholic Church rituals of creating prayer altars and confessing sins (see chapter 4).

Outsiders are largely feared and believed dangerous, as potential organ harvesters, sorcerers, or the like. Sorcerers can hide in the forest, gardens, or rivers. Villagers told me that they do not have sorcery (*samguna)* in the village, but sorcerors can come from the Ramu or the highlands. Settlers are feared as potential sorcerers, or for working with sorcerers, and are treated with respect for this reason. Villagers report that in the past they also had men's houses by the Ramu River where boys would remain for extended periods of time eating a special diet and learning about sorcery. Women and children were not allowed access to these areas, lest they fall ill or die. Sorcery is a prevalent explanation for demographic skewing towards a younger population.

> If you go to the highlands and other places you will see that they have big men and women, but here it is only the young that are left because of *sanguma*. This is why we do not know the ancestor stories and how the ancestors lived, and how to use our *masalai*.

In the past, the fear of *sanguma* required villagers to move when people died, but now they try to resolve fears through resolution. Following death of kin, the relationship with the suspected sorcerer must be remedied to reestablish peace through airing of grievances, compensation, and/or exchange.

Government Services

The Middle Ramu is largely beyond the reach of government services, such as education, medical care, and transportation, leaving communities to function according to their customs. Traditional decision-making is based on group consensus with villagers coming together to voice their opinions in lengthy discussions. There is limited formal leadership but rather *big men*, who exercise influence through their social relationships, lead community decisions and group exchanges. There are local level government officials, such as magistrate and law-and-order man. Their main roles are settling disputes and maintaining peace through community meetings and village trials. Although villages distribute wealth and make concerted efforts to maintain harmonious relations, villagers can be highly suspicious and jealous of one another.

The Wanang vernacular is an oral language and a minority of adults were literate in *Tok Pisin* or English. Forty percent of adults (34/84 adults) have had some formal education, mostly at the Kokel Church of Christ mission and 15% of adults (13/84 adults) attended some high school (grade 7-12) outside Wanang, including five teachers. All school age children were enrolled in Wanang Conservation School during my fieldwork.

Recent education that arrived with conservation will be described in more detail below in the community development section.

How Conservation Came to Wanang Village

In the late 1990s, the Middle Ramu, including Wanang village, was designated as a 158,000 hectare forest management area by the PNG Forest Authority for the purpose of timber harvest (PNGFA 2007, Figure 1.5). PNG Forest Authority authorizes industrial logging company activities contingent upon landowner approval. Following the concession designation, government agents and industry representatives visited villages to organize Incorporated Landowner Groups (ILG) to obtain their consent. Wanang villagers described these visits,

> [PNG Forest Authority and industry representatives] came in a helicopter and landed here by [Randy]'s house. They brought K48,000 with them to give to landowners. When they brought this K48,000, they brought an ILG form and gave it to me[1].

While logging interests were pursuing landowners consent, Bismark Ramu Group (BRG), was also visiting villages in the area on behalf of the United Nations Development Program's Bismark-Ramu Integrated Conservation and Development project (Van Helden 1998a, Van Helden 2001). BRG was using a 'self-reliant' approach to community

[1] Legal tender in Papua New Guinea is the Kina (K). During the time of study, the exchange rate with the US dollar varied between 2.06 and 2.95 K to 1 USD. Source: http://www.xe.com/currencycharts accessed October 24, 2014.

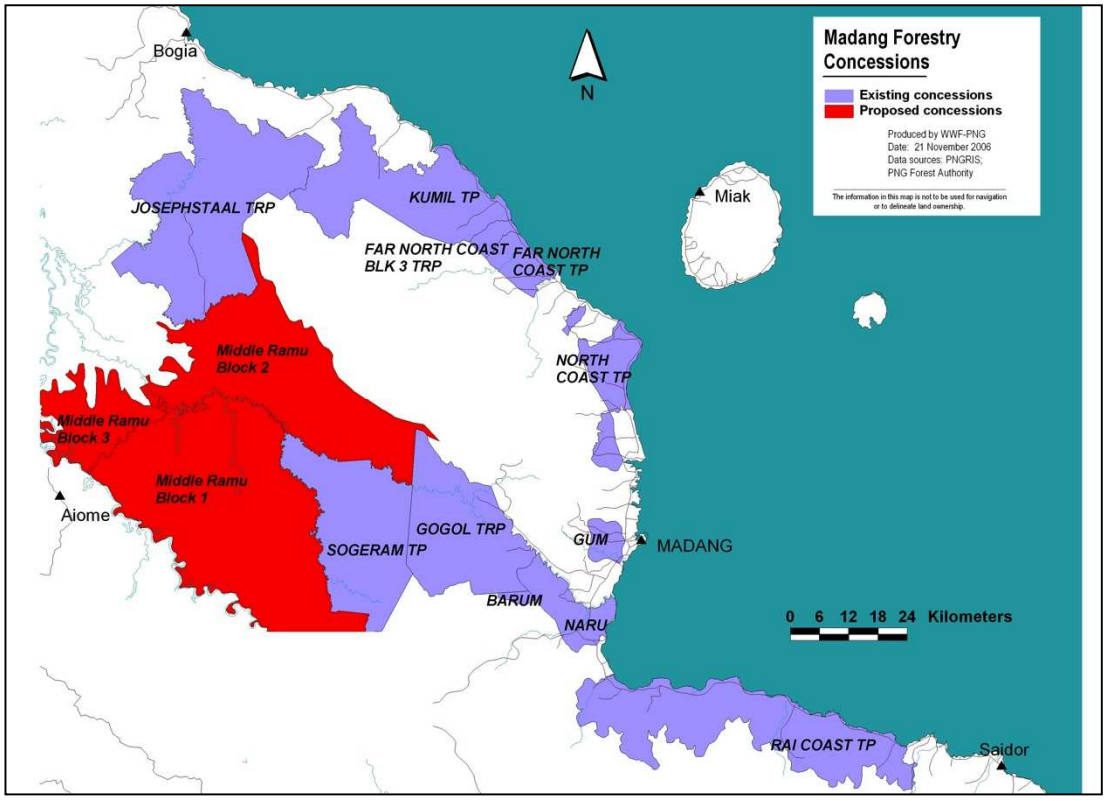

Figure 1.5 Middle Ramu Block 1 logging concession including Wanang customary land.

development, which they developed in response to what they regarded as neocolonialism and commodification in many integrated conservation and development projects (Anderson 2005). They warned landowners about the impacts of logging using stories, posters, dramatic performances and facilitated discussions (Figure 1.6). BRG's approach was to not broach the topic of conservation with villagers, but allow them to make their own decisions. If villagers expressed interest in conservation, BRG sought to design appropriate agreements or institutions without any promise or mention of development or material benefits.

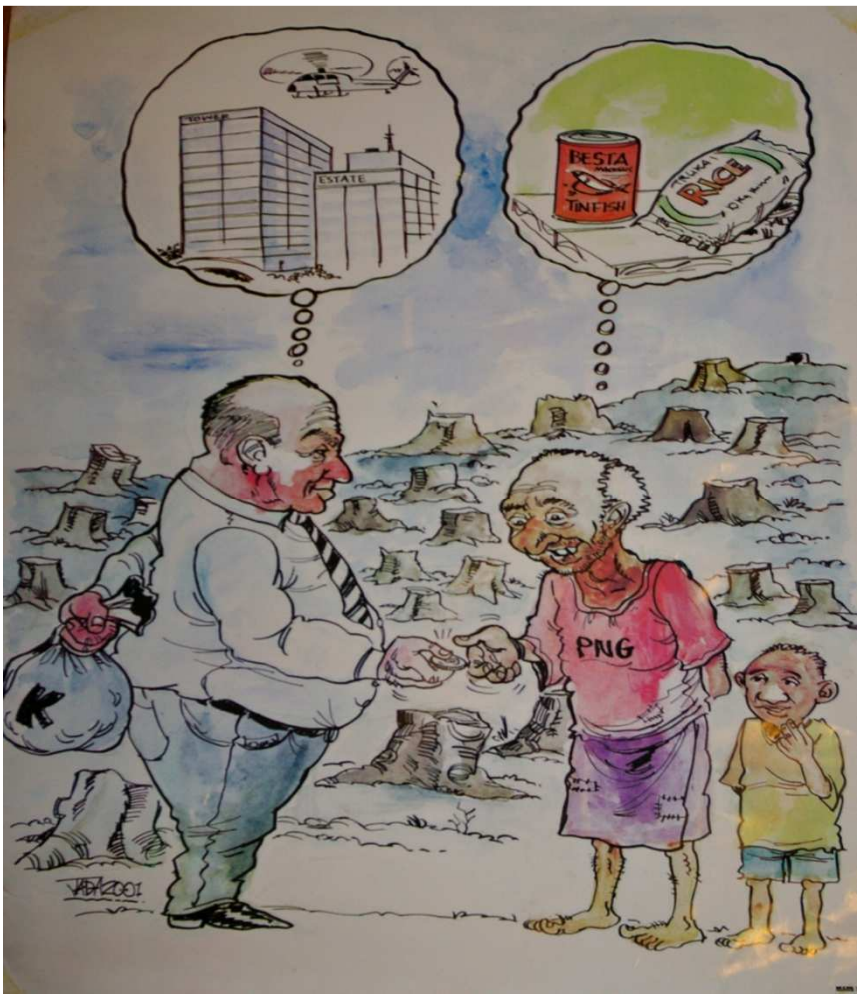

Figure 1.6 Example of poster used by Bismark Ramu Group in their community awareness campaigns.

Villagers saw the impacts of logging in other areas such as the logged Gogol area to the east and worried about what they saw (see De'Ath 1980). For example, Filip Damen, a village *big man*,

> … took the dogs and went hunting. The dogs were chasing a wild pig and they came to a big felled [*Instia* tree]. The dog couldn't get past the tree and lost the pig, so the dog started howling … I sat down and thought. I realized if the

> [logging] company comes and cuts my trees they will ruin my forest and it will be hard for my dogs to hunt, so I must … sit down with my community and try to convince them not to allow logging.

Filip and other villagers subsequently decided they wanted to keep industrial logging off their land. In the late 1990's, Filip learned that BRG was traveling around the area and sent word asking them to come to Wanang. Another man recalled what happened:

> They came … and brought pictures of how the [logging] company usually works. …The second time [BRG] came, they brought these pictures and gave them to each of us, they had stories and we looked at these pictures and read and understood how the company usually works. Or, if you are a man and you [conserve] your land and water, how it will work.
>
> We stayed [with them] and we knew the [logging] company wasn't good. The [logging] company is happy to take your trees and leave and go back to their country and the landowner will not have a good life, won't have good drinking water, and they usually take the place of the forest spirits and their animals. [We] usually talk to [forest spirits] on our home land and call on [our] forest spirits to fight and get game, but they won't remain. The machines will make them all leave. We saw this and [Filip] said, '…We will try to [conserve] our land. We

> were happy and in agreement and we told BRG that 'yes we are happy and we want this work, we will try it'

Villagers listened to what BRG told them but many were also concerned about how they would make money without logging income.

> In PNG, they say things like if you want to hold onto your forest, you will have to [prostitute] your wife and spend the money from her [sex work]. So lots of nonsense talk came up to challenge [conservation] ideas, but it didn't shake me.

On June 1, 2000, eleven Wanang lineages (Alkapke, Girosakang, Iga, Babugu, Mudd, Wanasakang, Kai, Kambasakang, Kaipsakang, Kmevung, Igumana) signed a deed among themselves that prohibited logging on their customary land (See appendix 3 for deed and map). Conservation Deeds have been described as "very strong law" and are essentially a business agreement among lineages that can be altered or nullified if all lineages agree (Horwich 2005). The deed allowed landowners to make land management decisions without government interference. The Wanang deed stated that the 11 lineages would conserve their 18,570 ha of land and develop it on their own terms. They agreed not to sign Forest Authority or Timber Authority agreements. Around 200, two lineages, Babugu and Mudd, defected from the conservation deed and switched to logging.

Landowners surrounding Wanang signed Forest Management Agreements with the PNG Forest Authority. Filip, the *big man*, described this time as tense.

> When conservation started it wasn't all easy and good, many fights and arguments came up about forest, land, water. … I brought many forestry men [to Wanang] and lots of boundary survey work was necessary. I brought the [logging company to] survey [here]. The Asian [logging] men came in and did a boundary survey, so they saw and knew the conservation boundary already.

Filip tried hard to keep the lineages together, but there were often divisions within them. Some divided their land between logging and conservation with different men presiding over separate pieces of land to prevent conflict. This allowed lineages to benefit from both options.

Despite BRG's efforts to dissuade villagers from expecting to benefit from conservation, people anticipated some type of development. One villager explained that even though BRG did not talk about money, he thought his life would be changed if he signed the deed.

> I heard stories that men who make restrictions and conserve their land…will live on money. …You will be full of money or you will not want anything because … you will … have a way to get money and you will get it everyday.

To maintain a commitment to conservation, villagers needed to find alternative development options. Logging activities had not yet begun in the area, but their leader

knew they would not be able to resist logging if he did not find an alternative before it got started. This was why he reached out to biologists at the New Guinea Binatang Research Center.

Biological Research as Development

In 1995, an international team of biologists working at the Christensen Research Institute (CRI) near Madang enlisted villagers as research assistants. When CRI folded in 1997, the team founded the Parataxonomist Training Center (PTC) in nearby Nagada harbor north of Madang town (Figure 1.2). This center served to train villagers in ecological research and as a base of operations for fieldwork conducted in and around the villages from which assistants were recruited. The PTC was renamed the New Guinea Binatang Research Center (BRC) in 2003.

The Bismarck-Ramu Group was also based at CRI prior to its closure, and its staff was familiar with the sort of research BRC did in remote forest locales. Unlike Bismark-Ramu Group, BRC was not focused on conservation but was interested in access to intact forests for research sites. The Bismarck-Ramu Group connected the Wanang *big man*, Filip, to the newly establish BRC. In 2001, Filip visited the researchers at their Nagada station and invited them to do their research in Wanang. The New Guinea Binatang Research Center then consisted of expatriate biologists, graduate students, and parabiologists, who were PNG nationals trained in technical aspects of research and skilled in community relations.

Back in the village, Filip told people of a dream he had in which white men would be coming to Wanang. He instructed villagers to build a house for them to sleep in and

use as a laboratory. They were also to clear a community area, which became the center of community life, eventually becoming the site of the school, soccer field, dancing grounds, and helicopter pad. One villager explained they did all this work without understanding what was to come. Others recalled how neighboring villages mocked them for doing manual labor that would otherwise be done by machines in logging areas.

In 2001, three BRC graduate students traveled to Wanang to conduct brief projects and scout for future research sites. Their report about Wanang's potential as a research site concluded, "Overall, we feel quite positive - especially about the forest and nature, the people would be good too." They were followed by a convoy of six researchers who were to stay for three months. Filip arranged that they be met by villagers at the Sogeram River to help carry their equipment across it and the remaining hour's walk to the village. No one went to the river, as they did not believe Filip's dream that a group of white men would be coming. Filip was eventually able to assemble some villagers who came to assist and welcome the researchers. Their project employed 10-15 villagers for three-months, during which it became evident to scientists that villagers were more interested in the research as an employment opportunity than in conservation. Scientists and villagers developed good working relationships and maintained contact afterwards.

Wanang leaders were also in contact with other NGOs that worked with community-conservation groups during this time. They talked to Village Development Trust (VDT), The Nature Conservancy, Foundation For People & Community Development Inc., and others looking for alternative development options. The

conservation deed they signed with BRG prevented small-scale logging and the remote location precluded the potential for ecotourism, which limited their conservation-friendly development options. In 2004, VDT assisted Wanang landowners in mapping their territory.

In 2006, biologists at BRC renewed their interest in working at Wanang with a research project examining the tropical plant-insect food webs. The scientists chose Wanang among eight village locations across Madang, East Sepik and Sandaun Provinces, where BRC previously conducted three-month biotics surveys. "Wanang was basically lucky," one BRC scientist recalled, "because it was perfect place for us. We could not do it in our traditional study sites … because [their forests] were too small." BRC then destructively sampled one ha of mature forest and one ha reforested, old garden plot adjacent to the village. According to one scientist they needed,

> a proper field camp which included two houses for accommodation and [an insect] lab and kitchen and shade house for rearing insects so that in itself was a major activity, which the community did with lots of sort of volunteer work. We did pay for it but at the same time the community really wanted to get it done so we [could] start the project.

Of what they did to help start the research station, a villager likened it to "the work the mothers and fathers…. In 2004, we cleared the area with axes and it was very hard work." Scientists and villagers report that this was a very exciting time in Wanang,

which was reflected in an elaborate opening ceremony for the new project. It was a three day event with a *singsing*, gathering and exchanging of food, K1000 payment from BRC to Wanang, dramas about conservation, speeches, a modern dance party, and closed with the *mambu wara* tradition, or unmarried women chasing and throwing water from bamboo vessels on eligible men from the alternate group (figures 1.7, 1.8, and 1.9).

Around this time, a logging concession was awarded to Rimbunan Hijau (RH), a Malaysian company with widespread business interests in PNG. Wanang villagers were pressured by the company and neighboring villages. Wanang land was also included in the logging concession approved by Forest Authority without reference to the conservation deed.

The unimproved road that was started by the provincial government ran through the middle of the area claimed in the deed. The logging company intended to use this route for their timber extraction and claimed to be unaware of the conservation deed. Confusion ensued, as members of all but one Wanang lineage signed both the Conservation Deed and the Forest Management Agreement (FMA) (see appendix 4 for 2006 letter from PNGFA). On March 30 2006, Filip wrote letters to the Forest Authority defending the Wanang Conservation deed and informed RH that they would not be allowed to operate in Wanang. On March 31, 2006 the provincial Forest Authority office responded to Filip and asked Wanang to clarify their interests considering that most lineages signed both the Conservation Deed and FMA. On June 13, 2006 the director of the PNG Forest Authority responded to Wanang that to be recognized by PNGFA it must be declared as a Conservation Area by DEC, but that FMA practices require excluding

Figure 1.7 Wanang men in front of food exchanged with scientists. Villagers provided tubers from gardens and scientist brought canned fish and rice. Photo credit George Weiblen

Figure 1.8 Wanang and neighboring villagers gathered for a drama reenacting logging and conservation. Photo credit George Weiblen

Figure 1.9 Wanang girls participating in the *mambu wara* tradition by chasing and dousing a scientist with water from bamboo vessels. Photo credit George Weiblen

10% of the area as reserve forest and Wanang might be accommodated in this way. On July 26, 2007 BRC also wrote to PNG Forestry Research Institute to request their support in excluding Wanang from the logging concession, highlighting the research and economic benefits biological research brings. On October 18, 2007 Filip and two scientists traveled to the national capital, Port Morseby, to hold a stakeholder meeting about Wanang Conservation, its research potential, and possible funding sources. In attendance were representatives from PNG FRI, PNGFA, BRC, the Smithsonian, and PNG World Wildlife Fund (WWF). Filip also happened to meet high profile supporters, Jared Diamond and US Ambassador Leslie Rowe, while in Port Moresby. On October 19, 2007, Filip wrote to the PNG Department of Environment and Conservation (DEC) requesting they entertain a proposal to designate Wanang as a Wildlife Management Area (WMA). WWF agreed to support an official mapping of Wanang Conservation and the development of a WMA proposal to DEC.

The logging company changed the placement of bridges and roads to avoid Wanang Conservation. Neighbors in the vicinity resented the change in alignment for limiting or delaying their road access. Logging industry representatives and neighboring villages pressured Wanang landowners to abandon conservation. Wanang villagers experienced conflicts with their neighbors, who felt that because Wanang was not participating in logging they should not receive the benefit of a road. BRC vehicles were stopped, drivers were threatened, and monetary compensation was demanded. In 2008, one parabiologist driving to Wanang overran a roadblock near the village of Wel. The next week when a BRC vehicle passed, it was stopped and a parabiologist was assaulted.

An impromptu meeting was held on the spot with BRC, Wanang villagers, Wel villagers, and RH employees. Villagers involved in logging complained that Wanang landowners were benefiting from BRC's use of the road without having to sacrifice any timber resources. BRC explained that it was not opposed to logging and that research at Wanang would continue to provide employment opportunities for villagers from surrounding communities including Wel. All parties agreed to undertake a boundary survey to clarify the extent of Wanang Conservation. First, BRC and Wanang surveyed, marked, and mapped the conservation area boundary with World Wildlife Fund support. Wanang conservation was revised to contain 10,770 contiguous ha in these surveys (Figure 1.2). Then, RH employees retraced the boundary.

Another dispute arose about the forest plots felled by BRC scientists. The customary landowners were brothers, one had signed the Conservation Deed and the other signed a Forest Management Agreement. They had not definitively divided their land, and the man with a logging agreement, then demanded K100,000 in compensation to be paid for the damaged trees and stop the research. The brothers negotiated an agreement and divided their land to settle the dispute. Yet use-rights continued as both men had rights to all their customary land. The brother in logging continued to use Wanang land and both brothers shared the benefits that they received from either logging or conservation.

Villagers, scientists, and parabiologists agree that the research activity and paid employment was essential for consolidating support for conservation. Employment with the felled plot project increased to 20 full time employees for two years. At the same

time, small land use compensation payments were made to landowners with funds coming from research grants from the US National Science Foundation and the Czech Academy of Sciences. Villagers enjoyed the work of cutting trees and looking for insects. In addition to payments, villagers also had transportation opportunities in the research vehicles and access to healthcare. One scientist viewed Wanang villagers as very happy with conservation at this time because neighboring villagers had not yet received any benefits from logging.

Scientists organized a Conservation Board to direct conservation actions and development. Although villagers on the Board had limited powers, the acknowledgement, uniforms, and stipends that went along with Board positions were important. The Board's functions eventually expanded, as conservationists expected them to take on greater responsibility for community development.

While working together, researchers and villagers developed personal relationships. Both researchers and villagers recalled jokes and stories about their time together. Numerous village children were named after visiting researchers. Parabiologists also developed relationships with villagers and were able to serve as intermediaries, translating the expectations and interests of villagers and expatriate scientists. Villagers, parabiologists, and scientists spent time together on days off, which led to an improvised school on Sundays. Villagers were interested in learning to read and write and researchers were in need of more educated workers.

Long-term Partnership

As the felled plot project was ending in 2008, villagers and conservationists envisioned a larger-scale project. The project would include a long-term forest plot, a surrounding 1,000 ha extraction-free research area, a permanent field research station, the first school in the area, and annual royalty payments to landowners. The plot and research station would become an international destination for scientific study and sustain employment opportunities. This partnership between villagers and BRC received support from multiple organizations with interests varying from support for biological research to conservation to community development. The US National Science Foundation and the Czech Academy of Science funded a 50 ha plot biotic survey and inventory. The Center for Tropical Forest Science, Smithsonian Institution, the University of Minnesota, and the Czech Academy provided resources and scientific expertise. In a planning document, one scientist described the significance of the project as,

> The 50-ha plot would provide exceptional opportunities for the study of plant-insect interactions. It will be situated in the Madang area which is becoming one of the best studied tropical sites for plant-insect herbivore interactions and herbivorous insects in general…Further, the long-term continuity of our insect research in Madang provides an opportunity for the study of the dynamics of insect communities, alongside with the study of forest dynamics in the plot.

Additional partners included: the Papua New Guinea Forest Research Institute, the University of South Bohemia, Arnold Arboretum of Harvard University, World Wildlife Fund, The Christensen Fund and Seacology among others. The research infrastructure supporting the 50-hectare plot was provided by John Swire & Sons (Pty) Ltd. and Steamships Trading Co. Ltd. that they branded the Swire PNG Rainforest Study (SPRS). The infrastructure included a professional land survey, research station buildings, a study center science director, a lease agreement with the landowners, and a school at Wanang village. John Swire & Sons (Pty) Ltd. described their interest in the project as,

> The only way to address the national issue of illegal deforestation is to provide real alternative economic future for forest dependent people. If you don't provide them with an alternative option for illegal forestry then what are they supposed to do, and so that is why we loved the Wanang project, because it demonstrated that it is possible to have alternative futures that balance conservation and economic development. We are certainly not conservationists for the sake of conservation. We are about, how does PNG find a future where they can retain their natural wealth in biodiversity without compromising development agendas?

Swire and Steamships focus on community development and branding led to articles in The National and the Post-Courier, PNG national newspapers, about their initial K700,000 contribution. These articles brought considerable attention, jealousies, and

suspicion to Wanang. One scientist believed it was the corporate investment in the conservation project rather than inconsequential NGO support that deterred logging pressure from RH. To the scientists' dismay, Swire and Steamships's initial enthusiasm for both scientific research and community development became more focused on community development with time, until the company signaled the end of its contributions in 2014.

50 Hectare Forest Dynamics Plot

The 50 ha forest dynamics research plot was designed as part of the Smithsonian's Center for Tropical Forest Science (CTFS) network, which has over 53 forest plots around the world using the same methodology to detect global patterns in forest dynamics (CTFS 2014). Both scientists and villagers have recognized the importance of Wanang as the first CTFS plot in this part of the world. The 50 ha plot is a very intensive form of field research with every tree over 1 cm diameter at breast height (over 250,000 trees in Wanang) being tagged, measured, mapped, and identified every five years. In addition, the topography of the plot was measured and mapped within cm accuracy.

Originally, scientists intended to have a makeshift camp built from bush materials, similar to the one they had for previous projects in the village. However, obtaining support from Swire and Steamships and the Czech Academy allowed them to construct a permanent, fully equipped field station adjacent to the forest plot. The station consisted of three permanent buildings, which were the first such buildings in the Wanang area (Figure 1.10). One housed visiting scientists and parabiologists, another

was for local research assistants, and the third was a laboratory. The station has solar panels, a diesel generator, autonomous water system, and radio communication. The materials for the modern facilities were transported by truck from Madang to the end of the road at Wel village, then flown by helicopter to Wanang. This received considerable attention from neighboring villages. In addition, villagers thought that the conspicuous metal roofs in an opening in the expansive rainforest canopy brought much admiration from airplanes seen flying over.

Figure 1.10: Building housing visiting scientists at Swire research station at Wanang Conservation.

Deciding where to locate the forest plot and research station posed a problem for villagers. The plot and surrounding 1,000 ha research area was to have significant restrictions on landowners' resource use. Conversely, the presence of the plot on customary land had the potential to provide wealth and prestige to landowners. For their

part, scientists were concerned about maintaining the biological condition of the forest as well as the security of the land, due to their previous experience with uncertain land claims and large compensation demands. They knew that some landowners, such as the *big man*, Filip, were steadfast supporters of conservation and so they decided to locate the plot on his land. The plot and research station were placed further from the village than originally desired, 10 km west of the village, on Filip's lineage's land. The surrounding research area included portions of two additional lineages' lands.

Although land is grouped under the conservation deed, villagers go on adhering to customary divisions. Each lineages want scientists to make use of their own land and are suspicious of the 50 ha plot on Filip's land, thinking that he is getting extra compensation. Simultaneously, lineage members express concern over what lost access to ancestral history and hunting and fishing grounds will mean for their children.

After efforts to declare a Wildlife Management Area stalled, BRC worked to see Wanang declared as a formal Conservation Area by the PNG government. Such a declaration would formalize the Board, its logging prohibition, and gate fees, as well as land use restrictions: no hunting by visitors, no unnecessary damage or cutting of fruit trees for harvest, no settling without Board approval, and no extraction or disturbance in the research area. Customary use by landowners would be allowed, except in the research area. The declaration was meant to assure that conservation land would receive institutional support, remain intact in the long-term, and make the project less dependent solely on Filip. Villagers supported this initiative because they viewed it as a way to gain

recognition and bolster the reputation of Wanang around the country and the world. However, the declaration stalled at the national level.

Building the research station and the initial plot work began in 2009. Villagers recalled that very few people remained in the village because they were all working on the forest plot and research station. Women recalled carrying loads of sand from the streambed up to the ridge top where the station was being constructed. Men told me stories of measuring and tagging trees in the initial forest survey. In addition, support from ancestor-spirits *(masalai*) was needed to make the work succeed. When a large snake appeared at the site and a man had a dream indicating a *masalai*-spirit was present, an offering of food was made to please it (Figure 1.11).

Figure 1.11 Wanang landowner making an offering to appease a disgruntled *masalai* during construction of Swire research station.

The influx of money and changes in lifestyle were welcomed by villagers, who longed for the luxuries of modern life. They were happy to be fed store-bought biscuits, canned fish, and rice while on the job. But a woman recalled that

> we were very hungry in 2010 because we all worked at the station in 2009 and didn't cut gardens. All men and women worked [leaving] only one or two [kin] … back … in the village. [BRC] gave us food while we worked [at the station] and told us we couldn't make gardens there. The work lasted three months. Then we had money and we had a big market at Wanang. People would come from [other villagers] to sell things but it wasn't enough, we ate unripe bananas and went to bed hungry.

Seventy percent of all villagers and 98% of adults reported having worked for the scientists at some point. Most Wanang villagers carried cargo from the end of the road to the research station (71% of all villagers, 85% of adults), being paid 80 *toea* to 1.5 *kina* per kilo, per trip. Fewer villagers worked as research assistants or camp cooks (22% of all villagers, and 48% of adults), mostly men (19% of women and 80% of men). Research assistants, managers, and cooks were paid K154-375 per fortnight.

Community Development

The project also provided funds for community development. Filip described a meeting with the donors, at which he asked them: ,

> ‘Are you able to give some support to my conservation to [develop in our village].’ … They said ‘Yes we can support you with money to go [do] this work.’ When they left, they gave this money, this K 700,000 they sent to come [here], so its like K 50,000 came to the community. The community got royalties from this plus they put some money to road maintenance and this K 650,000 went to constructing [the station] building and paying the carpenters and laborers to do this work.

Villagers decided to use the community development money for a school. They wanted their children to speak English, and to learn to run the project in the future. Scientists supported the school, as it met their needs for an educated workforce and also appealed to their donors who were interested in community development.

In 2009, the Wanang Conservation School was started. Filip arranged for a headmaster and a teacher to come to Wanang. Meanwhile, village men worked together to construct classrooms from bush materials, building one additional building each year as another grade was added. Women gathered to do community work once or twice a week, cleaning the area around the school and soccer field. Initially, the school enrolled 23 students, which grew to 150 by 2011, drawing in students from nearby villages.

Funds from corporate donors were used to buy school supplies and pay teachers. In 2011, funding was received from Seacology to support the construction of a permanent school building in return for a 1,000 ha expansion of the research area with resource extraction limitations. The school became registered with the PNG government, bringing

additional institutional and financial support. BRC also paid school fees for a number of older boys to attend schools outside the village. In addition, the scientists provided education opportunities for village men in university-level ecology field courses at Wanang.

The school became a symbol within the community. Villagers cite it as a sign that things are starting to change and the future will be better. All parties recognize the school as a measure of village support for conservation. Villagers attribute their willingness to do community work and carry cargo to their desire to sustain the school. Indeed, when not enough villagers showed up to carry cargo for scientists, Filip took students out of class to complete the task. Prior to government registration, one teacher complained that "The [conservation] project is supporting the school not the government, so if [the villagers] don't work hard [to support the project] the school will end."

Initial plans for the 50 ha plot were explained as a "long-term lease with annual royalty payments", yet sustainable funding has yet to be established. In 2008 royalty funds were provided by WWF. John Swire and Sons provided royalties in 2009 through 2013, and CTFS supported royalties in 2014. The nine lineage leaders received annual royalty payments of K 1,000 in 2008 and 2009 and K 2000 in 2010, 2011, and 2012, which they distributed as they saw fit. Some villagers felt that the money was evenly divided among lineage members, even young children received K 5. Others suspected that the *big man* of their lineage kept the money for his own uses. One villager explained that it was up to his leader to be generous and it was not the responsibility of researchers

to distribute the money. Villagers told me that they used the royalty money to purchase clothes, pots, utensils, soap, salt, kerosene, and the like. Expectations that the royalty payments would increase were common (see chapter 4), but funding sources beyond 2014 had yet to be identified at the time of writing.

Vehicles are also important symbols. BRC acquired four Land Cruisers since they started working in Wanang, which villagers view as a sign of their success and growth. Villagers also desired a vehicle and considered it one of their most important needs for trips to the town market and hospital. BRC discouraged villagers from buying a used vehicle and recommended saving their funds over several years to afford a new vehicle. In 2009 against BRC's advice, the villagers used conservation funds to purchase a small used truck for K 26,000. The vehicle ran for several days before requiring repairs. This happened more than a dozen more times before it fell into complete disrepair, as funds to fix it were unavailable. Villagers were frustrated that BRC did not help them and BRC was frustrated that villagers had wasted money on a run down vehicle. A rumor began to circulate in which villagers believed BRC was going to purchase a flatbed truck for them. In response, BRC agreed they would help finance a vehicle purchase if the community sold their used vehicle and contributed K 10,000 each year until it was paid off. Villagers were unable to sell the first car, were hesitant to commit more community money toward a vehicle, and had yet to obtain a new vehicle as of writing.

Villagers explained their access to Western medical care increased with conservation. To a survey I conducted in September 2011, 70% of households reported illness such as diarrhea or fever in the past two months and 8% reported a case of infant

mortality in their family. Prior to conservation, villagers relied on traditional healing and medicinal plants, which they continued to use for many ailments. Villagers used ceremonial washing to cleanse the body of sorcery. Similar practices were described further down the Ramu River by Kasprus (1973: 153). Scientists provided basic first aid and medicine. They also provided transport to the clinic and hospital in town, yet some women feared that children died when birthed there and caregivers were seen as callous and insensitive. Although villagers frequently turn to BRC for medical care, Western medicine is believed to be powerless against certain ailments. For example, a boy became very ill and received a ceremonial washing by a knowledgeable elder, but the remedy did not work and the illness was attributed to strong sorcery. Scientists in town demanded that the boy be brought to the hospital and sent a car to transport him. The elder resisted, saying Western medicine would not work in this case, but the scientists prevailed and brought the child to town for treatment where he recovered.

Scientists attribute much of the project's success to the community benefits that donor contributions enabled them to provide:

> Without the involvement of Swire there would be [many] more difficulties because we would not be providing any community benefit. We would be providing only employment benefit which inevitably would lead to some people getting benefits and some people not. We would be able to provide conservation royalties still but nothing more.

Villagers agree that the material benefits have been important but understood their significance differently (see chapters 2 and 4).

Change, Politics and Problems

The idea of change is pervasive throughout the conservation project (see chapter 4). Villagers want change in their lives and researchers are proud of the changes they have made for the community. They said that before conservation they were poor. They did nothing and had nothing (Tok Pisin: *stap nating*). One parabiologist described the village conditions prior to conservation in similar terms: "They had no way to town, no school. They used traditional medicine." Villagers emphasized the extensive changes conservation brought in terms of how they now participate in the market economy. For example, nearly all women reported selling produce, grown or gathered, at the Madang town market or at local markets that pop up around logging camps or the conservation project. Cacao production has become established in the Sogeram River area, especially Palimul village, and Wanang villagers started purchasing seeds and planting trees as well. One researcher added that the station itself is seen as

> very good by the community, not because its useful for them, but because it's … a clear sign of what they call development, basically even if these buildings don't have any direct relevance to them, unlike the school for instance, then its a sort of confirms the importance of the area.

Indeed, prestige was an important part of how villagers evaluated the conservation project. Villagers on the Conservation Board being flown to Port Moresby for a swanky Swire and Steamships opening event in 2010 attested to their importance. Visits by and relationships with foreigners, especially Merlin Swire and the Prince of Monaco, who came as part of the Papua Niugini Biodiversity Expedition, were also signs of Wanang's standing (Fiji Times 2012). Villagers were proud to be the only conservation project in the area. When they heard that a neighboring community was interested in conservation and wanted BRC to come work there, they dismissed them. One man told me of

> a poster … in the government office in Moresby that has Wanang Conservation on it. There isn't anything else on that poster. [Musak] can try to make a Wildlife Management Area but it won't be a Conservation Area with a deed. There can only be one.

At the same time as many changes have taken place, they have not met expectations. Villagers are waiting for a complete transformation of their lives. As one man told me, "Something bigger will happen. I think this still. It is in the plan. I will work slowly and it will come slowly and grow bigger." When the 50 ha plot and research station were established away from the village, some villagers began to change their view of conservation, as the focus of activity was no longer near the village and part of their everyday life. The future they associated with the project seemed to have departed and moved into their forest without them. The weekly market stopped. In addition, workers

were no longer able to stay with their families in the village. Furthermore, villagers who were not working with researchers were no longer welcome at the research station. People who carried cargo from the end of the road to the research station, now had to bring cargo and return to the village the same day. Villagers were accustomed to letting kinsmen travel through the area, stop at the research station, and show them hospitality. This was important for them and demonstrated their standing. For its part, BRC worried about ballooning expenses associated with hospitality, as well as the threat of theft that increased with increasing knowledge of the station in the region.

Indeed, the threat from neighboring villages appeared to be real, as robbery plots were discovered and roadblocks became violent. Community development benefits and conspicuous transportation of cargo attracted the attention of outside villagers and increased tensions. Conflict between Wanang and Wel villagers came to a climax in September 2009, at a soccer tournament held in Wanang that BRC had organized. One scientist recalled the events and had "the impression that [an RH employee] was inciting some of the conflict." The Tiklik village team lost their game and disrupted the final, which was to be played between Wanang and Wel. Logging company (RH) employees from Wel "rampaged" and "came with bush knives, threatened women, and cut down the goal post." Wanang youth fought back and beat one of the Wel villagers while others fled.

Later that month, BRC staff were stopped and threatened as they passed Wel, prompting BRC to bring a Madang Police escort on their next trip to Wanang. On that trip "10 to 15 men jumped out [on the road by Wel] and stopped the car from passing but

discovered police onboard and allowed the car to pass." A few days later BRC, Wanang villagers, and Madang police stopped at Wel to talk to RH employees. The police told the logging company employees that BRC had a right to use the road. Filip apologized for the soccer player being beaten, and invited Wel to a ceremonial exchange later that month. At the exchange, Wanang villagers presented money to Wel and everyone shook hands. Around this time, the Wanang school opened and children from Wel and other logging villages were invited to attend. The sharing of benefits further resolved tensions and allowed the project work to continue peacefully.

Leadership

Filip was the undisputed leader. As a woman explained to me:

> One man brought this work here. The leader was [Filip], he brought the work and gathered us… He told us to work and we worked. When he didn't tell us [to work] we were idle, so when conservation came here, we all left our garden work. One year, we only did community work, we forgot about our gardens, we were happy that [it]… came here.

While many villagers participated in various conservation activities, no one doubted that conservation had been the result of his initiative. Filip "carries the whole thing, the school, the project ... If later he dies or leaves, the work will end." Researchers nominated Filip for the 2009 Seacology Prize and 2010 Conde Nast Traveler Environmental Award. He received the Seacology Prize and was flown to Malibu, CA, USA where he was given

US$10,000, which he largely distributed amongst lineages. He was the first villager to fly on an airplane or leave the country and this experience won him no small degree of prestige. He attributed the school funding received from Seacology to the personal relationships he developed in Malibu.

Filip held the two highest positions, research project manager and Chairman of the Conservation Board. He wielded considerable control over community members--assigning them to work, controlling access to employment, and distributing pay. He had close relationships with scientists, which granted him and his family additional benefits. He guarded these relationships and actively prevented other villagers from developing them by limiting their communication or access to them. One researcher worried about his power. He is

> a very strong leader, who …. has achieved things that would otherwise be very difficult. Especially to basically fend off the loggers and then sustain the community during the hard times. But at the same time, in good times or relatively good times, he is not always very political and he feels [he] needs to be basically in total control, which again causes resentment. It is true that there [is] not much management talent around but at the same time, he is not really giving enough space to anyone else.

Other villagers complained that Filip alone should not hold all positions. He countered that other men were wrong to be suspicious of him and accuse him of absconding with 700,000 *kina*.

BRC made efforts to distribute influence. In 2012, cell phones were distributed to people holding key positions in the school and Conservation so they could freely communicate with BRC and not have to rely on the radio controlled by Filip. The trip to the corporate opening event in Port Moresby distributed some of Filip's status across the Conservation Board. Furthermore, the position of Chairman was reappointed and assigned to another villager. Board members formally approved the switch but it was basically seen as BRC's decision. As one scientist concluded, villagers trust BRC more than each other, so one of BRC's main roles is to provide "oversight and not [let] Filip alienate everyone." Suspicions were not limited to Filip, but included both scientists and basically everyone who had close relationships to the Conservation Project. Villagers suspected scientists were giving secret gifts to villagers, and indeed, many did offer small departure gifts to assistants.

Rules

When villagers signed the deed, they agreed to work together to conserve their land, not to allow industrial logging, and to control development themselves. The deed contained no restrictions on forest use. Yet villagers complained that Bismark Ramu Group expected them not to kill more game than they needed and to clean up fires in the forest by burying the ash or dousing them with water so as not to deter animals. The Wildlife Management Area proposal to DEC contained a new set of rules: no trespassing,

no earthworks, no commercial timber harvesting, and no cutting of tall trees to harvest fruits (e.g. taun, *Pometia pinnata*).

Then, the establishment of the plot and the proposal to DEC for a Conservation Area came with a new set of rules for the 1,107 ha research area surrounding the 50 ha plot: no bush knives, no cutting of trees or lianas, no gardens, no collecting including firewood, no dogs, no fires, and no houses. A gate fee for visitors was established: 100 *kina* was charged for a single overseas visitor staying less then one week, while up to 500 *kina* was charged for a group staying for more than one week.

Some villagers recalled that scientists suggested the rules and the Conservation Board approved them. Others held the view that scientists alone made the rules. The rules were clear to scientists who had them in writing and discussed them at meetings. By contrast, many villagers were not clear whether the rules applied to the whole conservation area and believed gardens were limited to land in the Forest Management Agreement zone. Some kin feared that men in their lineage would go to jail if they were caught using resources in the conservation area. Many women, who used resources that they believed violated the conservation rules, experienced anxiety but felt they had no option. Many men's understandings of the conservation rules were similar to those of scientists, especially those who worked as research assistants. They focused on how restrictions applied to non- Wanang and compensatory fees associated with violations.

One contentious rule was that of hunting in the research area. Prior to conservation men report, they spent much of their time hunting. Men employed by the scientists spent most of their time in the research area, yet were forbidden from hunting

there. Some men disregarded the rule against bringing hunting dogs into the conservation area and this was one of the few rules that villagers reported as being enforced. One scientist

> killed [a dog]…He forbid …dogs …inside the 50 ha plot ... He killed the dog and if later we still disobey[ed] and forgot, then [he would]… go to the [government] and take [the] man to court, or kill a man, or tell a man to pay him directly. However many times you break the law, you will pay.

Villagers did not take violations seriously unless researchers were present. One man recalled what happened when another man called Alan violated the rules by cutting a liana vine in the research area.

> Alan cut a vine in the research area and everyone knows that he did it. He tried to keep it a secret. [The scientist] knew and radioed [from Nagada to Wanang] and said that [Alan could] never work again… They did not hold court and he did not pay a fine. Later [when Alan] works [again], [Filip] will keep the money.

Villagers knew about rules restricting extraction from the conservation area yet observed researchers collecting leaves and butterflies. They thought scientists should pay for what they took, as well as for their photographs. One villager said:

> We put restrictions on our land and we see that many of our things go out of the conservation area…They are already gone, like our butterflies go, our insects go, our leaves go, everything has … gone. These things--we didn't see [money] for them.

Villagers were frustrated that scientists were not following the rules by not paying the gate fee and still making collections on their land. The rules and their enforcement demonstrated a loss of landowners' control over their land and a power differential.

The conservation restrictions led villagers to use alternate areas. Wanang village is now located on land belonging to two lineages: Pikas Paia hamlet is on land owned by a Wanang lineage and Wanang hamlet is located on land owned by a non-Wanang lineage. Some tension with the non-Wanang lineage has resulted when Wanang people cut down trees to make gardens. There have been compensation demands, but the issue has largely been relieved by cross-cutting kin ties between the groups. Some of the Wanang villagers remain anxious about living on land belonging to others and feel vulnerable. Some fear that they may no longer move back to their customary land in the conservation area, which they want to access so as to maintain ancestral connections.

Equality

Village life is largely egalitarian. Maintaining social relations in harmony is a major value. Filip and BRC have made efforts to prevent inequalities or perceived inequalities such as distributing employment across lineages. However, conservation has created or highlighted disparities. Young people complain they are not heard at

conservation meetings, to which elders respond that they have no voice because they did not contribute. Young people have taken the lead in labor complaints against BRC, which I discuss in the next section.

Although the NGO, the Bismarck-Ramu Group, reported that women were integral to the development of the Conservation Deed, in Wanang they were less influential than were men. Women influence family life but it is rare for a woman to speak out at conservation meetings. As one woman told me, the land belongs to the men and they do what they want and the women go along with them. However, men conceded that, "women do the community work and stand up in the sun. The men stand in the shade." In addition, women's workloads increased when men worked as research assistants outside of the village and were unable to help garden and hunt. Villagers saw that men's labor was clearly rewarded by fortnight pay from BRC, but women's community labor was seen as unrewarded. Some villagers felt their efforts were part of a reciprocal relationship that would be returned in the future while others believe it was reciprocated by the royalty, which might or might not reach women.

Landowners demanded preferential treatment. Simabi people, who resettled in Wanang, did not have customary land in the village environs, so Wanang people expected them to contribute more in the form of community labor, threatening eviction if they did not comply. Scientists saw the Simbai as productive and capable workers. They viewed them as more reliable in research work and also in producing garden food to sell to researchers. To the dismay of customary landowners, researchers assigned more responsibility and higher skilled tasks to the Simbai. Wanang landowners expected that

they should have priority for work on the land they owned and that employment opportunities should be spread among all villagers. This undermined the researchers' interest in developing skilled assistants. Training was a resource they provided to villagers and they wanted to target the best workers. But Wanang challenged them, claiming work must preferentially go to landowners. Simbai people were put under higher community work demands, were treated jealously by landowners, and lived on insecure grounds.

Partnership

Although the partnership between BRC and Wanang was seen as mutually beneficial, we can see that it also gave rise to many disputes. BRC saw the partnership as one of mutual self-interest that should go on as long as both sides benefitted from it. Wanang villagers saw it as mutual obligation that tied them together for the long run. One villager put their mutual self-interest this way:

> BRC [and researchers] make good reports about Wanang to get money from Swire … 50,000 *kina* …goes to the community, but I don't know how much money [they] give to BRC. …Sometimes [BRC] stands up on Wanang to make their proposals. If they don't have a good conservation report, they won't get funding for their proposal.

Indeed, while working in Wanang, BRC published papers in major research journals and became a world-renowned research organization. BRC garnered millions of dollars of

support from many sources. The base station in Madang town built two additional buildings and added three satellite field stations. The staff grew to over 25 full time employees as BRC trained students and parabiologists.

Wanang villagers expected that both groups should benefit and grow at the same rate. Villagers were upset by visible disparities.

> When I was working on the old car, BRC bought a new car and earlier when they were working in Wanang they bought the green and white cars. BRC bought many new cars and Wanang only has this broken car and they won't give us one. This kind of thing will cause conservation to end. [They are] like a developer, who only works for himself. BRC [depends on] Wanang to make a good report… to get funding, but they don't pay the community.

The quality of reports submitted to donors were frequently mentioned by villagers as a consequence of their actions, good or bad. Filip told villagers they needed to do community work or they wouldn't merit a good report. Villagers, he went on, also needed to manage conservation money wisely or they would get a bad report. Lack of change has been seen by villagers as a consequence of reports not reaching the appropriate recipient (see chapter 4). Reports were one of the only ways villagers felt they could have an impact on the project.

They complained about what little control they had on the project. They were not able to set the gate fee. BRC said the village should collect it, but Wanang people

expected that the BRC would do it. As a result, gate fees were rarely collected. The new Chairman wanted to correct this but felt inappropriate soliciting the gate fee from researchers and preferred to wait for visitors to offer. Similarly, when women in the village provided visitors with garden produce, they refused immediate payment but expected reciprocation at some point.

They complained that the Board had no power. When the research activities were moved away from the village to the 50 ha plot, their sense of ownership and involvement suffered. They felt disconnected and powerless, as new researchers would come unannounced and without local consent, going straight to the research area. As a man told me:

> You cannot come for no reason or without introduction. The [leaders] must know first. They must know you and your work and your study first. Now the community is concerned about this. Why do you come and not introduce yourselves?

Labor disputes were also common. Villagers protested that they were not paid enough as cargo carriers or as research assistants. BRC in turn complained that villagers would not show up for work, would fail to do as they were told, and complained too much. Both sides staged strikes against the other. Villagers held labor strikes until they received pay raises, and BRC stopped work to send a message to villagers not to take them for granted. In each case, meetings were held to clear the air and end the strikes.

With no little bitterness, villagers declare that are inadequately paid. Filip voiced this view when he told me that he had

> become a slave for BRC because when the student [researchers] come in I work hard but I don't get anything… I get workers for them and direct everyone for them. I figure out a place for them to sleep and wash and get everything they need for them…I don't get any money. They come and use me and leave, but they don't give me a present. Its like with my father and the Australian government. They made us slaves but not now. If a white man comes here they don't pay me. I only get fortnight and this doesn't cover when [additional] scientists come here. Some year I will just quit this work and some other man can do it because I don't get anything good out of it.

The term "slave" also came up when a representative of the Christianson Fund came to Wanang to check on the project and Filip told her that BRC treated them like slaves. This comment infuriated one scientist, who felt he had worked hard to the benefit of ungrateful villagers. He called upon other villagers to say that they disagreed. A contentious meeting, which I attended, was held in Madang town between BRC and village men to resolve the conflict. BRC scientists and staff threatened villagers that if they really felt "like this, we will leave you." When cornered, villagers did not own up to this claim. Instead, they wanted to continue the project, and blamed the complaint on

women, none of whom were present. BRC expressed no qualms for not paying women to labor for the community's benefit.

The villagers and I returned to Wanang, where I continued to ask about these feelings. Upon learning that I had been asking people about feeling like slaves, Filip became upset with me for continuing to stir up an issue that he thought was resolved.

> You want to know what a slave means and you keep talking about it, but this is finished!... I will tell you what it means. When Australian government came they were always, "Come on, hurry up," pulling people to do things, carry cargo, cut roads, clear areas, just like we do now. [Today] I get messages from [BRC] and I put all the women to work. They do the work because I tell them to, but they don't want to. They do not get paid for this. [BRC] is a developer and all developers must satisfy … the landowners, so just like the logging company gives things, so must [BRC]. [A scientist] made a promise to buy us a vehicle but …it was an empty promise

The issue of women's unrewarded labor was suppressed. There was a follow-up meeting in the village and the villagers presented a pig and garden food to BRC for the grief they caused. Everyone agreed these kinds of complaints should not happen again and shook hands. However, the issue of women being uncompensated for their efforts remained.

Figure 1.12: Wanang villagers present a pig and garden food to BRC to resolve the issue of telling a donor that they were treated like slaves.

The villagers' unceasing complaints, slackening work efforts, and increasing demands frustrated scientists and parabiologists. They were not used to basing their research in a single village for a long period of time and felt they should relocate to where they would be appreciated. When I presented one scientist with the unmet expectations of villagers (see chapter 4), he responded that they also had complaints, which he listed as follows:

1. Villagers do not grow food to sell us
2. Villagers do not respect the ban on hunting in the research area

3. Villagers complain about our failure to meet unrealistic expectations beyond the scope of the project
4. Villagers continue to depend on BRC for community organization, initiative, and events
5. Villagers fail to provide adequate hospitality to visitors to the conservation area, which could be a potential source of benefit, independent of BRC

The tenuous nature of the project questions its long-term sustainability, which was a concern within the conservation project. In 2008, one scientist described the project as,

> something that can sustain [Wanang] community for generations to come. There's a direct investment in the local people and in preserving their forests through this research opportunity.

Scientists acknowledged that the project needed continuing support and hoped that the donors would be part of that support. Unfortunately, corporate donors did not want to continue funding the project indefinitely and expected the research station to become a source of sustainable development for the village by mobilizing additional sources of funding that would relieve them of further responsibility. Scientist were disappointed when Swire announced that they expected the project should be self-sustaining after five years. For his part, Filip was familiar with the notion of sustainability

> Sustainable means a little bit of something will come and stay for a long time. An important part of sustainability is that it won't be big, but it will last for a long time, like 1-2 *kina*. To be sustainable, [the project] can only become a little larger for the fathers and the children. The school is here now, we must get [a]… car too. It can come slowly and a little at a time. Sustainable means we pass [the project] on to our grandchildren and down to their grandchildren and their grandchildren. Sustainable is different than the royalties which are a big thing but only exist until 2015. The sustainable part is the money that comes from scientists each year and continues to come. They hire carriers and assistants. They buy things from the women. That is sustainable. People can continue to use the forest. The car is part of this, so they can go to the market and sell things.

Indeed, everyone involved wanted the project to be sustainable, but there was disagreement over what that meant. Different understandings were common through the project yet commitment, perseverance, and flexibility have kept the project going.

Conclusion

Wanang chose to conserve their land because they thought it would change their way of life and provide development. They entered into an exchange relationship with scientists contributing labor, land, and gifts of pig and garden food. In turn, the scientists have provided benefits, such as employment, the school, and royalty payments, yet complaints abound. Villagers complain about inequalities among villagers and between villagers and scientists, while scientists complain about villagers' unreasonable

expectations. Neither party is perfectly satisfied with the project, yet the relationship continues with exchanges, demands, and complaints. Villagers continue to participate out of moral obligation and hope that the development they desire will be produced. Scientists are dedicated to creating a successful research station and long term research plot. And so the project continues amidst tension.

Chapter 2: Much more than biodiversity protection: The meanings of rainforest conservation among the people of Wanang, Papua New Guinea

Summary

Community-based conservation projects adapt to local context in order to have more fair and successful results. Projects with superficial understandings of local interests may function at first, but will be unlikely to persist as conservation institutions challenge local customs. Local perspectives can be broad and complicated necessitating a biocultural approach to conservation. I explicitly examine the local narratives of the Wanang Conservation project in Papua New Guinea to gain an in-depth understanding of local interests. I identify the five prominent narratives used by Wanang villagers to talk about Wanang Conservation. Villagers discussed the project in terms of inherited ancestral resources, material benefits, exchange relations, political leadership, and a connection to ancestors. Narratives are easily misinterpreted, often used concurrently, and are best understood in their cultural context. The diversity of local interests in Wanang Conservation highlights the importance of the biocultural approach to conservation to ensure local interests are not alienated. Projects that focus exclusively on the intersection of Western and Melanesian narratives, such as material benefits, risk losing local support.

Community-based, Biocultural Conservation

Community support is not necessary for successful conservation of biodiversity, but community support is necessary if conservation is to be fair, just, and inclusive (Brockington 2004). Community-based conservation efforts are designed to achieve conservation goals by working at the local level. By incorporating local views and

interests, community-based conservation aims to merge conservation and development to achieve both simultaneously (Western et al. 1994). Indeed, systematic review of community-based conservation projects found that interventions supported by, and engaged with, local culture and institutions have more successful results, in terms of attitude, behavior, economics, and ecology (Waylan et al. 2010). Unfortunately, even projects that aim to fit local needs can have a weak grounding in local interests. West (2006) described the Crater Mountain Conservation Project in Papua New Guinea, which intended to meet local development interests, but failed due to incomplete understanding of local cultural context. This paper examines local meanings of the Wanang Conservation project to understand local interests and how they are expressed.

This disconnect between biodiversity conservation efforts and local culture has led some conservation groups to recognize the importance of biocultural diversity, or the interrelated and interdependent nature of biodiversity and culture (Maffi 2014, MEA 2005, Pretty et al. 2009). This recognition has developed into a biocultural approach to conservation integrating the maintenance and revitalization of biodiversity, local cultures and languages (Maffi 2014). One essential feature of this approach is clarifying "a community's values, goals, and assets and on that basis determining the community's own endogenous development path and rules of engagement with outsiders"(Maffi and Woodley 2014). To this end it is necessary for conservation projects to recognize and build on local interests in conservation.

Berkes' (2004) call to rethink community-based conservation stressed the need to recognize complex local points of view. Indeed, the term "community" may conceal the

intricacies of a specific group. Teasing apart the various interests, actors, and institutions within that "community" will lead to more constructive conservation efforts (Agrawal and Gibson 1999). Initial local enthusiasm for a conservation project may eclipse disparate interests between conservationists and locals or among locals, that inevitably come to light when project limitations and local complications are realized (Van Helden 2001, 2005). For example, initially the Cofan people's interests aligned with those of conservationists, but the institutional arrangements of the conservation project in Equador were not compatible with local practices and led to conflict (Cepak 2012).

The necessary awareness of the diversity of local interests can be gained through attention to different narratives of conservation issues. Bixler (2013) adopts this methodology in a study of mountain caribou conservation in British Columbia in which multiple discourses reveal rival interests and understandings of the environment, which lead to alternate preferences. Moreover, Bixler found that individuals might use more than one narrative, complicating their interests.

In this paper, I examine the main narratives that Wanang villagers in Madang Province, Papua New Guinea use to talk about Wanang Conservation. Although conservationists involved in Wanang Conservation predominantly talk about Wanang Conservation in terms of the economic benefits it provides, I will argue that, in addition to a material benefits narrative, there are four other narratives that Wanang villagers often use to talk about the Wanang Conservation project. I will discuss how villagers use different narratives, as well as complications that can arise when conservationists misunderstand them. The diversity of local interests in Wanang Conservation highlight

the importance of the biocultural approach to conservation to ensure local interests are not alienated.

Study site

In 2010, approximately 250 residents of Wanang village were living in the lowland rainforest in the middle Ramu River basin in Madang province, Papua New Guinea (Figure 2.1). The village is 80 km west of the nearest town, Madang, and until recently could not be accessed by road, leaving the residents without government services and very limited market access. The Wanang vernacular is called Maghu. It is a dialect of Aisi in the Sogerum language group (Daniels 2010). In addition, most villagers speak Melanesian Pidgin or *Tok Pisin*, the trade language, and children use it as their dominant language. Although the vernacular is exclusively oral, there is a minority of literate villagers who have learned to read and write *Tok Pisin* and/or English. Residents practice subsistence slash and burn gardening, growing banana, taro, yam and other crops while hunting and gathering to obtain protein from the forest. Men and women subscribe to a sexual division of labor to provide for their families. Men clear forest for gardens, build houses, and hunt while women plant and harvest gardens, prepare food, care for children, and gather from the forest.

The population density is very low with 5.2 people per square kilometer (NRI 2010) leaving large swathes of land under the control of villagers. The land is held under customary landownership ensured by the PNG constitution, which prohibits official sale and purchase. Patrilineages pass customary land from father to sons, while women have land use rights on their husband's land. Land use rights are based on past use and recall

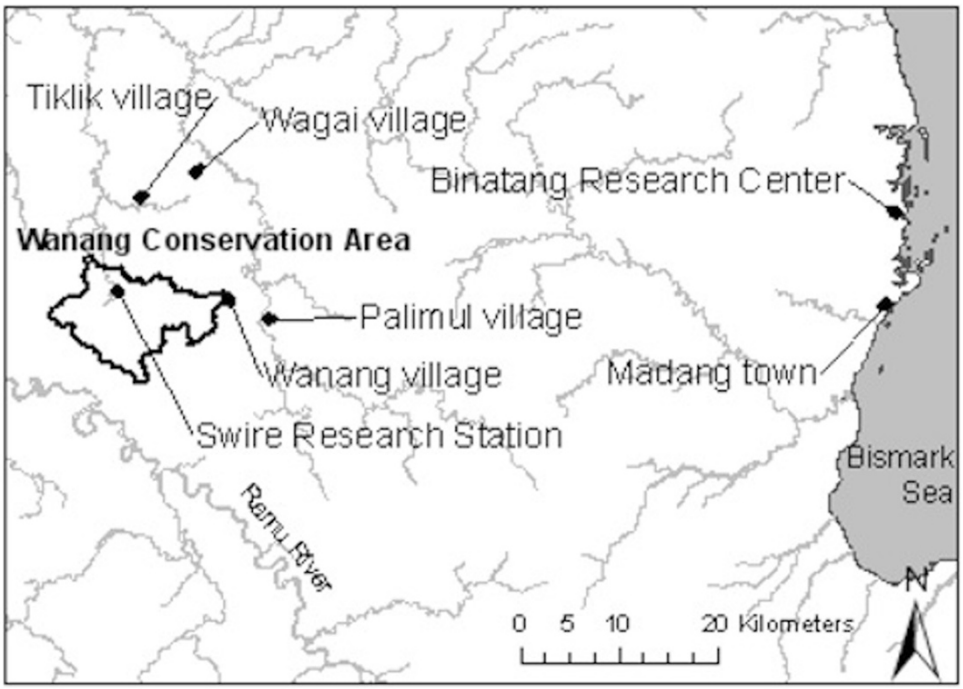

Figure 2.1: Map of area of study in Madang province indicating Wanang Conservation in black outline and the location of Swire Research Station, nearby villages, and New Guinea Binatang Research Center in Nagada Harbor.

of past migrations and marriages. Traditional decision-making is based on group consensus with villagers assembling to voice opinions in lengthy discussions. There is limited formal leadership, but rather big men exercise influence through social relationships and lead community decisions and group exchanges.

The Wanang villagers originally settled in their current location in the mid-1990's when a road was to connect their customary lands to Madang town. The road was never completed, but the community remained in the new location, living in dispersed hamlets. The area has been outside the reach of government services, such as education, medical care, and transportation, until the recent arrival of loggers and conservationists in the early 2000's.

In 1999, the Middle Ramu, including Wanang village, was proposed as a 158,000 hectare logging concession by the PNG Forestry Authority, which permits industrial logging company activities contingent upon landowner approval (PNGFA 2007). While logging interests were pursuing landowners consent, Bismark Ramu Group, an environmental and community empowerment non-governmental organization, was educating landowners on the economic and environmental impacts of logging using stories, posters, and theatrical performances. In contrast, landowners surrounding Wanang accepted cash bonuses and promises of community development, such as roads and schools, when they signed logging agreements. However, eleven Wanang lineages declined to consent to industrial logging and in 2000 signed a deed among themselves, with the help of Bismark Ramu Group, that prohibited industrial logging on their customary land (Van Helden 2001, appendix 3). The deed did not include any type of economic development or incentives. The leader of this faction sought out international biologists, then based in Madang, and invited them to work in Wanang. From 2001 to 2008, biologists associated with the Binatang Research Center (BRC) and their parabiologist assistants, repeatedly visited Wanang to conduct short-term research projects.

In 2008, biologists and villagers planned a 50-hectare long-term research plot, a permanent fully equipped field research station, and a 10,000 ha conservation area surrounding the plot that would sustain research and associated benefits in the area. The biologists garnered support for the project from government grants, corporate donors, and non-governmental organizations, such as World Wildlife Fund, Seacology, and The

Christensen Fund. Through combined support, villagers were provided with annual royalty payments, increased employment, and the first elementary school in the area, in addition to limited transportation and medical assistance.

Methods

I spent ten months from 2010 to 2012 conducting ethnographic research with villagers and conservationists in and around Binatang Research Center, Madang town, Wanang village, and the Wanang forest. I held semi-structured interviews and did ethnobiology surveys, but I primarily engaged in participant observation with villagers and conservationists during their daily activities, casually observing and discussing topics that arose. My interactions with villagers were conducted in *Tok Pisin*. My interactions with BRC were conducted in English and *Tok pisin*. This group consisted of graduate students and parataxonomists, as well as international biologists whom I largely focus on and refer to as conservationists. Interviews were audio recorded, translated, and transcribed. I used discourse analysis of interviews, documents, and field notes to identify narratives about conservation that were used by villagers. Names of some villagers have been changed to protect their identities.

Narratives of Wanang Conservation

I identified five major narratives in Wanang Conservation discourse: protection of ancestral resources, connection to ancestors, material benefits, exchange relations, and political leadership. Some villagers utilized to all five narratives while other villagers employed fewer. Below I describe each narrative and discuss their uses.

Conservation as Protection of Inherited Ancestral Resources

One way villagers discuss conservation in Wanang is in terms of inherited ancestral resources. The forest, which was passed on from the previous generation, provides the current generation with the resources they rely on. Villagers charged that logging degrades the comfortable forest microclimate, fish and game populations, edible vegetation, medicinal plants and is harmful to villagers' health. One man explained that protecting his land, which he received from his ancestors, was the reason that he would not allow industrial logging on his property,

> [Logging companies] damage the good land where you hunt pig or where your forest spirits stay, they ruin the good drinking water. Where will you plant food? In what forest? All of your forest is damaged by the [logging] machines already.

Villagers talked about logging damage they had observed firsthand in nearby areas. One man, who had hunted with his dogs in logged areas with an abundance of downed trees as compared to the relatively open understory in the unlogged forest, concluded that conservation was better for the hunting dogs.

Villagers also saw the importance of conserving their ancestral resources for future generations. One man imagined what would happen,

> The [logging] company will come and damage all of this, and after the children grow up they will ask us, 'Papa where are the cassowaries? We don't know the cassowary.' They will say, 'We don't know the cassowary. We don't know the

> hornbills. We don't know the pig. We don't know all kinds of animals and forest and the names of the big trees. Where are all these trees?' And we will say, 'Oh sorry children, the company came before you. They came and damaged the forest and took all the trees and its gone now.' They won't know the names of the trees or the animals or the birds.

Passing knowledge about forests on to the next generation is important to landowners and underscores the social basis of the resource.

Another component of the ancestral resource is social history. One woman explained that in logged areas, "It is hard to find old paths to walk on. Whoever used to walk on them, our ancestors and fathers, now [are] changed." Kinship and history crisscross the landscape and stories are often sited in specific places and landmarks. Encountering an area while walking in the forest often triggers the memory of ancestral forest spirits, which are part of the landscape. Access to these places and spirits is important for villagers, who rely on their cooperation to make them successful hunters. They fear forest spirits will abandon areas if they are disturbed by logging, causing villagers to lose access to their ancestral support until it is rediscovered in another location.

Many responses to questions about what conservation meant, started with the same adage, "Take care of the forest, land, and water" (*Lukautim bus, graun, wara).* This phrase was frequently used by the Bismark Ramu Group and has stuck with the villagers as the way they should think about conservation. Indeed, this narrative most closely

resembles a Western conservation narrative, but the ancestral history of the resource is imperative.

Conservation protects the resources ancestors have passed on to Wanang and that they will pass on to the next generation. These resources are essential for everyday needs but also serve as a record of social history. This narrative most resembles Western conservation narratives of preserving natural resources for the future, which may enable conservationists and villagers to relate to one another by using superficially similar narratives. Indeed, the ancestral resource narrative was frequently used when outsiders, such as donors, conservationists, or others interested in conservation, asked villagers about conservation. The exclusive use of this narrative limits outsiders' perceptions of villagers' interests.

Material Benefits of Conservation

Another conservation narrative concerns material benefits. The material benefits from Wanang Conservation are noteworthy to villagers for the amount of benefit received and also for the duration of the benefit provisioning. Villagers readily talk about the benefits of employment, royalty payments, the school, transportation, and medical assistance. Being a field research assistant or cargo carrier is seen as one of the most important opportunities created by conservation. One woman was enthusiastic about access to the market, which conservation has provided,

> Before we had nothing and we only ate garden food. We had no knives. We used bamboo and fire for light. Now I get money for carrying and my husband works for conservation, so we can buy things.

Another man expressed similar views of the material benefits afforded by conservation in Wanang.

> We now eat rice but before we didn't usually eat rice. … Before conservation, a man would rarely capture a young cassowary and sell it to buy soap, salt, kerosene, but only rarely. …Before we didn't have batteries, we didn't have money to buy batteries, so we now have conservation and they help us … We have a good life and are happy. Many things have happened ... We get royalty. We have a car and can go to town. We have … money… enough to pay for the ride [to town] and buy things and come back. We didn't have education and now the school has come here and we are happy that our children can go to school.

Villagers attribute their new access to material goods and education to the conservation project.

In articulating the material benefits of conservation, villagers highlight the length of time that benefits continue. When compared to the one-time windfall of money from logging, the initial material benefits of conservation may seem meager but they continue to flow into the village. As one man put it,

> When logging comes [the landowners] get big money, but only [then]. [The logging company] gives money to the landowner, then they cut the trees, take the timber and go. Later when [the company] leaves, the landowners remain. Poor men, they don't have money.

Obligation to kin and the lack of investment and banking options means that large sums of money from logging do not last long or result in the types of services desired. Furthermore, it is difficult to maintain services that are provided by conservation or logging without outside support. For example, roads and schools need continuous maintenance. One man emphasized the importance of the long-term provisioning of conservation benefits,

> When logging comes and takes the trees, … they pay the landowners or give them cars and later they make a road and they get the trees, then it is finished. They take everything and its over. If the bridge breaks or the road is damaged, it's still finished. This is bad. They get big or little money but it still runs out… On the side of conservation, [villagers] get a little money, not a lot, but this doesn't end… [Conservationists] give just 10,000 kina or 20,000 kina each year. They funded a school and [villagers] can work as carriers … [Conservation] is still here and its not like [logging] where there are workers, but after the trees are all cut they don't have work and they do nothing. BRC and conservation are still here

> and they pay [landowners], the carriers get paid, and after the parents die, the later generations will still be here [with conservation] because conservation is good.

Villagers described receiving less money in conservation and, though they sometimes complained, were pleased with conservation compared to logging because conservationists continued to work with them.

In this second narrative, conservation is expressed as a source of material benefits. Wanang villagers stress the access to commodities and education, which they contrast to logging. This narrative is frequently used by villagers when discussing the conservation project among themselves and in negotiations with conservationists. It is regularly employed when villagers are being critical or appreciative of the conservation project.

Conservation as an Exchange Relationship

In Melanesian societies, exchange relationships are an important moral concern and a source of one's identity (Strathern 1988). Although these exchange relationships provide material benefits, the relationships are valuable in their own right (Gregory 1982). Wanang villagers seek to expand their social network and talk about conservationists as new exchange partners, who reciprocate gifts to create and maintain relationships. This give and take is referred to as *hamamasim,* or pleasing the recipient. One villager explained that the conservation royalties are given to them because the conservation organization "is pleased, they want to make us happy and they give us the royalty." When I asked one man to explain how the royalty was meant "to please the landowner," he imagined the following scenario in terms of exchange:

> I will be happy if you give me something, I will look after you and whatever you need for food and other things like meat, and you will give me something back, when you want to leave, you will be happy that I had good behavior towards you. I looked after you, so now you will pay me back, make me happy, give me clothes or money or something like that, a headlamp, that is pleasing.

Conservationists are seen in the same light as kin. Conservationists, like kin, are expected to provide material support to maintain their relationship. One villager explained the obligation of their relationship using kin terms, "You cannot leave us. You are like our father. We work together and both get money. If you leave us, where will you go?" Conservation, like kinship, is described as a long-term obligatory relationship.

Villagers give pigs to conservationists to mark the achievements and milestones of their partnership. As one villager said, "We bought a pig for them, and they bought a pig to give us. Its this kind of life." This exchange is similar in nature to ceremonial exchange that the Wanang stage to celebrate milestones like marriage and childbirth, to bond two groups together. Exchange maintains relationships, as well as resolves conflicts. Following one dispute between villagers and conservationists, villagers presented conservationists with a pig and garden vegetables to reaffirm their bond.

Conservationists have become integrated into the Wanang social network through exchange, and they are also expected to contribute to their partners' other exchange obligations. Several years prior to the onset of my research, a fight broke out in Wanang

between a villager and a man from a neighboring village. Still aggrieved, the outsider demanded compensation from the villager, who had become ill. If the villager did not comply with the neighboring man's demands, it was feared he might die, his rival reputedly being a dangerous and powerful sorcerer. The ill villager radioed the conservationists in town, and asked them to help pay his adversary, as he felt the conservationists were part of his social network due to their bond of conservation.

Villagers explain the conservation project as an exchange relationship they participate in with conservationists. As exchange is central to all relationships in Melanesian societies (Strathern 1988), much of this narrative is not explicitly stated, but exchange obligations are implicit in villagers' actions and expectations. This narrative is regularly used when villagers explain the motives of conservationists as well as when they express dissatisfaction with conservationists' reciprocity.

Conservation and Political Leadership

Villagers also talk about the conservation project in terms of political leadership and power. Power in Wanang is acquired through exchange relations. Men who have the largest and strongest exchange network have the most influence. Conservationists are valued as exchange partners, as they potentially link local leadership to the global community and grant them access to wealth and influence outside the village.

Filip Damen, who served as the conservation project manager, spoke with conservationists more often and more in-depth, which contributed to his extensive exchange network. Conservationists communicated with him via the radio, which he controlled and operated requiring other villagers to relay their messages through him.

Unlike other villagers, he traveled overseas with conservationists and stayed with them at the base station 100 km away on the coast more often than other villagers. He guarded this relationship against other villagers. For example, he viewed schoolteachers as a threat and made efforts to obstruct their relationships with conservationists. Teachers were paid with conservation funds, for which Filip served as middleman, but occasional conflicts caused teachers to seek out the conservationists directly. At one poignant community meeting, the teachers were chastised for going to the base station for their pay which Filip was withholding, becasuse the school is part of Wanang Conservation, not BRC.

While teachers challenged Filip's role, other villagers respected and obeyed him. He was largely given full credit for bringing conservation and its benefits to the community. One man explained Filip's role in starting conservation,

> Filip sat down and assessed [conservation] and he went to Nagada and met [BRC]. There wasn't a man that took him there. It was his idea and he wanted to go and find them… There wasn't another man that helped him to go there. When he went and saw them and then came back to the community, he brought the community to a meeting and he told us about [conservation]. The community got this idea from our leader.

Filip's role in establishing Wanang Conservation afforded him great influence over the project and the benefits that flowed from it. For example, he designated which men were

hired to work on research projects. This control raised suspicions and led to complaints about concentration of power. Young men in particular expressed feelings of powerlessness from not being heard by elder men.

In response to villagers concerns, conservationists created additional leadership positions and tried to strengthen their relationships with other villagers to disperse power. They bought cell phones for villagers newly appointed to conservation leadership positions to enable communication, as the radio had become a source of contention because of Filip's control over it. Filip's own view was as follows,

> There were many complaints. [Villagers said I] had too many positions. So they said they want … to have a position, so I gave up my position for them. BRC was not in agreement that I left the Chairman seat, but I myself didn't want to hear any more complaints, so I gave it up for [the villagers]. I will let them try to get the seat and try to run it, but they won't be able to change anything about conservation. I am giving them a try. If they change something or not, it is in their hands. I do not hold the Chairman seat anymore.

Another villager, who was selected by a board of villagers and the conservationists for the open Chairman position, still looked to the leader to give him power. He acted with restraint because, he said, the leader had not told him what to do.

> [Filip would say], 'Just now I have gotten the power and given it to you, it's wrong for you to bypass me.' So that is why I didn't do anything.

Conservation is a new political resource with which this man was unfamiliar since previously he would have earned power through exchange, not appointment. Filip refused to advise him, claiming that no one taught him how to manage conservation, so he had to teach himself. Of course in Filip's view, "If the seat was still in my hands, then plenty more support would come." Conservation management at the local-level had become a center of political activity. The success of conservation was not the ultimate goal in village-level power struggles; rather it was measured as an achievement.

Furthermore, Wanang Conservation also influenced villagers' political leadership beyond the village level. Two men from Wanang ran for ward level government positions: president and councilor. They ran on the community conservation platform by publicizing the benefits they have brought to Wanang. One Wanang man was elected councilor. Wanang Conservation had increased their prestige and standing in Wanang as well as the wider region.

Discourse of power and conservation was not just about intra and inter-village rivalries but also between villagers and conservationists. Villagers owned the land and controlled access to it, but the conservationists continued to administer and manage the financial accounts. Villagers complained about this and were suspicious about how the funds were being managed and who might have access to them. In addition, the newly appointed Chairman looked to conservationists to instruct him on how to exercise his

new authority, and the men who ran for public office also looked to conservationists for approval prior to running. As conservation became a new center of political activity, some men felt uncertain, as they were unfamiliar with Western business practices that had become a large part of political leadership.

Wanang Conservation was talked about as an arena in which to gain and exercise power. Villagers with close relationships with conservationists had more influence and these relationships were pursued. His strong relationships with conservationists enabled Filip to have a monopoly of power, yet conservationists had the power to redistribute village leadership positions. Villagers were unsatisfied with the degree of control conservationists held over the project and their land.

Conservation as a Connection to Ancestors

Whereas the ancestral resource narrative described the importance of resources inherited from ancestors, there is also a narrative about conservation as a direct exchange with ancestors. Villagers talked about conservation as a connection to the world of the dead, a parallel world to that of the living (Burridge 1960, Lawrence 1964, Worsley 1968). The world of the dead is a place full of wealth where ancestors reside. The living and the dead are capable of having exchange relationships just as in the world of the living. Conservation is seen as part of this exchange between Wanang villagers and their dead ancestors. Ancestors are believed to be responsible for bringing conservation to Wanang. As one man said he had a premonition in,

> a dream before the project ever started that something big would happen. My ancestor told me I had to give [him] a white pig and money, so I buried [it] … He knew I did it and the ancestor made it happen. A strong ancestor can bring white men in.

Persuaded by this man's vision, others worked to help this exchange and were now waiting for the return,

> We did big work before we … saw the faces of conservationists. We listened to what [the man who had the dream] said and started … clearing the community area…Now [after] we did this work, … we wait for the money to come.

The villagers fulfilled what the ancestor had asked of them and were prepared for the ancestor to reciprocate with the benefits they expected.

The ancestors brought conservation to Wanang, they could also create havoc if they were not pleased. One ancestor was believed to have sent snakes to bite the workers while they were building the research station. A ceremony was held and gifts were presented to the ancestor, which allowed conservation activities to continue.

In addition to bringing conservation to Wanang, ancestors themselves are believed to be able to return to Wanang in the form of conservationists. One man recalled how he knew conservationists were only men,

> At first, people in Palimul [village] said [a conservationist] was my dead father, who had come back to help me because he was short and fat like him. Then they said [another conservationist] was my dead brother. But I told them this wasn't true because they had come from somewhere else where they have families and they had only come to work.

Although this man was skeptical of particular conservationists being ancestors, he did not deny the possibility that ancestors could return to Wanang via this route. Another informant also told me that rumors circulated among villagers that I was,

> an ancestor because you follow PNG customs. You carry firewood and cook for me when I am hungry and give me things. [They expect] other ancestors will also come and they will be mixed in with white men. You cannot tell who they are because their faces have changed but they know you. If you go with a white man to the river and he asks you about your family and how many children you have, then you know he is an ancestor because white men don't worry about those things, and they are trying to decide if you are their ancestor…If the project ends, the white men and the ancestors will not have a way to come here anymore.

This informant describes conservation as a connection to ancestors and the world of the dead.

The fifth narrative expresses conservation as a connection to ancestors. Ancestors are responsible for bringing conservation to Wanang and may also return to Wanang through the conservation project. Discussing exchange with the world of the dead has become stigmatized due to past suppressions of cargo cult activity (Lattas 2007). Therefore, this narrative is used infrequently, yet this belief may underlie more conservation activities than it appears.

Conclusion

Coexisting and Competing Narratives

There are multiple narratives in which villagers talk about Wanang Conservation, indicating that conservation in Wanang means more than protection of biodiversity. It is also more than an economic transaction, as in much of Western conservation discourse. Indeed, conservation has penetrated all aspects of Wanang life: social, political, and economic. Some narratives are evident while others are understated. For example, ancestral resources and material benefits narratives are openly used, while the connection to ancestors is concealed from outsiders. Use of narratives is guided by social roles. For example, men, who are responsible for the political domain, frequently use the political leadership and exchange narratives, while women, who have domestic roles, predominantly use the ancestral resource and material benefit narratives.

Narratives are also used strategically. Nearing the end of my stay in Wanang, a group of villagers asked if I would assist in creating a booklet to provide visitors with information about Wanang Conservation. When I met with villagers to discuss what information they wanted in the booklet, they consistently used the ancestral resource

narrative, such as “Take care of the forest, land, and water” and “For our grandchildren and their children.” In discussing the limited way villagers were portraying conservation with one man, he explained that,

> You must have a good story for the white men because they ask plenty of questions. You must know what kind of stories [they like], like you cannot talk about money.

He thought the ancestral resource narrative was the best for talking to conservationists. This viewpoint may derive from villagers’ first experiences with the Bismark Ramu Group who emphasized community empowerment and self-reliance and rejected potential material benefits of conservation (Anderson 2005). Through subsequent experiences with Western conservationists, villagers have learned that conservationists respond well to the ancestral resources narrative.

Narratives must be understood in terms of the culture in which they are used. Indeed, conservationists and villagers have understood narratives differently. The material benefit, exchange relation, political leadership, and ancestor connection narratives all contain aspects of material benefits and can easily be misinterpreted as simply about material benefits from a Western perspective. For example, a villager’s request for conservationists to provide greater material benefit may be an expression of an unreciprocated exchange relationship, an exercise of political power, a request to an ancestor, a communication of a material need, or all four. Milne and Adams (2012) describe a similar misinterpretation in a conservation project in Cambodia, where

villagers received payments for ecosystem services. Conservationists imagined the project as a market transaction, but to villagers it did not resemble that type of arrangement. The biocultural approach to conservation can build more genuine understanding and agreements between conservationists and villagers (Maffi and Woodley 2014).

Failure to understand cultural narratives of conservation projects may lead to conflict and potentially end projects. This is what Goldman (2011) calls a "conservation opportunity lost," or an area that initially held local support for conservation but lost it due to practices unsuitable in the particular context. For example, the Maasai, who were initially supportive of the Ngorongoro Conservation Area in Tanzania, began to resent and resist it after discovering that there had been a misunderstanding about who had ownership and control of the project (Goldman 2011, Temudo 2012). Likewise, Roberts et al. (1995) argue Western conservationists' failure to understand the Maori's conservation motivations has limited their work in New Zealand. Wanang villagers and conservationists have indeed had their share of misinterpretations and conflict as the result of different understandings of the project. For example, conservationists were unaware that they are perceived as a connection to ancestors. Also, when villagers gave conservationists a pig they were disappointed they did not receive a reciprocal gift. Furthermore, conservationists, imagining that villagers' main interest lies in material benefits, place restrictions on certain land uses in exchange for material benefit. This appears to be a win-win if one focuses only on the material benefit narrative, but concern about accessing ancestral resources significantly complicates the situation.

Yet different understandings of the conservation project do not necessarily preclude success. Tsing (2005) argues that understanding environmental issues differently allowed environmentalists, nature lovers, and locals in Indonesia to work together against logging. Conservationists and villagers in Wanang have also been able to work through their differences. Conservationists have come to use their economic benefit narrative to appeal to Wanang villagers and to explain the project to outsiders (Novotny 2010). The appeal of this narrative to villagers is not surprising as it relates not just to material benefits, but also to their interest in exchange relations, political leadership, and connections to ancestors. Despite these different understandings and occasional conflicts that result, the relationship has been fruitful to date. Furthermore, ongoing interaction allows villagers and conservationists to build common ground and learn from one another (Chernala 2014).

Long-term success of conservation in Wanang is uncertain, and will depend on villagers and conservationists' ability to continue working through differences and gaining better understandings of one another's interests. Wanang Conservation and other cross-cultural projects demonstrate the complexity of conservation interests and the need to explicitly examine conservation perspectives. More sophisticated approaches to conservation incorporating the full complexity of social-ecological systems are necessary (Berkes 2004). The biocultural approach to conservation is a promising direction for conservation to engage locals in a fair, just, and inclusive manor.

Chapter 3: Ecosystem service bundling: an interdisciplinary examination of forest carbon storage and local forest benefits in Papua New Guinea

Summary

Concern about climate change has increased interest in tropical forests for carbon storage, but forests also provide important ecosystem services for local people. It is imperative for landowners making land management decisions to understand the co-occurance of ecosystem services and tradeoffs inherent in their decisions. This study used interdisciplinary methods incorporating anthropology and botany to examine the alignment of carbon storage and subsistence benefits of hunting success, plant use, and religious practices in the lowland rainforest of Papua New Guinea. Local forest benefits that are used in high quantities were compared to those extracted in low quantities or not at all. Local benefits, which require little to no extraction, like medicine, tools, and forest spirits, occurred more in mature forest that also had high carbon storage. Food sources such as plants, pig, wallaby, and cuscus were also more abundant in mature forests. Fuel sources were more abundant in recently disturbed forests with lower carbon storage. This newly identified ecosystem service bundle of carbon storage, game species, useful plants, and forest spirits, will be useful to landowners making land management decisions.

Introduction

The environment contributes to human well-being through multiple ecosystem services, for example, provisioning services such as food production, cultural services like spiritual connection, and supporting services as climate regulation (Millennium

Ecosystem Assessment 2005). Climate change has greatly increased awareness of one particular ecosystem service, carbon storage, and led to efforts to maintain this service by reducing carbon emissions from deforestation and degradation (i.e. REDD). These efforts give preference to promoting high carbon forest over low carbon forests. High carbon tropical forests are frequently old growth, primary forests that tend to have high biodiversity, slow growth rates, and low turnover (Pregitzer and Euskirchen 2004). However, secondary forest restoration and monoculture cultivation can capture large amounts of carbon (Stickler et al. 2009). Concern that REDD implementation could create perverse incentives to develop monocultures that would replace natural systems led the United Nations to revise the policy to incorporate concern for biodiversity, sustainable development, and other ecosystem services (i.e. REDD+, Phelps et al. 2012, UNFCCC 2010).

The recognition of the importance of ecosystem services is vital to the 1.6 billion people around the world who are directly dependent on forests to some extent (Chao 2012). People have been living in and around forests for millennia, creating mosaics of forest types that vary in age and composition (Filer et al. 2009). Following intensive human use, forests follow a general pattern of forest succession originating with common, fast-growing, pioneer species transitioning to more rare, slow growing, large tree species with high species diversity, while forests under less intensive human use maintain these mature forest characteristics (Whitfeld 2011). These domestic forests meet human needs through ecosystem services according to their stage of forest succession and how they are used (Michon et al. 2007). Ecosystem services research has

endeavored to understand variation in ecosystem services between places and across scales. In many cases, the land management preferences of local people are not aligned with those of the global community (Mustalahti et al. 2012, Smith and Scherr 2002, van Noordwijk et al. 2008, Zia et al. 2011). Recent efforts have aimed to identify ecosystem services that co-occur, or bundle, creating win-win situations and those that involve tradeoffs leading to hard choices (Daily et al. 2009, Paterson and Bryan 2012, Raudsepp-Hearne et al. 2010). This study aims to improve the understanding of the alignment of local forest benefits and globally beneficial carbon storage.

The relationship between forest carbon storage and local benefits is very important in Papua New Guinea (PNG), a United Nations REDD+ pilot nation with a largely forest dependent population. New Guinea forests consist of expansive tropical forest area making it important in the global carbon cycle (Brooks et al. 2006). With 97% of the land under customary land ownership, land management decisions are largely influenced by traditional landowning kin-groups or clans (Keppel et al. 2012, Melick et al. 2012).

The people of Wanang in PNG have prevented industrial logging on their land, in part due to their concern about ecosystem services (see chapter 2). These people have expressed interest in ecosystem services differentially provided by their conservation area and the surrounding logging area. Clarification of the relationship may assist Wanang in the future, as they navigate the domain of payments for ecosystem services and REDD+.

Local forest benefits are indispensable to such subsistence communities, whereas forest carbon storage confers a global benefit of climate change mitigation. It is necessary

to understand which benefits co-occur and which have tradeoffs. In a study of 80 forest commons around the world, Chhatre and Agrawal (2009) found no correlation between forest carbon and local forest benefits. However, other studies have found complementarity of high carbon storage and various local forest benefits (Anyinam 1995, Menton 2003), while others have found tradeoffs (Lawrence et al. 2002, Parry et al. 2009, Voeks 1996, Wilkie and Finn 1990). Discrepancies in the complementarity of forest carbon and local forest benefits may be due to the complexity of forest use. For example, in the Amazon although there was no difference in the percent of useful plants among forests of varying ages, different forest ages provided distinct types of benefits (Phillips et al. 1994).

Local forest benefits are multidimensional as they take many forms such as food, medicine, material goods or religious practices derived from resources such as plants, animals, or sacred places. Many ethnobiological studies have examined how forest-dependent people use and relate to the forest. These studies often focus on a narrow range of benefits such as marketable plants (Lawrence et al. 2002), plant biomass (Chhartre and Agrawal 2009), medicinal plants (Voeks 1996), game (Wilkie and Finn 1990), or sacred groves (Gadgil and Vartak 1976). Selection and measurement of benefits may influence the relationship found between local benefits and forest carbon. For example, timber use may compromise forest carbon storage, while medicinal plant extraction may not. It is critical to consider the range of benefits important in an area to inform land management decisions. The Wanang expressed interest in services such as hunted game, medicinal plants, food plants, forest spirits as well as water quality. The integration of dissimilar

benefits in a single ecosystem service analysis requires interdisciplinary methods, as benefits as disparate as food and spirituality cannot be assessed with the same metrics.

Cultural services, such as religious and aesthetic values, are frequently excluded from analyses of land management decisions because biophysical services are much more readily quantified (Vejre et al. 2010). However, cultural services in Western countries, such as deer hunting, tourism, and nature appreciation, have been assessed quantitatively (e.g. Raudsepp-Hearne et al. 2010). Yet there has been debate surrounding whether or not many cultural values can be attributed to ecological structures (Daniel et al. 2012a, Daniel et al. 2012b, Kirchhoff 2012). Anthropologists are uniquely suited to study cultural significance of ecosystems, but their field methods and theoretical frameworks do not lend themselves to simplification of this significance to quantities comparable within the ecosystem service framework. However, our understanding can benefit if the anthropological and ecosystem service approaches can be bridged.

Ecosystem services are classified into provisioning, cultural, and supporting categories by the Millennium Ecosystem Assessment. However, subsistence societies experience significant overlap among these categories. For example, within Melanesian society provisioning services, such as food and medicine, are inseparable from cultural services, while other cultural services, such as forest spirits seen as the source of fertility, are also perceived as supporting services. For such situations an alternative classification is required for the examination of bundling ecosystem services.

I examined carbon storage, hunted game, forest spirits and useful plants. Local forest benefits can be divided by the intensity of extraction based on the frequency of use

and quantities extracted. Observations suggest forest benefits extracted in high quantities include fuel, timber, and food, in contrast to those benefits requiring minimal extraction because they are used less frequently or in lower quantities including medicine, tools, and ritual materials. In addition there are religious benefits, which do not require extraction or a specific resource, but are tied to specific forested places with limited human disturbance (Gadgil and Vartek 1976, Moretti 2007). Using botanical and anthropological methods, I examined the co-occurrence of carbon storage benefits, hunting success, plant use, and religious practices tied to forests. This analysis aims to identify which local forest benefits co-occur with carbon storage to explore the potential impacts of REDD+ policy on non-target ecosystem services.

Study Site

The research took place in the lowland tropical forests around the Wanang Forest Dynamics Plot in the Middle Ramu region of Madang Province, Papua New Guinea (Figure 3.1, Vincent et al. 2014). Elevation within the plot ranges from approximately 90 to 190 m above sea level. Climate is aseasonal, averaging 26□ C and 3,500 mm precipitation with over 125 mm of precipitation in each month (Anderson-Teixeira et al. 2014). Soils are a shifting mosaic of Entisols, Inceptisols, and Alfisols, depending on time since soil disturbance (Vincent et al. 2014). Vegetation is classified as lowland tropical wet mixed evergreen forest (Paijmans 1976). The ten most abundant trees are *Pometia pinnata, Intsia bijuga, Mastixiodendron pachyclados, Celtis latifolia, Pimelodendron amboinicum, Gnetum gnemon, Neonauclea obversifolia, Vitex cofassus, Erythrospermum candidum,* and *Pterocarpus indicum* (Vincent et al. 2014).

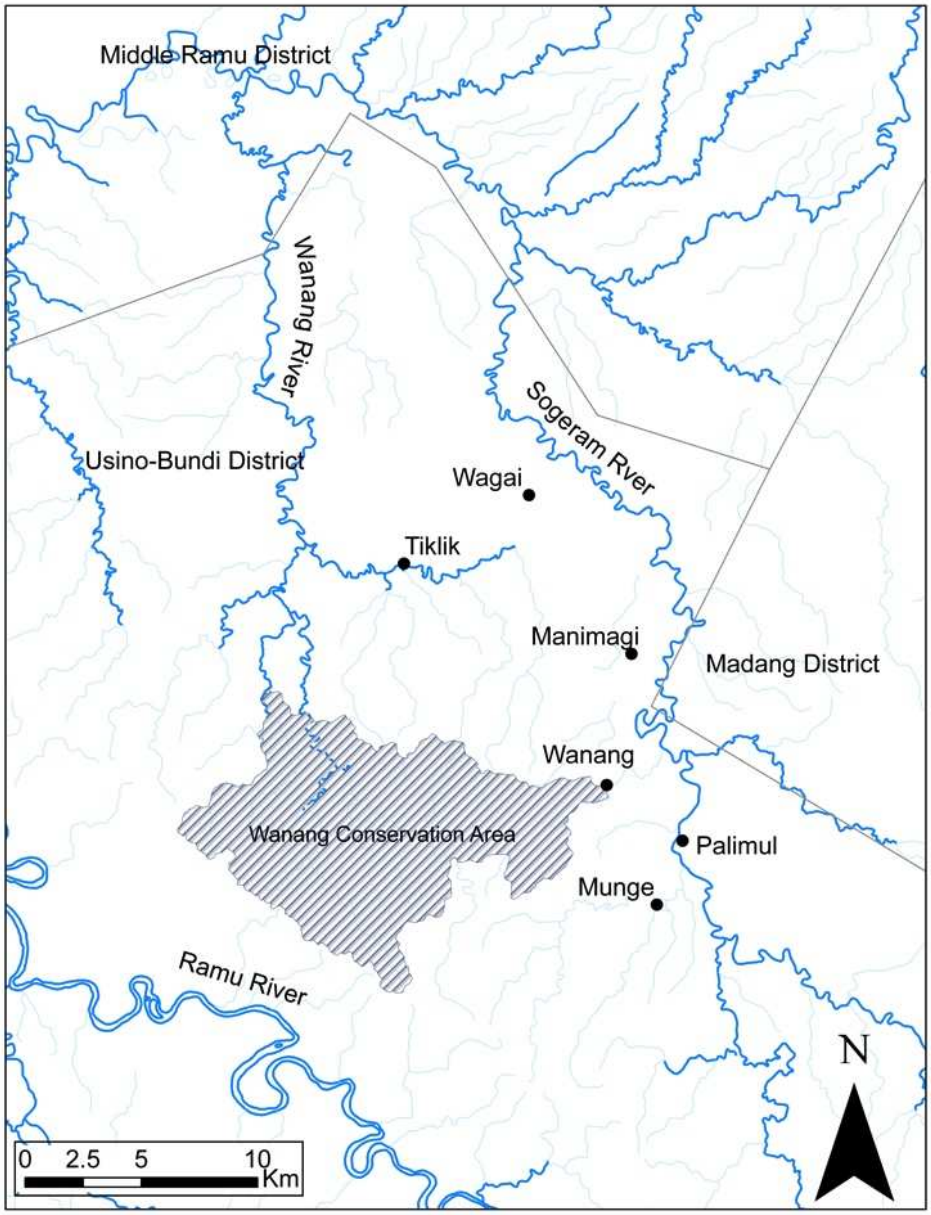

Figure 3.1: Sogeram River communities: Tiklik, Wagai, Manamagi, Wanang, Palimul in Usino-Bundi district of Madang Province, Papua New Guinea.

The Sogeram River communities, including Wanang, manage the forest to satisfy their needs through subsistence practices, industrial logging, and conservation. The central Sogeram River Valley in Usino-Bundi district has a very low population density, with 5.2 people per square kilometer in 2000 (National Research Institute 2010). The

people reside in hamlets dispersed throughout the matrix of forest in various stages of succession created by logging, subsistence use, and natural disturbance. Men and women, adhering to normative roles, clear and burn roughly one-hectare forest patches annually to grow staple crops of yam, taro, and banana, typically in previously fallowed areas. In addition, villagers promote the growth of selected wild species in gardens and in the forest through selective cutting. Villagers opportunistically hunt and gather from the forest to satisfy other needs. Until approximately 1995 with the increase in cash crops and employment opportunities, villagers were almost entirely dependent on the forest for their needs.

Villagers maintain strong religious ties to their forests. Melanesian landowning groups regard forest dwelling ancestor-spirits or *masalai* in Melanesian Pidgin (*Tok Pisin*) as rightful owners and residents of the forest. *Masalai* can be ancestors or other beings that are neither good nor evil but are considered dangerous and must be respected (Moretti 2007, Tammisto 2008). *Masalai* may harm or cause illness in those who disturb them, especially those who are not from the landowning group. In addition, *masalai* may enable landowning individuals to be strong, successful hunters if individuals are familiar with the relevant traditional customs. Humans and *masalai* have direct relationships, as *masalai* reveal productive potential to people, who in turn may elicit action and power from the *masalai* (Wood 1998). In the Sogeram area, *masalai* can appear in dreams to direct actions, and landowners may ask *masalai* to allow certain activities in the forest, such as the presence of outsiders for logging or conservation reasons. Typically, rituals or sacrifices are made to *masalai* after they have been offended, but the relationship

between landowners and *Masalai* is adaptable as some Melanesian groups started preemptively making offerings to *masalai* when faced with modern mining disturbances (Moretti 2007, Robbins 1995). Current generations in the Sogeram River valley claim to rely less on *masalai* for hunting success since they adopted the use of hunting dogs, and many people claim to have lost the magical knowledge necessary to employ *masalai*.

In 1999, the Middle Ramu, including the study area, was proposed as a 158,000 hectare logging concession by the PNG Forestry Authority, which permits industrial logging company activities contingent upon landowner approval (PNGFA 2007). The Wanang community (fewer than 250 people) declined to consent to industrial logging on 10,000 hectares of customary land within the logging concession that they designated as a community-based conservation area. The selective logging surrounding the conservation area resulted in forest disturbance far beyond the scale and degree of subsistence use, as roughly 40% of tree volume is killed and followed by species invasions (Bryan et al. 2010b, Fox et al. 2010, Makana and Thomas 2006, Shearman et al. 2008). Villagers cite environmental, economic, political, social and religious reasons as motivation for conserving their land.

Methods

Carbon Storage in Mature and Recently Disturbed Forests

Carbon storage was assessed extensively at a landscape level and intensively at the local level. The larger, landscape-level assessment of logged versus unlogged forest utilized published literature on carbon storage in logged and unlogged PNG lowland forests. The general characteristics of the logged area and conservation area supports the

classification, nevertheless there remains minimal subsistence extraction in the conservation area and mature forest areas within the logging area.

Carbon storage was assessed more intensively at the local level using two 1-hectare forest plots, one mature and one recently disturbed, adjacent to Wanang. See Whitfeld et al. (2012) for further plot details. The mature forest plot appeared undisturbed and oral history ensures it has not been used since before the 1950s, and the recently disturbed forest plot was a decade old, abandoned garden. All woody plants over five cm diameter at breast height were identified, diameter at breast height measured, and wood specific gravity was determined (Whitfeld et al. 2012). The allometric equation for tropical wet forests derived by Chave et al. (2005) was used to estimate aboveground living biomass: AGLB(in kg) = 0.0776 x $(\rho D^2 H)^{0.940}$, where ρ is wood specific gravity (g/cm^2), D is diameter (cm), and H is height (m). A conventional conversion factor of 0.5 was used to convert from AGLB to carbon (Malhi et al. 2004, Fox et al. 2010). All calculations were performed in R v2.15. Lack of replication was a limitation of the plot data and did not allow for statistical comparison.

Hunting Success in Mature and Recently Disturbed Forests

To examine differences in hunting success between mature and recently disturbed forests at the landscape-level, data were collected from hunting trips to industrial logging areas and the adjacent protected forest at Wanang. Households from six villages (Manimagi, Munge, Palimul, Tiklik, Wanang, and Wagi, figure 3.1) were invited to participate in the study. Fifty-six households recorded daily hunting activity for two months from September to November 2011 using simple pictorial calendars (appendix 6).

Although hunting success may vary seasonally, seasonality effects should be consistent across areas due to proximity. Weekly visits to households were made to assist data collection and improve accuracy. Hunting locations were categorized as conservation area, logged area, or other. The conservation area is dominated by mature forest, although evidence of subsistence use is present, whereas the logged area is dominated by recently disturbed forest that has experienced significant disturbance in the past 10 years. Ambiguous areas such as gardens, village areas, and logging areas that were not yet cut were excluded from analysis. Game captured were recorded in the following groups: pig (*Sus scrofa*), cassowary (*Casuarius sp.)*, wallaby (family Macropodidae), cuscus (family Phalangeridae), bandicoot (family Peramelidae), bird, megapode egg (*Talegalla* sp.), prawn (family Palaemonidae), crab, turtle, and other. To compare success hunting in the conservation area and logged area, a generalized linear mixed effects model (glmer in 'lme4' package) was used in R v2.15 (Bolker et al. 2009, R development core team 2008). A Laplace approximation was used to estimate likelihood and a logit link function was used to fit the data (Bolker et al. 2009). Game categories were analyzed separately as a binary response variable (captured or not captured per hunting day). The effect of hunting area (conservation or logged) was modeled as a fixed effect and tested using a Wald Z test. Because there were multiple recordings from each household and date, these were treated as random-effects.

Plant Use in Mature and Recently Disturbed Forests

Plant use was assessed at the local level using Whitfeld et al. (2012)'s plots and at the landscape scale using informant interviews. To examine differences in plant use

between the mature and recently disturbed forests plots, data were gathered from the two 1-ha plots including local use, according to a knowledgeable male elder. Plant use was later classified as food, fuel, construction, medicine (including treatment of illnesses caused by sorcery), ritual material (such as for romantic attraction, decoration, drums, etc.), tools (such as gardening tools, bow and arrows, plates, steel wool), or other (such as cloth, animal feed, wildlife habitat). Diversity and abundance of useful plants were compared between mature and recently disturbed forests.

Landscape scale data on important, useful plants was recorded through interviews. Informal interviews were conducted in Melanesian Pidgin with 17 individuals across clan, gender, education, and age. Informants were asked to list useful plants, local names, and uses. Interviews were conducted privately or with a number of other interested villagers observing and occasionally contributing. Informants were encouraged to start with edible and medicinal plants and expand into other categories. Plants species named by more than one informant were identified by parataxonomists of the New Guinea Binatang Research Center. These locally important species were classified by successional stage (mature and recently disturbed) according to literature and/or expert consultation (Hyland et al. 2010, Whitfeld 2011, George Weiblen 2012 pers. comm.), and their uses were classified in the use categories mentioned above. Plants considered habitat generalists were considered neutral and excluded from analysis. A chi-square test of independence was used in R to determine if locally important plants were randomly distributed between successional stages (R development core team 2008). Locally important species were also classified as logging industry target or non-target species

according to Conn and Damas (2006) to clarify the potential impact of industrial logging on locally important species.

Masalai in Mature and Recently Disturbed Forests

To examine the effects of forest disturbance from industrial logging on *masalai,* participant observation and interviews were conducted. Nine months of participant-observation research was conducted in the Sogeram River communities during which the researcher spent days and nights with villagers hunting, gardening, cooking, celebrating, playing, and conversing. Extensive note-taking accompanied all activities. During this time formal and informal interviews were conducted across logging and conservation communities, but the significance and beliefs surrounding *masalai* were frequently revealed during casual conversations and daily activities. Fifty-one household questionnaires also addressed the topic of *Masalai* disturbance. Through coding of notes, themes and patterns of beliefs surrounding the effect of forest disturbance on *masalai* were extracted.

Results

Carbon Storage in Mature and Recently Disturbed Forests

Primary forests were found to provide more carbon storage at both the landscape and local levels. Published estimates of aboveground carbon storage in lowland mature forests in PNG range from 96.5 to 193.1 Mg/ha with a mean of 131.76 Mg/ha. Estimates are 118.0 Mg/ha in Vincent et al. (2014), 124.7 Mg/ha in Fox et al. (2010), 193.1 Mg/ha in Bryan et al. (2010a), and 96.5 Mg/ha and 126.5 Mg/ha in Bryan et al. (2010b). In comparison, published estimates of aboveground carbon storage in lowland recently

disturbed, logged forests in PNG range from 73.46 to 79.4 Mg/ha with a mean of 76.43 Mg/ha. Estimates are 73.46 and 79.4 Mg/ha in Bryan at el. (2010b). The local 1 ha mature forest plot was found to contain 131.34 Mg of carbon, while the 1 ha recently disturbed forest plot contained 27.53 Mg of carbon.

Hunting Success in Mature and Recently Disturbed Forests

Household hunting calendars recorded on average 45.9% of days were spent hunting (95% CI: 24.6-67.2). Hunting trips to the conservation area (221 trips) and logged area (832 trips) were analyzed. Hunting success was related to forest type for some game taxa but the effect was dependent on the taxa (Table 3.1). Pig, wallaby, and cuscus hunting were significantly more successful in the conservation area than the logged area. Cassowary, bandicoot, bird, megapode egg, prawn, crab and turtle hunting was not affected by forest type, but for many of these taxa the number captured may have been too small to detect a difference.

Plant Use in Mature and Recently Disturbed Forests

In the mature one ha forest plot, 203 species were recorded among 1,421 individuals, and 95 species were recorded in the one ha recently disturbed forest plot among 1,328 individuals. The forest is an extensively used resource as fewer than three percent of plants were recorded as having no use. See appendix 7 for a list of Wanang plants with Maghu names and their local use. The mature forest had greater diversity and abundance of useful plants than the recently disturbed forest overall, which is not surprising as it had higher species diversity and abundance in general (Figure 3.2). Plants used in low quantities, including medicinal plants and tools, had more species in the

mature forest than the recently disturbed forest (Figure 3.2). Plants used for rituals were rare in both forest types. Benefits required in high quantity, such as food, fuel, and construction material, did not show a consistent association with forest type. Abundance of fuel sources was higher in recently disturbed forests but richness and abundance of edible plants were higher in mature forests. Abundance of construction material was similar between forest types but richness was higher in mature forests.

Table 3.1. Success hunting the listed game was compared between the conservation area and the logged area. Game were categorized as pig (*Sus scrofa*), cassowary (*Casuarius sp)*, wallaby (family Macropodidae), cuscus (family Phalangeridae), bandicoot (Family Peramelidae), other birds (class Aves), megapode eggs (*Talegalla* sp.), prawns (family Palaemonidae), crabs (Decapoda), turtle (order Testudines), and other. Success hunting pig, wallaby and cuscus were higher in the conservation area.

Game captured	Number of successful hunting trips (percentage of trips per area)		Probability of hunting success (95% confidence interval)		Z value	P value
	Mature forest/ Conservation area	Recently disturbed forest/ Logged area	Mature forest/ Conservation area	Recently disturbed forest/ Logged area		
Megapode egg	35 (16.0%)	162 (19.8%)	0.140 (0.092 - 0.206)	0.167 (0.111 - 0.244)	-0.884	0.377
Pig	59(26.9%)	109 (13.3%)	0.179 (0.114 - 0.270)	0.088 (0.056 - 0.136)	3.287	0.001 *
Bandicoot	40 (18.3%)	72 (8.8%)	0.065 (0.035 - 0.119)	0.038 (0.021 - 0.067)	1.893	0.058
Wallaby	42 (19.2%)	58 (7.0%)	0.137 (0.089 - 0.206)	0.055 (0.033 - 0.089)	3.774	0.0002*
Cuscus	22 (10.1%)	30 (3.6%)	0.047 (0.024 - 0.091)	0.018 (0.008 - 0.037)	2.578	0.01 *
Bird	9 (4.1%)	28 (3.4%)	0.034 (0.016 - 0.071)	0.026 (0.011 - 0.061)	0.579	0.563
Prawn	8 (3.6%)	26 (3.2%)	0.026 (0.011 - 0.061)	0.019 (0.007 - 0.049)	0.691	0.490
Cassowary	8 (3.6%)	21 (2.6%)	0.017 (0.007 - 0.041)	0.012 (0.005 - 0.032)	0.676	0.499
Turtle	5 (2.3%)	20 (2.5%)	0.007 (0.002 - 0.025)	0.008 (0.002 - 0.028)	-0.161	0.872
Crab	7 (3.2%)	7 (0.8%)	0.004 (0.001 - 0.016)	0.002 (0.0004 - 0.009)	0.996	0.319

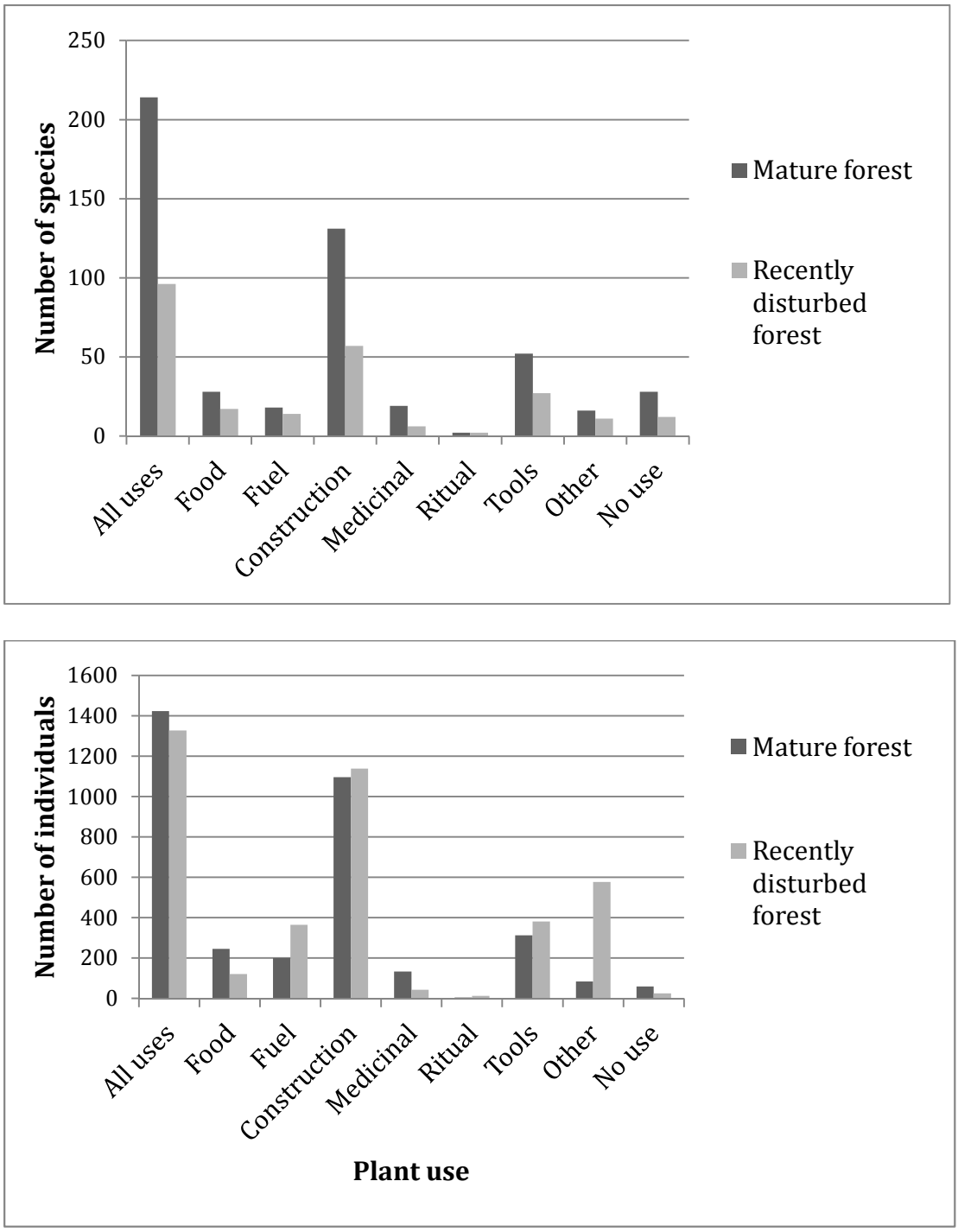

Figure 3.2: Two 1-ha mature and recently disturbed forest plots were compared in terms of useful plant species richness and abundance. Top graph shows species richness, which may be important for species-specific uses. Bottom graph shows abundance, which may be important for resources used in high quantities.

Sixty-five locally important plants were identified through interviews, 53 used in low quantities and 30 used in high quantities (Figure 3.3, 18 species had multiple uses placing them in both high and low quantity use categories). Locally important species extracted in low quantities tended to be found in mature forests (χ^2=3.76, df=1, p value=0.053), while species required in high quantity did not differ between forest types (χ^2=0.043, df=1, p value=0.83). In addition, 45.7% of the locally important tree species were targets of industrial logging.

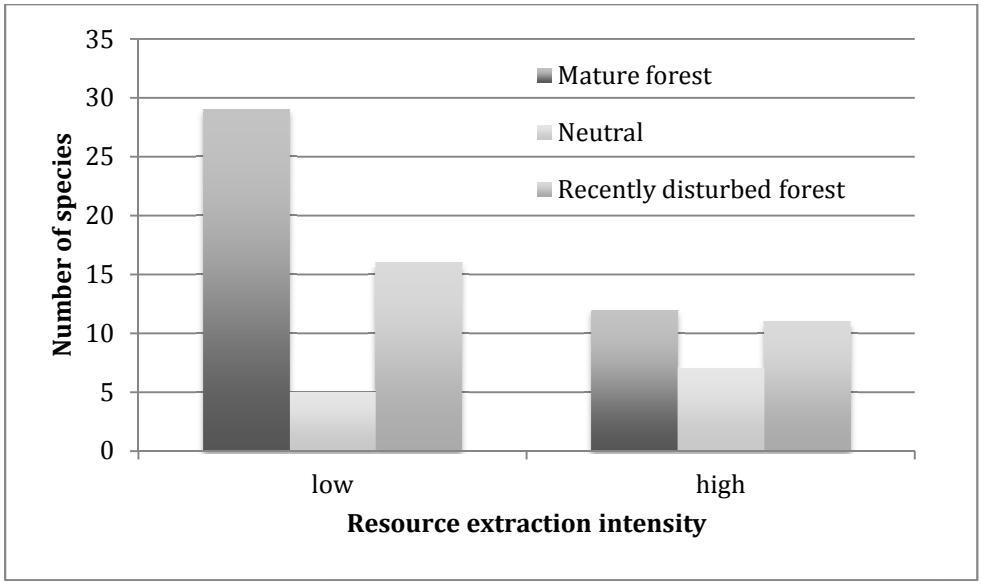

Figure 3.3: Locally important plants extracted in low quantities and high quantities were compared between successional stages. Locally important species extracted in low quantities tend to be found in mature forests (χ2=3.76, df=1, p value=0.053), while species required in high quantity do not differ between successional stages (χ2=0.043, df=1, p value=0.83)

Masalai in Mature and Recently Disturbed Forests

Masalai respond negatively to forest disturbance. Although *masalai* are capable of residing in any type of forest, they are most often found in mature forests. *Masalai*

can become upset if the forest is cut or disturbed causing the *masalai* to leave the area or to harm the intruder. When asked about the effect of logging on *masalai* one landowner responded, "[the *masalai*] was not angry with me but it was angry with [the loggers] and caused their machinery to get stuck". Often when *masalai* are disturbed, they will simply move to another area but landowners will not know where they reside until they later reveal themselves. Landowners do not fear harming *masalai*, as humans are not believed capable of harming them, but there is concern of losing the cooperation of *masalai* if they are disturbed. Previously, hunters were reliant on *masalai* to be successful hunters but now they use hunting dogs and rely less on *masalai*.

Discussion

In response to calls for more inclusive examination of co-occurance and tradeoffs of ecosystem services (Grabowski and Chazdon 2012), this study has revealed both a bundle and a tradeoff of ecosystem services between mature and recently disturbed forests in Melanesian lowland rainforest. High carbon storage co-occurs with plants used locally as medicine, food, and tools, hunted game such as pig, wallaby, and cuscus, and forest spirits in mature forests. However, high carbon storage has a tradeoff with fuel wood provisioning, which is better provided by recently disturbed forests. Mature and recently disturbed forests differ in terms of the local and global ecosystem services they provide.

These findings are useful to the Wanang people, who depend on forest resources, as well as REDD+ practitioners, who must understand local forest use to develop projects. REDD+ policy implications cannot be understood by landowners or

practitioners unless there is a sound understanding of the local forest benefits currently derived and how those uses will be impacted (Leggett and Lovell 2012). Policy makers are increasingly recognizing the importance of local people's interests for successful initiatives in developing countries (Melick et al. 2012). Projects aiming to protect forests with high carbon storage may have different implications than projects intending to sequester carbon through restoration of disturbed forests. Recently disturbed forests, once thought to be insignificant as an ecosystem service provider, are increasingly recognized for their contribution to human well-being (Putz et al. 2012). Although mature forests best provide carbon storage, fast growing young forests more rapidly sequester carbon. Recently disturbed forests provide fewer benefits around Wanang and restoration may lead to improvements in both local and global services, yet contain a tradeoff in loss of fuel wood. The low extraction uses of mature forests discussed here should minimally impact carbon storage and are therefore compatible with REDD+ aims. These uses should not be restricted by such policies.

Although these bundles are helpful for thinking through tradeoffs, there are complexities that confound land management decisions. There may be a level of flexibility and substitutability in ecosystem services. The higher plant diversity of the mature forest may be more important for species-specific uses such as medicinal plants, and plants used in rituals, while resources required in higher quantities may be more substitutable between species and the service provisioning more driven by abundance. For example, fuel wood, food calories, or building timber needs can be met by many tree types, but treatment against a sorcerer requires a specific species.

Cultural significance further complicates the situation. Although game can be thought of as a source of protein and calories needed in high quantities, there are specific species that have cultural significance. For example, pig, more successfully hunted in mature forests, was the most desired game species. The cultural distinction among game species was obvious when hunters returned from the forest having captured multiple taxa of game but were only considered successful if they captured pig. Therefore, pig is an important resource, required in high quantities, that is not substitutable.

Masalai were more closely associated with mature forests. However, it may be that forest spirits are more tied to place than to ecological structure. There may be other influences than forest type that determine their presence. This is a topic that should be further investigated.

The benefits provided by forest mosaics are multidimensional, and a meaningful understanding of these benefits requires interdisciplinary methods. This study demonstrates the use of different disciplinary methods to enrich an understanding of disparate benefits. Although the methods lead to different types of results (statistical or descriptive), they combine to create a holistic interpretation. However, it is very difficult to directly compare the importance of different benefits, as there is no reasonable common metric.

In addition to the benefits studied, there are other benefits (water provisioning and microclimate control) and factors (political, social and economic) incorporated into land management decisions. The ecosystem services framework alone cannot capture the complexity of such decisions. Social harmony is a central Melanesian concern and while

it does not lend to study within the ecosystem service framework because it is not tied to ecological structure, it is an essential value in local land management decisions. There are additional values, such as sense of place, that do not easily fit into the ecosystem services framework (Kirchhoff 2012), but communication across disciplines can lead to improved assessments, even if some values cannot be directly incorporated into the ecosystem services framework.

Conclusion

Local forest benefits do not have a simple relationship with forest carbon. Policies that promote high carbon, mature forests at the expense of low carbon, recently disturbed forest will do so at a cost to some local forest benefits such as fuel, yet gains in other services may be possible. Continued degradation of mature forests will harm services such as plants used for medicine, food, and tools, hunted game, and forest spirits. Local forest use is diverse and requires multiple forest types to provide the full range of benefits. Ecosystem service analyses can clarify tradeoffs to landowners considering REDD+ projects. Studies that aim to examine these benefits must use interdisciplinary methods to capture the diversity, but it can be difficult to synthesize such results in a cohesive framework, such as the ecosystem services framework. Despite this difficulty, there is much to gain from interdisciplinary communication regarding forest benefits.

Chapter 4: Market-based conservation in a Melanesian context: How do direct payments for conservation in Papua New Guinea meet contrasting expectations of landowners and conservationists?

Summary

Conservationists have long been interested in the biodiverse country of Papua New Guinea but have had limited success on the ground. Direct payments for conservation appeal to Western conservationists because they can compete with the material benefits from resource extraction enterprises. Direct payments are also attractive to Melanesian villagers because they appear to be the beginning of a socially-appropriate reciprocal relationship with conservationists. Market-based conservation assumes exchange takes place between independent, self-interested actors, but Melanesian villagers assume that exchange takes place between morally obligated, interdependent actors. Such cultural differences led to contradictory expectations and friction between conservationists and villagers in Wanang Conservation, the particular ethnographic focus of this article. However, direct payments have simultaneously satisfied some expectations of both parties. Direct payments may be useful in conservation but for different reasons than expected. They succeed as part of a wider socially acceptable reciprocal relationship, but direct payments alone will likely fail.

Introduction

Papua New Guinea (PNG), part of the Pacific region known as Melanesia, has been a target of international biodiversity conservation efforts because it is part of the

third largest remaining contiguous tropical rainforest with an estimated five percent of global terrestrial biodiversity (Melick et al. 2012). However, these conservation efforts have been largely ineffectual due to the limited investment, the lack of government owned land for protected areas, and the inability of integrated conservation and development projects to meet landowner expectations (Van Helden 2005). The use of direct payments for conservation has been called for by the international conservation community and local Melanesian landowners, but motivations for direct payments vary (Novotny 2010, Benson 2012, Van Helden 1998b).

During the 1980s and 1990s, Western conservationists in PNG established protected areas and grew increasingly aware of local demands for economic development (Lele et al. 2010). This led to integrated conservation and development approaches that aimed to create enterprises for subsistence communities that were dependent on conservation outcomes, such as ecotourism, non-timber forest products, and biological research. However, these projects faced many challenges and most were short-lived (Van Helden 2005). Many conservationists reasoned that benefits from integrated conservation and development were simply inadequate, while landowners thought the conservation and development schemes were not socially appropriate (Orsak 1998, West 2006). Today, conservationists speculate that direct payments for conservation may provide economic benefits sufficient to contend with competing land use activities (Novotny 2010), while Melanesian landowners perceive material benefits as an indication that conservationists are willing to participate in what they view as culturally appropriate exchange relationships (Benson 2012, West 2006). This paper aims to explore whether,

or the extent to which, direct payments for conservation can meet these dual expectations through an investigation and comparison of Western conservationists' and Melanesian landowners' expectations, justifications, and experiences. I argue that Melanesian villagers expect direct payments to be part of long-term reciprocities based on a model of kinship, while Western conservationists expect a relationship based on market exchange in which only a temporary, anonymous relationship takes place. The resulting relationship created within the friction of these differing ideologies contains aspects of both reciprocity and market exchange, and is judged differently by Western and Melanesian actors.

Neoliberal Conservation

According to Harvey (2005), neoliberalism "proposes that human well-being can best be advanced by liberating individual entrepreneurial freedoms and skills within an institutional framework characterized by strong private property rights, free markets, and free trade." The process of neoliberalization includes deregulation, privatization, and withdrawal of the state. Neoliberalization of conservation may take many forms, but in general it deemphasizes the responsibility of environmental protection by governments and reframes conservation in terms of market mechanisms (Igoe and Brockington 2007). Proponents argue that such market-based conservation will increase funding available for conservation efforts, make conservation more democratic and participatory, protect indigenous property rights, increase environmentally-friendly business practices, and promote environmental consciousness among Western consumers (Igoe and Brockington 2007). Conservationists are using neoliberal approaches to engage with business

interests that enable them to have more influence in an increasingly neoliberal world (Holmes 2011). Ferraro and Kiss (2002) reason that direct payments for conservation are more effective and efficient than indirect approaches, such as integrated conservation and development, which are not conditioned upon results and require expensive institution-building. Such market-based, neoliberal projects are designed on the economic assumption that landowners will make rational, self-interested, profit-seeking decisions.

On a large scale, neoliberalism involves restructuring of policy and institutions, but on a personal level these practices more closely resemble market-based reasoning. Novotny (2010) argues that Papua New Guinean landowners prefer loggers to conservationists because conservationists have failed to use market-based approaches such as direct payments to compete with loggers. Although market-based arrangements are seen as effective and efficient, in practice there can be social problems that are overlooked, as the use of economic discourse simplifies the complexity of issues in conservation projects with multiple stakeholders and interests (Igoe and Brockington 2007).

Despite its simplifying techniques, Western economics has begun to recognize that social consideration can play an important part in transactions, even market exchange. Economists have found that actors care about fairness, as they are not only interested in the benefit they receive, but also the benefits that others receive (Rabin 1993). Some actors are adverse to inequality in transactions and will reject an unfair transaction even if they personally stand to profit (Fehr and Schmidt 1999). Despite evidence of the influence of social considerations on economic transactions, social factors

are typically excluded from economic analyses, such as cost-benefit analysis (Kahnemann et al. 1986). While fairness and equality are easily overlooked in Western economics, it is likely much more influential and conspicuous in the Melanesian context where equality is fundamental.

Melanesian Material Expectations

Subsistent rural Melanesians in and around the rainforests of PNG, without access to basic government services, express strong desire for development and expect conservationists to provide it. Landowners seeking to increase their material wealth engage either resource extractive companies or conservation groups and regard both as means for material improvement (Van Helden 1998a). Landowners involved in the April-Salomei REDD (Reduced Emissions from Deforestation and Degradation) project in East Sepik were not satisfied with the community-level benefits they received and felt they needed individual benefits as well (Legget and Lovell 2012). Benson (2012) interviewed villagers involved in Madang conservation projects and found they were dissatisfied with conservation because it had not provided material benefits or long-term relationships. The Crater Mountain integrated conservation and development project in the highlands was designed by conservationists to assist villagers in establishing enterprises, such as a handicraft market, ecotourism, and a scientific research station. However, the wealth, education, technology, medicine, and knowledge desired by villagers were far beyond what conservationists were prepared to provide (West 2006).

These expectations led conservationists to question if they could "compete on a one-to-one basis against what the loggers are offering" (Saulei 1998). One non-

governmental conservation organization, Bismark-Ramu Group, altered their strategy and sought to prevent material expectations from developing during project discussions by reducing their appearance of material wealth, such as helicopter transportation and expatriate staff (Van Helden 2001). The organization made a concerted effort to communicate that the project would not provide villagers with material benefits, but would rather help them organize and become educated about environmental issues. However, material development was the main preoccupation of villagers, leading one conservationist to frankly suggest, "Another possibility is to just pay people for conservation" (Van Helden 1998b).

Exchange Relationships

Landowner expectations may be more complicated than conservationists have assumed. What may simply be perceived as economic interest or greed from a market-based perspective is actually a legitimate part of reciprocal relationships from the Melanesian perspective. In Melanesian societies, a great moral concern is to maintain social relationships through reciprocal material exchange, and the value of the objects exchanged lies in the relationships that they create (Gregory 1982). Anthropologists have theorized exchange, from reciprocal gift exchange to market commodity exchange, using various terms and emphasizing different attributes. Gregory (1982) identifies three distinctions between gift and commodity exchange: inalienability of gifts from the giver, substitutability between commodities, and the independence of actors in commodity exchange. Sahlins (1972) emphasized material flow in market exchange and the importance of social relations in generalized reciprocal relationships, like kinship.

Graeber (2001) distinguished between open exchange, which does not reach equality, but maintains a debt and therefore the relationship, and closed exchange, which achieves balance and ends the obligation and relationship between the parties. These theories present idealized typologies of exchange, but in practice, exchange can be and is messy and may overlap anywhere between analytical categories. I use the terms reciprocal exchange and market exchange in order to highlight the distinction between the implicit, moral obligation and inextricable link between parties in the former, in contrast to the nature of explicit obligation between autonomous actors in market exchange.

The distinction between reciprocal exchange and market exchange is exemplified in the Melanesian gift economy in contrast to the market economy (Malinowski 1961). The distinction concerns the meaning of transactions: where market economies focus on the value of the things exchanged, gift economies value the social relationships created and maintained through exchange (Gregory 1982). Market exchange is based on the idea of independent individual actors acting in their own self-interest. Melanesian actors, on the other hand, are never independent, discrete individuals, but are part of a kin network in which they act out moral obligations to the living and the dead (Sahlins 1972, Strathern 1988). Melanesian exchange relationships are expected to be long-term with ongoing material exchanges, having the effect of creating and maintaining social equality between parties. Melanesian exchange is composed of a dynamic of nurturing and dependence, where giving and generosity are regarded as ethically superior to receiving (Meeker et al. 1986). Western conservationists are positioned to take the superior role of nurturing but

have been perceived to reject fulfilling the obligations that are taken for granted in it. That is, they are viewed as ungenerous and unequal persons.

For Melanesians, all things are produced through relationships, such as children raised collectively, food produced by divisions of labour in gardens, and landscapes shaped through relationships with ancestors (Strathern 1988). At Crater Mountain, villagers thought access to modernity and the future they desired would be produced through entering a relationship with the Crater Mountain conservationists (West 2006). However, conservationists saw the project as a barter relationship that was satisfied by teaching villagers to sell their labour and commodities. Similarly, Curry (2003) observed that Melanesians participating in the market economy surrounding oil palm production did not work to maximize profits, but rather production peaked only under demands for gift exchange. Furthermore, social conflict reduced palm oil production in these communities. The reduction was explained by market logic as the result of loss of labour cooperation, but Melanesians explained it as a supernatural response to the loss of social harmony. Conflicts and compensation demands, which commonly surround resource extraction projects in PNG, are often assumed by Westerners to be a result of economic greed. They are actually caused by the alteration of identities and relationships that accompany changes in material wealth (Banks 2005).

In her analysis of Melanesian coffee production, West (2012) illustrates that to Melanesian coffee producers the value of participating in market transactions was not the money or wealth itself, but the relationships created with the income or through the transaction. Finney (1973) also found that Melanesians leased their land to settlers for

reasons beyond income. They assumed that leasing land would grant them access to additional exchange relationships and potentially teach them the 'secret knowledge' held by whites of how to access material goods, or cargo.

The past century produced numerous accounts of unexpected and confusing Melanesian reactions when exposed to Western cargo, as well as political, economic, and religious systems (Worsley 1957). Melanesian religious systems are flexible and embrace the idea of social transformation, enabling the accommodation of Western material wealth and practices in ways that often surprise Westerners (Tonkinson 2004). In some cases, villagers practiced elaborate rituals imitating Western religious or economic activities in hopes of gaining access to material goods from their ancestors, who were believed to have returned in the form of white men or to be in contact with white men possessing material wealth (Lawrence 1964). These practices became knbown as 'cargo cults', which appeared to Westerners as primitive explanations of either unfamiliar religious, economic, or political systems (Burridge 1960). However, religion, politics, and economy are closely interwoven in Melanesian societies. The exchange of material wealth, which results from productive relationships among the living and the dead, is a means of forming relationships, gaining influence, and increasing prestige (Jebens 2004). In the colonial situation, which exposed extreme inequalities in material wealth and power, villagers sought to elicit wealth from colonialists with the help of ancestor spirits to correct social tension. Although 'cargo cult' practices have largely diminished, they illustrate a divergent Melanesian interpretation of Western systems that persists today.

Methods

Western conservationists hope that direct payments will meet material expectations of villagers. Similarly, Melanesian landowners believe that direct payments will foster socially appropriate conservation. But how do direct payments for conservation actually achieve these duel goals? I examined this question through study of Wanang Conservation in Madang Province, PNG. It is the first instance in PNG where landowners have been directly paid for conserving their land. I spent ten months from 2010 to 2012 conducting participant observation research with villagers and conservationists in and around Binatang Research Center, Madang town, Wanang village, and the Wanang forest. I conducted surveys and semi-structured interviews but mainly I spent time with villagers and conservationists during their daily activities, casually observing and discussing topics that arose. I used discourse analysis of interviews, documents, and field notes to elucidate how direct payments are perceived by conservationists and villagers. I explore the expectations that conservationists and villagers have of the material benefits conferred to villagers for participating in conservation and how such differing expectations are formed. A financial cost benefit analysis of conservation and industrial logging for villagers was performed to clarify the market-based reasoning of the project. The dialogue around the project reveals that Western interests using market logic are contested by Melanesian motives of reciprocal exchange. Although I speak of the Wanang villagers as a group, it is important to remember that neither their beliefs and expectations, nor those of the conservationists, are homogeneous. In the following sections I will describe (1) the development and

organisation of the conservation project, (2) differing material expectations in the project, (3) the cultural basis of differing expectation and the friction between them, and (4) the combination of differing systems of exchange. I conclude that direct payments can meet some expectations of both groups, but payments must be part of a wider, socially-appropriate relationship to be accepted by villagers.

Argument

Wanang Conservation, A Brief History

In 2010, roughly 250 residents of Wanang village were living in the lowland rainforest in the middle Ramu River basin in Madang province, Papua New Guinea (Figure 4.1 and 4.2). The village is 80 km west of the nearest town, Madang, but until recently could not be accessed by road, leaving the residents without government services and limited market access. Residents practice subsistence slash and burn gardening, growing banana, taro, yam and other crops while hunting and gathering to obtain protein from the forest. Men and women subscribe to a sexual division of labour to provide for their families. Men clear forest for gardens, build houses, and hunt while women plant and harvest gardens, prepare food, and gather from the forest. The population density was very low with 5.2 people per square kilometer in 2000 (NRI 2010) leaving large swathes of land under the control of these villagers. The land is held under customary landownership ensured by the PNG constitution, which prohibits official sale and purchase. In the Wanang area, kin-groups that pass down customary land from one generation to the next consist of a lineage of 10-30 people, who trace common decent via men to a male ancestor. Land use rights are based on ancestry, social relations, and past use. Such rights

are dynamic and are often based on recall of ancestor stories.

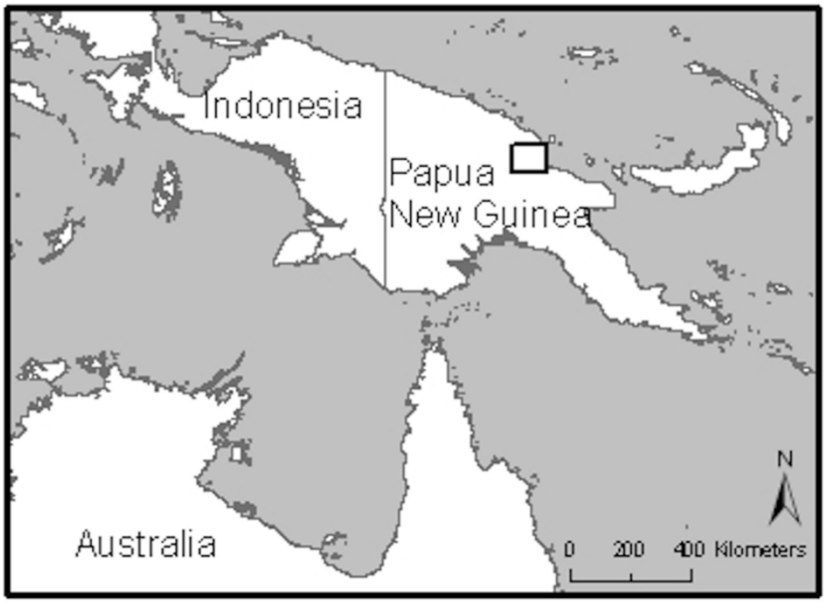

Figure 4.1: Map of Papua New Guinea indicating area of study in Madang province.

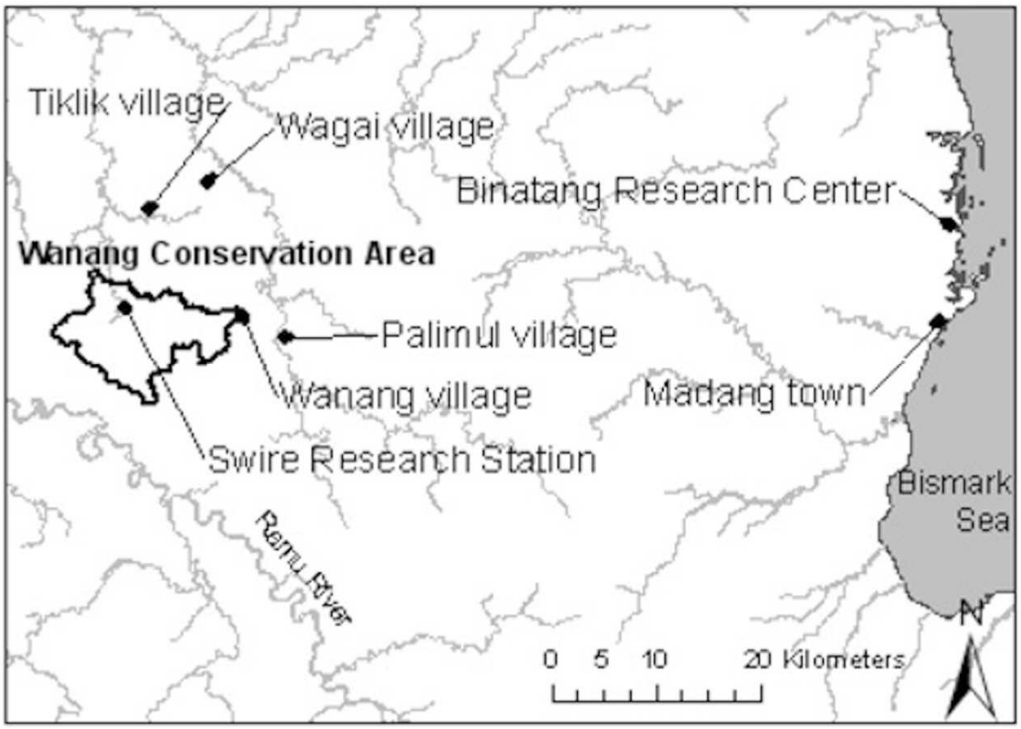

Figure 4.2: Map of area of study in Madang province indicating Wanang Conservation in black outline and the location of Swire Research Station, nearby villages, and New Guinea Binatang Research Center in Nagada Harbor.

The Wanang villagers originally settled in their current location in the mid-1990's, as a road was being cleared from Madang town through the Wanang area to the Ramu River. The road failed to provide the connection to town the people desired, but the community remained, living in dispersed hamlets. People report that they infrequently used the remaining dirt track to travel to town to sell young cassowaries to buy goods. The area remained outside the reach of government services, such as education, medical care, and transportation, leaving communities to follow customary practices until the recent arrival of loggers and conservationists. Traditional decision-making is based on group consensus with villagers assembling to voice opinions in lengthy discussions. There is limited formal leadership but rather *big men*, who achieve influence and respect through exchange relationships. These men exercise their power on decisions through their social relationships and debts. They lead community decisions and group exchanges.

The Wanang vernacular is called Maghu. It is a dialect of Aisi in the Sogerum language group (Daniels 2010). Most villagers speak Melanesian Pidgin or *Tok Pisin*, the trade language, and children use it as their dominant language. Although the vernacular is exclusively oral, there is a minority of literate villagers who have learned to read and write *Tok Pisin* and/or English. My interactions with villagers were conducted in *Tok Pisin*.

In 1999, the Middle Ramu, including Wanang village, was proposed as a 158,000 hectare logging concession by the PNG Forestry Authority, which permits industrial logging company activities contingent upon landowner approval (PNGFA 2007). While

logging interests were pursuing landowners consent, Bismark Ramu Group, an environmental and community empowerment NGO, was educating landowners on the impacts of logging. Cash bonuses and promises of community development, such as roads and schools, led landowners surrounding Wanang to sign logging agreements, but in 2000 eleven Wanang lineages declined to consent to industrial logging and worked with Bismark Ramu Group to create a deed among themselves that prohibited logging on their customary land (Van Helden 2001). Villagers and BRC biologists recalled that Wanang villagers still desired development that Bismark Ramu Group would not provide. The leader of Wanang sought out international biologists, then based in Madang, and invited them to work in Wanang. From 2001 to 2008, biologists associated with the Binatang Research Center (BRC) and their parabiologist assistants, repeatedly visited Wanang to conduct short-term research projects. With time, the projects grew in size and in employment benefits, but villagers wanted more sustained activity.

In 2008, foreign biologists and villagers planned a 50-hectare long-term research plot, a permanent fully equipped field research station, and a 10,000 ha conservation area surrounding the plot that would sustain research and associated benefits in the area. The biologists garnered support for the project from government research grants, non-governmental organizations, such as WWF and Seacology, donor organizations, such as The Christensen Fund, and corporate donors, such as John Swire & Sons (Pty) Ltd. and Steamships Trading Co. Ltd. Through combined support, villagers were provided with annual royalty payments, increased employment, the first elementary school in the area, in addition to limited transportation and medical assistance.

Although the scientists worked to exclude industrial logging from Wanang and elsewhere, they did not consider themselves to be 'conservationists.' They imagined 'conservationists' to be idealistic foreigners aiming to facilitate a harmonious coexistence of people with forest. The "conservationist's ideal solution, that is, to leave nature untouched, usually also means conserving the people's poor standard of living" (Novotny 2010). The scientists involved in Wanang viewed themselves as more practical than traditional 'conservationists' in their willingness to use a market-based approach to protect their research site. They used incentives to appeal to landowners by competing with resource extraction options. Although these scientists differ from traditional 'conservationists,' I will refer to them as conservationists hereafter, as their efforts to limit logging align with the actions of forest conservation regardless of motivation and method.

The conservationists work with parabiologists, who are PNG nationals that have been trained in technical aspects of research. The latter conduct and lead much of the field work in Wanang. They have come to understand the positions and limitations of conservationists, yet being Melanesian themselves relate to villagers. They often find themselves in an intermediary position between the two, needing to negotiate agreements and explain expectations. For the most part, parabiologists hold Wanang villagers to market-based standards set by conservationists, yet many maintain exchange relationships with villagers. Parabiologists understand landowners' expectations and interests as many of them come from villages that desire the type of support and development that Wanang has received, yet there is some jealousy as many parabiologists

do not believe Wanang is any more deserving than their own village.

Contrasting Expectations from the Wanang Conservation Project

Western Conservationist Perspective

Conservationists expected the relationship with villagers to be one of rational market exchange where each side acts independently in self-interest. They use economic reasoning to explain the project to outsiders and judge the adequacy of the benefits to villagers. In such cost-benefit analyses, two options are compared and the option seen to provide greater overall benefit is the superior choice. In this case, conservation must overcome the opportunity cost of logging, the benefits foregone by not logging. This is the reasoning that Western conservationists expect Melanesian landowners to follow in deciding whether to allow industrial logging on their land or to conserve their forest. According to Novotny (2010), landowners focus on the opportunity cost of conservation:

> Forest conservation looks deceptively inexpensive since, if conservation is successful, not much happens to the protected forest. In fact, the true cost of conservation is equal to the potential profits that could be generated by alternative uses of the forest: conservation's opportunity cost. These profits may rise from near zero in remote communities to very high for communities located near a logging frontier.

Conservationists thus assumed that villagers' expectations of material benefits would be determined by a comparison of logging and conservation. Conservationists reasoned that

over the long-term the benefits of conservation exceed those of logging and, therefore, is the preferable choice. Although conservationists did not perform a formal cost-benefit analysis, they made ad hoc comparisons with logging to determine the level of benefit necessary to compete with logging. The material benefits from conservation in Wanang, and logging in the adjacent Wagai and Tiklik communities, consist of direct payments, in-kind payments, and employment opportunities. I will compare these benefits using cost-benefit analysis to clarify the conservationists' approach (Table 4.1). The following sections will quantify direct payments, in-kind payments, and employment opportunities for the period 2008–2011 and extrapolate to a 40 year period based on PNG forestry policy for sustainable harvest practices on a 40 year cutting cycle (Keenan et al. 2011). Although benefits accrue at different scales (i.e. individual, lineage, and community), they will be summed at the lineage level using a typical lineage size of 24 (8 adults). A range of values, from more conservative estimates to more generous estimates, are given to express uncertainty. All values are given in US dollars calculated using annual conversion rates.

Table 4.1: Benefits of conservation versus logging in the Middle Ramu Basin. Benefits derived from the Wanang Conservation project as compared to benefits in the adjacent logging villages of Tiklik and Wagai. Benefits are calculated per lineage (around 24 individuals, 8 adults) in US dollars per year. Ranges express uncertainty and parenthesis indicate a moot benefit.

US$ per lineage per year	**Conservation**	**Logging**
Direct payments	$ 725–753	$ 786–12,446
In-kind payments	$ 422	$ 0 (23,945)
Employment	$ 5,580 – 13,589	$ 3,947–8,553
Total	$ 6,727–14,764	$ 4,733–20,999 (44,944)

Direct payments

Between 2009 and 2012, landowning lineages in Wanang Conservation have received yearly royalties averaging $725, with payments expected to continue. In addition, a community leader received a $10,000 conservationist award from Seacology, which was distributed among landowners contributing an additional $28 per lineage per year.

By comparison, logging companies are mandated to compensate landowners at a rate of $10.90 per cubic meter of timber in the form of royalty and premium payments. Projected logging payments based on estimated average lineage territory size (1505 ha) and estimated cubic meter of timber per ha (30.38 m^3, Keenan et al. 2008) project one-time logging payments of $497,861 per lineage ($12,446 per year). However, 13 landowning lineages in adjacent logging areas received between $345 – 125,585 in one time logging royalty payment in 2009. Each group received on average $31,471 ($786 per yer).

In-kind payments

From 2008–2012, Wanang received funding from various donor organisations to support community needs, such as a permanent school building, conservation board uniforms, and medical assistance. The in-kind payments equal $152,068 ($16,896 per lineage per year). Although in-kind payments may continue into the future, they remain uncertain as funding is obtained through short-term grants.

Agreements with logging companies frequently stipulate community development projects, such as schools and health facilities, which rarely materialize (Forest Trends

2006). In Wagai and Tiklik, the development infrastructure has consisted of roads connecting the area to the previous logging area to the east and on to Madang town. Road construction costs are estimated at $907,408 per km (DOW 2010). A road from the previous forestry management area to Wanang covers 9.5 km and would cost $8.6 million or $23,945 per lineage per year to build. However, the PNG government recently aimed to improve transportation infrastructure and started work on a road through Wanang, effectively removing the road as an opportunity cost. In addition, the estimate would be an overestimate as the road is not exclusively an in-kind payment to the community, as it benefits the logging company and other areas that it could connect to in the future.

Employment

Employment for both conservation and logging varies. Research projects are completed and new ones start requiring different amounts of labor. Logging activities vary through the 40 year cutting cycle. Scientists working in Wanang have employed villagers as research assistants for $56–136 per fortnight (annual salary $1456–3536). Forty-eight percent (41/85) of adults (3.8 per lineage) have been employed as research assistants, providing $5,580 to 13,589 per lineage per year. In addition, 97% (83/85) of adults and 77% of all individuals (187/242) have been employed by scientist to carry cargo to remote research sites, but records on wages are incomplete.

The logging company employs men to work for $126–652 per fortnight (annual salary $3,290–16,961). Fifteen percent (6/40) of the working age adults in the logging

villages were employed in industrial logging (1.2 individuals per clan) providing $3,947 to 8,553 per lineage per year.

Although payments vary and are uncertain, the gains from conservation and logging are fairly comparable on both the low end ($6,727 to $4,733) and the high end ($14,764 to $20,999), at least after the road is excluded. From a market-based perspective, over the long term the conservation project should have been close to meeting the material expectations of villagers, which would have been determined by comparison with logging benefits. The cost-benefit analysis considers benefits that accrue over the long term, however, logging benefits accure upfront, which is more highly valued from the Melanesian landowner perspective. Melanesian expectations, as the following section will demonstrate, did not conform to market-based logic. Western conservationists judged the transaction by the value of the benefits, whereas villagers judged the transaction by the relationship it created and maintained.

Wanang Perspectives

In contrast to the market-based perspective, Wanang expectations did not hinge on opportunity cost. When villagers discussed the benefits of conservation, they talked about 'change.' Villagers consistently mentioned many changes took place following conservation: battery operated headlamps now provide light instead of burning bamboo torches, women cook in pots, people eat meals on plates, and everyone has at least some money. One man catalogued the change as follows:

> We now eat rice but before we didn't usually eat rice. … Before conservation, a man would rarely capture a young cassowary and sell it to buy soap, salt, kerosene but only rarely. …Before we didn't have batteries, we didn't have money to buy batteries, so we now have conservation and they help us, … we have a good life and are happy. Many things have happened in conservation. We get royalty, we have a car and can go to town, we have … money… enough to pay for the ride and buy things and come back. We didn't have education and now the school has come here and we are happy that our children can go to school.

Despite acknowledging change, villagers complained that the benefits had been inadequate. They expected and hoped for nothing less than complete transformation of their lifestyle, which is what they understood as 'change.'

> We have had this conservation now for 11 years. During this 11 years, yes, the royalties come to make the landowners happy. Yes, little things have come like employment to get money to buy soap, salt, kerosene, rice, tin fish, and what we want to eat. We can work to get it. An important idea is that we the landowners have not had change to our lives. We live like our grandfathers, our houses are in the style of our grandfathers.

Beyond improvements to their houses, villagers talked about living off money, having their own car, traveling to America, and not having to work hard anymore. One woman recalled a period of high activity surrounding the conservation project, during which a majority of adults worked full time building the research station in the remote bush. She expected this to be the beginning of a transformation in her lifestyle. She did not cultivate a garden during this year and was disappointed the following year when she had to resort to eating unripe wild bananas. This woman could not articulate exactly what she thought would happen or what she would eat, but she expected a totally new way of life. In a number of interviews, villagers listed all the changes mentioned above, but then concluded that no 'change' had taken place at all. Although the 'change' was imagined, the details about how it would come about were not clear, except that it would be produced through the relationships created in conservation.

Basis of Differing Expectations

Different cultural understandings of the benefits that the conservation project might yield divided conservationists from villagers. The dual perspectives were best illustrated during a dispute between them. During a project evaluation visit, villagers complained to a representative from a donor organisation that they had become 'slaves', as BRC was receiving all the benefits from the donor and the village was not receiving any. Conservationists become upset that the villagers had jeopardized their funding and invited a group of village leaders to come to the base station in Madang town to discuss this and other issues. During the meeting, one parabiologist tried to explain the conservationists' position,

> Christensen (the donor) gave *us* (the conservationists) money and asked *us* where we wanted it to go… We got funding before we came to Wanang and we can go elsewhere. But now we came to Wanang and it's our primary place to work.

To conservationists, the relationship with the villagers was one of business, which did not tie them to villagers permanently. Although Wanang was their priority at the moment, they had no obligations to them. Another parabiologist explained, "Many research projects end and now you say we can't leave you, but we can." Conservationists did not see a reason to continue the relationship if either party was unhappy, as both were autonomous. Conservationists saw the value of building and maintaining a good working relationship for success of the project but felt no obligation beyond the market exchange. By contrast, villagers contended, they were in more than a market relationship; they were inextricably linked. As one villager explained, they were kin. "You cannot leave us. You are like our father. We work together and both get money. If you leave us, where will you go?" By invoking a kinship idiom for their relationship, the villager brought conservationists out of the business realm and moved them into the realm of ongoing, reciprocal moral obligations as understood by the Wanang. Following from Gregory's (1982) distinction between gift exchange and market economy, the conservationists maintained their independence while villagers asserted interdependence.

A few weeks following the meeting, the villagers presented a pig and garden foods to the conservationists as an act of reconciliation. The conservationists appreciated

their gesture and accepted their apology and the pig as compensation for the harm done by the complaint to the donor and to right the perceived wrong. To the villagers, however, the issue was not their complaint, exactly, but the disharmony created in the relationship between them and the conservationists. Accordingly, their unstated expectation was that the conservationists would reciprocate a pig or chicken in return, as in a traditional rite of reconciliation to re-established equality between the two disputing parties. To the villagers' disappointment, no gift was forthcoming.

Moral Obligation in Conservation

Different expectations can be interpreted in the contrast between market exchange and reciprocal exchange. Conservationists see the complete transformation of material life in a society as an unreasonable and even irrational expectation of a market transaction. Conservationists used concepts of opportunity cost and cost-benefit analysis to judge expectations, and through comparison with other use options like logging, they determined an appropriate level of expectation. On the one hand, Melanesian villagers in part set expectations based on their hope that they would be inserted wholly into market exchange and exit the world of reciprocity all at once. Yet, on the other hand, they also expected that transactions with the conservationists were like relationships with kin. This latter assumption followed from gift exchange relationships, which aim towards achieving material equality between exchange partners, in this case villagers and conservationists, over the long-term. When discussing their expectations, villagers often compared their wealth to that of conservationists.

> When [the conservationists] first came here, they had one car and then [they] got another new car and another new car. And [they] built a new building. We do not have a car. Why do they have three cars, when we have none?

Such objections are common in Melanesian exchange relationships, where there is an expectation that material exchange should balance out equally over time. Exchange partners have a moral obligation to be generous with wealth and there is an unstated expectation that they will reciprocate. For example, when Wanang villagers were invited to an exchange with Musak, another village indebted to them through marriage, each Wanang villager contributed as much money and fabric purchased from town as they could. Village leaders facilitated the exchange that was the result of a Wanang woman bearing a Musak child, an overdue brideprice, and a Musak man intending to repay Wanang men who took care of him when he was ill. The gifts from Musak were slightly short of what the Wanang donated as Wanang had come into greater wealth, but the gift was distributed so that everyone got back nearly as much as they had originally given. The exchange resulted in little to no material gain, but demonstrated the equality of the two groups and their desire to maintain a relationship. Similarly, villagers expected conservationists to reciprocate their generosity by providing ‘change.’ One man explained the stigma that he viewed as having resulted from his relationship with the conservationists,

> I get workers for [conservationists] and direct everyone for them. I figure out a place for them to sleep and wash and get everything they need. Other people think I am like a slave because no big changes have happened. Yes the school is good for the students but it is just for the students. The adults don't get anything for their work. Musak, Tiklik, Well, and all the other communities see me like this, as a slave. They say, "He doesn't have a car or metal roof. There has been no change. His life is still the same as before." I see that [conservationists] have [made]… a lot of change happen, but not so in the community. Swire station is not change for the community. The new school is good change but it must also get permanent metal roofing.

The failure of conservationists to reciprocate this man's generosity was a source of shame for him. Villagers felt they had been generous towards the conservationists and expected to be treated equally. The conservationists with their greater material wealth had the opportunity to be generous in return but seemed to refuse. Inequalities were especially egregious to villagers because they accredited their own contributions as responsible for the conservationists' success in fund raising. Thus a villager told me:

> Swire doesn't give money to [a conservationist] for no reason and he cannot just ask them for money. It is because Wanang has big conservation. [Conservationists] stood up on Wanang and asked for support.

The villagers attributed the conservationists' achievement to themselves, which justified their expectations of reciprocity and greater benefits.

In Wanang, as in many other Melanesian societies, hospitality, host-guest relations, is an essential value. Wanang villagers generally go out of their way to provide for guests. Following the arrival of guests, women go to their gardens to harvest vegetables and men go hunting to find game. Often guests may also be given gifts of money, handicrafts, or store bought goods. What is more, Wanang become exceedingly offended should they not be fed when visiting another village. Wanang treated the conservationists as guests. They prepared for arrivals by cleaning the common area and the conservationists' house. They sometimes gathered greens. However, conservationists were known to prefer store-bought foods. Wanang women and children welcomed them with handicrafts and little performances. Such efforts, of course, had strings attached. They implicitly obliged conservationists to reciprocate. However, conservationists did not recognize their debt. Rather, they made efforts to minimize their imposition by building their own village house and bringing food with them.

In turn, when villagers had medical or business reasons to travel to town, where they had no kin or connections other than the conservationists, they often stayed at the conservation base station. However, rules limited the time they were allowed to stay at the station, as there was limited room and resources. Villagers had to call ahead. Fears of ballooning room and board expenses and limited space led conservationists to consider charging villagers for their stay. These perceived restrictions made villagers feel unwelcome and demeaned. A villager said that the conservationists,

> let you sleep [at the station], but they only let you stay one day, not many, because they have rules. But if they come [to Wanang] they can stay and everything is ready for them and we sit, eat, and story… We are like brothers.

The villagers recognize a difference in hospitality, a difference that reflects inequality in status, and conservationists' unwillingness to play by their rules. They were offended by conservationists' immoral behavior, while conservationists were frustrated by villagers' expectation of perks. One conservationist acknowledged the differing expectations, but believed Melanesian expectations to be "impractical" for operating a conservation project.

To the Wanang, the conservation project also entailed moral obligations to their non-living ancestors, as exchange relationships also include the dead. Ancestors reside in an abundant place full of wealth. There is plentiful rice and tinned fish, which they share with the living, if they so wish. The appearance of Westerners and wealth in colonial times challenged the egalitarian basis of social and economic order in many parts of Melanesia (Worsely 1957). Melanesian societies attempted to reestablish order and equality by combining different systems of belief; they used magico-religious rituals to try to gain access to ancestors and their material wealth. Madang province has a long history of such cargo cults, which varied greatly among communities (Lawrence 1964). A mid-twentieth century cult led by Yali, of which Wanang was a part, was the most prominent of these. Villagers told me that Wanang built a house dedicated to Yali where

they practiced rites that resembled Catholicism. They also placed a bottle with flowers on a table in the center of the house, with the intention of soliciting gifts of cargo and money from ancestors. Such ritual practices have subsided, and there remains a sense of shame about the cargo beliefs of the past. However, the underlying conviction that ancestors can participate in material exchange with the living has also remained.

The conservation project itself was believed to have resulted from this kind of exchange. It was attributed to one landowner whose ancestor contacted him,

> I had a dream before the project ever started that something big would happen. My ancestor told me I had to give [him] a white pig and money, so I buried [it] … He knew I did it and the ancestor made it happen. A strong ancestor can attract white men.

According to this view, the supernatural agency of the community recruited conservationists to Wanang. Another man recalled that,

> We did big work before we … saw the faces of conservationists. We listened to what [the man who had the dream] said and started … clearing the community area. The other communities, Tiklik, Palimul, Musak, all gossiped about us and the work we were doing. They would say that [the people of] Wanang's arms and legs are like machines. Now [after] we did this work, … we wait for the money to come.

When issues surrounding the project arose, further efforts were made to satisfy the ancestors. For example, repeated snakebites were explained as punishment from a displeased ancestor, who appeared in a dream to another villager. Gifts were given to the ancestor, and problems with snakes stopped. To villagers, in other words, their relationship with conservationists also involves reciprocity with the ancestors. Their understanding of the conservation project was in stark contrast to the secular, market assumptions about individual autonomy, and this contrast produced conflicts.

Market Practices in Conservation

Western conservation projects rely on contracts to define relationships with host communities, while the hosts' agreements are guided by moral obligations they derive from kinship. In Wanang, conservationists regarded discrepancies between themselves and villagers as the result of miscommunication that could be corrected through clearer, more explicit agreements. They believed that villagers tended to misunderstand the project and their roles. As one conservationist explained: "isolated rural communities desperately seeking economic development are ill-prepared to negotiate contracts favoring long-term interests over short-term economic gain." Although contract negotiation in Wanang may have been problematic, more clearly communicated contracts were unlikely to resolve the issue of mismatched expectations. Wanang expectations were based in the taken-for-granted assumption that donors try to please their partners, whose future desires may be unknown. The 'change' desired by Wanang villagers was

not incorporated into any contract they entered into with conservationists, but they believed the conservationists could provide it.

As a villager explained, his expectations were not based in a contract, but from rumor.

> [Conservationists] told me to put restrictions on my land. Yes, I passed my own laws … and I brought … conservation here, but I don't know what will happen here from this conservation. I … heard stories that men who put restrictions [on] and conserved their land, [would]… live on money…[and] not want anything because … you … have a way to get money and you will get it everyday.

In addition to contracts, Western conservation assumes that autonomous actors follow economic principles. Conservationists became frustrated when villagers expected to make money in non-market ways. One conservationist concluded that the people of Wanang were just not entrepreneurial enough to respond to the market opportunities presented by conservationists, such as the increased demand for garden food. Conservationists also criticized villagers for being unwilling to perform hard labour and for not competing against others who were willing to work.

Employed villagers did not feel they had to compete, because the conservationists were morally obliged to provide them with income opportunities, such as wage labour and otherwise. One man explained, "Here, the only way we know is to work hard … with our forest spirits." In contrast, villagers saw wealthy people in Wanang and in town who

did not appear to work for a living. One man explained why having to work hard to make money frustrated him: he suspected that most successful businessmen in town were helped by their ancestors.

> Some men aren't educated but they get money. They will talk to ancestors to get money. Most businessmen usually use cargo cults and sacrifices and ancestors to help them get money. But a few will use knowledge and education. The ancestor will die and carry a letter from the living to the dead, marking the day and time to meet them, so the ancestor can give them money. The dead man will come meet them and they will make a plan for business or something. We don't know how they do this, but its true.

These businessmen, he went on, guard this knowledge, and leave the common villager having to suffer through hard labour. Another villager, who first denied the role of cargo cults in conservation, asked me later whether I knew of another way to access material wealth. Some villagers suspected that conservationists, like other white men, possessed secret knowledge of how to access wealth, which they hoped would be revealed.

When faced with villagers' complaints about labour, conservationists explained that learning skills was the only way to achieve an alternative lifestyle. Villagers, they said, should look forward to a time when their children, who recently gained access to education, might grow up to work as scientists and take over the research in Wanang.

This new lifestyle could only be achieved by hard work and personal achievement. In the near term, villagers were frustrated with mere employment as labourers.

Dialogue between Market Exchange and Reciprocal Relationships

The relationship between Wanang villagers and conservationists has been sustained for over 10 years despite disagreements. This could be due to the mutual satisfaction of reciprocity-based moral obligations and market principles, although the co-existence of market and reciprocal exchange was messy, to say the least. Villagers and conservationists were able to incorporate aspects of both systems into their practices, and yet they continued to understand the relationship in mainly their own terms. Wanang villagers viewed conservation as a reciprocal relationship, which integrated social and economic aspects including market exchange. Conservationists spoke of the conservation project as a business relationship with economics as the central concern, while regarding social relationships as a separate, secondary concern, albeit important for a functional conservation project. The benefits of material exchange brought the varying perspectives together.

Wanang villagers regularly incorporated market exchange into their reciprocal exchange practices. They sold fish and betel nuts to each other. They also traveled to town and other markets to sell garden produce or edible *Gnetum* leaves and purchase items from the market and stores in town. However, villagers explained that they preferred market exchange to be constrained by reciprocal relationships. One woman recalled how market relationships had entered into reciprocal relationships when she began selling fish to her father and brothers. Previously, she gave fish freely and they

gave her things or otherwise helped her. Now they helped her with money. It was good to sell betel nut in the village, another man said, but only intermittently. “One time you sell it, then the next time you must give it for free, then sell it, then give it for free.” Villagers viewed the conservation project the same way, selling labour and purchasing goods from conservationists, but also exchanging gifts.

Conversely, conservationists brought small gifts of betel nut, contributed gifts to funeral feasts, and supported celebrations of project milestones. One conservationist was willing to contribute to villagers’ education expenses or healthcare, but was unwilling to provide them with things that he considered indulgent. Another conservationist explained why he felt obliged to the villagers, “I suppose it's Lutheran guilt that compels me to give something back to Wanang after all we’ve discovered there.” That is, he did not follow Wanang moral obligations but heeded his own convictions. While conservationists participated in social relationships with villagers, their norms and practices guided their behavior. The conservationists followed the market convention that separated economic from social relationships.

The sale of headlamps illustrates this point. Villagers who worked as research assistants for visiting scientists were sometimes given headlamps or other goods as gifts when the job ended. The headlamps became popular and a conservationist was led to import the headlamps from overseas to sell at cost. He viewed doing so as fulfilling desires for a good they could not have otherwise obtained in PNG. He said that he needed to cover his costs, but did not expect to make a profit. He also felt that a precedent should be set so that no one would expect things for free from conservationists in the future. The

expense would limit requests. If he gave things away, he expected that everyone would make requests. The conservationist, when reflecting on how these transactions fit into gift exchange, explained that the labour and risk associated with purchasing goods and transporting them through customs was his gift to villagers. He wanted to meet their expectations but in terms of market exchange.

From their viewpoint, villagers repeatedly asked why the conservationist made them pay for the headlamps. Sometimes, they observed, these goods were given away. And so they concluded, the conservationist had been able to afford the purchases in the first place. Why wasn't he more generous? Several villagers wanted to hold the conservationist responsible for fixing or replacing faulty headlamps, expecting a long-term exchange relationship with him, but one not strictly defined in market terms. Nevertheless, villagers were pleased to have the headlamps and looked favorably at him for making them available. While the conservationist incorporated the morality of gift exchange into marketing headlamps, villagers incorporated market exchange into the morality of gift exchange.

Royalty payments also exemplify this divergent understanding of exchange. Royalty payments were annually distributed to landowners. Conservationists viewed these payments as a fee for service, as they were paying rent for using land. The payments were important. They indicated that the conservationists were not taking advantage of the villagers, but were fairly compensating them (Novotny 2010). Conversely, villagers viewed royalty payments as a way to please an exchange partner. The donor organisation, as a man told me, "is happy, they want to make us happy and

they give us the royalty." When I asked one man to explain how the royalty was meant "to please the landowner," he imagined the following scenario in dyadic terms:

> I will be happy if you give me something, I will look after you and whatever you need for food and other things like meat, and you will give me something back, when you want to leave you will be happy that I had good behavior towards you. I looked after you, so now you will pay me back, make me happy, give me clothes or money or something like that, a headlamp, that is pleasing.

This man expressed his view in immediate, personal terms. That is, he adopted the idiom of reciprocal exchange to convey how he understood royalty payments. Royalty payments were not, in his perspective, a legal-economic compensation. They were part of a sequence of give and take through which moral sentiments are aroused because obligations are fulfilled.

Another man, by contrast, felt tension in the exchange relationship with the donor, as he felt incapable of reciprocating. "They give [royalty] money and I am not able to give back food, its hard for me to repay them, I don't know why they give this money to help Wanang." He was troubled because he did not know the donors personally and had no direct contact with them, so he could fulfill his side of the relationship.

Other villagers were relieved of the pressure of this obligation by contributing to the local big man's exchanges with conservationists. This individual had close personal relationships with conservationists and donors, satisfying various obligations by offering

pigs and other things as gifts. In the view of the big man, villagers were paid royalties because they made conservationists' work possible, and their work benefitted people in other countries. This explanation, together with his gifts, answered the two conflicting exchange systems by combining them. Gregory's (1982) distinctions were blurred, as both alienable money and inalienable land rights were exchanged.

Villagers included conservationists in their social networks and called on them, just as they called on kin, when they needed to amass wealth. A few years prior to my fieldwork, a fight had broken out in Wanang. One man remained offended by a particular party and demanded compensation from him to resolve it. The latter man had become ill and it was thought that he would die if he did not satisfy his demands. His antagonist was reputedly a dangerous sorcerer. In this kind of circumstance, people call on kin to raise funds. The ill villager radioed the conservationists in town to ask for money. When presented with such requests, the conservationists tended to grant it, if it was made by somebody whom they employed. He would be given a pay advance, which they could be confident would be repaid. However, large requests, or requests from individuals whom conservationists did not employ, would be declined. The willingness of conservationists to accommodate such requests was highly valued by villagers, who wanted to regard conservationists as kin. At times, reciprocal relationships and market exchange came together to satisfy these requests and meet the expectations of both sides, but only when conservationists' market expectations were satisfied.

Some villagers imagined the conservationists to be ancestors. Beyond initiating the project by bringing conservationists to Wanang, ancestors were also suspected of

coming back to the village disguised as conservationists. For example one man told me that,

> People in Palimul [village] said [a conservationist] was my dead father come back to help me because he was short and fat like him. Then they said [another conservationist] was my dead brother. But I told them this wasn't true because they had come from somewhere else where they have families and they had only come to work. Then you came and they say you are my dead daughter. But I tell them no, because when you first came you traveled to Tiklik and Palimul to learn their customs, but if you were a dead ancestor you would already know their customs.

In the debate this man recounted, he rejected the spectral identity of particular conservationists, as well as of me, but he did not discount the possibility that ancestors could return to the community. In other words, villagers desired relationships as potential access points to ancestors, but such desires were not openly discussed. As one man said privately,

> Some people think you are an ancestor because you follow PNG customs. You carry firewood and cook for me when I am hungry and give me things. [People think] other ancestors will also come and they will be mixed in with white men. You cannot tell who they are because their faces have changed but they know

> you. Like if you go with a white man to the water and he asks you about your family and how many children you have, then you know he is an ancestor because white men don't worry about those things, and they are trying to decide if you are their ancestor…If the project ends, the white men and the ancestors will not have a way to come here anymore.

My participant-observation methodology allowed me to mimic custom more closely than the typical biologist, leading to view that I was an ancestor. This man watched the conservationists, waiting for his ancestors to reveal themselves and provide him gifts. At least some Wanang villagers interpreted relationships with them through their own cosmology. They judged the project focusing on what they valued and discounted inconsistencies to allow it to continue.

Conclusions

How do direct payments for conservation in Papua New Guinea meet contrasting expectations of landowners and conservationists? As I have shown, expectations are complex and depend on cultural perspectives. Western conservationists, using direct payments to create simple market relationships that maintain their independence, will be frustrated by the expectations placed on them. Villagers receiving direct payments will welcome them as the first step in creating and maintaining relationships with conservationist. However, their interest in creating a long-term relationship and their expectations about the future will frustrate them. This difference follows from Polanyi's (1944) contrast between what he called 'disembedded' economic relationships in

capitalist societies and economic relationships that are 'embedded' within larger social and political traditions. The embeddedness of relationships in Melanesia means that direct payments alone cannot satisfy local expectations. The assumption that direct payments would be disembed from wider relationships will frustrate the market-based expectations that reduce the definition of the goals to those of self-interested, cost-benefit rationality.

Melanesian villagers and Western conservationists are not playing by the same rules. Conservationists follow market principles in which autonomous actors enter into explicit agreements, while villagers understand exchange relations as an interdependent moral give-and-take. These systems of exchange may not be sustainable at their extremes. However, it is possible to maintain conservation projects. If conservation projects are to last, both sides must be committed to tolerating dual expectations with patience and flexibility. Similarly, in the PNG coffee production industry buyers partake in exchange relationships with villagers, while simultaneously participating in the industrial coffee market (West 2012). Similarly, in Wanang the friction between market and reciprocal exchange resulted in a new system that encompassed aspects of both. For example, Gregory's distinctions (1982) were muddled. Some goods exchanged were alienable (money), while others were inalienable (land and labour), different types of items were exchanged, and the actors became dependent on one another. Unsurprisingly, a strict market-based approach to exchange did not work in a Melanesian society. Likewise economists have begun to recognize the influence of fairness in transactions, yet the incorporation of such factors in market-based logic is minimal (Fehr

and Schmidt 1999, Kahneman et al.1986, Rabin 1993). The Wanang project further makes the case for incorporating fairness and other social or cultural considerations in exchanges planned by conservationists.

The use of direct payments for conservation in Melanesia is promising despite the differing expectations and potential it creates for local-level conflict. Long-term, direct payments may be necessary to bring conservationists and Melanesian villagers closer to achieving conservation in practice. The material exchange, fundamental to royalty payments, seems like an improvement over integrated conservation and development projects, which did not allow for direct material benefits and the relationships based on them (West 2006). Ironically, direct payments more closely resemble reciprocal exchange relationships than conservation and development projects. For Western conservationists to facilitate projects in PNG, they must maintain a working relationship with landowners, which will require the ongoing work of maintaining equal status through gift exchange. In addition, direct payments appeal to villagers who value long-term relationships. Direct payments, however, will inevitably create complications that will not follow market conventions, and cannot be anticipated in contracts. It is likely that conservationists will fail to fulfill the material expectations of Melanesian villagers, but doing so is not necessarily what is required in a working relationship, because being in debt is socially acceptable.

A culturally sensitive approach to conservation will require conservationists to negotiate and renegotiate exchange with villagers. However, maintaining support for direct payments raises challenges for the sustainability of conservation efforts. Donors,

such as Swire and Steamships, will not continue provide direct payments in perpetuity but favor short-term, high-profile projects. Supporting conservation efforts that allow conservationists on the ground the flexibility and resources to maintain relationships with landowners will require a transformation within donor organizations. Yet conservationists playing by at least some of the same rules as villagers will achieve more than sustainable conservation, it will result in ethically sound conservation (Brosius 2006).

The literature, I should add, bears out this conclusion. A meta-analysis of conservation projects found that culturally appropriate conservation approaches were better predictors of conservation success than economic benefit (Waylen et al. 2010). Halvaksz (2014) found that a conservation project unwilling to engage in Melanesian systems of land tenure but using Western concepts of land tenure, created social tensions and led to the end of the project. Van Helden (2001) found that conservationists focused on biodiversity protection failed to develop projects with villagers, who were more interested in material benefits, territoriality, and traditional identity maintenance.

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Appendix 1: *Maghu* glossary

Maghu	**English translation**
ab	firewood
ab munum	firewood (not burning)
abi	woman
api maku	male dog
api ningi	female dog
abib	old woman
abisiya	come and go
abiv	grandmother
ading kane	where is it?
ading ki ti yang	where do you come from
adu	us,we
adu aning kunar	we are at the river
adu sab mungaviv	we work
adu uling kunar	we are at the house
adu uvi	we go
agrinda	two
agrinda pavra	three
agu	ball (testicles)
agur	eel
akab	wild
akav	wild
aluvii	let's go
amaske	last
amaské	last born (boy)
amaskum	last born (girl)
ambakumbi	sleep
ambrakum	hometown
ambrakum	place, cut bush to make place
ambut	sleep
ambut kuving	sleep
amu	breast
amukam	crab
amul	tomorrow
amunanmune	afternoon
amunda	night
anamuna	small
ang	river/creek
ang	water
ang muge	rain
ang mugi sulung	you go bath
angguming	wet season

angu	foot
anguangi	large, black water snake
aning	water
aning uvi	we go to water
anul	after tomorrow
anur	day after tomorrow
apapal	butterfly
api	dog
apunga	turtle
arabuning	three days after tomorrow
araku	him, her
arkungar	third born (girl)
asid	large
asur	big eel
augubi	we go
aul kambiang	rest
auri	betelnut
av	fire
avu	tell
avu	talking
avung	you say
avung	talk
ayu	bamboo
bangé	ginger
bara	flat and round
beyaka	friend
bumbar	grass
butir	genus *Hydriastele*
dibur	cucumber
diku	raptor
dindu	star
duag	ear
gabu	hornbill
gading	cuscus
gagam	sweat, hard work
gagong	megapode with brown eggs
galang	long
gavuduguku	red tips
giou	snake
guria	pigeon
huie	go
i	me
ibura	dusty undersurface
ibura	dust, dirt, ash

iding	know
igigum	general name for snakes
igu	give
ikium	grandfather
iku	to cut
ikugum	uncle's wife
ikumigiri	smell or odour
ikung	uncle
imu	work
imus	fern
ipas	hammer
irikal	bark with hairs
irina	moon
isabi	we carry
isung	big brother or sister
itang	fence
itumakivung	I want to smoke
ivu	yam
iyu	bamboo
kaim	knife
kamooung puta	dew
kamour	pepper
kamul	cloud
kang yang	skeleton
kaningi	who is that?
kaniv	potato
kapu	bird
kapulke	to shoot
katam	head
katamda	five
kati	post
katusaun	fly (insect)
kawang	coconut
kayagu	white poisonous snake
kayang	strong
ke	singsing, traditional song and dance
kenung	fish (bone fish)
ki	talk
kiar	chicken
kiavubi	speech
kika	bass-like fish
kiku	new
kiku	green
Kikur	new

kimengé	first born (boy)
kimu	insect
kimungum	first born (girl)
kingiou	megapode with white eggs
kinu	tamiok
kisir	fruit
kiung mulu	large turtle of sandy beaches
kiungav	fish
kiungi	cockatoo
kiungu	fish
kivekive	cassowary swallow
kivra	cassava
klakle	good
kual	garden
kuar kikur	new garden
kuar mange	old garden,
kub	trail
kub ubi	walk
kubu kubu	pigeon
kugar	arm
kuiv	bird of paradise
kukangyung	back
kul	man
kulabi	people
kumar	fish (with barbels)
kumba	aglaia
kumbiung	will
kumbiung	is
kumub kasir kasir	hand
kumuke, kapu	cassowary
kunar	to be
kundu	morning
kunga	yellow
kungal	large
kungar	calf
kunika	you stap
kunukel	allow
kunung	cause, base, start
kunwar	big
kupubi	wake up
kur	small
kusur	fruit
kutum	abdomen
kuv	trail

lu	see, look
magakumbi	sit down
maghu	no
makal	lizard
makal ningi	poisonous lizard
maki	sago
maklu	to smoke
makpiung	black cockatoo
maku	male, teeth
mang	banana
mangar	sugar cane
mange	old
manim	genus *Livistona*
miduag	think
miging	tongue
mimi	ancestor
mine	shoulder
mis	cat
moning	later
muklum	white cuscus
mukum	new edible growth
mulim	white latex
mumu katam	nose
mun'e	small
mundagiun	green, small, poisonous snake found in grass
munde	grassland
munde	herb
mundu	red
munga kunu	sit down
mungapa	to hold
muni	younger brother or sister
mur	mushroom
musungyea	lightening
muta	I don’t want
mutiagrinda	four
muting	to not want to, tired of
na subur	you want
nagi	mosquito
nagise	mosquito
naisi	why
nangali	now, today
naning	here
nar	to eat

naru	you all
natatamu	prawn's eye
natu	prawn
nidu	they
nigum	small eel
ning	taro
ningi	female
nive	edible
nudu	you (plural)
nudung	child
nugoomda	many
nuvirung	you will eat
nuviung	eat
p'ine	palm
paliang	lie
palum	mountain
papasi	flower
pavra	one
puna	palm
punang	good
quanam	tree name only
sabibi	work
sagul	bark cloth
sakum	neck
sakwa	genus *Caryota*
sanu	pig
sap	big garden
sauar	quickly
sauar sauar ye	come quickly
sav	work
savar	yam (mami)
sawar	quickly
siau	tree name only, eg. Aceratium
sicur	two days after tomorrow
simi	woody climber
sinosoi	cloud
sipu	rat
sir	dead man
sirakua	third born (boy)
sisi	hair, leaf
su	ass
subula	bad
sukivung	food
suku	true, very

suli	forest
sumbu katam	mouth
suming	wild
sunam	leafy green (Abelmoschus manihot)
suvung	nambis
takuvyung	to cut
tamul	eye
tangivu	sarang
tarum	thigh
tavu tavu	wall
te	tree
te sisi	leaves
te'anemina	seedling
te'kisir	fruit
tikaya	get
tikivla	hairy/irritating
tiving	planted
tugo	fish
tumab	side of torso
ukul	fish (kol pis)
ul	house
ul kungir	general name for house frame trees
uling	house
ulua	pumpkin
umbung	chest
umuning	yesterday
una	light
unganamu	hear
unge	bandicoot
upiung	good
ut	tobacco
uti	smoke
utum kunair	stand up
uvi	we
uving	walk
uviung	go
vi	ground
vi madu kame	dark already
vid	ground
waba	father
waba animuna	father's brother
wakulvi	hunting
wangu	bilum
wanum	arenga

wawa	papa
wayan	sun
wayanguming	dry season
wayankumar	big sun
wayenda	noon
weyung	cloud
yaka	my
yama	mama
yama animuna	mother's younger sister
yama kunwar	mother's older sister
yame	crocodile
yangabum	second born (girl)
yangubé	second born (boy)
yarum	wallaby
yavarke	fish (red)
yaver	I come
yeh	come
yikun	mother's brother
yiupinung	I want
yum	sky
yu	I

Appendix 2: Ancestor stories

Wallaby story as told by Filip Damen

A Galisakang woman married into Masla, moved there, and had a son. She was called back home for a party. She went and was given lots of food. On her way back to Masla, her son started crying. She stopped in a sago swamp to feed him. She opened one of the bundles of sago that was given to her at the party and saw that it was mixed with dirt. She opened another package and it was also mixed with dirt. She hung the baby up in a bilum on a branch and started to cut sago. She cut one tree, then a second, and a third, fourth, fifth, and sixth as it started raining. The water started rising and it rose so high that it carried the woman away and she drowned. The baby was still hanging up and was crying. A wallaby heard the baby and looked everywhere for its mother. When she couldn't find the mother she took the baby and raised it. She brought it out to the ridge where Swire Station is now built and they lived by the bamboo patch. When the boy got bigger, he told his mother to clear the bush. He built them two houses and made a garden. One day the man and the wallaby went to collect *taun* fruits by the Digitam River. Two sisters and their brother from Igumana approached, so the man and wallaby left and tried to hide in a tree. The sisters and brother saw the t*aun* fruit peels they left behind and followed them. The brother and the dog led because the dog could smell the wallaby. When the dog started to chase the wallaby, the man yelled from the tree for it to stop. The wallaby and the man ran back to their house. The wallaby knew the sisters would come looking for them so she changed into a woman and dressed like she was the one up the tree with a rope on her shoulder and pollen on her body. The sisters came and found her. They asked if she was up in the tree and if she had build this house and garden herself. The wallaby woman said yes but the sisters knew she was lying. Their brother had already left so the sisters said they would stay the night and leave in the morning. The wallaby woman knew she couldn't hide him, so she went and told the man to come out of the house. The two sisters were happy and wanted to marry him so they stayed and made two large gardens.

When the man was ready to pay their brideprice and had pigs ready, the sisters invited their family to come. The man killed the first pig and the first wife gave it to their brother but he said he didn't want that pig. The man killed a second pig, but the brother didn't want that one either. The man killed a third pig but the brother didn't want that one either. He told his sister he came to eat the wallaby. The first wife talked to the second wife and they decided that they would tell their husband to see if he would agree. The man agreed and shot the wallaby with a bamboo spear. The brother took the wallaby and told the rest of family, "This one is for me. You all can eat the pigs." They all knew that it was the woman as they had seen her change.

Some time had passed until the man and his wives were going to clear bush for a new garden. The man told his first wife to ask her brothers to come and help but that only one at a time should come. Then the man began to prepare a trap. He dug a very deep hole as deep as a house and sharpened spears to stand up in the hole. Then he covered it in leaves and built a house full of food. When the first brother came, he went

to this house and ate. As he ate, a frog called out but the brother said, “No. I won’t share with you.” Then the brother smoked and the frog called out again but the brother said, “No. I won’t share with you.” When he was finished he walked down the trail toward the garden but he fell in the trap, was impaled, and died. This happened 6 more times as more brothers came to help in the garden. When the eighth brother came and the frog called out for food, he gave him some. When the frog called out for tobacco the eighth brother gave him some. Then the frog said, “Because you have shared with me I will help you. When you walk down the trail to the garden look for the leaves and pick them up.” The eighth brother did this and found his seven dead brothers. The eighth brother ran back home and prepared bundles of spears and arrows for battle. The man also prepared bundles of arrows and his wives attached string to the ends of them. When the brother was ready he gathered the rest of his clan to kill the man. But the man was ready and killed the brother’s entire clan.

The story of Alkapke- The bird clan, told by Mathew Kumba

Alkapke is sitting on the ground under an *Intsia* tree. His little brother is on top of the tree. There is a woman sitting in the shade of the *Intsia* tree and Alkapke shoots birds flying into the tree. After he shoots the birds, the woman gathers them. The brother shot a red bird in the tree and it flew out of the tree, but the man told the woman she could not go near the bird. The woman was confused. She left the tree and got the red bird. The woman was not supposed to go close to the bird or she would be confused and want to marry the man who shot it. She went and got the bird. Then went to be with the brother on top of the tree. She followed him into the forest, and they hunted and got water. They returned to the top of the tree. Alkapke looked everywhere for her and returned to the *Intsia* tree. There he saw the remains from crafting a *bilum* (a netbag made by women from treebark). He called out to his brother, who sent the woman down. Alkapke got all the men to cut the *Intsia* tree down and it took a week to do. Amaske, the last born man, cut the tree down, but the brother on top of the tree had a rope between the trees. Alkapke went to the top of the tree and chased his brother up and down and up and down the trees. He followed his brother and they arrived at the coconut. He continued to chase his brother until they came to another place, like Lae, or Goroka, or Musak. Then a *singsing* (song and dance celebration) was to be held. Alkapke prepared his drum and decorations and the woman prepared water for him. They sang and danced and all the women liked Alkapke The women gave him betel nut and fought over him. Alkapke drank water that had a centipede in it. He swallowed it, fell down, and died. The woman carried his body in a bilum as she sang and danced. He was very tall and required five bilums to carry him. The woman ate when the food was shared out. When the *singsing* was finished she carried his body back to his home, crying while she walked. The birds sang out along the way. His brother had been jealous and put the centipede in the water that the girl gave to Alkapke. The woman carried him for four days to his home. She slept and water came out of his body. She removed his decorations and continued walking. The hornbills sang out “jimur jimur i go” to tell all the other birds. Hornbill was angry because this man used to shoot them all. The woman met up with all the pigeons at the home of all the pigeons.

The crowned pigeon is the king of all the birds. He said, “We will look out for this man.” Pigeon does not go on top of the *Intsia* tree like cockatoo and hornbill, the birds this man used to shoot. The black cockatoo said, “The man smells take him away.” The woman carried him to the megapode nest. Pigeon told her, “We will look after him” and put him in the nest. The eagle came and said, “Its good meat” and wanted to eat him. The pigeon gave the woman a house and she put the man inside. He was just bones and she wanted to bury him. They cut a palm leaf sheath for a coffin and put him in a fire. She put his skull in the bilum that she made with his decoratiosn from the *singsing*. The pigeon took the woman and bathed her. The bones of the man turned the colors of pigs: red, white, and black. The house filled with pigs. The pigeon and the man’s line planned for an exchange, so the pigeon built a house. They had a party with four pigs and sang and danced a *singsing*.

Appendix 3: Conservation deed and map

THE DEED

1. This Deed is a binding agreement made by the following clans: Alkapke, Kaipsakang, Iga, Babugu, Katam, Kai, Mudd, Kmevung, Wanasakang, Igumana and ~~Garisakang.~~ KAMBASAKANG SALDON

2. We control those areas of land described and marked on the map set out at the bottom of this Deed.

3. We agree to conserve our land and agree to develop our land on our terms.

4. We agree to work together to conserve the bush, ground and water on our land.

5. We agree that we will NOT sign a Forest Management Agreement (F.M.A) with the Forest Authority.

6. We agree that we will NOT enter into any agreement to allow timber to be harvested under a Timber Authority (T.A).

7. We agree that no one will be invited onto our land without all clans consenting.

8. We agree to work together to set up a way to control development on our land.

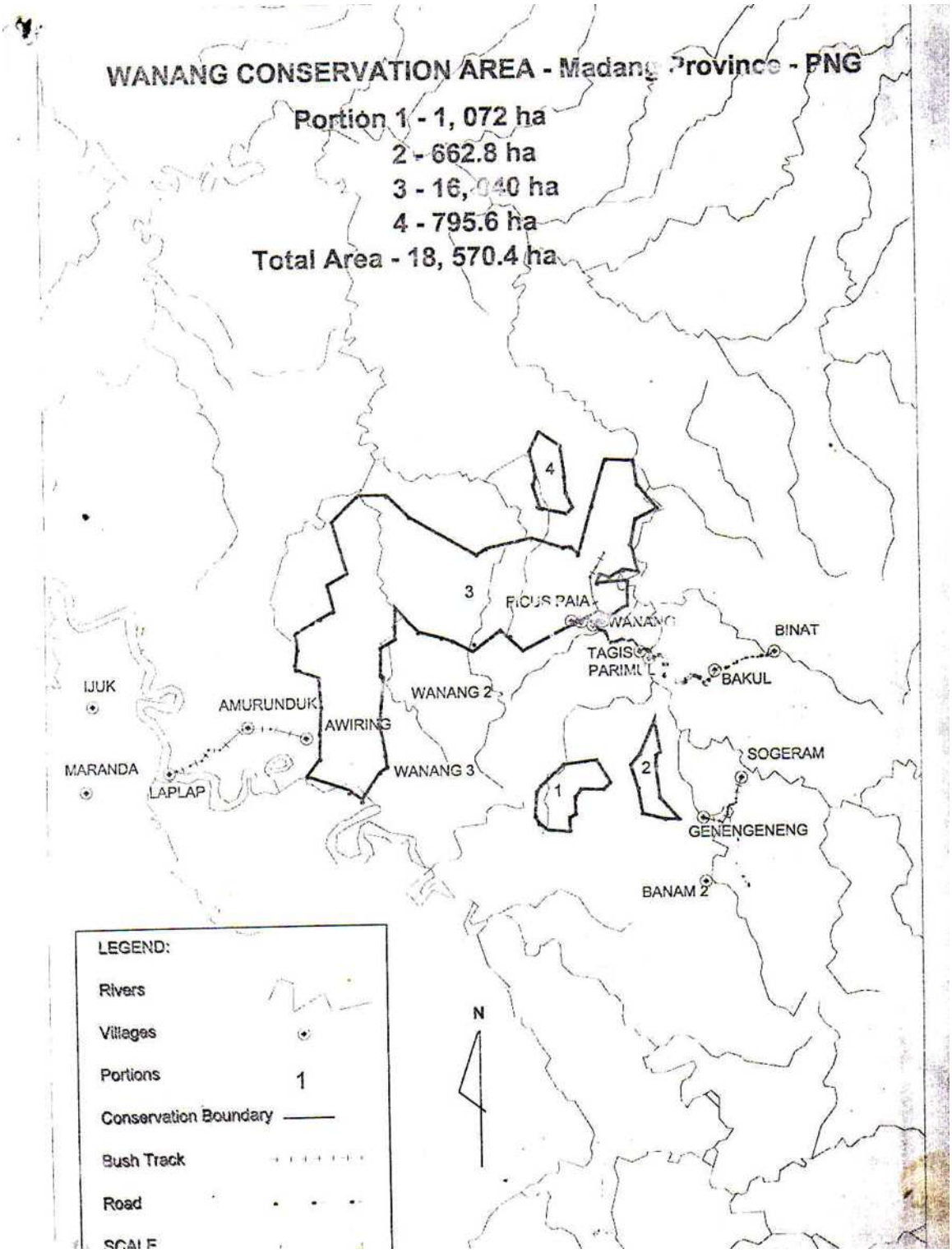
9. We recognise that this Deed is a legal document which binds the parties to their promises and can be enforced in the National Court.

10. This Deed will still be in force even if one of the persons who signs it dies or gets very sick.

11. If a person who signs this Deed on behalf of the clan dies or gets too sick, we agree, that clan must appoint a new person. When a new person is appointed, they should sign the Deed again to show that the clan is still bound by the Deed. However, even if that person does not sign, the Deed will still remain in force.

12. This Deed will be signed by person(s) appointed by the clan as the person(s) who are authorised to sign on behalf of the clan.

13. The Deed will be signed in public, in front of the clan who have instructed the person(s) appointed by them to sign it


WANANG CONSERVATION AREA - Madang Province - PNG
Portion 1 - 1, 072 ha
2 - 662.8 ha
3 - 16, 040 ha
4 - 795.6 ha
Total Area - 18, 570.4 ha
4
3
RIGUS PAIA
WANANG
TAGIS
PARIMU
BINAT
BAKUL
IJUK
AMURUNDUK
AWIRING
WANANG 2
WANANG 3
MARANDA
LAPLAP
1
2
SOGERAM
GENENGENENG
BANAM 2
LEGEND:
Rivers
Villages
Portions
1
Conservation Boundary
Bush Track
Road
SCALE
N

SIGNED BY PILIP DAMIEN (PHILIP DAMIEN) ON BEHALF OF Alkapke Clan ON THIS DATE: 1st June 2000

X (TIMOTHY DAMIEN)

X (ROBSON DAMIEN)

SIGNED BY (JAMES MARKUS) ON BEHALF OF Iga Clan ON THIS DATE: 1st June 2000

(TOM MARKUS)

X (JACOB MANDUNG)

SIGNED BY X (MANSA ANI) ON BEHALF OF Katam Clan ON THIS DATE: 1st June 2000

X (ALBERT MANSA)

X (SAMUEL MANSA)

SIGNED BY _____ (PAUL KEMA) ON BEHALF OF Babugu Clan ON THIS DATE: 1st June 2000

_____ (CHRISON BUGA)

_____ (HASEL PAUL)

SIGNED BY _____ (DIDE SIRAKULA) ON BEHALF OF Mudd Clan ON THIS DATE: 1st June 2000

_____ (GEORGE DIDE)

SIGNED BY _____ (SIRAKULA KEPE) ON BEHALF OF Wanasakang ON THIS DATE: 1st June 2000

_____ (KEMA KEPE)

_____ (ADAM KEMA)

SIGNED BY _____ (JEPI ROP) ON BEHALF OF Kai Clan ON THIS DATE: 1st June 2000

_____ (SAMUEL JEPI)

_____ (ANDOS SAM)

SIGNED BY SALDON (SHELDON YAVI) ON BEHALF OF ~~Gorisakang~~ KAMBASAKANG SALDON Clan ON THIS DATE: 1st June 2000

X (CHRISTOPHER SHELDON)

X (STEVEN SHELDON)

SIGNED BY X (JORI UMBANG) ON BEHALF OF Kaipsakang Clan ON THIS DATE: 1st June 2000

X (JOEL JORI)

PATRICK (PATRICK JORI)

SIGNED BY MARK SESE (MARK SESE) ON BEHALF OF Kmevung Clan ON THIS DATE: 1st June 2000

SIGNED BY S (SAMSON MAREKS) ON BEHALF OF Igumana Clan ON THIS DATE: 1st June 2000

WITNESSED BY: (PAUL ZUVANI) DATE: 01/06/00
PO BOX 483, MADANG, MADANG PROVINCE

WITNESSED BY: Samuel Mengoun (SAMUEL MENGOUN) DATE: 01-06-00
PO BOX 144, WEWAK, EAST SEPIK PROVINCE

Appendix 4: Letter from PNG Forest Authority 2006

PAPUA NEW GUINEA FOREST AUTHORITY

NATIONAL FOREST SERVICE

HEAD OFFICE - FRANGIPANI STREET, HOHOLA.

P O BOX 5055, BOROKO,
NATIONAL CAPITAL DISTRICT,
PAPUA NEW GUINEA

TELEPHONE (675) 3277800
FACSIMILE (675) 3254433

13 th June, 2006
File 98-10-2

Mr. Philip Damen
C/- New Guinea Binatang Research Center
P.O Box 604
Madang

Dear Sir,

SUBJECT: WANANG CONSERVATION AREA LANDOWNERS STAND

Reference is made to your letter dated 30th March 2006 relating the above-mentioned subject matter.
In your letter you raised queries in regard to firstly whether or not the National Forest Service (NFS) recognizes the Wanang Conservation Area and secondly whether or not the area is inside the FMA boundary.

We reply to your queries as follows:

1. The NFS at the moment has heard and received letters relating to the Conservation Deed some landowners signed with an NGO group. However it does not recognize the deed unless there are evidences to show that the area has been declared as conservation area by the Department of Environment and Conservation and published in the National Gazette.

The NFS would appreciate it very much if you could make available any copies or documents relating to the declaration of the area as a conservation area.

2. Secondly for your information the earmarked conservation area is in the FMA area.

Our records show that during the first trip for FMA signing those ILG aligned with the NGO group refrained from signing the FMA. However sometime later these groups changed their minds and wanted to sign and they did during the second round FMA signing trip except one ILG which did not sign. The NFS is not pleased that those ILGs

that signed both the FMA and the Conservation Deed did not inform the Forestry team that conducted the FMA signing in 2004 and now you are raising the matter (*Attached list of names*)

Be advised that it is a practice now that in the FMA 10% of the total area is allowed for conservation purposes. Therefore in the Ramu Block 1(Kumlam) FMA an area of 12481hectares have been earmarked as conservation area and your need would be accommodated under this arrangement It is therefore prudent that you identify and zone this conservation area and provide to us the map thus that it can be incorporated in our FMA map

We hope that the information provided here has clarified any doubts you have raised in your letter

Thank you

Yours faithfully,

BROWN KIKI
ACTING MANAGING DIRECTOR

Cc: Chairman PFMC Madang
Cc: PFO Madang
Cc: Area Manager Momase Lae

Points for Consideration

1. The location of the claim to be Conservation area is within the FMA area.

2. The NFS will not recognize the Deed of Agreement unless an evidence *(copy of gazette)* is provided where the Department of Environment and Conservation has done ground work (surveys) and declared in the gazette as a conservation area

3. During the second round FMA signing the ILG that divided to two groups did not inform the Forestry team except one that withdraw (Kaie ILG - Jerry Rop)

4. One land group splitting to two groups (*meaning the land is also being divided*) will create problems during the harvesting of timber. The operating company will have difficulties trying to avoid conservation areas that are scattered

5. There are two options to decide from

    a) All the divided ILG negotiate and compromise to forego the deed of agreement and be in the FMA only.
    b) All the divided ILG be excluded and be withdrawn from the FMA. If this option is taken then NFS will adjust all the information in the FMA.

6. The total area designated for conservation is 18,570.4 hectares that (11) land groups claim to own.

7. There is 10% allowed for conservation in the agreement that is 12481 hectares however under this deed of agreement the estimated area is 18570.4 hectares that is 6089.40 hectares in excess.

8. There are (3) land groups that are not party to the FMA agreement.

The Provincial Forest Officer in Madang requested that the NFS should make clear its stand on the queries being raised by the landowners and it is suggested here that based on the information provided NFS should decide on its stand.

Submitted for your information.

Muyang Basenke
Supervisor Landowner Liaison/FMA

KWANANG CONSERVATION DEED LANDOWNER VERIFICATION

#	CLAN NAME	NAME OF CLAN AGENT	REMARKS	ILG NUMBER
1	Alkape	Philip Damien Marthias Kumba	Signed Conservation Deed Elder brother signed FMA	5211
2	Iga	James Markus Markus Digam	Signed Conservation Deed Father signed FMA	5214
3	Katam	Mansa Ann	?? Land under dispute	
4	Babugu	Paul Kema	Signed Conservation Deed Same person signed FMA	5219
5	Mudd	Didei Sirakula Francias Kema	Signed Conservation Deed Same clan signed FMA	5223
6	Wanasakang	Sirakula Kepe Kema Manava	Signed Conservation Deed Elder brother signed FMA	5207
7	Kai	Jepi Rop Jepi Rop withdraw	Signed Conservation Deed Signed FMA withdraw	
8	Kambasakang	Seldon Yavi Alphonse Manga	Signed Conservation Deed Person signed FMA	5213
9	Kaipsakang	Jori Umbang Angu Kema	Signed Conservation Deed Same person signed FMA	5216
10	Kmenung	Mark Sese	Signed Conservation Deed	OK
11	Igumana	Samson Maneva Marson Maneva	Signed Conservation Deed Elder brother signed FMA	5210

Appendix 5: Sample questionnaire

Questionaire
Yupela stap we? Conservation area □ FMA □
House line bilong husait:_____
Hamas haus bilong em_____
Husait I stap long dispel haus line:_____
_____
_____
Husait I save go painim abus? (Mark above with *)

Taim yu go painim abus, yu save go we?
FMA_____ CA_____ Other_____

Health
I gat sampela man o meri bilong dispel haus i bin sik nogut o dai pinis insait long tripela yia bipo nau? _____
Wanem kain sik? □Pekpek wara □Pekpek blut □Kol /malaria
□ Bebe dai pinis □Narapela _____

Masalai
Yupela gat masalai? □Yes □Nogat
Sapos yes. Masalai bilong yu bin gat bel hevi insait long tripela yia bipo nau? Olsem long 2009, 2010, o 2011? Stori_____
_____
_____

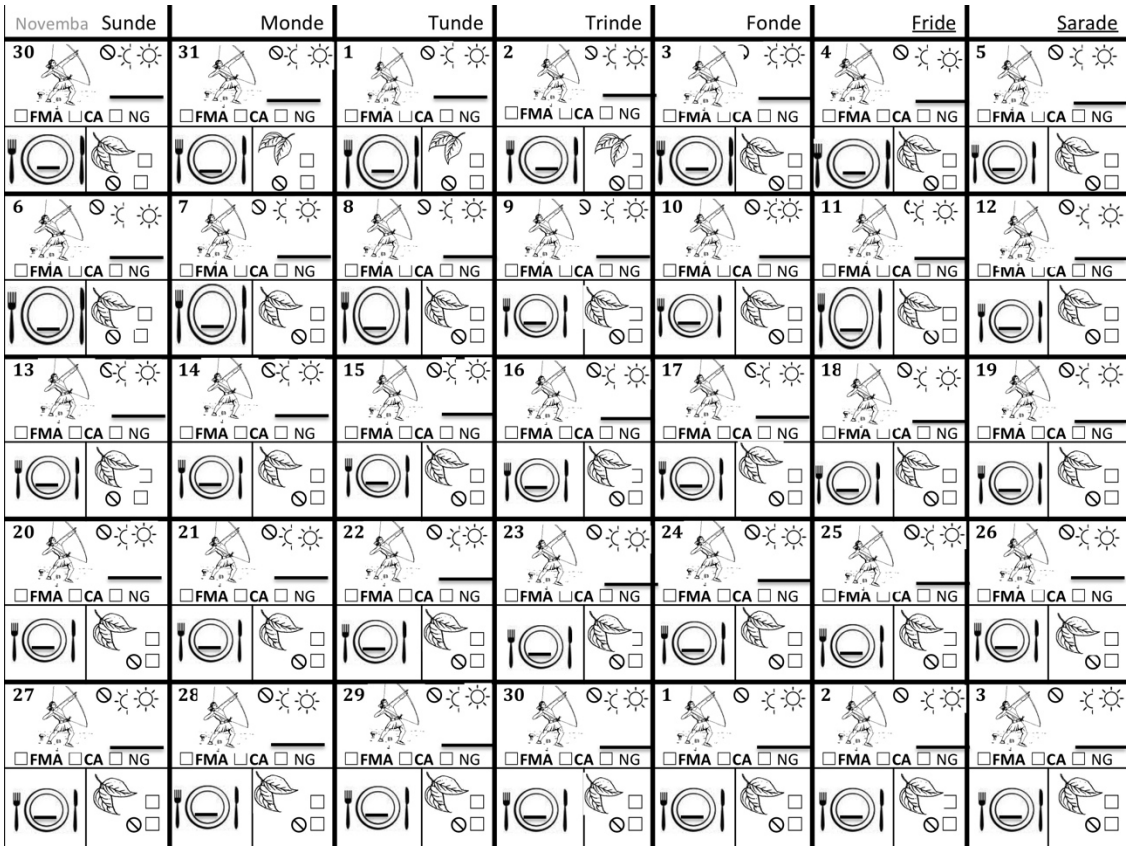
Wealth
Wanem dia samting bilong yupela: □Truk □ Generator □Kapa roof (hamas hap?_____) □ Fermentary □ Radio □ Cellphone (hamas?_____) □ Sewing machine □ Lamp/torch (hamas?_____)
Other_____

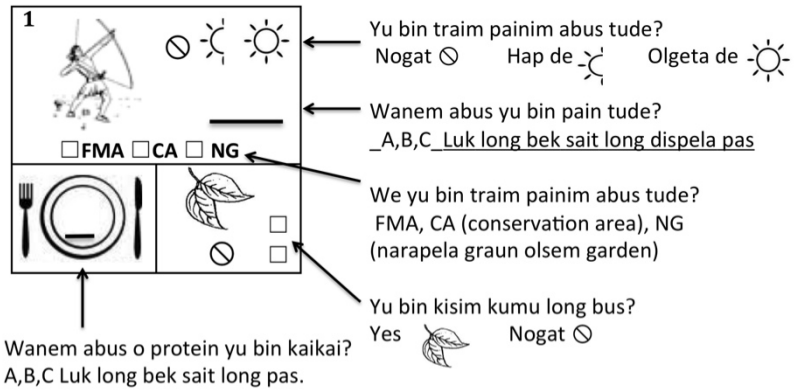
Pik
Yupela gat hamas pik nau?_____
Hamas pik yupela bin bai, kaikia, salim, o givim long dispel tripela yai (2009-2011)? _____
Stori_____
_____

Moni
Dispela mon, yu bin kisim sampela moni? □Yes □Nogat
Long we? _____
Hamas moni?_____
Yu bin kisim sampela royalty moni pinis? □FMA □Conservation □Nogat
Wanem taim?_____
Hamas moni?_____

GPS trace garden □ yes □ no Name of GPS track_____

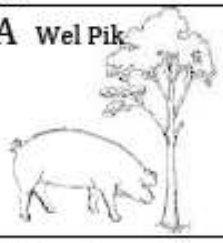
Appendix 6: Sample hunting survey





Nogat Hap De Olgeta De	**FMA** Painim long logged graun **CA** Painim long Conservation Area **NG** Narapela grau	Kumu 

Kaikai

A Wel Pik 	B Murok 	C Sikau 	D Kapul 
E Mumut 	F Pisin 	G Pis/Maleo 	H Wel Kiou 
I Kindaun 	J Kuka 	K Trausel 	L Narapela abus (Wanem kain abus?) ?
M Kakarok/ pisin bilo ples 	N Dok o pussi 	O Pik bilong ples 	P Tin mit/pis 

Appendix 7: Wanang plants and their uses

List of plants found in Wanang, their *Maghu* name, and use as assembled by Whitfield et al. 2012, CFTS 2014, and myself. Whitfeld et al. (2012) identified trees greater than 5 cm dbh and recorded their use according to an elder male, in two 1-ha forest plots, one mature and one recently disturbed. In the Wanang CTFS plot all trees greater than 1 cm dbh were identified within the 50 ha plot with the support of U.S. National Science Foundation grant DEB-0816749. My research (see chapter 3) included interviews with 17 villagers across age, gender, and kin-groups, focused on identifying useful plants. Useful plant lists were cross-referenced to find species identified by more than one informant.

Family	Scientific name	Wanang Maghu name	Growth form	Wanang uses
Fabaceae	Abrus precatorius L.	quanam simi	climber	food for dogs
Elaeocarpaceae	Aceratium ledermannii Schlechter	siau siau ningi	tree	timber used for constructing small huts
Elaeocarpaceae	Aceratium oppositifolium DC.	siau siau maku	tree	timber used for constructing small huts
Lauraceae	Actinodaphne nitida Teschn.	malang malang maku	tree	
Passifloraceae	Adenia heterophylla (Blume) Koord.	andindin simi	climber	medicine to treat ear aches
Meliaceae	Aglaia	angkumba ningi		
Meliaceae	Aglaia agglomerata Merr. & L.M.Perry	angkumba maku		
Meliaceae	Aglaia argentea Bl.	kumba iburra		
Meliaceae	Aglaia brassii Merr. & L.M.Perry	kumba kuyuv	tree	timber used in house construction and framing, firewood
Meliaceae	Aglaia brownii Pannell	kumba suku	tree	timber used in house framing
Meliaceae	Aglaia conferta Merr. & L.M.Perry	maksang kumba		
Meliaceae	Aglaia cucullata Pellegr.	kumba kuyuv		
Meliaceae	Aglaia denticulata Turcz.	maksang kumba maku	tree	timber used in house construction
Meliaceae	Aglaia lepiorrhachis Harms	kumba sipu sipu maku	tree	timber used in house framing
Meliaceae	Aglaia rimosa Merr.	kumba sipu sipu ningi	tree	timber used in house framing
Meliaceae	Aglaia sapindina (F.Muell.) Harms	kumba tikivra		

Meliaceae	Aglaia subcuprea Merr. & L.M.Perry	kumba kiku		
Meliaceae	Aglaia tomentosa Teijsm. & Binn.	kumba tikivla maku	tree	timber used in construction
Simaroubaceae	Ailanthus integrifolia Lam.	aplang		
Fabaceae	Albizia procera (Roxb.) Benth.	kurumbi	tree	timber used as house posts
Sapindaceae	Allophylus cobbe (L.) Blume	s'ram ningi	tree	firewood, food for animals, leaves used for wrapping meat, timber used in house construction
Araceae	Alocasia brancifolia (Schott) A.Hay	ning akab	herb	liquid put on sores
Apocynaceae	Alstonia scholaris (L.) R.Br.	bugul	tree	liquid consumed for common cold and diarrhea, trunk used by birds to make nest cavities
Zingiberaceae	Amomum aculeatum Roxb.	sil bangé	herb	edible flowers and fruits, leaves used to wrap greens, roots used as medicine for common cold and to treat sores
Araceae	Amydrium magnificum (Engl.) Nicolson	mang mang sisi mumung		
Araceae	Amydrium zippelianum (Schott) Nicolson	mang mang sisi mumung ningi		
Apocynaceae	Anodendron oblongifolium Hemsl.	mibul simi		
Rubiaceae	Anthocephalus chinensis Hassk.	ang biré		
Meliaceae	Aphanamixis polystachya (Wall.) R.Parker	maksang simi galang	tree	timber used for house construction, fencing, small benches, and tables
Phyllanthaceae	Aporosa papuana Pax & Hoffm.	kuverang		
Fabaceae	Archidendron glabrum K.Schum. & Lauterb.	kial'te aningising	tree	timber used in construction of small huts
Fabaceae	Archidendron lucyi F.Muell.	kialte suku	tree	timber used in construction of small huts

Fabaceae	Archidendron ptenopum Verdc.	viningé		
Myrsinaceae	Ardisia imperialis K. Schum	te natotamu maku		
Myrsinaceae	Ardisia lanceolata C.F.Gaertn.	te natotamu ningi		
Arecaceae	Areca catechu L.	auli	tree	nuts chewed with lime and Piperaceae
Aristolochiaceae	Aristolochia tagala Cham.	ngdinding make simi	climber	stem used as rope in pig pen fencing
Moraceae	Artocarpus altilis (Parkinson) Fosberg	wara		
Moraceae	Artocarpus camansi Bl.	amuké	tree	edible nuts, bark use to make traditional cloth, leaves used for roofing
Moraceae	Artocarpus communis J.R. Forst & G.Forst.	wala	tree	liquid consumed to treat diarrhea, edible fruits
Moraceae	Artocarpus lacucha Buch-Ham.	wala wala akab	tree	edible nuts, bark used to make traditional tapa cloth, firewood
Moraceae	Artocarpus sepicanus Diels	wala wala sagul	tree	boil bark, mix water with food and feed to mothers after birth to make the baby gain weight
Aspleniaceae	Asplenium nidus L.	mab		
Myrtaceae	Austromyrtus floribunda (A. J.Scott) Guymer	murulung; simul n'mali; yamé tumab ningi	tree	timber used as post for house framing
Poaceae	Bambusa forbesii (Ridl.) Holttum	papang	herb	stems used in house construction, stems used to hold water
Lecythidaceae	Barringtonia apiculata Laut.	pumbu pumbu maku	tree	timber used for construction of small huts
Lecythidaceae	Barringtonia calyptrocalyx K.Schum.	pumbu pumbu ningi		
Lecythidaceae	Barringtonia novae-hiberniae Lauterb.	pumbu pumbu sisigalang		
Lecythidaceae	Barringtonia racemosa (L.) Spreng.	pumbu pumbu sisibara	tree	timber used for construction of small huts
Bixaceae	Bixa orellana L.	siau	tree	fruits used as traditional red body paint
Malvaceae	Bombax ceiba L.	kimbang		
Phyllanthaceae	Breynia cernua (Poir.) Muell.Arg.	kiagi té		

Phyllanthaceae	Bridelia macrocarpa Airy Shaw	kusim kusim sisi bara		
Anacardiaceae	Buchanania arborescens (Blume) Blume	yapan	tree	bark cooked and chewed by breast feeding mothers, timber used in canoe construction, timber used in house construction, liquid consumed to treat sorcery and other illnesses
Anacardiaceae	Buchanania mollis Lauterb.	yapan		
Lamiaceae	Callicarpa farinosa Bl.	suming		
Lamiaceae	Callicarpa longifolia Lam.	suming; suming maku	tree	timber used for garden fencing, bark chewed like betel nut, leaves used as toilet tissue, firewood
Lamiaceae	Callicarpa pedunculata R.Br.	suming simi		
Lamiaceae	Callicarpa pentandra Roxb.	suming akab	tree	timber used for garden fencing
Clusiaceae	Calophyllum soulattri Burm.	sané miging		
Fabaceae	Calopogonium mucunoides Desv.	umé simi	climber	
Acanthaceae	Calycacanthus magnusianus K.Schum.	blumes ningi	tree	plant used as house and ceremony decoration
Annonaceae	Cananga odorata (Lam.) Hook.f. & Thomson	silpunu		
Burseraceae	Canarium acutifolium (DC.) Merr.	ang simul	tree	timber used in house construction
Burseraceae	Canarium asperum Benth.	simul n'mali		
Burseraceae	Canarium indicum Linn.	baping		
Burseraceae	Canarium macadamii Leenh.	simul suku		
Burseraceae	Canarium oleosum (Lam.) Engl.	baping ningi	tree	timber used in house construction, nuts gathered for food
Burseraceae	Canarium schlechteri Laut.	dugul simul		
Burseraceae	Canarium vitiense A.Gray	ang sumul ningi		
Rhizophoraceae	Carallia brachiata (Lour.) Merr.	kapu kapu amaske		
Cardiopteridaceae	Cardiopteris moluccana C.L. Blume	ang simi, ang dungdung simi	climber	liquid can be consumed as beverage or medicine, stem used as rope

Caricaceae	Carica papaya L.	pupu		
Arecaceae	Caryota rumphiana Mart.	saukua	tree	edible new growth, stem used as axe handle
Salicaceae	Casearia clutiifolia Bl.	té amaske ningi		
Vitaceae	Cayratia geniculata Gagnepain	kated		
Vitaceae	Cayratia japonica (Thunb.) Gagnep.	kangir kangir simi tikibla	climber	liquid extracted and consumed
Vitaceae	Cayratia schumanniana (Gilg) Suess.	kangir kangir	climber	potable beverage
Cannabaceae	Celtis	ang klang		
Cannabaceae	Celtis latifolia Planch.	klang	tree	timber used for house construction of small huts, leaves used as decoration during ceremonies, firewood, edible to pigs
Cannabaceae	Celtis philippensis Bl.	nimung	tree	timber used for construction of small huts, leaves are chewed with betel nut, saplings used for roofing
Apocynaceae	Cerbera floribunda K.Schum.	mangaté	tree	latex applied to sores and used as glue, herbal medicine for scabies
Oleaceae	Chionanthus brassii (Kobuski) Kiew	sisi mumung ningi		
Oleaceae	Chionanthus ramiflora Roxb.	kining maku		
Meliaceae	Chisocheton ceramicus Miq.	maksang irikal	tree	timber used for construction of small huts, porches, and balconies
Meliaceae	Chisocheton cumingianus Harms	maksang garudugudu	tree	timber used in house framing and in construction of small huts
Meliaceae	Chisocheton formicarum Harms	maksang irikal ningi		timber used for garden fencing
Meliaceae	Chisocheton lasiocarpus (Miq.) Valeton	maksang maku	tree	timber used for construction of small huts, porches, and balconies
Meliaceae	Chisocheton longistipitatus (F.M.Bailey) L.S.Sm.	maksang kumba	tree	timber used in house framing and in construction of small huts
Meliaceae	Chisocheton montanus P.F.Stevens	maksang kunga kisir		

Meliaceae	Chisocheton pachyrhachis Harms	maksan guli		
Meliaceae	Chisocheton trichocladus Harms	maksang garudugudu ningi	tree	seeds edible to hornbills, timber used in construction of small huts, porches, tables, and balconies
Meliaceae	Chisocheton weinlandii Harms	maksang igumigling	tree	timber used in construction of small huts, porches, and balconies
Sapotaceae	Chrysophyllum roxburghii G.Don	yamusung		
Lauraceae	Cinnamomum grandiflorum Kosterm.	giving	tree	bark chewed and spit on the body to cure illness resuting from sorcery
Vitaceae	Cissus adnata Roxb.	kangir kangir simi ningi	tree	stem used to bunde firewood
Vitaceae	Cissus hypoglauca A.Gray	katad	climber	stem used for lashing frames, fences, and sago palm thatch roofing
Vitaceae	Cissus repens Lam.	kangir kangir simi ningi		
Euphorbiaceae	Claoxylon polot (Burm. f.) Merr.	apiv apiv		
Lamiaceae	Clerodendrum inerme (L.) Gaertn.	sunam akab maku	tree	woood used to make kundu drums
Lamiaceae	Clerodendrum tracyanum F.Muell. ex Benth.	sunam akab ningi	tree	timber used in construction
Rutaceae	Clymenia polyandra (Tanka) Swingle	simbli dum	tree	trunk used in axe handles
Rubiaceae	Coelospermum salomoniense (Engl.) Joh.	ibu simi; mibul simi	climber	liquid consumed as beverage and medicine
Commelinaceae	Commelina paleata Hassk.	digum digum ningi		
Malvaceae	Commersonia bartramia (L.) Merr.	makal gubung	tree	timber used in construction of small huts and tables, leaves used to roll tobacco
Asparagaceae	Cordyline terminalis Kunth.	pumbu	herb	planted as boundary indicator, decoration, peace pact, or memorial, leaves used to cleanse skin and treat sores

Euphorbiaceae	Croton womersleyi Airy Shaw	malau ningi		
Lauraceae	Cryptocarya apamifolia Gamble	magi ningi		
Lauraceae	Cryptocarya caloneura (Scheff.) Kosterm.	sisi galang	tree	timber used for house construction and fencing, young leaves are chewed with betel nut, firewood
Lauraceae	Cryptocarya densiflora Bl.	gabud		
Lauraceae	Cryptocarya depressa Warb.	tanglé umbang ningi	tree	timber used in construction of small huts
Lauraceae	Cryptocarya endiandrifolia Kosterm.	tanglé umbang maku		
Lauraceae	Cryptocarya idenburgensis C.K.Allen	magi ibura, malang malang ningi	tree	timber used to construct small huts and tables
Lauraceae	Cryptocarya mackinnoniana F.Muell.	simam ningi	tree	timber used in house construction
Lauraceae	Cryptocarya massoy (Oken) Kosterm.	magi ningi	tree	timber used in house and balcony construction; aromatic bark used as incense in Indonesia and subject to an export ban
Lauraceae	Cryptocarya medicinalis C.T.White	kubing gubing suku	tree	timber used in house construction
Lauraceae	Cryptocarya multipaniculata Teschn.	kubing gubing tikibla	tree	timber used in fencing and construction of small huts, houses, tables, and shelves
Lauraceae	Cryptocarya novo-guineensis Teschn.	magi ibura	tree	timber used in house and balcony construction
Sapindaceae	Cupaniopsis acuticarpa F.Adema	guli guli	tree	timber used in construction of small huts, fences, and tables
Sapindaceae	Cupaniopsis curvidens Radlk.	guli guli	tree	timber used in construction of small huts
Sapindaceae	Cupaniopsis macropetala Radlk.	guli guli		
Annonaceae	Cyathocalyx obtusifolius Beccari & Scheffer	katam pilange	tree	timber used in construction
Annonaceae	Cyathocalyx polycarpa C.T.White & W.D.Francis	panpan		
Fabaceae	Dalbergia densa Benth.	kim simi	climber	used for polishing bows

Urticaceae	Debregeasia longifolia (Burm. f.) Wedd.	balibang simi		
Myrtaceae	Decaspermum	sirkangyang maku		
Myrtaceae	Decaspermum rhodoleucum Diels	sirkangyang ningi		
Urticaceae	Dendrocnide cordata (Warb. ex H.J.P.Winkl.) Chew	apiv sisibarra		
Urticaceae	Dendrocnide longifolia (Hemsl.) Chew	apiv kual s're		
Fabaceae	Derris pinnata Lour.	kapu kiské simi	climber	nutrient source for breast feeding, herbal medicine, timber used in house construction
Fabaceae	Derris rubrocalyx Verdc.	yamul simi	climber	liquid used to poison fish
Fabaceae	Derris trifoliata Lour.	mub simi		
Sapindaceae	Dictyoneura obtusa (Endl.) N.Snow & Guymer	kulumbi tikivla		
Dilleniaceae	Dillenia papuana Martelli	kavangkavang te		
Dioscoreaceae	Dioscorea alata L.	ivu tiping	climber	edible tubers
Dioscoreaceae	Dioscorea pentaphylla Linn.	mikum	herb	edible tubers
Ebenaceae	Diospyros	mau ningi		
Ebenaceae	Diospyros areolifolia Kosterm.	mau maku ningi	climber	used as gardening tool, stem used for trap building
Ebenaceae	Diospyros foliosa (Rich ex A.Gray) Bakh.	mau maku	tree	timber used in construction
Ebenaceae	Diospyros hebecarpa A.Cunn. ex Benth.	mau suku		
Ebenaceae	Diospyros lolin Bakh.	mau sisigalang	tree	branches used as gardening tool
Ebenaceae	Diospyros peekelii Lauterbach	mau kiku		
Athyriaceae	Diplazium esculentum (Retz.) Sw.	gunding gunding	fern	young leaves are boiled and used as medecine
Aspleniaceae	Diplora longifolia (Pr.) C.Chr.	tei kakum	climber	leaves used as spice
Marantaceae	Donax canniformis Rolfe	katung	herb	stem used to fasten fences, sago leaves as roofing and fish or tobacco bundles

Ruscaceae	Dracaena angustifolia Roxb.	tigi		
Anacardiaceae	Dracontomelon dao (Blanco) Merr. & Rolfe	kawab	tree	timber used in house construction and fences, edible fruits
Anacardiaceae	Dracontomelon lenticulatum Wilkinson	sane kawab		
Putranjivaceae	Drypetes	yamé tumab suku		
Putranjivaceae	Drypetes bordenii Pax & K.Hoffm	yamé tumab maku	shrub	timber used in house construction, branches used as gardening tool
Putranjivaceae	Drypetes lasiogynoides Pax & K.Hoffm.	yamé tumab ningi	tree	timber used in house construction, branches used as gardening tool
Meliaceae	Dysoxylum alatum Harms.	guliguli		
Meliaceae	Dysoxylum alliaceum (Blume) Blume	maksang sipu sipu ningi	tree	timber used in house construction and fencing
Meliaceae	Dysoxylum annae Mabb.	maksang sipu sipu		
Meliaceae	Dysoxylum arborescens (Blume) Miq.	maksang sipu sipu kike	tree	timber used in construction of small huts and fencing
Meliaceae	Dysoxylum brassii Merr. & L. M. Perry	maksang sipu sipu sisi galang	tree	timber used in house construction
Meliaceae	Dysoxylum gaudichaudianum (A.Juss.) Miq.	igu mingling		
Meliaceae	Dysoxylum macrostachyum C.DC.	maksang sipu sipu ningi	tree	timber used in framing of small huts
Meliaceae	Dysoxylum molle Miq.	maksang sipu sipu	tree	timber for house construction, used for construction of small huts
Meliaceae	Dysoxylum papuanum (Merr. & L.M.Perry) Mabb.	sipu sipu		
Meliaceae	Dysoxylum parasiticum (Osbeck) Kosterm.	sipu sipu igu migling		
Meliaceae	Dysoxylum pettigrewianum F.M.Bailey	sipu sipu ningi	tree	timber used in house construction and fencing
Meliaceae	Dysoxylum richardianum Merr. & L.M.Perry	ang sipu sipu	tree	timber used in construction of small huts and fencing

Meliaceae	Dysoxylum setosum (Span.) Miq.	maksan klum	tree	timber used in house construction and fencing
Elaeocarpaceae	Elaeocarpus amplifolius Schlechter	sanume		
Elaeocarpaceae	Elaeocarpus miegei Weibel	sanume ningi	tree	timber used for constructing small huts
Elaeocarpaceae	Elaeocarpus sphaericus Schum.	kapu siram		
Elaeocarpaceae	Elaeocarpus undulatus D.J.Liddle	iburra		
Myrsinaceae	Embelia cotinoides (S.Moore) Merr.	umbangaul simi; mukus akab; munde té	climber	latex applied to sores
Lauraceae	Endiandra	tanglé umbang	tree	timber used in house construction
Myristicaceae	Endocomia macrocoma (Miq.) W.J.de Wilde	kapup mabal	tree	wood used for construction of beds and as posts for house framing
Euphorbiaceae	Endospermum labios Schodde	aung	tree	liquid used to prevent pregnancy, treat illnesses from sorcery, and cleanse female pollution
Euphorbiaceae	Endospermum medullosum L.S. Smith	aung akab		
Fabaceae	Entada phaseoloides (L.) Merr.	pirawang simi	climber	stems used as rope, used for polishing bows, used as medicine for animals, used as garden fertilizer
Araceae	Epipremnum pinnatum (L.) Engl.	mang mang simi maku		
Salicaceae	Erythrospermum candidum Becc.	gublib	tree	liquid from bark used to treat sores
Anacardiaceae	Euroschinus papuanus Merr. & L.M.Perry	malte	tree	timber used in house construction
Lamiaceae	Faradaya splendida F.Muell.	subla subla simi		leaves used as soap
Moraceae	Ficus adelpha Laut. et K. Schum.	ang mutung		
Moraceae	Ficus adenosperma Miq.	ang budu	tree	leaves are used as paint during celebrations, figs and leaves food for animals

Moraceae	Ficus ampelas Burm. f.	kusakam kusakam	tree	wood used for making small benches
Moraceae	Ficus archboldiana Summerh.	ning dawang		
Moraceae	Ficus arfakensis King	ungé mutung	tree	edible fruits, firewood, leaves used as steel wool
Moraceae	Ficus aurantiacafolia Weiblen & Whitfeld	ungé mutung maku		
Moraceae	Ficus badiopurpurea Diels.	akembi akembi	tree	leaves used as sandpaper
Moraceae	Ficus benjamina L.	dawang dawang	climber	food for animals
Moraceae	Ficus botryocarpa Miq.	muting ibura		
Moraceae	Ficus congesta Roxb.	mutung	tree	firewood, food for animals
Moraceae	Ficus conocephalifolia Ridley	kundam kundam		
Moraceae	Ficus copiosa Steud.	kundam	tree	edible leaves and fruit, latex uesed on parasite sores
Moraceae	Ficus drupacea Thunb.	ning dawong		
Moraceae	Ficus erythrosperma Miq.	kamamté ningi	tree	leaves are used as paint during celebrations, figs and leaves food for animals
Moraceae	Ficus glandifera Summerh.	dawang suku		
Moraceae	Ficus gul K.Schum. & Lauterb.	yalim katam	tree	leaves used as steelwool
Moraceae	Ficus hahliana Diels	ang sugi		
Moraceae	Ficus hispidioides S.Moore	mutung sanagu kike		
Moraceae	Ficus hombroniana Corner	mukul mukul	tree	used for dressing sores, food for animals
Moraceae	Ficus melinocarpa Bl.	yaram katang sisibarra	tree	leaves used as steel wool
Moraceae	Ficus mollior F.Muell. ex Benth.	yalim katam asid		
Moraceae	Ficus nodosa Teijsm. & Binn.	ang iga	tree	bark used to make traditional tapa cloth, firewood, edible figs for animals, timber used in house construction
Moraceae	Ficus odoardi King	dwang simi tikibla	climber	used to treat persons poisoned by sorcery
Moraceae	Ficus pachyrrhachis K.Schum. & Lauterb.	muting sana agu		
Moraceae	Ficus phaeosyce K.Schum. & Lauterb.	akembi ningi		

Moraceae	Ficus polyantha Warb.	budu sisi barra	tree	firewood
Moraceae	Ficus pseudojaca Corner	budu tikivla	tree	edible figs for animals
Moraceae	Ficus pungens Reinw. ex Blume	irim		
Moraceae	Ficus rubrivestimenta Weiblen & Whitfeld	kamamté		
Moraceae	Ficus semivestita Corner	iga makal		
Moraceae	Ficus subcuneata Miq.	kamamte asid		
Moraceae	Ficus subtrinervia K.Schum & Lauterb.	budu maku		
Moraceae	Ficus trachypison K.Schum.	akembi	tree	leaves used to wash plates and pots like steal wool
Moraceae	Ficus variegata Blume	iga sagul		
Moraceae	Ficus virens Aiton	té dawang	tree	bark used to make traditional tapa cloth, latex used as medicine for broken bones and toothaches
Moraceae	Ficus virgata Reinw. ex Blume	dawang kiku		
Moraceae	Ficus wassa Roxb.	kusakam	tree	edible young leaves
Apocynaceae	Finlaysonia obovata Wall.	nuplum simi	climber	stems used to fasten fences
Salicaceae	Flacourtia rukam Zoll. & Moritzi	suaranga ningi		
Flagellariaceae	Flagellaria indica Linna.	kaningé simi	climber	stems used for fastening sago leaves for roofing, used as medicine on oral sores
Commelinaceae	Floscopa scandens Lour.	dugum dugum ningi		
Pandanaceae	Freycinetia kanehirae B.C.Stone	umukam	tree	leaves used for weaving mats and bilums
Annonaceae	Friesodielsia glauca Hook. f.	ipé kapé simi	climber	leaves used for rolling tobacco
Pandaceae	Galearia celebica Koord.	mukus akab	tree	timber used in house construction, branches used as gardening tool digging, edible fruits
Sapindaceae	Ganophyllum falcatum Bl.	aim kisku	tree	timber used in house and small hut construction
Clusiaceae	Garcinia assugu Lauterb.	kapu kugam		
Clusiaceae	Garcinia dulcis Kurz	kapu kugam ningi	tree	branches used as gardening tool

Clusiaceae	Garcinia hunsteinii Lauterb.	kapu kapu suku	tree	timber used in construction, branches used as gardening tool
Clusiaceae	Garcinia latissima Miq.	kugam sisi barra		
Clusiaceae	Garcinia ledermannii Lauterbach	kapu kapu		
Clusiaceae	Garcinia maluensis Lauterb.	kapu kapu ipas		
Rubiaceae	Gardenia hansemannii K. Schum.	k'nung	tree	branches used as gardening tools
Burseraceae	Garuga floribunda Decne.	aisapul		
Araliaceae	Gastonia spectabilis (Harms) Philipson	mui	tree	timber for house construction, leaves used for wrapping smoked leaves, used for construction of small huts and tables
Fabaceae	Gigasiphon schlechteri (Harms) de Wit	baim		
Phyllanthaceae	Glochidion angulatum C.B. Rob.	mende te		
Phyllanthaceae	Glochidion novo-guineense K.Schum.	mende te		
Lamiaceae	Gmelina moluccana Backer ex K.Heyne	amim	tree	wood used to make kundu drums, liquid mixed with water and fed to sick dogs, bark used on sores
Lamiaceae	Gmelina palawensis Lam.	mibur simi		
Gnetaceae	Gnetum costatum K.Schum	sir kunu		edible fruits and young leaves, bark used to make string for netbags
Gnetaceae	Gnetum gnemon L.	kunu	tree	edible young leaves and fruit, inner bark used as fiber for traditional string bags, liquid put on sores
Gnetaceae	Gnetum gnemonoides Brongn.	kusingi simi	climber	latex applied to cuts
Gnetaceae	Gnetum latifolium Bl.	kusingi simi gling; kusingi simi;		latex applied to cuts, timber used in house construction
Annonaceae	Goniothalamus aruensis Scheff.	nagité suku		

Annonaceae	Goniothalamus imbricatus Scheff.	nagité ningi		
Cardiopteridaceae	Gonocaryum litorale (Blume) Sleumer	kiange mungim		
Theaceae	Gordonia amboinense (Miq.) Merr.	mali akab		
Acanthaceae	Graptophyllum pictum (L.) Griff.	blumes	climber	used in breast feeding and as medicine, timber used in house construction, house decoration
Sapindaceae	Guioa comesperma Radl.	dugag pli	tree	timber used in house construction
Myristicaceae	Gymnacranthera paniculata (A. DC) Warb.	kapup maku	tree	timber used in construction of small huts, balconies and fencing
Rhizophoraceae	Gynotroches axillaris Bl.	munde sai		
Burseraceae	Haplolobus floribundus (K.Schum.) H.J.Lam	malite asid	tree	timber used in house construction
Burseraceae	Haplolobus lanceolatus H.J.Lam	kaim gaim tikivla	tree	best timber for house construction
Annonaceae	Haplostichanthus longirostris (Scheff.) Heusden	ibutei	tree	planted with yams, timber used in house construction, wood burned as mosquito repellant, medicine for dogs
Sapindaceae	Harpullia aeruginosa Radlk.	kulandum		
Sapindaceae	Harpullia arborea (Blanco) Radlk.	kulandum maku		
Sapindaceae	Harpullia longipetala Leenh.	kulandum sisigalang	tree	timber used as posts for house framing
Sapindaceae	Harpullia petiolaris Radlk.	dugag pli maku	tree	timber used in construction of small huts
Sapindaceae	Harpullia ramiflora Radlk.	dugag pli ningi		
Proteaceae	Helicia affinis Sleumer	wanging		
Proteaceae	Helicia latifolia C.T.White	wanging suku		
Proteaceae	Helicia oreadum F.L.E. Diels	sil té	tree	hard timber used in construction
Malvaceae	Heritiera littoralis Dryand.	umé ibura	tree	timber used in house construction and fencing
Hernandiaceae	Hernandia ovigera L.	paku		
Malvaceae	Hibiscus ellipticifolius Borss.Waalk.	masamasa		

Malvaceae	Hibiscus papuodendron Kosterm.	masamasa ningi		
Euphorbiaceae	Homalanthus novoguineensis K.Schum.	buku		
Salicaceae	Homalium foetidum Benth.	te'amaske		
Dipterocarpaceae	Hopea iriana Slooten	ikeike		
Zingiberaceae	Hornstedtia lycostoma K.Schum.	bangé ang sugi	herb	edible flowers and fruits, leaves used to wrap edible greens, roots used as medicine
Zingiberaceae	Hornstedtia scottiana (F.Muell.) K.Schum.	bangé kol	herb	liquid applied to sores and swallowed for common cold
Myristicaceae	Horsfieldia basifissa De Wilde	kapup ningi	tree	prefered timber for construction of houses and fences
Myristicaceae	Horsfieldia hellwigii (Warb.) Warb.	kapub garudugudu ningi		
Myristicaceae	Horsfieldia irya Warb.	garudugudu maku	tree	timber used in construction of small huts and fences
Myristicaceae	Horsfieldia spicata (Roxb.) J.Sinclair	kapub ningi		
Myristicaceae	Horsfieldia subtilis Warb.	angkabup ningi		
Myristicaceae	Horsfieldia sylvestris Warb.	kapup sisigalang	tree	timber used in bed construction and as posts in house frames
Apocynaceae	Hoya rubida Schltr.	kunga mibul; nibul simi;	climber	
Arecaceae	Hydriastele costata F.M.Bailey	pune		
Apocynaceae	Ichnocarpus frutescens (L.) W.T.Aiton	nibilum simi	climber	stem used as rope to fasten fences
Poaceae	Imperata cylindrica (L.) Raeusch.	mundé	herb	leaves used for roofing and as steel wool
Fabaceae	Intsia bijuga (Colebr.) Kuntze	kulum	tree	liquid mixed with water or food and fed to dogs so they gain weight, seeds chewed with betel nut, liquid consumed for body aches, wood use for slit drums

Fabaceae	Intsia palembanica Miq.	kulum sane papit		
Convolvulaceae	Ipomoea batatas (L.) Lam.	kubiang	climber	edible
Rubiaceae	Ixora amplexifolia Laut	kiangam maku	tree	branches used to excavate sago palms
Rubiaceae	Ixora timorensis Decne.	kiangam ningi		
Convolvulaceae	Jacquemontia paniculata (Burm.f.) Hallier f.	ning dumul	climber	stem used as rope for bundling firewood
Sapindaceae	Jagera javanica (Blume) Blume ex Kalkman	yarum kualu tikiula	tree	timber for house construction
Fabaceae	Kingiodendron alternifolium (Elmer) Merr. & Rolfe	kulum kulum sisi barra		
Fabaceae	Kingiodendron novoguineense Verdc.	klum klum sisi mumung		
Malvaceae	Kleinhovia hospita L.	siuling		
Apocynaceae	Kopsia flavida Bl.	kupsa pakus		
Lythraceae	Lagerstroemia archeriana F.M.Bailey	kingu asid	tree	timber used in house construction
Lythraceae	Lagerstroemia piriformis Koehne	kingu suku		
Vitaceae	Leea indica (Burm.f.) Merr.	gugub	tree	leaves used to roll tobacco
Sapindaceae	Lepidopetalum	guli guli suku		
Sapindaceae	Lepidopetalum xylocarpum Radlk.	guli guli ningi		
Apocynaceae	Lepiniopsis ternatensis Valeton	ugam galang		
Convolvulaceae	Lepistemon urceolatus (R.Br.) F.Muell.	ning dimul simi	climber	stem used as rope, medicinal plant
Urticaceae	Leucosyke australis Unruh	sikiang irikal	herb	leaves are used as steel wool and toothbrush, timber used in construction of small huts
Urticaceae	Leucosyke capitellata Wedd.	sikiang irikal ningi	tree	leaves are used as steel wool, timber used in construction of small huts
Arecaceae	Licuala beccariana Burret	sadu	tree	stems used to make spears and arrows for hunting, leaves used as decoration and as umbrellas, leaves used to wrap and package

				meat
Lauraceae	Litsea collina S.Moore	gabud	tree	timber used in construction
Lauraceae	Litsea globosa Kosterm.	gabud maku	tree	timber used in construction
Lauraceae	Litsea guppyi F. Muell. ex Forman	gabud ningi		
Lauraceae	Litsea timoriana Span.	malang malang suku	tree	bark used to make traditional tapa cloth, firewood, edible figs for animals, timber used in house construction
Celastraceae	Lophopetalum torricellense Loes.	klung klung maku	tree	timber used in house construction
Euphorbiaceae	Macaranga aleuritoides F.Muell	kui kapangusing		
Euphorbiaceae	Macaranga bifoveata J.J.Sm.	kui mudang suming		
Euphorbiaceae	Macaranga ducis Whitmore	kui kapangusing, kui iburra	tree	timber used in construction of small huts
Euphorbiaceae	Macaranga fallacina Pax & K.Hoffm.	kui sané dugag	tree	timber used in construction of small huts
Euphorbiaceae	Macaranga inermis Pax & K.Hoffm.	kui sisi tikivla		
Euphorbiaceae	Macaranga neobritannica Airy Shaw	kui kungil		
Euphorbiaceae	Macaranga novoguineensis J.J.Sm.	kui yalum dugag	tree	timber used in construction, firewood
Euphorbiaceae	Macaranga punctata K.Schum	kui yalum dugag	tree	timber used in construction of small huts, firewood
Euphorbiaceae	Macaranga quadriglandulosa Warb.	kui simblé	tree	timber used in house construction
Euphorbiaceae	Macaranga schleinitziana K.Schum.	siau siau simi		
Euphorbiaceae	Macaranga tanarius (L.) Muell.Arg.	kui iburra	tree	timber used in construction of small huts

Moraceae	Maclura amboinensis Bl.	kusim simi	climber	liquid consumed or directly applied for cuts and sores
Fabaceae	Macrotyloma axillare (E.Mey.) Verdc.	umé simi tikibla	climber	stem used to fbundle firewood and sago leaves
Euphorbiaceae	Mallotus chromocarpus Airy Shaw	mangas akab		
Euphorbiaceae	Mallotus floribundus Muell.Arg.	ang kombing		
Euphorbiaceae	Mallotus oblongifolius (Miq.) Muell.Arg.	unge duag	tree	timber used in construction of small huts, firewood
Euphorbiaceae	Mallotus peltatus Müll.Arg.	kombing ningi	tree	timber used in construction of small huts, firewood
Anacardiaceae	Mangifera indica L.	gisa tiping (cultivated mango)		
Anacardiaceae	Mangifera minor Bl.	gisa	tree	edible fruits, bark applied to sores
Fabaceae	Maniltoa lenticellata C.T.White	k'pai sisibarra	tree	hard wood for permanent house construction
Fabaceae	Maniltoa megalocephala Harms	k'pai kapu umbang		
Fabaceae	Maniltoa plurijuga Merr. & L.M.Perry	k'pai suku	tree	timber used in construction of furniture and small huts, branches used as gardening tools
Fabaceae	Maniltoa psilogyne Harms	k'pai	tree	timber used in construction of furniture and small huts, branches used as gardening tool
Fabaceae	Maniltoa schefferi K.Schum.	k'pai sisimumung	tree	timber used in construction of furniture and small huts, branches used as gardening tool
Cyperaceae	Mapania macrocephala (Gaudich.) K.Schum.	pasa	herb	seeds food for animals
Asclepiadaceae	Marsdenia velutina R.Brown	mulim simi	climber	stem used as rope, latex applied to sores
Rubiaceae	Mastixiodendron pachyclados Melch.	yagul		
Melastomataceae	Medinilla crassinervia Blume	wanging	climber	liquid consumed
Stemonuraceae	Medusanthera laxiflora (Miers.) Howard	mangal mangal		

Euphorbiaceae	Melanolepis multiglandulosa Rchb. & Zoll.	guakul	tree	liquid consumed for snake bites or sorcery
Rutaceae	Melicope elleryana (F.Muell.) T.G.Hartley	malau		
Sabiaceae	Meliosma pinnata (Roxb.) Maxim.	mururung kiku		
Apocynaceae	Melodinus forbesii Fawc.	yamu simi		
Convolvulaceae	Merremia peltata (L.) Merr.	bamul	climber	latex consumed or applied directly for wounds, stem used to bundle firewood, used against sorcery
Convolvulaceae	Merremia umbellata (L.) Hallier f.	bamul maku		
Icacinaceae	Merrilliodendron megacarpum (Hemsl.) Sleum.	kingu		
Arecaceae	Metroxylon sago Kon.	maki	tree	pith crushed and washed to extract edible starch (sago flour), edible new shoots, leaves woven for roofing; young leaves used to make grass skirts
Malvaceae	Microcos	kubal		
Malvaceae	Microcos argentata Burret	ang kubal	tree	timber used in house construction, bark used as poison for killing fish
Malvaceae	Microcos grandiflora Burret	kubal	tree	timber used in construction of small huts, bark used as poison for killing fish, nutrient source for breast feeding, herbal medicine
Malvaceae	Microcos stylocarpa Burret	ang kubal	tree	timber usd in house construction
Asteraceae	Microglossa pyrifolia Kuntze	bubu simi		
Rutaceae	Micromelum minutum (G.Forst.) Wight & Arn.	kuplung maksang	tree	timber used in house construction and fencing
Fabaceae	Millettia pinnata (L.) Panigrahi	ang té	tree	timber used in construction of small huts
Sapindaceae	Mischocarpus largifolius Radlk.	maksang guli guli	tree	timber used in construction
Sapindaceae	Mischocarpus sundaicus Blume	maksang guli guli ningi		

Rubiaceae	Morinda citrifolia L.	mibul té		
Fabaceae	Mucuna bennettii F.Muell.	muli simi	climber	flowers used for decoration during celebrations
Cucurbitaceae	Mukia maderaspatana (L.) M.Roem.	ang dung dung maku	climber	stems used to bundle firewood
Musaceae	Musa peekelii C.A.G.Lauterb.	mang	tree	edible fruits
Musaceae	Musa sapientum L.	mang	herb	edible fruits
Rubiaceae	Mussaenda cylindrocarpa Arechav.	mundé papasi maku		
Rubiaceae	Mussaenda ferruginea K.Schum.	mundé papasi ningi	tree	flowers used as decoration
Myristicaceae	Myristica buchneriana Warb.	kapuv kuiv ningi		
Myristicaceae	Myristica crassipes Warb.	kapub kuiv maku	tree	timber used in construction of small huts and balconies, timber used for fencing
Myristicaceae	Myristica fatua Houtt.	kapuv ibbura	tree	timber used in house construction
Myristicaceae	Myristica globosa Warb.	kapuv		
Myristicaceae	Myristica hollrungii Warb.	kapuv mawal		
Myristicaceae	Myristica insipida R.Br.	kapuv		
Myristicaceae	Myristica schleinitzii Engl.	kapuv		
Myristicaceae	Myristica subalulata Miq.	kapuv		
Rubiaceae	Nauclea orientalis (L.) L.	até sisibarra		
Apocynaceae	Neisosperma citrodora (Lauterb. & K.Schum.) Fosberg & Sachet	ugam galang		
Rubiaceae	Neonauclea obversifolia (Valeton) Merr. & L.M.Perry	ate makul		
Euphorbiaceae	Neoscortechinia forbesii (Hook.f.) C.T.White	savanté		
Bignoniaceae	Neosepicaea viticoides Diels	muki kupal simi	tree	timber used in construction
Loganiaceae	Neuburgia corynocarpa (A.Gray) Leenh.	ugul kiske		
Urticaceae	Nothocnide repanda (Blume) Blume	simi tiving	climber	food for dogs

Urticaceae	Nothocnide repanda (Blume) Blume		climber	food for dogs
Tetramelaceae	Octomeles	kivul kalip		
Euphorbiaceae	Omphalea papuana Pax & K.Hoffm.	apanga simi	climber	edible fruits, seeds used as medicine
Rubiaceae	Ophiorrhiza decipiens Merrill & L.M.Perry	mari	herb	traditional perfume
Arecaceae	Orania lauterbachiana Becc.	gimang gimang		
Urticaceae	Oreocnide rufescens (Bl.) Miq.	aul kasal		
Urticaceae	Oreocnide trinervis Miq.	aul kasal ningi		
Araliaceae	Osmoxylon novo-guineense Becc.	ipé kapé té		
Annonaceae	Oxymitra grandiflora Merr.	semed simi		
Sapotaceae	Palaquium morobense P.Royen	mulim te'	tree	timber used in house construction
Sapotaceae	Palaquium warburgianum Schltr. & K.Krause	mulim té ningi	tree	timber used for garden fencing and house construction
Pandanaceae	Pandanus danckelmannianus K.Schum.	gigial		
Pandanaceae	Pandanus kaernbachii Warb.	umukam		
Bignoniaceae	Pandorea montana (Diels) Steenis	maksang gavu; ibu simi;		
Bignoniaceae	Pandorea pandorana (Andrews) Steenis	sabal simi maku		
Achariaceae	Pangium edule Reinw.	yandu	tree	leaves used as poison for killing fish, edible fruits, liquid used to treat new sores
Apocynaceae	Papuechites aambe (Warb.) Markgr.	idau idau simi		
Fabaceae	Parkia versteeghii Merr. & L.M.Perr.	quanam maku	tree	timber used in house construction
Apocynaceae	Parsonsia alboflavescens (Dennst.) Mabb.	niblum simi	climber	stem used to fasten fences

Apocynaceae	Parsonsia burnensis Boerl.	niblum simi maku		
Apocynaceae	Parsonsia velutina R.Br.	nibilum simi	climber	stem used to fasten fences
Passifloraceae	Passiflora foetida L.	simi amung	climber	edible fruits, liquid from crushed leaves swallowed for common cold
Rubiaceae	Pavetta platyclada K.Schum. & Lauterb.	muki muki		
Lamiaceae	Petraeovitex multiflora (Sm.) Merr.	ibu simi	climber	firewood, planted with yams, stem used to fasten house frame
Annonaceae	Phaeanthus macropodus Diels	katam pirangke	tree	timber used in house construction
Thymelaeaceae	Phaleria macrocarpa Boerl.	kubul ningi	tree	bark used to make traditional skirts
Marantaceae	Phrynium macrocephalum K.Schum.	bunup	tree	leaves used to wrap and cook sago and fish
Phyllanthaceae	Phyllanthus clamboides (F.Muell.) Diels	kugad kugad	tree	branches used as gardening tool,timber used as posts for house frame; timber used for construction of beds, small huts, and tables
Simaroubaceae	Picrasma javanica Bl.	aplang ningi		
Euphorbiaceae	Pimelodendron amboinicum Hassk.	mulal	tree	liquid used to treat anemia
Piperaceae	Piper betle L.	kamul kamul	climber	fruit and leaves chewed with betel nut and lime pepper
Piperaceae	Piper fragile Benth.	ang kamul ningi	climber	fruits chewed with betel nut
Piperaceae	Piper interruptum Opiz	kamul akab tikibla	climber	food for animals
Piperaceae	Piper macropiper Pennant	ang kamul	climber	fruit and leaves chewed with betel nut
Piperaceae	Piper rodatzii K.Schum & Lauterb	ang kamul	climber	fruit chewed with betel nut
Piperaceae	Piper triangulare Chew ex P.Royen	kamul akab tikibla	climber	food for animals
Urticaceae	Pipturus argenteus (G.Forst.) Wedd.	sikiang maningula		
Nyctaginaceae	Pisonia longirostris Teijsm. & Binn.	kinesang		

Nyctaginaceae	Pisonia umbellifera (J.R.Forst. & G.Forst.) Seem.	kinesang maku		
Pittosporaceae	Pittosporum	siau akab ningi		
Pittosporaceae	Pittosporum sinuatum Blume	blumes		
Sapotaceae	Planchonella myrsinodendron (F.Muell.) Swenson, Bartish & Munzinger	yamu sisi barra	tree	timber used in house construction
Sapotaceae	Planchonella xylocarpa (C.T.White) Swenson, Bartish & Munzinger	yamu ningi	tree	timber used for house construction, fruit food for animals
Lecythidaceae	Planchonia papuana Knuth	dupu		
Podocarpaceae	Podocarpus neriifolius D.Don ex Lamb.	yum tigi	tree	timber used in house construction
Annonaceae	Polyalthia glauca Boerl.	pan pan		
Annonaceae	Polyalthia oblongifolia Burck.	giaung kubli		
Icacinaceae	Polyporandra scandens Becc.	yandi yandi simi		
Sapindaceae	Pometia pinnata J.R.Forst. & G.Forst.	guli	tree	edible fruits, liquid used on sores
Annonaceae	Popowia pisocarpa Endl.	pan pan ningi		
Araceae	Pothos hellwigii Engl.	sabiring; nindumul ningi;	climber	young leaves used as salt
Araceae	Pothos rumphii Schott	saping simi		
Sapotaceae	Pouteria firma (Miq.) Baehni	mulim té sisi mumung		
Sapotaceae	Pouteria keyensis H.J. Lam.	yamu sisi mumung	tree	timber used in house construction
Sapotaceae	Pouteria thyrsoidea (C.T.White) T.D.Penn.	imi		
Moraceae	Prainea papuana Becc.	dipul wala wala	tree	edible nuts, bark used for making cloth
Lamiaceae	Premna obtusifolia R.Br.	kwaindé		
Burseraceae	Protium macgregorii (F.M.Bailey) Leenh.	simul sanumé	tree	timber used in house construction, seeds food for animals
Rosaceae	Prunus gazelle-peninsulae (Kaneh. & Hatus.) Kalkman	angidivu tikivla		

Rosaceae	Prunus schlechteri (Koehne) Kalkman	angidibu	tree	timber used in house construction
Annonaceae	Pseuduvaria versteegii Merr.	panpan suku		
Rubiaceae	Psychotria leptothyrsa Miq.	gavkam tikivla simi		
Rubiaceae	Psychotria micrococca Valeton	mangal mangal suku		
Rubiaceae	Psydrax cymigera (Valeton) S.T.Reynolds & R.J.F.Hend.	kunugul ningi	tree	plant used as house decoration
Fabaceae	Pterocarpus indicus Willd.	giva	tree	liquid used as glue to attached lizard skin as the head of a kundu drum, timber used as house posts, wood forbidden to use as firewood
Malvaceae	Pterocymbium beccarii K.Schumann	ningl	tree	leaves used as poison for killing fish, edible fruits
Fabaceae	Pueraria triloba Makino	umei simi	climber	stem used for tying light wood and greens, seeds used as marbles
Rubiaceae	Randia decora Valeton	kimal kimal maku	tree	branches used as gardening tool ,leaves used to wrap eggs, fruits poisonous, used in the past by sorcerors to kill human spirits
Rubiaceae	Randia dryadum (S.Moore) Merr. & L.M.Perry	kimal kimal ningi	tree	branches used as gardening tool, leaves used to wrap eggs, used to make bow
Rubiaceae	Randia schumanniana Merr. & L.M.Perry	unga kiang		
Araceae	Rhaphidophora australasica Bailey	saping		
Araceae	Rhaphidophora geniculata Engl.	saping	climber	leaves are used for wrapping and applied to sores
Araceae	Rhaphidophora korthalsii Schott	saping	climber	leaves applied to sores and cuts
Araceae	Rhaphidophora pachyphylla K.Krause	saping		
Araceae	Rhaphidophora peekelii Engl. & K.Krause	mang mang simi		

Myrtaceae	Rhodamnia sessiliflora Benth.	ulgidi ningi akab	tree	timber used as posts in house framing, timber used in construction of small huts
Anacardiaceae	Rhus taitensis Guill.	kuking	tree	liquid consumed for general illness or sorcery, liquid fed to dogs to prevent pregnancy
Icacinaceae	Rhyticaryum novoguineense (Warb.) Sleumer	siwang té kanyang		
Poaceae	Rottboellia exaltata L.f.	bumbal akab	herb	fruits attract hunted birds
Connaraceae	Rourea minor (Gaertn.) Alston	kapu kiské simi		
Salicaceae	Ryparosa calotricha Mildbr.	ang sugi maku		
Salicaceae	Ryparosa javanica (Blume) Kurz ex Koord.	ang sugi ningi		
Celastraceae	Salacia chinensis L	igam simi		
Celastraceae	Salacia erythrocarpa K.Schum.	igam simi ningi	climber	stem used as rope, leaves applied to cuts, used to treat runny nose
Meliaceae	Sandoricum koetjape Merr.	apisang	tree	timber used in house construction
Rubiaceae	Sarcocephalus coadunatus (Sm.) Druce	birr	tree	timber used in house construction, timber used to make wooden plates
Annonaceae	Schefferomitra subaequalis Diels	simed simi		
Araliaceae	Schefflera ischnoacra Harms	ipé kapé simi	climber	latex used as medicine for common cold and sorcery induced illnesses
Anacardiaceae	Semecarpus australiensis Engl.	amandum sisi galang		
Anacardiaceae	Semecarpus magnifica K.Schum.	kengi m'lim		
Anacardiaceae	Semecarpus schlechteri C.A.G.Lauterb.	amandum	tree	leaves used for wrapping sago, edible fruits, timber used in house construction, resin used to paint bows and arrows
Anacardiaceae	Semecarpus undulatus C.T.White	amandum		
Malvaceae	Sida rhombifolia L.	japul tum	tree	young leaves chewed with betel nut

Celastraceae	Siphonodon celastrineus Griff.	iringté		
Elaeocarpaceae	Sloanea forbesii F. Muell.	alung alung maku		
Elaeocarpaceae	Sloanea sogerensis Baker f.	alung alung	tree	branches used as gardening tool, prefered timber for door framing
Smilacaceae	Smilax australis R.Br.	mudé simi	climber	liquid used as lotion to treat fungal infection (tinea)
Solanaceae	Solanum oliverianum K.Schum. & Lauterb.	munde té		
Anacardiaceae	Spondias dulcis Forst.	pukial	tree	leaves boiled and used to wash boils, new growth consumed for colds or sore throat
Monimiaceae	Steganthera hirsuta Perkins	guni té		
Malvaceae	Sterculia	ume té		
Malvaceae	Sterculia conwentzii K.Schum	umé iburra	tree	timber used in house construction
Malvaceae	Sterculia schumanniana (Lauterb.) Mildbr.	alamé	tree	edible nuts
Malvaceae	Sterculia shillinglawii F.Muell.	umé	tree	edible nuts
Loganiaceae	Strychnos minor Dennst. & Franken	klang klang simi	climber	leaves used for rolling tobacco, liquid used to treat sores
Asteraceae	Synedrella nodiflora (L.) Gaertn.	sipi maku		
Araceae	Syngonium podophyllum Schott	mang mang sisibarra	climber	bark used to make traditional cloth, liquid used to treat sores
Myrtaceae	Syzygium	ulgidi maku		
Myrtaceae	Syzygium amplum T.G.Hartley & L.M.Perry	kurkungil		
Myrtaceae	Syzygium branderhorstii Lauterb.	sisi barra; kurkunil ki mundé;	tree	timber used in house construction as posts, branches used as gardening tool to plant taro and yams
Myrtaceae	Syzygium fastigatum (Bl.) Merr. & L.M.Perry	kurkungil	tree	timber used in house construction as posts, branches used as gardening tool to plant taro and yams
Myrtaceae	Syzygium furfuraceum Merr. & L.M.Perry	sisi barra	tree	timber used in house construction as posts, branches used as gardening tool to plant taro and

				yams
Myrtaceae	Syzygium gonatanthum (Diels) Merr. & L.M.Perry	ulgidi ningi	tree	timber used as post in house construction
Myrtaceae	Syzygium goniopterum (Diels) Merr. & L.M.Perry	biulgidi		
Myrtaceae	Syzygium hylophilum (Lauterb. & K.Schum.) Merr.	ulgidi akab	tree	timber used as post in house construction
Myrtaceae	Syzygium longipes (Warb.) Merr. & L.M.Perry	ulgidi suku	tree	timber used in house construction as posts, branches used as gardening tool to plant taro and yams
Myrtaceae	Syzygium pteropodum (Lauterb. & K.Schum.) Merr. & L.M.Perry	ulgidi asik		
Myrtaceae	Syzygium richardsonianum Merr. & L.M.Perry	maksang ningi		
Myrtaceae	Syzygium thornei Hartley & Perry	kirkungil		
Apocynaceae	Tabernaemontana aurantiaca Gaud.	kapisang suku		
Apocynaceae	Tabernaemontana pandacaqui Lam.	kabisang sanu maku	tree	timber used in bush hut construction, branchess used to make sling shots, fruits used as ball for playing
Costaceae	Tapeinochilos pubescens Ridl.	mangal mangal	herb	house decoration
Rubiaceae	Tarenna buruensis Merr.	unge kiang ningi	tree	timber used as posts and fram of houses
Bignoniaceae	Tecomanthe dendrophila (Blume) K.Schum.	sabal simi		
Lamiaceae	Teijsmanniodendron ahernianum (Merr.) Bakh.	sigil sigil		
Lamiaceae	Teijsmanniodendron bogoriense Koorders	sigil sigil		
Combretaceae	Terminalia archipelagi Coode	kumad yangam	tree	edible nuts

Combretaceae	Terminalia complanata K.Schum.	kumad yangam ningi	tree	timber used as posts in house construction
Combretaceae	Terminalia impediens Coode	kumad sai		
Combretaceae	Terminalia kaernbachii Warb.	sai	tree	edible fruits, timber used in house framing and in garden fencing
Combretaceae	Terminalia macrocarpa Steud. & Kurz	kumad kapu kuvé kuvé	tree	leaves used for wrapping meat, used to process sago
Combretaceae	Terminalia microcarpa Decne.	kumad kapu kivekive		
Combretaceae	Terminalia sepicana Diels	kumad sai ningi		
Pentaphylacaceae	Ternstroemia cherryi (F.M.Bailey) Merr. ex J.F.Bailey	dumu	tree	bark used used as poison to kill fish
Tetramelaceae	Tetrameles nudiflora R.Br.	digam		
Vitaceae	Tetrastigma lauterbachianum Gilg	katad; kated;	climber	stems used as rope
Rubiaceae	Timonius rufescens (Miq.) Boerl.	ungakiang	tree	timber used in construction of small huts, branches used as gardening tools
Rubiaceae	Timonius timon (Spreng.) Merr.	mundé yagul		
Menispermaceae	Tinomiscium petiolare Miers	kunga simi maku	climber	stem used as rope for fasten fences and furniture
Menispermaceae	Tinospora dissitiflora Diels	amumut simi	climber	medicinal plant
Meliaceae	Toona sureni Merr.	mururung ikam		
Boraginaceae	Tournefortia sarmentosa Lam.	dudigal simi; malau;	tree	timber used in home construction
Cannabaceae	Trema orientalis (L.) Blume	gubung		
Cucurbitaceae	Trichosanthes ovigera Blume	mak mak simi	climber	edible fruits
Cucurbitaceae	Trichosanthes schlechteri Harms	amu simi	climber	edible fruits
Malvaceae	Trichospermum pleiostigma (F.Muell.) Kosterm.	tikul	tree	juice extract from bark swallowed to treat sorcery, timber used in house framing, firewood
Sapindaceae	Tristiropsis acutangula Randlk.	kubu keng geng		

Rubiaceae	Uncaria appendiculata Benth.	gabkam simi	climber	woody vine a source of drinking water when cut, medicine for common cold and sorcery, used for dressing wounds
Rubiaceae	Uncaria cordata (Lour.) Merr.	ang gabkam, gabkam simi ang	climber	liquid in trunk consumed, leaves used for healing wounds
Rubiaceae	Uncaria lanosa Wall.	ang gabkam, gabkam tikibla	climber	liquid in trunk consumed, leaves used for healing wounds
Rubiaceae	Uncaria valetoniana Merr. & L. M. Perry	ang gabkam, gabkam simi ang, gabkam tikibla	climber	liquid consumed as beverage or medicine, leaves used for healing wounds
Annonaceae	Uvaria	simed simi iburra		
Annonaceae	Uvaria lutescens K. Schum.	simed simi	climber	leaves used for smoking
Annonaceae	Uvaria rosenbergiana Scheff.	simed simi		
Dipterocarpaceae	Vatica papuana Dyer	dikua maku	tree	timber used in construction
Rubiaceae	Versteegia cauliflora Valeton	simun simun	tree	branches used as gardening tool, timber used as posts in house framing
Lamiaceae	Vitex cofassus Reinw. ex Blume	muki	tree	timber used in balcony, small huts, and bridges construction, trunk used for slit drums, wood causes skin irritation when burned
Lamiaceae	Vitex quinata F.N.Williams	ang glu		
Apocynaceae	Voacanga grandifolia (Miq.) Rolfe	kapisang		
Stemonuraceae	Whitmorea grandiflora Sleumer		tree	timber used in house construction
Apocynaceae	Wrightia laevis Hook.f.	té kubul	tree	wood used by ancestors to make plates
Polygalaceae	Xanthophyllum papuanum Whitmore ex van derMeijden	yandu yandu		
Annonaceae	Xylopia papuana F.L.E. Diels	giaung suku		
Cucurbitaceae	Zanonia indica Carl Linn.	ang dungdung simi	climber	medicinal, stem used as string
Rutaceae	Zanthoxylum pluviatile T.G.Hartley	kaniangté		
Rhamnaceae	Ziziphus angustifolia (Miq.) Hatus. ex Steenis	saiam	tree	timber used in construction of small balconies and fences, branches used as gardening tool

Rhamnaceae	Ziziphus djamuensis Lauterb.	saim ningi