

インドネシア・北スラウシ島のウォロアン1地区とワーレム ブガン地区住民の地域資源の利用に関する研究

特に森林利用と維持・管理を中心として

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A Study on Utilization and Maintenance of Local Resources at Woloan I sub-district and Warembungan village, North Sulawesi Province, Indonesia with Special Reference to Forest Use and Management

FRANKY Roring Rocky¹, Jun TAKEDA¹, Lotje KAWET² and Eung-Cheol LEE³

¹Laboratory of Ecological Anthropology and Marine Ethnobiology, Department of Resource Management and Social Sciences, Faculty of Agriculture, Saga University, JAPAN

²Faculty of Economics, Sam Ratulangi University, Manado, Sulawesi, INDONESIA

³Seoul Jangsin University, Seoul, SOUTH KOREA

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Summary

Forests in Indonesia have played important roles in preserving the growing place of numerous natural resources with their valuable biodiversity of flora and fauna as an ecological function. They have also provided foods and raw materials to local people. A large, though undetermined, number of communities live in and/or depend on Indonesian forests.

In order to elucidate the products of forests and the relationship between local people and the natural resources, we selected two study sites and made field studies in January and February 2007, which are still strongly depending on the forest among local groups in North Sulawesi province while living in villages around the forest and being engaged in agriculture: Woloan I sub-district, West Tomohon district, Tomohon city and Warembungan Village, Pineleng district, Minahasa regency. We studied how local people in both sites utilize, maintain and manage products of forests, and discussed.

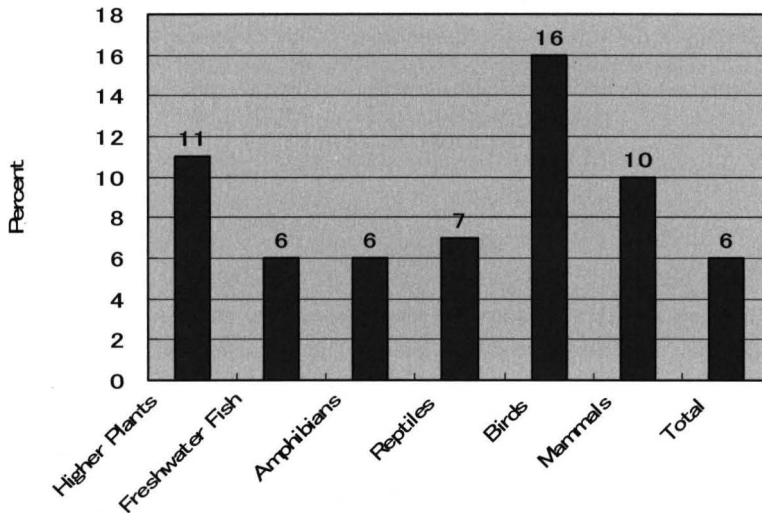
Keywords: Forest management, local resources, forest products, North Sulawesi, Manado

1. Introduction

Indonesia is situated on the equator and has vast and dense tropical forests. Accordingly, Indonesia has lots of natural resources with its valuable biodiversity, not only for Indonesian nation, but also for the international society in general. Indonesia's tropical forests are ranked third (on the basis of area) after Brazil and the Democratic Republic of Congo (formerly Zaire).

The Indonesian archipelago spreads over 5000 kilometers along the equator. Biogeographically, this country is affected by the Indomalayan plain to the west and the Australasian to the east. On account of this, Indonesian's biogeography can be divided into 7 main regions: Sumatra, Java-Bali, Borneo (including Natuna and Anambas), the Lesser Sunda (including Wetar and Tanimbar), Sulawesi (formerly called Celebes), Moluccas, and New Guinea, including Aru and Kai Islands. The Lesser Sundas, Sulawesi, and Moluccas are considered a traditional region between the Indomalayan and Australasian plains. Among 17,000 islands in the archipelago, many of them have been separated from the main plains for thousands of years. Thus, these islands exhibit unique

characteristics, with high endemic species. Indonesia's total land area is 193 million ha (735,356 sq. miles), of which 75% is classified by the Ministry of Forestry as forestland. The remaining 25% is divided into agricultural estates (5.8%), gardens (6.5%), rice fields (4.2%) and other uses (9.6%). Although Indonesia comprises only 1.3% of the earth's land surface, it harbors a disproportionately high share of its biodiversity, including 11% of the world plant species, 10% of its mammal species, and 16% of its bird species. The majority of these species are found in the country's forests. The biotic richness by percent of world species is shown in Figure 1.



Source: World Resources 2000-2001. Washington DC: World Resources Institute: 246-248.

Figure 1 Biotic richness: Percentage of World's species found in Indonesia

The wealth of biodiversity in flora and fauna is spread all over Indonesia province, including North Sulawesi province.

About 6,000 species of plants, 1,000 species of animals and 100 kinds of microorganisms are known for their potential and used by the people in Indonesia. Thousands or maybe millions of creatures are yet to be uncovered and await discovery, which can be put to use for the human welfare all over the world. This includes the rich array of fauna in North Sulawesi province, and with its expanse of forestland, there are so many kinds of flora, which grow naturally, but are now cultivated and developed by the people. Due to the abundance of natural resources, Indonesia is called a "megabiodiversity country" and attracts international attention, especially in the aspect of natural resources conservation. International attention has become prominent as indicated by the flow of international aid and development of global issues. Indonesian tropical forests are used not only by Indonesians, but also have the role to contribute to the international community. This is reflected, for instance, in the statement that the Indonesian tropical forests are the "lungs" of the world (Ministry of Forest and Estate Crops, Republic of Indonesia, 1999).

Besides flora, North Sulawesi province is also rich in fauna, with mammals, reptiles, amphibians, birds, fish, etc. The fauna lives naturally in the forest as wildlife. Unfortunately, the population of many kinds of fauna like *anoa*, *babirusa*, deer, *maleo* (*Macrocephalum maleo*), Sulawesi rangkong (*Aceros cassidix*), Cussus bear (*Phalanger celebensis*) and some others are

decreasing. Recently, three of them have become very rare and difficult to find in some areas of Minahasa, Sangihe and Talaud, and also Bolaang Mongondouw, as they have been hunted and eaten by the local community. There are so many other kinds of animals still living freely and hidden from hunting and human consumption.

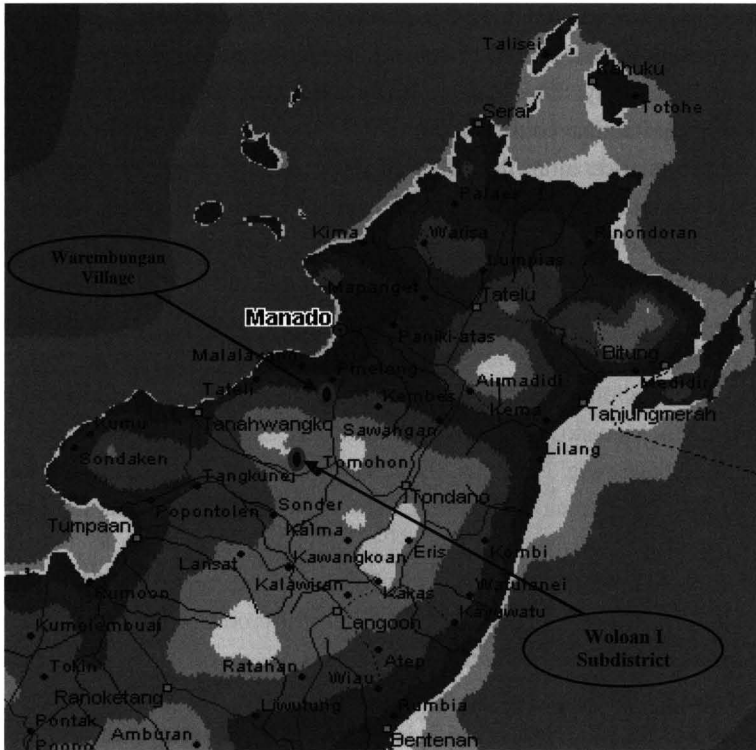
In Woloan I sub-district, more than 28% of inhabitants are engaged in paddy farming and plant cultivation while utilizing forest products such as cereal, root crops, legumes, vegetables, fruits, sugar palm, *pakoba* tree, coconut tree, and so on. They cut trees like bamboo, mahogany tree, *cempaka* tree (*Elmerrillia celebica*, Margoliaceae) and *nantu* tree (*Palaquim obtusifolium*, Sapotaceae) so that people may get the wood for housing; although the last three species were abundant until the early 1990s, they are very scanty nowadays. More than 30% of the people work as carpenters for building traditional Minahasa house, which is sold to local people in Sulawesi Utara, especially Manado, Minahasa, Bitung and Bolaang Mongondow, and big cities such as Jakarta, Bandung, Semarang, Surabaya, Bali, Palu, Kendari, Papua, Ambon, and Ternate. It has also been exported to Germany, Argentina, France, Australia, Malaysia, the Philippines, very commonly and Costa Rica, recently.

In Warembungan village like Woloan I sub-district, where more than 33% of the people are farmers without paddy, cultivate plants and also use forest products: cereal, root crops, legumes, vegetables, fruits, sugar palms, coconut trees, candlenuts and so on. They cut trees like *cempaka*, *bua rao* and *linggua* for housing, but the quantity of trees was limited at this time. There is another important source for pure water, which is located in the western part of the village, where many kinds of trees and plants grow on the protected forest. Bauxites are also available for material construction. In addition, they hunt wild pig, cave bat, and wild white-tailed rat, and utilize lemongrass, cinnamon, *mengkudu*, etc. for medical use.

2. Study sites and method

The sub-district of Woloan I is located in the small town of West Tomohon district, which is part of Tomohon city, around 5 km to the west of the city and around 30 km to the south of Manado city, North Sulawesi province (Fig. 2). Woloan I sub-district, with a total area of more than 250 ha and total population of approximately 3,150 inhabitants in 2006, is rich in forest and agricultural products. In particular, it is a major producer of wooden house called traditional Minahasa house, and timber in North Sulawesi. The traditional Minahasa house is a famous product from this sub-district, not only in Indonesia but also all over the world. The traditional Minahasa house is special, because all parts of the house including floors, walls, beams, ladders, plafonds and so on are made of wood. The local government has also decided the sub-district as one of the vegetables producing areas in Tomohon city. This village is rich in forest product such as hard wood trees including mahogany, yellow *champaka*, *nantu* and bamboo; wild pork and cave bat, etc. which are source of animal protein; and agricultural products such as cereals, vegetables, root crops, legumes and fruits in abundance.

Warembungan village is located around 5 kilometers to the south of Manado city, in the Pineleng district of the Minahasa regency, North Sulawesi province. Like Woloan I sub-district, inhabitants use the forest while engaging in agriculture for survival and livelihood. This village is



Source: Government office of North Sulawesi, 2006

Figure 2 Location of Woloan I sub-didtrict and Warembungan village

also known as a producer of bauxite, which is used as material construction for building houses, roads, bridges, breakwater, soil stabilization, etc. Warembungan village is also one of four villages (Lota, Malalayang, and Koka village), which supply pure water for local inhabitants in Manado city and its surroundings. PDAM (*Perusahaan Daerah Air Minum*) Water Company is a local one, which was appointed by the government of Manado city to manage to distribute the water to local people in Manado and its surroundings.

Given the big forest potential of both Woloan I sub-district and Warembungan village, people still strongly depend on forest and are engaged in agriculture. Both Woloan I sub-district and Warembungan village not only rich in animal and tree products of forest, but also agricultural products like cereal, vegetables, fruits, root crops, legumes and so on. More than 33% of the population in Warembungan village, and more than 28% in Woloan I sub-district, are still strongly depending on forest and engaging in agriculture.

Focusing the various functions of the forests and the relationship between local people and the natural resources, the field survey was conducted in January and February 2007, at Woloan I sub-district, West Tomohon district, Tomohon city and Warembungan village, Pineleng district, Minahasa regency, North Sulawesi province. To get primary data (qualitative and quantitative) during field research, three methods were used: interviews, direct observation and questionnaires. Secondary data are based on information from Government offices in Manado city, Tomohon city, Minahasa regency, and other reference books. The main objectives of the study are as follows:

- a. To reveal and prove the functions of the forest for local farmers and local inhabitants.
- b. To study how the local people utilize and maintain forest and agricultural products for survival and livelihood.
- c. To study how the local people gather, hunt the resources of forest and depend on agriculture, and also other potential uses.

3. Natural resources in Indonesia and North Sulawesi

a. Forest.

With the forest area of 788,691.88 ha, North Sulawesi is overgrown with many kinds of forest resources like timber, vegetables, fruits, palm trees, orchids, rhizomes, root crops, legumes, and other kinds of the forest crops.

The trees and plants not only grow in the mountains, highland, and hilly areas, but also in rather steep place in the swamps. The geographical location of the community and its proximity to the original sources of food varieties is obviously a positive factor, when the plant diversity of a particular locality is taken into consideration.

Food crop plants are accepted by rural communities through their customs, habits and traditions as appropriate and desirable foods. People use them and know how to maintain, cultivate and prepare them for daily consumption and the other usages. In addition, people have folk knowledge as to their nutritive, therapeutic and economic value. The variety of plants in North Sulawesi province is shown in Table 1 in alphabetical order of local names.

Besides growing naturally in the forest, some of them are replanted by the local inhabitants

Table 1 Forest food crop plants in North Sulawesi province

Local name	Scientific name	Common name
Angrek tanah	<i>Phaius tankervilleae</i>	Orchid
Angrek bulan	<i>Phalaenopsis amabilis</i>	Orchid
Alpokot	<i>Persea gratissima</i>	Avocado
Asam jawa	<i>Tamarindus indica</i>	Tamarind
Bambu / Bulu	<i>Bambusae</i> sp.	Bamboo
Benalu	<i>Loranthus</i> sp.	Epiphyte
Beringin	<i>Ficus benyamina</i>	Banyan tree
Cempaka mariri	<i>Michelia champaca</i>	Yellow champaca
Cempaka mawure	<i>Michelia alba</i>	White champaca
Cengkih	<i>Syzygium aromaticum</i>	Clove
Coklat	<i>Theobroma cacao</i>	Cacao
Duku	<i>Lansium domesticum</i>	Lanseh tree
Durian	<i>Durio zibethinus</i>	Durian
Jambu air	<i>Eugenia aquea</i>	Rose apple
Kapok	<i>Ceiba pentandra</i>	Kapok tree
Kayu lawang	<i>Cinnamomum lawang</i>	Cinnamon
Kayu manis	<i>Cinnamoman burmani</i>	Cinnamon
Mahoni	<i>Swietenia mahagoni</i>	Mahogany
Mangga	<i>Mangifera indica</i>	Mango
Mengkudu	<i>Morinda citrifolia</i>	Indian mulberry

Melon	<i>Citrullus lanatus</i>	Water melon
Manggis	<i>Garcinia mangostana</i>	Mangosteen
Pala	<i>Myristica fragrans</i>	Nutmeg
Pinus	<i>Pinus merkusii</i>	Sumatran pine
Rambutan	<i>Nephaliium lappaceum</i>	Rambutan
Seho	<i>Arenga pinnata</i>	Sugar palm
Semangka	<i>Euphorbia plumerioides</i>	Water melon
Vanili	<i>Vanilla planifolia</i>	Vanilla

Source: Field survey January and February 2007, and available at: <http://www.minahasaraya.net>

in their house yard or garden, especially as for seasonal crop plants. Shoots of some plants are grafted. Farmers do this as a means of harvesting plant easily, without having to go continually to the forest.

b. Major gathered plants and usages

The Province of North Sulawesi is widely known as “*bumi nyiur melambai*” (the land of waving coconut leaves) and the coconut tree is used frequently as a symbol and part of the emblem.

Coconut plant is still categorized as a basic commodity in the local economy, because it is one of the preeminent sources of income for farmers and the local community. For the people in North Sulawesi, coconut has an enormous value because it has not only been closely connected with so many farmers, but has also provided the biggest benefits of the plant for the people. Other preeminent commodities are clove, vanilla, cocoa and nutmeg.



Source: Field Survey, 2007

Figure 3 Manado Bay viewed from Warembugan village

North Sulawesi province is also rich in clove and vanilla. Clove is cultivated by farmers in almost every part of North Sulawesi province, including Woloan I and Warembugan, who had experience wealth period and vintage crop until the early 1980s. At that time, cloves were Minahasan mostly beneficial crop, as they were cultivated on a large scale, because of the high price; the crop did not require special processes in cultivating and maintaining, or in post-harvesting. The Minahasan have called clove as ‘Brown Gold’, because green cloves with young flowers’ buds in clusters during the harvesting are dried directly under the sunlight, causing brown in color and then are sold for a high price. Recently the price of clove has stabilized, ranging between Rp. 30,000 to 35,000 per kg, though it fetched 2 times, even 3 times in price in its heyday era. The tree begins to produce flower buds at about 5 years and reaches to full bearing tree in the age of 20. Cloves are used world-widely and also used for Minahasan food to flavor and preserve food while small buds are important part of many dishes. Cloves are able to improve a fresh effect to the body and to increase the activity of heart. Farmers eat cloves in the morning before going to

their gardens and/or paddy fields to start work. The essential oil, *eugenol*, found in cloves is highly volatile, so it is used by dentists as antiseptic, and also in the manufacture of perfumes and as flavoring in medicines. See also Takeda, *et al.* (in press) as to other usages of spices used and consumed in Sri Lanka, India and Bangladesh. Cloves are also used in *kretek* cigarettes (clove cigarettes), demanding to be so that the spice now has to be imported to its original home from Zanzibar and Madagascar.

Like cloves, vanilla is native to the Moluccas and has been used in the eastern Mediterranean since the 12th century, when Arab traders brought it there. Vanilla is the most widely used flavoring, fragrance ingredient, and expensive spice. Vanilla was an alternative crop, when clove, copra and nutmeg prices fluctuated markedly, which started around the early 1990s. Although the cultivation of vanilla is rather complicated and expensive in the maintenance, many farmers in North Sulawesi are interested in the cultivation of this commodity, not only for its high price, but also for traditional food and medical treatment. During the harvesting time, the farmer generally sells the crop to traditional market or to spice shop, but sometimes, there are merchants who come to buy the product directly from farmers. Part of this income is used to pay the labor who helps farmers gather the vanilla, and the rest is saved for paying school expenses of kids or for repairing home.

The nutmeg tree, now grown in many areas outside its original home, including North Sulawesi, produces a firm nut with yellow flesh. The plants live naturally in forests or cultivated in local gardens.

Sugar palm grows in abundance in North Sulawesi, both Woloan I sub-district and Warembungan village, but it is not being sufficiently cultivated in spite of its big benefits. It has a variety of uses: part of wrapping the stem is used for brooms, rope, cloth brush, and palm rib. The male palm blossoms, once tapped, go out the liquid, namely *saguer* that contains sugar. Processed *saguer* becomes palm sugar (a kind of jaggery), which varies in the color from red to chocolate. The farmers do not add any chemical substances for making sugar palm, so the product can be said organic palm sugar. The villagers usually make the sugar early in the morning in the gardens, which are located not so far from their house. Palm sugar is used in many Minahasan foods. One of the favorites is *dodol*, made of glutinous rice, coconut milk, palm sugar and *kenari* nuts (*Canarium* spp.). Several farmers make *dodol* in times of special events, also being as a home industry in Minahasa.

Many Minahasans drink *saguer* as a traditional beverage from Minahasa, because of its delicious taste by approximately 5% alcohol content. The taste of *saguer* can be adjusted *petifar* (taper) till it becomes sweet, sweet-acidic, or acidic in taste. Sweet *saguer* can be drunk by mothers who have a just new baby, with the aim to add contents of *asi* (*air susu ibu*: mother's milk). Some stalls in Minahasa generally sell *saguer* and people believe that drinking *saguer* gives a good appetite. Some farmers make the *saguer* 'forte', by putting palm blossoms into bamboo containers (*gatah*). The 'forte' *saguer* is the starting step to making 'forte' *cap tikus* (distilled palm wine; a kind of arrack), which releases a blue flame if burned by a match. The *saguer* can be processed distilled into *cap tikus* by traditional refining methods, and the concentration of alcohol increases to about 40%. This beverage is produced by Minahasans in the forest or in the plantation areas among the palm trees. The beverage *cap tikus* has been popular among Mina-

hasan farmers for a long time. Minahasan farmers generally drink a shot glass of cap tikus before going to their garden or starting work. The beverage is recognized by everyone in Minahasa as a body-warming beverage and spirit impeller for working. Cap tikus is also used as the main raw material in a number of wine fabrics in Manado. In addition, if the sagueer is stored for a sufficient length of time, it will change into vinegar, called *cuka sagueer* (sagueer vinegar), with a specific acid taste.

Like cloves, nutmeg is native to the Moluccas and has been used in the eastern Mediterranean since 12th century, when it was taken there by Arab traders. This spice tree is harvested manually. The ripe nutmeg is indicated by firm, yellow flesh which is pickled or soaked in sugar syrup and eaten as a confectionery, also as an antidote to seasickness. The Minahasan make two kinds of nutmeg sweets: sweet acidic and hot acidic and with an aromatic fragrance apart from its delicious taste. The sweets are produced as a home industry and are typical snacks of Manado. Inside the fruit is a nut, the nutmeg, covered by a hard shiny brown shell. On the outside of the shell is a vivid red lacey web or aril. This is mace, which is also used as a spice in Minahasan dishes and the West, but which is used only in dishes of Indian origin in Southeast Asia. The dried nutmeg will keep almost indefinitely, and should be grated or crushed just before use. Often nutmegs are sold in North Sulawesi and Asia still with their hard shell, which should be broken off and discarded. Although nutmeg is a popular sweet flavoring in the West and Manado, it is used only in savory dishes in Southeast Asia such as curries and soups (Takeda et al., in press).

Long time ago, there were many *pakoba* trees in the forests, yards and gardens of local inhabitants, but recently the plants have become rare. Even so, some can be found in plantations and yards, which are nurtured by the community for the fruit crop or as a constructing timber for yard or land plantation. *Pakoba* trees that keep living until this time are approximately 20 to 30 years. Especially Tomohon city government wants to restore the natural resources of pakoba tree as a pre-eminent tree in Tomohon city in the future by recultivating it for its ecological and economic value. For this purpose, the government distributes seeds to farmers in order to cultivate large areas, hoping that the farmers will harvest the products in the future and process them to be a typical kind of food from Tomohon city. Its wood can be used for housing, furniture, firewood and also its resin as a raw material in colorant, to make fishing nets, and so on. Typical foods made by farmers, involve processing the ripe pakoba fruit for sweets, jams, etc., which assign additional value to the family. So far, the government has conducted to repair natural resources through rehabilitating forests and farm lands by replanting wood trees, including pakoba trees, and to fulfill the requirement of wood and fruit products in Tomohon city. In effort to develop, the Government considers the advantage of pakoba trees in Tomohon as a preeminent endemic crop that will have a good future. The target of replanting pakoba trees in the short term is to improve the participation by local farmers and the local community, especially on farm land with the aim of increasing the earnings on one hand and supporting programs (rehabilitation of forest and land agriculture) of the government in emboldening and replanting this tree on the other hand.

There are other crops cultivated by the farmers like cinnamon, coffee, cacao, sago palm, rambutan (*Nephaliium lappaceum*), mango, jackfruit, breadfruit, banana, *langsar* (*Lansium domesticum*), durian (*Durio zibethinus*), snakefruit (*salak*), etc. Other locally cultivated crops such as leek, Chinese chives (*Allium tuberosum*), chili (*Capsicum* sp.), pandan (*Pandanus amarillyfo-*

lius), celery (*Apium graveolens*), ginger, water convolvulus, egg plant, spinach, long bean, corn, chayote, and so on.

There is a kind of *kenari*, normally known as canary nut or Java almond, and gathered by the seed from fruits of *Canarium indicum* and *C. vulgare*. Some local people coat the canary nut with jaggery from sugar palm, called *halua kenari*. This is done as a private or home business, and sold to the traditional markets and supermarkets, and bought as gifts of typical food from Manado. Local food name, *dodol* is a favorite food in Minahasa that also contains the canary nut, made by a kind of home industry in Minahasa. There is another kind of *kenari* (*Canarium odontophyllum*) with a taste similar to avocado. It can be eaten after being soaked in warm water. This species contain protein, carbohydrate, and fat, and so is a nutritious foodstuff.

Bamboo is a very important product of the forest, which is used for housing materials and people eat tender young shoots from a species of *rebung* bamboo. *Rebung* is obtained by cutting at the base part of young shoots using a *peda* (chopping knife) or axe. It is then placed carefully into a plastic or cloth sack, as the pinfeather on the surface of *rebung* produces an itchy effect if coming into contact with the skin of the collector. Some are infinitely superior, lacking in the bitterness. Bamboo shoots from a cooler climate including those grown at higher altitudes are generally much sweeter. They are sold in several ways in the markets: whole, complete with their leaf sheaths or peeled and sliced ready for cooking or cut and pre-boiled.

Sago palm is one of the principal substitutes for rice in tropical areas, which have insufficient rain for rice cultivation. The sago starch is obtained in two forms, spinless one (*Metroxylon sago*) and prickly one (*M. rumphii*). It forms clumps both in cultivation and in the wild. Its natural habitat is lowland-freshwater swamps and sago palms are found throughout Sangihe Talaud Island though rare in Minahasan area, and are mainly consumed in the drier areas of Indonesia. The palm builds up its storages of starch over its life of about 15 years and attains its maximum store just before the inflorescence opens. One sago produces 300-500 kg of starch. The palm is felled; the trunk cut into many lengths and the pith is manually extracted and processed. The purified starch is then dried and preserved, notably as flour and baked biscuits. It is also used in the textile and pharmaceutical industries. Sago pearl just like cassava pearl is commercially the starch mixed again into a paste and sieved through various sized meshes. The finished sago pearl has a long shelf life.

Cashew trees are among wood products of the forest, but also cultivated in gardens, and on other land by the people of North Sulawesi province. Two edible products are obtained from the cashew tree: the cashew apple (*jambu monyet*) which is red or yellow, soft and juicy when ripe, but it is not a proper fruit; and the kidney-shaped nut (*kacang mete*), attached to the base of the fruit, which is the true fruit. People eat the fruit only when fully ripe. When it is crisp and sweet otherwise it is unpleasantly astringent. In addition, cashew apples can be processed for juice, syrup, as sweet dry apple (*manisan*), cashew jam, etc. The fried cashew nut is a highly nutritional food and enjoyed as local favorite. Besides using as food, people consume other parts of the cashew for medicine, i.e. as a treatment for dysentery. The preparation consists of boiling 1 piece from the cortex of the cashew tree and a handful of cashew leaves with 1.5 liters of water. After diluting with water, it should be drunk twice daily (morning and afternoon). In addition, the leaves are also used to treat diabetes, and burns (external use), while the cortex is used for di-

arrhea and thrush.

Tamarind fruit looks like long bean, pods and contain seeds. The pod is green at the immature stage, and becomes fatter and changes color to a sandy brown when mature, with a high tartaric acid content which is rich in vitamin C with an amount of sugar. The flesh of the fruit consists of dry, sticky, and dark brown pulp with the shiny black seeds and tastes like hot, unsweetened lemon. There are a few thick strands, running along the length of the pod, which help enclose the pulp. Women use the hard green pulp of young fruit (which is very sour and acidic) most often as a component of curry dishes and meat condiments, and mature ones in the preparation of *sayur asam* (acidic vegetable soup). The ripe pulp is used for jams, syrup, sweets, and can be directly eaten. Farmers use leaves (which are first chewed) to apply to fresh wounds when stabbed or cut. Three seeds (from ripe pulp) with an adequate amount of sugar palm are boiled with two glasses of water, diluted and taken for stomachaches. Moreover, the tamarind heartwood, which has a bold red wood color, can be used for furniture and flooring, because of its density and durability.

c. Wild animals and usages

North Sulawesi is important as part of the eastern side of the Wallace line, which cuts through Indonesia and was first named around 150 years ago. Wallace's line is an imaginary line named after the English naturalist, Alfred Russell Wallace. This line indicates a clear difference in fauna between on the west side and on east side of Indonesia. Many animals endemic to Sulawesi live in a conservation area in this province (National Development Planning Agency, Republic of Indonesia, 2003). The wild animals in North Sulawesi province is shown in Table 2.

Table 2 Wild animals in North Sulawesi province

	Local name	Scientific name	Common name
Mammals	Anoa	<i>Babulus depressicornis</i>	Lowland anoa
	Babi hutan	<i>Sus celebensis</i>	Wild pork
	Babirusa	<i>Babyrousa babyrussa</i>	Babirusa
	Bajing pohon	<i>Prosciurillus leucomus</i>	Pale tree squirrel
	Bajing sulawesi	<i>Prosciurillus murinus</i>	Sulawesi tree squirrel
	Ikan duyung	<i>Dugong dugon</i>	Dugong
	Kalong	<i>Cynopterus brachyotis</i>	Lesser dog-faced fruit bat
	Kelelawar	<i>Chironax melanocephalus</i>	Black-capped fruit bat
	Kuskus sulawesi	<i>Strigocuscus celebensis</i>	Sulawesi dwarf cuscus
	Kuskus, kuse	<i>Ailurops ursanus</i>	Bear cuscus
	Monyet hitam	<i>Macaca nigra</i>	Celebes black macaque
	Monyet tonkean	<i>Macaca tonkeana</i>	Tonkean macaque
	Musang Tanggalong	<i>Viverra tangalunga</i>	Malay civet
	Musang sulawesi	<i>Macrogalidia musschenbroekii</i>	Sulawesi palm civet
	Rusa	<i>Cervus timorensis</i>	Deer
	Reptiles	Tangkasi	<i>Tarsius spectrum</i>
Tikus hutan		<i>Maxomys musschenbroekii</i>	Musschenbroek's spiny-rat
Tupai hidung panjang		<i>Hyosciurus ileile</i>	Northern long-nosed squirrel
Cecak terbang		<i>Draco volans</i>	Common flying lizard
Kadal		<i>Hemidactylus frenatus</i>	House gecko
Ular gadung		<i>Ahaetulla prasina</i>	Green whip snake

	Ular hijau	<i>Tropidolaemus wagleri</i>	Wagler's pit-viper
	Ular kobra	<i>Naja sputatrix</i>	Indonesian spitting cobra
	Ular laut kuning	<i>Laticauda colubrina</i>	Yellow-lipped sea snake
	Ular piton	<i>Python reticulatus</i>	Reticulated python
	Ular pohom coklat	<i>Boiga irregularis</i>	Brown cat snake
	Tokek	<i>Gekko gekko</i>	Tucktoo lizard
Amphibian	Biawak	<i>Varanus salvator</i>	Water monitor
	Penyu bersisik	<i>Eretmochelys imbricata</i>	Hawksbill turtle
	Penyu hijau	<i>Chelonia mydas</i>	Green turtle
Birds	Burung hantu	<i>Ninox ios</i>	Speckled boobook
	Burung niu	<i>Eutrichomyias rowleyi</i>	Caerulean paradise-flycatcher
	Burung hantu	<i>Ninox ochracea</i>	Ochre-billed hawk-owl
	Burung pendeta	<i>Streptocitta albicollis</i>	Blibong pendeta
	Elang alap Celebes	<i>Accipiter griseiceps</i>	Sulawesi goshawk
	Jalak moloneti	<i>Scissirostrum dubium</i>	Finch-billed myna
	Kadalan Celebes	<i>Rhampococyx calorhynchus</i>	Sulawesi lizardhawk
	Kakatua jambul	<i>Cacatua sulphurea</i>	Yellow-crested cockatoo
	Maleo	<i>Macrocephalon maleo</i>	Maleo maleo
	Pergam hijau	<i>Ducula aenea</i>	Green imperial pigeon
	Pergam putih	<i>Ducula luctuosa</i>	White imperial pigeon
	Raja perling celebes	<i>Basilornis celebensis</i>	Sulawesi myna
	Rangkong	<i>Rhyticeros cassidix</i>	Sulawesi rangkong
	Sampiri	<i>Eos histrio</i>	Red-and-blue lory
	Serindit Celebes	<i>Loriculus stigmatus</i>	Sulawesi hanging-parrot
	Sikatan matinan	<i>Cyornis sanfordi</i>	Matinan flycatcher

Source: Field survey January and February 2007, and available at: <http://www.minahasarayana.net>

The increased hunting of wild animals and tree logging by the local inhabitants have resulted in the decrease of the wildlife population including scarce and even threatened species. Some inhabitants, especially farmers shoot and trap wild animals, which come to eat the harvested crops. The gardens around forests become hunting targets of the animals. Many inhabitants consume the meat of wildlife animal for protein and also believe they are useful as traditional treatments. The black-capped fruit bat (*kelelawar*) is used for treating asthma. People also believe that consuming the meat of wild snake is good for health, especially as cardio tonic. People hunt wild pig, wild chicken, monitor lizards (*biawak*), cave bats, wild rats with white tails, etc., for family consumption, and also sell in traditional markets for family income.

d. Potential of the forest in North Sulawesi province

Forest in North Sulawesi province is dense with trees, and other plants, covering a large area and exhibiting a different environment compared to areas beyond it. The forest consists of a complex mixture of vegetation with its soil microorganisms and animals, while maintaining interdependence among them. North Sulawesi forest can be described as a tropical evergreen forest including many kinds type of vegetation like swamp and mangrove forest, beach forest, plain forest or low land forest, down the hill forest, and mountain forest. North Sulawesi forest is dominated by special kinds of trees belonging to the families of Moraceae, Annonaceae, and Euphorbiaceae.

Based on instruction by the Minister of Plantations and Forestry No. 452/Kpts-II/99 on June

17th 1999, the forest area of the North Sulawesi region is 1,615,070 ha before the separation of Gorontalo Province from North Sulawesi province. After the separation, the forest of the North Sulawesi region decreased to 788,691.88 ha and was shared in 5 regencies and 3 cities (Department of Forestry Office, North Sulawesi Province, 2007).

Since then, the forest area of the North Sulawesi was divided into several functions as protected and natural conservation forest which had the largest area with more than 40% of the total, further protected forest, forest production limited, production forest and convention forest. The smallest one was convention forest with 14,643.01 ha or 1.9% of the total forest. The forest function and their area is shown in Table 3.

Table 3 Area of forest function

No.	Forest function	Area (ha.)	(%)
1	Protected and Natural Conservation Forest	320,543.00	40.6
2	Protected Forest	175,958.00	22.3
3	Forest Production Limited	210,116.36	26.6
4	Production Forest	67,431.53	8.6
5	Convention Forest	14,643.01	1.9
Total		788,691.88	100.0

Source: Departement of Forestry Office, North Sulawesi Province, 2007.

Based on the area of the available forest region in North Sulawesi province, it can be seen that more than 65% of the forest spread over Bolaang Mongondow. The biggest area of the national park and the conservation region is located in the north of Minahasa and Talaud island, whereas the smallest one is in Tomohon city, 193,647 ha, 44,486 ha, 29,804 ha and 694 ha, respectively as shown in Table 4.

Table 4 Distribution of forest function in North Sulawesi province

No	City / Regency	Forest function				
		PNCF	Prot. F	FPL	Prod. F	CL
1	Manado City	2,540.82	1,202.01	4.52	-	-
2	Bitung City	9,706.16	9,329.75	-	-	-
3	Tomohon City	649.00	585.00	1,615.00	-	-
4	Minahasa Regency	8,417.02	9,173.00	5,758.00	270.53	-
5	South Minahasa Reg.	18,770.00	22,551.00	30,423.00	16,334.27	-
6	North Minahasa Reg.	44,486.18	17,428.00	10,361.74	-	-
7	Bolaang Mongondow Reg.	193,680.00	95,089.00	259,610.62	50,826.73	14,643.00
8	Sangihe Island Reg.	-	13,820.00	-	-	-
9	Talaud Island Reg.	29,806.68	10,199.00	2,348.00	-	-
Total		320,543.00	175,958.00	210,116.36	67,431.53	14,643.00

Source: Department of Forestry, North Sulawesi Province Government, 2007

The forest of the national park and the conservation region has certain typical characteristics, which serve as a life support system and conservation of the species-diversity of flora and fauna, as well as a lasting manner of the biological resources and the ecosystem.

Bitung city has protected forest and natural conservation forest such as Manado city with also small area of forest production limited. Sangihe island regency, which is located in the north of Manado, has only protected forest with an area of 13,820 ha (7.9% of the total protected forest).

In addition to extensive forests in North Sulawesi province, there are many kinds of natural and cultivated plants. The government of Tomohon city and Minahasa regency support the farmers to maintain the forests with programs which include community counseling about the forest, distribution of seeds and fertilizer especially for wood plants such as *nantu* (*Palaquim obtusifolium*), *meranti* (*Shorea* sp.), and *cempaka* (*Elmerrillia celebica*). These are used in the production forest and forest production limited to get more wood products in the future, as well as in the protected forest to protect soil and water flow.

More than 300 kinds of original wood trees in the forest grow in Bolaang Mongondou (Bolmong) and Minahasa (including Manado, Tomohon and Bitung) in North Sulawesi province. They grow naturally in these forests and also cultivated by the inhabitants who live around the forest. Trees found in the North Sulawesi forest are listed in Table 5.

Table 5 Major wood trees in North Sulawesi province

No	Local name	Market name	GP*	Family name	Scientific name	DC
1	Ayat	Binuang	BM	Datisceae	<i>Octomeles sumatrana</i>	IV
2	Alipega	Surian	Min	Meliaceae	<i>Toona sureni</i>	IV
3	Alulin		Min	Myrtaceae	<i>Pisonia umbellifera</i>	V
4	Alwastuna		Min	Moraceae	<i>Ficus</i> sp.	V
5	Amurang	Surian	Min	Meliaceae	<i>Toona sureni</i>	V
6	Apeju	Pedu	Min	Rutaceae	<i>Evodia celebica</i>	-
7	Aras	Ares	Min	Sonneratiaceae	<i>Duabanga moluccana</i>	-
8	Aripungu	Nahe	Min	Lauraceae	<i>Phobe cuneata</i>	III
9	Aripungu	Nahe	Min	Lauraceae	<i>Phobe sterculioides</i>	III
10	Aripungu Tuama	Wakan	Min	Lauraceae	<i>Litsea albayana</i>	IV
11	Bahu	Laban	Min	Verbenaceae	<i>Vitex</i> sp.	IV
12	Bakalaung	Nyatoh	BM	Sapotaceae	<i>Madhuca pilippinensis</i>	II
13	Balembang	Nyatoh	Min	Sapotaceae	<i>Palaquium</i> sp.	IV
14	Batu	Kolaka	BM	Rosaceae	<i>Parinari corymbosa</i>	III
15	Bakele	Nyatoh	Min	Sapotaceae	<i>Palaquium</i> sp.	IV
16	Bengkaol	Ebony	Min	Ebenaceae	<i>Diospyros minahasae</i>	V
17	Bengkudu	Mengkudu	Min	Rubiaceae	<i>Morinda bracteata</i>	?
18	Besi panto		Min	Papilioideae	<i>Pongamia pinnata</i>	V
19	Bobang	Kenari	BM	Bursaceae	<i>Canarium hirsutum</i>	V
20	Bojito muputio	Bayur	BM	Guttiferae	<i>Calophyllum soulatri</i>	III
21	Bolaangitang	Binuang	Min	Datisceae	<i>Tetrameles nudiflora</i>	IV
22	Bolongan bolai		BM	Moraceae	<i>Ficus nervasa</i>	V
23	Bongoniugu		BM	Myrtaceae	<i>Horsfieldia globularis</i>	IV
24	Bua rau	Bua rau	BM	Euphorbiaceae	<i>Dracontomelon dao</i>	IV
25	Budebu		Gor	Rutaceae	<i>Fagara rhetsa</i>	IV
26	Bugis	Bugis	Min	Anacardiaceae	<i>Koordersiodendron pinnatum</i>	III
27	Bulaso	Wolato	BM	Verbenaceae	<i>Vitex cofassus</i>	II

28	Daagon	Aga	Min	Moraceae	<i>Ficus variegata</i>	V
29	Daan		Min	Myristicaceae	<i>Myristica fatua</i>	V
30	Daan rintek		Min	Meliaceae	<i>Aglaia argentea</i>	III
31	Damak	Agathis	BM	Araucariaceae	<i>Agathis celebica</i>	IV
32	Damak buaya	Agathis	BM	Araucariaceae	<i>Agathis celebica</i>	IV
33	Damar	Agathis	Min	Araucariaceae	<i>Agathis philippinensis</i>	IV
34	Danoan		Min	Loganiaceae	<i>Neuburgia celebica</i>	V
35	Danoan	Aga	Min	Moraceae	<i>Ficus variegata</i>	V
36	Danoan		Min	Staphyleaceae	<i>Turpinia sphaerocarpa</i>	III
37	Dedi	Kenari	Min	Bursaceae	<i>Canarium vulgare</i>	IV
38	Didane dankou		Min	Melastomataceae	<i>Astonia macrophylla</i>	V
39	Dongi	Simpur	BM	Dilleniaceae	<i>Dillenia serrata</i>	III
40	Duguan		BM	Myristicaceae	<i>Myristica celebica</i>	V
41	Dungu		BM	Sterculiaceae	<i>Heritiera sylvatica</i>	II
42	Durian hutan	Durian	Min	Annonaceae	<i>Cyathocalyx</i> sp.	IV
43	Ebenhout	Ebony	Min	Ebenaceae	<i>Diospyros rumphii</i>	-
44	Entame	Ebony	Min	Ebenaceae	<i>Diospyros ebenum</i>	-
45	Entamin	Ebony	Min	Ebenaceae	<i>Diospyros pilosanthera</i>	-
46	Gangai	Bugis K	Min	Anacardiaceae	<i>Koordersiodendron pinnatum</i>	III
47	Gofasa	Gofasa	Min	Verbanaceae	<i>Vitex glabrata</i>	I
48	Gofasa	Gofasa	Min	Verbanaceae	<i>Vitex quinata</i>	IV
49	Gofasa Batu	Gofasa	Min	Verbanaceae	<i>Vitex quinata</i>	IV
50	Hitam	Ebony	Min	Ebenaceae	<i>Diospyros rumphii</i>	I/II
51	Hitam laki-laki	Ebony	Min	Ebenaceae	<i>Diospyros rumphii</i>	II
52	Hitam laki-laki	Ebony	Min	Ebenaceae	<i>Diospyros pilosanthera</i>	II
53	Hitam perempuan	Ebony	BM	Ebenaceae	<i>Diospyros pilosanthera</i>	IV
54	Hitam perempuan	Ebony	Min	Ebenaceae	<i>Diospyros ebenum</i>	II
55	Ipil bila	Merbau	BM	Caesalpinoideae	<i>Intsia palembarica</i>	I
56	Iwu		BM	Meliaceae	<i>Aglaia</i> sp.	II/I
57	Kajawu	Bintungan	Min	Euphorbiaceae	<i>Bischoffia javanica</i>	II
58	Kajongian	Ebony	BM	Ebenaceae	<i>Diospyros buxifolia</i>	III
59	Kakepajaan		Min	Staphyleaceae	<i>Turpinia sphaerocarpa</i>	III
60	Kalimbouwan		Min	Herndiaceae	<i>Hernandia evigera</i>	V

Source: Department of Forestry, North Sulawesi Province, 2007

Note: GP: Growing place; BM: Bolaang Mongondouw; Min: Minahasa; Gor: Gorontalo; DC: Durability Class

I: Very durable, II: Durable, III: Rather Durable, IV: Low Durability, V: Very Low Durability

The forest in North Sulawesi province apart from being a source of wood products, is also a source of various kinds of non-wood products. Besides rattan and bamboo, there is also resin, tree gum, and palm fiber, root-vetier oil as tree products, and bird nests, honey, beeswax, silk worms, and shellac as animal products.

Most of the resin used for varnish making in Indonesia is obtained from pines (*Pinus mekusii*), which grow in abundance all over North Sulawesi. The pine resin is usually collected and shipped to Java for processing with its minimal local use. Some local use of "raw" resin as varnish occurs in Minahasa, such as the "damar batu" found in the iron shops, which are used in conjunction with processed varnishes in cottage furniture industries in Minahasan villages, where it is used to cover nail holes/heads and gaps in newly built wooden furniture.

e. Conservation area

As one of the most important purpose for conservation areas is to protect the biodiversity, North Sulawesi has 8 conservation areas to protect the wild animals, firstly because animals are easily affected by human activities. They are Tangkoko rainforest, Lokon rainforest, Mount Ambang rainforest, Manembonembo conservation area, North Karangkelang rainforest, South Karangkelang rainforest, Bunaken sea garden and Bogani Nani Wartabone National Park.

4. People and manpower

The people of Minahasa are ethnically a majority group in North Sulawesi province. Inhabitants who live in Woloan I sub-district and Warembungan village were all derived from this majority group, and are called Minahasanese or Minahasan. Minahasa Raya is an area, covering 3 cities (Bitung, Manado and Tomohon), and 3 regencies (Minahasa, North Minahasa, and South Minahasa), which occupy six of the nine regional administrations in North Sulawesi province.

The name of the land of Minahasa has been historically changed several times: from Batacina, Malesung, Minaesa and then finally the current name Minahasa, meaning "becoming one united". North Sulawesi developed into a large empire by 670 AD. In North Sulawesi the leaders of the different tribes, who spoke different languages, met together by a stone known as Watu Pinawetengan. There they established a community of independent states, which would form one unit to stay together and would fight any outside enemies if they were attacked.

a. Woloan I sub-district

The geographical location of Woloan I sub-district is bordered by Kayuwatu village to the north, Kamasi sub-district to the east, Lansot sub-district to the south, and Woloan II sub-district to the south. The territory is 252.58 ha in area and is occupied by approximately 868 households, with 3,143 inhabitants consisting of 1,611 men and 1,532 women.

The topography of Woloan I sub-district is remarkably flat and there are hilly areas with height of about 20-50 meters, growing mainly coconut, sugar palm, bamboo and some types of wood trees. Inhabitants occupy flatter parts on the left and right side of the main road, which connects with other sub-districts of Woloan I, like Walian, Matani, Tara Tara sub-district, etc. There are several kinds of vegetables and fruits cultivated near the homes of the inhabitants, such as long beans, sweet potato, cassava, mango, papaya, etc. It is in a strategic location, being very close to Tomohon city and other countryside areas of Minahasa district, and supported by adequate road access, so that the sub-district is expanding with quick mobilization of goods and services. The Woloan I sub-district office is located along the main road of this town, which is useful to quick communications and easier access by the people who need services. Moreover, the West Tomohon district office is also located in Woloan I, which helps the government develop programs easily. In Woloan village, almost 100% of the total inhabitants are Christians who are believers in GMIM (Christian Evangelical in Minahasa Church), Roman Catholic Church and the GPDI (Pentecostal Church), 64.8%, 31.4% and 3.4% of the population, respectively while the remainders belonging to Maranatha Church or Moslem. They live together harmoniously and adjacent to one another, honoring their mutual religious differences.

As for the occupation, the majority of the local inhabitants are farmers, carpenters/ crafts-

men, and entrepreneurs, with 28.56%, 30.07% and 6.61% respectively, besides these many people working at the public service sector such as teachers, nurses, army, and so on. The occupations of local inhabitants based on the 2006 census are shown in the Table 6.

Table 6 Job Occupations of local inhabitant in Woloan I village

No	Occupations	Total	(%)
1	Farmer	321	28.6
2	Carpenter and Craftsman	338	30.1
3	Civil Servant	48	4.3
4	Teacher	88	7.8
5	Nurse	14	1.3
6	Army/ Police	15	1.3
7	Particular office	91	8.1
8	Retired	51	4.5
9	Entrepreneurs	108	9.6
10	Driver	34	3.0
11	<i>Ojek</i> *	16	1.4

Source: Woloan I Village Office, January 2007

**Ojek*: a motorcycle, which is driven by a man for carrying people from one place to another like a taxi.

Farmers harvest foods for their daily life not only from paddy fields but also get forest products. They also produce cereals, root crops, legumes, vegetables, fruits, and so on while cultivating many kinds of trees for wood, fruit and other products used for food, medicine, tools, etc. In addition, many farmers are also expert at trapping animals from the forest and the garden. To prepare wetland paddies and other field crops such as corn and cassava, the community has still observed mutual cooperation in the village, called *mapalus*: they work together and help each other based on their willingness to do without paying wages. It has become an inherited custom from generation to generation from Minahasan ancestors. *Mapalus* is a communal relationship among people in order to achieve some purposes and give benefit or value each another or cooperate to reach a target.

The breakdown of students registered in this village was 33.9% of elementary school, 31.9% of junior secondary school and the senior high school, 34.2% of higher education with a total of 893 students, ranging from 7 to 24 of age. Commonly, the students receive their elementary school and junior secondary school education in Woloan, but need to go to Tomohon, Manado, or Tondano if they want to continue their senior high school or higher education. Teachers go to Tomohon, Tondano or Manado to teach the students at Senior High School and University. However, teachers do this duty happily as they follow a philosophy, known as "sitou timou tumou tou" (advocated by Dr. the late Sam Ratulangi), simply meaning "people live with dignity to help the lives of others" and his philosophy is still followed today by all educators.

Nurses work in government or private hospitals like Gunung Maria Hospital, Bethesda Hospital, and the Public Health Centre in Tomohon city and near the village. Several also work for private doctors at night as part-time job, after finishing their main job in daytime. Moreover, nurses also help the community members in their village in the matter of health service.

Every village has its own specialty. Woloan is known for traditional wooden houses. The carpenters of Woloan build wooden houses on poles, which can be seen along the main road. Potential buyers are capable enough to order their own houses. Once selected, the house is taken apart and loaded on trucks to be transported to the buyer's place, where it is unloaded and rebuilt. Besides the demand of wooden houses by people who live in North Sulawesi province and other areas in Indonesia, they even supply houses for overseas demand.



Source: Field survey, January 2007

Figure 4 Wooden house industry in Woloan I sub-district



Source: Field survey, January 2007

Figure 5 Amphitheater and Warugas in Woloan I sub-district

An open space theater or amphitheater in Woloan I sub-district looks out onto the beautiful scenery of Mt. Lokon and the village below. The amphitheater is used as a place to show the traditional dance and music of Minahasa, as well as special events held by the government, local inhabitants and community groups. Surrounding the amphitheater, there are about 100 traditional graves of Minahasan ancestors (*warugas*) still in their original positions which are made of stone and consist of two parts with the upper part being triangular in shape like the ridge of a house, while the lower part is a box containing a space in the center.

b. Warembungan village

The village, *Kampung*, of Warembungan is one of 17 villages in Pineleng district, Minahasa regency, which is located around 5 km to the south of Manado city. Based on the census in late 2006, the population of the village is 3,637 people, with 1,980 men and 1,657 women, and with 1,006 households. The village area is 1,118 ha and the population increased to 3,865 in 2005, caused by refugees from Ambon and Ternate, who left their town and came to Warembungan village because of unstable political conditions and fear of terror bombing, and lived with relatives who had already married with local families. For maintaining their livelihood, the refugees worked for local people as farmers, looking after animals, or as laborers and other job workers. When the security got better around the middle of 2006, most of them returned back to Ambon and Ternate, though a few of refugees continue to stay in Warembungan. The geographical location of Warembungan village is bordered by Bahu sub-district to the north, Pineleng II village to the east, Tinoor village to the south, and Koha village to the west.

There are four pioneers who lived in this village, called *dotu*. The village was established in the 1850s, by Dotu Rori, Dotu Tamandatu, Dotu Mantoring, and Dotu Maramis, and then built Warembungan as an authority village. The Warembungan village is led by a village head, called *hukum tua*, and from 1858 until now, there have been 22 *hukum tua* to lead the village, who are

directly elected by the local inhabitants of more than 17 years of age. The Hukum tua's term is 5 years, and it can be extended once. Besides managing and carrying out the governance of the village, the hukum tua also has authority to make regulations for arranging the local people at the village and working together with inhabitants who do government programs. The hukum tua is helped by *badan permusyawaratan desa* (BPD: village deliberations) when he needs considerations and consultations for various activities at the local level. In addition, the hukum tua also becomes a partner of the government to help with development programs of the local government.

The Warembungan village is divided into 15 sub-villages, called *jaga or dusun* and led by a head, called *pala*. The pala is helped by his assistant, called *meweteng* in order to motivate and organize the people to participate in village programs. The hukum tua is helped by the palas for example: when making an access road from the village to gardens and fulfilling social work project such as building a village hall, erecting security posts, cleaning the drainage, and so on.

Table 7 Occupations of local inhabitant in Woloan I sub-district

No	Kind of Job	Total	(%)
1	Farmers	550	33.1
2	Public servants (teachers, nurses, army, government offices, etc.)	251	15.1
3	Skilled laborers (carpenters, bricklayers, foremen, etc.)	86	5.2
4	Retired (army, public servant, and company employee)	57	3.4
5	Entrepreneurs and private company employees	673	40.5
6	Others (drivers, <i>ojek</i> and temporary work)	36	2.7

Source: Field survey, January 2007

There are 3 elementary schools, one junior secondary school, and a senior high school though no building available in Warembungan village. It has rather the same problem as Woloan I sub-district, so that the students who want to continue into senior high school or higher education, have to go to Manado, Tomohon, or Tondano city by public transportation or private car. The breakdown of students registered in this village are university (2.0%), senior high school (9.3%), junior secondary school (17.3%) and elementary school (36.8%), with a total of 1,043 students. In Warembungan village, self-employed people generally open a stall or small shop, called *warung*, selling local foods and beverages, or a shop for selling many kinds of household goods and tools. There are also merchants who sell forest and garden vegetables, fruits, and spices to the traditional markets in Manado or Tomohon city. The infrastructure is developing quickly in Manado city and the growth of new companies has a positive impact on way of life of local people in Manado and the surrounding areas. Some people from this village work in several private companies. The location of Warembungan close to Manado city, and public transport from Manado to Warembungan enable people to get jobs easily. Working all day till late at night, they do not need about transportation. Taxi is available as an alternative transport. In addition, *ojek*, a kind of motorcycle, will drive just in front of home with less charge.

In Warembungan village there is a mountain, containing millions of cubic meters of basalt, which stretches to other villages near Warembungan like Sea village and Tateli village. The basalt is managed by the local government and quarried by the local community. The basalt is used

in the construction of bridges, breakwaters, and buildings such as houses, offices and hotels, not only by local people but also by people in Manado, Tomohon and Minahasa. With the development of infrastructure in North Sulawesi province, especially Manado, Tomohon and Minahasa, significant quantities of basalt are required for construction material. It is widely used in road preparation as a sub-base coarse and base coarse, over which top soil is laid and then a mixture of heated asphalt.

Other people work to break up the stone/ basalt from the mountain near the village to sell. They break the boulders being manually operated with 5 kg hammers. It is then removed and distributed by trucks. In addition, near the village, there are some contracting and supplying companies, which break the basalt into various sizes by using stone crushers and gravity screening.



Source: Field survey in January 2007

Figure 6 Basalt as construction material broken by local people

The Warembungan village is one of three villages (Lota village, Malalayang village, and Koka village), which supply pure water to Manado city and surrounding areas. Pure water comes from a reservoir in the mountains to the west of Warembungan village, which was built by the Dutch in 1527, and is still in use today. The reservoir is located in a protected forest area, with a wide variety of trees. Water is distributed to users in Manado city, but unfortunately some of the pipes being old now, more maintenance is needed. The leakage from pipes has been caused by the access roads from the village to gardens and the forest. It has also been damaged by vehicle tires, cow carts (*roda*), horses and cattle scrape at the soil around the pipes. Originally, the pipes were buried considerably deep and were not located near the access roads. Many pipes have been changed and repaired by the local government and local community.

Pure water from four sources is distributed by a pipe installation to a big reservoir, located in Pall II, Manado city. From the reservoir, the water is sent and purified further before being distributed to consumers. The distribution of water is managed by a local company, called *PDAM* (*Perusahaan Daerah Air Minum*: water supply company). The company charges consumers on a monthly basis depending on the amount used. In addition, there is a small private company, which takes water directly from the same source and sends it for bottling with permission from the local government.

5. Discussions

a. Agriculture and forestry

Agriculture and forestry have held important roles for both Woloan I sub-district and Warembungan villages. Generally, they are very similar in the production of agricultural and forest products: cereals, legumes, vegetables, fruits, wood and non-wood products. Likewise there are also similarities in the methods of farming, harvesting and gathering, and using local resources, etc. It is because a majority of the people who live in Woloan and Warembungan had come from the Minahasa ethnic group, who have the experience descended from their parents, village elders, and their ancestors about how to cultivate, judge the best times for cultivating, harvesting methods, what kinds of plants to grow in their area.

Almost all source of agriculture and forest in the Woloan I sub-district were available found in Warembungan village, the difference was in the main product. The main products of Woloan I sub-district are cereals (rice and maize), root crops (cassava and sweet potato), legumes (peanut, bush beans and long beans), vegetables (Chinese cabbage, long peanut and a leafy water convolvulus called *kangkung*), fruits (papaya, mango and avocado), sugar palms, *pakoba* trees, coconut palms, etc. They cut also trees like bamboo, *cempaka* trees, *nantu* trees, *bua rao* trees for housing. These plants are also available in Warembungan village.

Whereas, the main products in Warembungan village are cereal (maize), root crops (sweet potato and taro), legumes (peanut and bush beans), vegetables (egg plant, spinach and long peanut), fruits (vanilla, alsum tree and durian), sugar palms, coconut palms, *kenari* trees, and so on. They hunt wild pigs, cave bats and white-tailed wild rats. They utilize trees like *cempaka* tree, *nantu* tree, *linggua* (*Pterocarpus* sp.) for house building, but the quantity of trees is now limited. There are several plants used as traditional medical treatment such as lemon grass, cinnamon, *mengkudu*, *mayana*, *tungkara*, etc. Pure water is available in the western part of the village and many kinds of forest plants are in the protected forest. Paddy land area is not available in this village, so farmers, instead planting fruits, vegetables, and other plants, hunt wild animals for food.

b. Animal husbandry

Cattle, pig, chicken, goat, dog, cat and duck are kept and bred by people who live in both villages. However, duck and goat are neither kept by each household or in a large number. Although several people keep horses in small number, they are not kept for draught purposes. Horses are used for the purpose of transporting crops from fields to homes, or riding when going to forests or fields some distance away. Both villages did not have horses for the purpose of racing, neither ride on horseback in times of events or consume the meat for food.

Pigs are most commonly kept in both villages by Christian Minahasans in general, but not by Muslim believers. Since a long time ago, people in Minahasa keep pigs for a commercial purpose as well as for family ceremonies such as weddings, birthdays, anniversaries and similar events. Pig pens are built in the fields because of waste disposal and unpleasant odors. If they make a pen close to their house, it is above the stream fast flowing waters. Generally, the pen is made of bamboo, with the floor laid tightly together, while the walls are interwoven up to 1.0 to 1.2 m in height and bound with *gomutu* strings. The roof is around 2.0-3.0 m and made of thatch (*atap katu*) or corrugated iron. The cage is constructed usually with openings meaning, there is a

gap between the upper part of the wall and the roof enough to allow sunshine and air circulation. The size of the pen are 7.0-9.0 square meters, usually with 5 to 7 pale piglets, although the pen for an adult female and male is 4.0-6.0 m per pig. Some pens are made with a concrete mixture in model and size similar to the bamboo construction. The floor is made from rather oblique and harsh concrete, with a sloping gutter to flow wasted water when cleaning. The position of the gutter is located along the back wall and around 25 cm wide.

c. Gathering, hunting and fishing

In the forest, wild animal like wild pig and *babirussa* are caught in traps, which are set where animals often pass along and near swamps. Part of the snare rope is covered with foliage and connected to a sapling that bends easily and releases quickly when it is touched by the animal, called *dodeso*. When a wild pig is caught, it soon squeals, signaling that prey has been trapped, and afterwards it is killed with spear or a machete.

In general, some Minahasan people like to consume wild white-tailed rats caught in rice fields or forest. The rats are trapped or caught when smoked out of their holes. Recently, some people use guns to shoot rats and bats.

Honey from wild bees (*Apis* spp.) is gathered at night by men and boys, but this is only done occasionally. Hives made of stacked up and inverted pots are sometimes set up in trees, but there are rarely bees swarming inside.

Bats, called *kelelawar* or *kalongare*, are eaten as a source of animal protein by some Minahasans. To get bats, the hunter goes into fields or areas of the forest and set up transparent nylon nets where bats feed on many fruit trees. The net is set before dusk when bats are ready to leave the trees. The length of the net is 3.0 to 4.0 m and 1.0 to 2.0 m wide and is placed in a fork of the tree, precisely where the animals will pass when returning home. Before setting up the nets, the hunter checks the routine movements of the bats. To guarantee an abundant capture they collect next morning. While waiting for the bats they may hunt wild pigs though there are also hunters who only catch bats. Bat flesh is popular and usually sold fresh, namely people buy live bats by choosing them directly from suspended cages. The buyer usually asks the seller to slaughter and skin the bats; if the bats are not properly skinned, the meat smells bad. This scent is thought to come from a kind of gland under wing and around the neck of the bat. Bats are eaten fried, and also in curry as a spicy food with coconut milk. People believe that bat meat is good in curing asthma and also used as a medicine for skin infections like scabies. Bats are a seasonal commodity available in the fruit season, easily found in trees and sold at many traditional markets. But in poor fruiting season, the amount of bats is scanty and the price leaps higher as compared to better fruiting seasons. The sellers usually give only water to the bats for drinking, because if given any food they do not naturally eat which will damage the taste of the meat. In nature, bats feed on clean, eating flowers, honey and fresh fruits.

Other sources of animal protein for some inhabitants who live in Woloan I besides pig, dog, chicken and duck are golden fish and mujair fish (*Oreochromis mossambicus*). Other resources from the forest besides wild rat and bat, are monitor lizards, deer and wild boar (though the last two are scarce now). In addition to safe-guarding homes, dogs are used to watch over and prevent cattle being stolen.

In the case of Minahasans, vegetables are usually hand-picked by women when accompany-

ing their husbands and sons who work in paddy fields and gardens. While women collect the firewood, hunting activities are limited to men.

Hunting with a gun called *senapan* is used for shooting birds like white egret and quail, or for wild pigs. Hunters also shoot at birds feeding in the paddy fields. Farmers also use scarecrows (*orang orangan*) in rice fields, which are made by long nylon string from which old milk cans are hung to scare away birds.

Catapults made with a strip of rubber from used tires with branches from plants (such as mango and guava) are also taken along on group hunts. Boys use them to try to hit various kinds of birds, lizards, etc.

There are many rivers that flow through both villages and people make boxes to place at the edge of the stream on river, to keep fish fresh. The boxes are made of bamboo usually 1.5-3.0 square meters. Other farmers set bamboo fences, where the bamboo is stuck into the river bed and a net is used to prevent the fish swimming out (like a basin between the bamboo and edge of the river). Fish such as *mujair* fish, *nila* fish, golden fish and so on are caught by line fishing or directly by hand and nets. There are also farmers who keep the fish in flooded rice paddies. Kids also like to catch fish in rivers, by hand or with punctured crate at fishpond areas.

Many wild animals in fields and forests are consumed by Christian majority of the Minahasan people, but rarely eaten by Moslems, even though they go together to the jungle, forest and swamps for hunting.

d. Traditional wooden house

There are some people working as carpenters to build wooden houses. This is unique in the countryside for builders of traditional wooden houses enough to become a building industry. The industry has been expanding since the 1960s and it was first exported overseas in the early 1980s. As a result Woloan carpenters have become known to the people of Indonesia and all over the world. Carpenters can be seen working, continuing their work of shaping and planing timbers while being unconcerned about the weather; some of them being barehanded and bare-chested with only pants and sandals for protection. The specialist tradesmen called '*bas*' in the local dialect who live in this small village are well known as the 'home' of wooden houses. Here, these tradesmen create fantastic kitset traditional houses from wood, without using any modern technology other than electric sawing machines and planers. Every single part of these houses is made by hand. They work in a team with their closest friends or with relatives. The team is financed by the owner who pays all the expenses, materials and salaries. Significantly, despite all the obstacles they face, they can successfully build up an overseas market to sell their handiwork.

The builders are paid on a daily basis, ranging from Rp. 40,000-50,000 for the chief carpenter and Rp. 30,000 to Rp. 35,000 for his assistants.

Woloan I sub-district has its own unique characteristics, distinguishing it from its neighbors in the city of Tomohon. Stretching over about 5 kilometers from where the village is located, are tens of unfinished (or completed) traditional wooden houses standing lined up next to one another. But most of these unfinished houses have been sold. The owner explained that before a kitset is delivered to the buyer, it needs to be completely assembled to ensure so that every part may fit. Then the house is disassembled before packing it in a container for shipping. Most of the wooden houses made in Woloan use knockdown technology, so that it is easy to disassemble and

relocate. Buyers usually want them for cottages, villas or rest houses. The raw materials are readily available in many forests growing near the village, but by this time the wood has become very limited, the wood is supplied from outside area like Bolmong (Bolaang Mongondouw) reGENCY or Gorontalo province. Some well-known timber such as *cempaka* (*Michelia champaca*; a kind of fragrant tropical magnolia), *mahagoni* (*Swietenia macrophylla*), *kayu besi* (ironwood: *Eusideroxylon zwageri*), *linggua* (*Pterocarpus* sp.) and *nantu* (*Palaquium obtusifolium*) are used as main components of the houses. These high quality timbers ensure that the house will last a long time, more than 70 years, even up to a 100 years. The carpenter said that they use high quality woods, so the houses can be erected anywhere in the world and until this time, there have never been any complaints from their overseas buyers. Many wooden houses produced in Woloan have already been sold to Singapore, Germany, Holland, USA, Australia, Costa Rica, etc. Locally, they are sold mostly in the big cities of Indonesia. Standing near the unfinished wooden houses, there is a small office, also made from wood. This is where visitors can find out more about how the wooden houses are made as well as the various models available, types of wood, technical details, and prices. Pictures of various models on offer also hang on the office walls. Woloan-style wooden houses commonly stand on stilts. Historically, this was done to protect the household from attacks by wild animals. Although such attacks are very rare today, the houses are still built in this way. However, in terms of type, specification and design, Woloan style wooden houses are very flexible. As well as offering several standard designs, custom designs and specifications requested by a buyer are welcomed by some tradesmen.

The prices of these wooden houses are certainly low enough. For example, a 54 and a 84 square meter house with two bedrooms may cost only Rp. 45 and 65 million respectively. A 112-type house, measuring 8 meters by 14 meters, can be sold for Rp 80 million. The biggest model, with three or four bedrooms and more than 132 square meters cost around a Rp. 120 million. They are far cheaper than conventional houses of the same size. It is possible to order the wood construction with any variation of size, i.e. $6 \times 7 \text{ m}^2$, $7 \times 9 \text{ m}^2$, $8 \times 15 \text{ m}^2$, $12 \times 15 \text{ m}^2$ and so on. In general the wooden house contains bedrooms, eating room as well as a sitting room and a terrace. However, the knockdown house has neither a kitchen nor bathroom. In the original construction the kitchen and bathroom are usually built separately from the main house in traditional Minahasan homes, which is why they do not include a kitchen and a bathroom in their prefab houses. But if the buyer wants the carpenter to provide these two spaces, they will build them. They make these houses based on order, but generally, buyers would like to have the original version. Usually standing 3 meters high, the house has two large stairs in the front and rear parts of the house as well as 19 glass windows and six doors. The height of the house can be adjusted depending on the buyer's needs and conforms to their security considerations. Sometimes the house is built on stilts about 3 meters above the ground and the space underneath can be used for various purposes such as a parking area.

All Minahasan traditional houses are usually made of 3 types of wood. The main support beams and the house frame are made from iron wood, walls from cempaka wood and the ceilings are made of nantu wood. The roof of the house is made of iron sheets.

Buyers of wooden houses who put them up in North Sulawesi province pay no more additional costs. But buyers from outside the province, or those from overseas, need to add the ship-

ping costs. The bigger the house they buy, of course, the higher the shipping costs are. They usually send 5 to 6 people to assemble the house for buyers living in Java, Bali, and other areas in Indonesia. For a foreign buyer, two people will be enough to do the assembling job. Usually, they send the chief carpenter and one of his more experienced hands, but the buyers will pay for the travel expenses.

At the beginning, despite the increasing number of buyers, the marketing of the wooden houses was not well organized. There has never been any serious advertising campaign for the product. Buyers come from words of mouth promotion and some minor promotion by the local government. In general, the carpenters were only concerned about the work of building houses. Nowadays, the local government takes in several management skills, training courses, and setting up cooperatives to handle the production management and market the wooden houses.

Because of its uniqueness, Woloan is becoming quite well known as one of the favored tourist spots in North Sulawesi. Tens of local and overseas tourists visit it every day. Not to buy wooden house, however, just come to observe what the carpenters do from day-to-day.

Woloan is less than 5 km from the center of Tomohon, which itself is only 25 km from the capital city of North Sulawesi, Manado. It takes around 30 minutes to get there by private transport. But, as an alternative, there is always public transportation available at very reasonable prices. This is available from 6 in the morning to 8 at night. Even though the place is very easy to access to, it still promises many delights for those visiting it for the first time. If there are any guests who come outside these times, an *ojek* (*ompreng*, a kind of motorbike with a driver) is ready to assist visitors wherever they go. The scenery in Woloan I and Tomohon town in general looks very much like the Puncak area in West Java's highlands. The air there is very clean and feels very cool and fresh. However, the biggest and most pleasant difference between Tomohon town and the Puncak area is the lack of traffic jams. Cars and motorbikes can travel freely, even during the weekend in Woloan. Just going there is really a good way to beat stress, commented a visitor from the US. Traditional wooden houses are not the only interesting sights will find there. There is also a natural hot water pool, the mountains, and local nuances like the traditional form of transportation - the *bendi*, a horse-drawn cart. One of the most beautiful sights is Lokon Mountain. Tourists get a perfect view of the mountain from the foot hills. Not very far from Tomohon, the easily accessible Tondano Lake calls one of the most naturally beautiful spots in Minahasa.

6. Conclusion and consideration

Forest provides many benefits and added value products to the community who live in Woloan I sub-district and Warembungan village and also to the people who live in North Sulawesi province in general. The potential of forest and other agricultural products such as wood, cereal, vegetable, fruit, and various spices are used by the local inhabitants for their living.

In Woloan I sub-district, more than 28% of inhabitants are engaged in paddy farming and plant cultivation while utilizing forest products. There are also people who work as carpenters of traditional Minahasan houses, which also depend on wood forest products.

In Warembungan village, like Woloan I sub-district more than 33% of the people are farmers

without paddies, instead cultivating plants and using forest products. Forest supplies also an important source for pure water and bauxite used in construction.

Based on our findings, we would like to emphasize that the potential of Woloan I sub-district and Warembungan village should be properly managed in order to sustain the forests, while utilizing and maintaining local resources for the survival and the prosperity of the inhabitants. A policy to balance forest utilization and maintenance operations is needed to help these forests retain their natural condition and be available for the future.

Moreover, forests should be paid more attention in the following aspects: the prosperity of the community living around forests and the sustainability of water, flora and fauna. On the other hand, the forests have made a great contribution to protect the land from erosion, supplying water systems and fresh air (oxygen) which are essential for maintaining life, the traditional culture, the recreation of local people, and so on.

Further, to improve knowledge of the local people for managing and using the products of forest and agriculture, and also to achieve the abovementioned benefits for local farmers and local inhabitants, there are several actions that should be conducted by the local government to enhance the prosperity of the communities. Those actions are as follows:

- a. Improvement of the organization of the market place. Beside daily foods, other products of the forest and agriculture are sold in the markets. For that purpose, farmers need a supportive organization, which may provide more accessible marketplaces and also may reduce post-harvest losses.
- b. Improvement of the management system. The farmers and carpenters need management skills, training and counseling on the following issues: how to use medicinal plants correctly, how to improve crop products, how to utilize and maintain local resources as well, how to sell their products and how to identify and solve problems. They need continuous cooperation with experts and universities.
- c. Assistance of farmers on how to handle their crops for marketing or selling, especially during the harvesting period. Such an operation could be carried out by cooperative forums that already exist in every village or sub-district.
- d. In the case of carpenters, they need advice on construction materials, especially timbers, and the government should provide facility even from outside of North Sulawesi province in order to increase the availability of housing production materials.
- e. Improvement of the function of cooperation: the government should guide, give input and suggest, and cooperate with business in an effort to improve the earning to all members.

7. References and bibliography

- Arief, A. (1994) "Forest: Reality and its influence to the Environment", Yayasan Obor Indonesia, Jakarta.
- Agung, N.M (2005) and Marsali, A. "Forest anthropology", Wana Aksara, Jakarta.
- Chapman, J.L. (1997) "Ecology: Principles and Application" Cambridge University Press, Fifth Edition, London.
- Central Board of Statistics And Regional Development Planning Board of Minahasa Regency, "Minahasa in Figures 2001-2005", Minahasa regency, North Sulawesi Province.
- Central Board of Statistics And Regional Development Planning Board of Tomohon City, "Tomohon in Figures 2001-2005", Minahasa regency, North Sulawesi Province.

- Desmont, T. (1999) "Tropical Fruit", Archipelago Press, Singapore.
- Directorate General of Forestry (1976) "Indonesia's Forest Handbook", Directorate General of forestry, Department of Agriculture, Jakarta.
- Forestry and Environment Department of Tomohon city (2007) "Forest Data's", Tomohon, Indonesia.
- Forestry Department of North Sulawesi Province Government (2007) "Forest Data's", North Sulawesi Province.
- Grey, G.W. and Deneke, F.J. (1978) "Urban Forestry", John Willey and Sons Inc, Canada.
- Indriyanto (2006) "Forest Ecology", Bumi Aksara, Jakarta. pp. 109-117.
- Kathy, M. (1986) "Origin of Indonesia Nature: Flora, Fauna and the Compatibility", Gramedia, Jakarta.
- Ministry of Forest and Estate Crops, Republic of Indonesia (1999) "Sustainable Forest Development as Reflection of Faith and Piety" Ministry of Forest and Estate Crops, Jakarta.
- National Development Planning Agency, Republic of Indonesia (2003), "Indonesian Biodiversity Strategy and Action Plan (IBSAP) 2003-2020", Planning and Development National Board, Republic of Indonesia.
- Spurr, G.H. (1980) "Forest Ecology", The Ronald Press Company, NY, USA.
- Suhardi & Ass. (1999) "National Food from Forest and Land Plantation", Kanisius, Jakarta.
- Takeda J., S. De Silva, P. Muthuraman, S. M. Rahman, and L. Kawet (in press) Spices in Sri Lanka, India and Bangladesh with special reference to the usages and consumptions. *Bulletin of the Faculty of Agriculture, Saga University* No. 93.
- Yudo, E.B.I. and Friends (2006) "Re-Set Up of Wood Industry National", Global Pustaka Utama, Yogyakarta. pp. 142-151.
- Vickery, M.L. (1984) "Ecology of Tropical Plants". John Wiley and Sons. New York.
- World Bank (WB). (2006) "Sustaining Indonesia's Forest", Strategy for the World Bank 2006-2009. pp. 25-37.

インドネシア・北スラウシ島のウォロアン1地区とワーレムブガン地区住民の地域資源の利用に関する研究：特に森林利用と維持・管理を中心として

フランキー ロッキー ローリング*¹・武田 淳*¹・カウエット ロッチェ*²
李 應喆*³

(¹佐賀大学農学部生物生産学科地域資源学研究室

²インドネシア・サムラトゥランギ大学経済学部, ³韓国・ソウル長神大学)

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摘 要

本研究は、ブラジル、コンゴ民主共和国について世界で三番目に大きな森林面積を擁するインドネシアの中で、スラウシ島北部で森林資源に強く依存している二つの集落（Woloan I sub-districtとWarembungan village）住民に焦点を当てて行ったフィールドワークに基づく。生産性の高い熱帯降雨林という生態系に属する地域住民が農耕を営む一方、いかに森林資源の利用および維持管理を図りながら、森林との有機的な諸関係、民族生物学的諸相（ethnobiological aspects）と社会経済文化的特性（socio-economic-cultural characteristics）を維持しているかを明らかにした。多種多様な生物相（flora & fauna）に恵まれた自然生態系の有用資源を利用・維持・管理する地域住民の現地調査研究は、不可欠であり、今後、数多く事例を集積しなくてはならない。本事例研究では、現在、熱帯降雨林における森林伐採が深刻な社会問題になっている中で、森林資源に強く生業基盤を置き、文化社会経済的な紐帯を築いている二つの集落における住民たちの実態を明らかにした。