

PART III FEASIBILITY STUDY FOR THE INTENSIVE AREA

CHAPTER III-1 THE INTENSIVE AREA

III-1.1 Natural Conditions

III-1.1.1 Topography

The Intensive Area occupies the southern part of the Study Area. It is located around Lake Tondano, of which the water surface is about EL.683 m, at latitude between 1° 06' and 1° 20' north, and longitude between 124° 45' and 124° 58' east. Its total area is counted about 120 km² out of 250 km² of Tondano watershed including 46,38 km² of Lake Tondano. The Intensive Area is divided into three areas, namely East Area, West Area, and South Area.

(1) East Area

The East Area is located to the east of Lake Tondano with an area of about 34 km². A part of each sub-district Toulimambot, Eris, and Kakas comprises the East Area. The area is bounded on the east by the mountain ridges including the highest peak of Mt. Kaluta (El.1,156 m).

The northern part of the area (Eris) slopes toward Lake Tondano having narrow width of 500 m to 2,500 m from the boundary ridges to the lake. Its area is about 26 km². The southern part (Kakas) features high peaks with steep slopes and has an area of about 7 km². Average slope gradient of the East Area is 29 %, which is steeper than the other areas. The area at higher elevation, especially in the northern part, tends to be eroded inherently, where it is composed of old volcanic rocks of Miocene and weathering process has extended a considerable depth into tuff breccia and tuff. Severe erosion has developed a dissected surface and features frequent slope failures and landslides due to weathering.

The mountain slopes are used as secondary forests, clove plantations, and scattered upland farming lands. There are protection forest areas around Mt. Kaluta, Mt. Kamintong, and Mt. Kaweng.

Twenty streams, most of which are minor with the drainage area of less than 3 km², originate from the dividing ridges.

(2) South Area

The South Area has an area of about 35 km². A part of sub-district Tompasso and about

3/4 of sub-district Langowan comprises the South Area. The volcanoes including Mts. Soputan, Manimporok, bound the area on the south and west. The lower boundary is the road connecting the spring-line villages on the hill-foot. Average slope gradient is 25% in the South Area.

Main part of the South Area (Soputan) of about 29 km² is situated at the southern volcanic mountain area extending from the western volcanoes toward eastern piedmont plain. The average slope gradient is 23%. The altitude of the southern mountains is El.1,500 m to El.1,650 m high and the spring-line villages are situated at between El.800 m and El.850 m. The higher parts of the mountain slopes are designated protection forest. Agricultural lands are wide spread on the piedmont plain below El.1,100 m. The west part of the area (Kawatak) is comprised of old volcanic rocks and the average slope gradient is 33% including extremely steep slopes of 122%. Around Kawatak village, steep land of more than 60% slope is cultivated.

The two major rivers flowing into Lake Tondano, Panasen and Saluwangko, originate from the area. They have no flow in the section situated between El.800 m and El.1200 m except during and shortly following heavy rainfall. The two major rivers have perennial flow.

(3) West Area

The West Area is to the west of Lake Tondano with an area of about 49 km². The area consists of the Remboken Sub-district, and a part of the Sub-districts of Tondano and Kakas. The area is bounded on the west by several volcanoes including the high peak of Tampusu (El.1,206 m).

Lava flow plateaus characterize the surface feature of the area. Several lava flow layers pile up vertically making alternation of wide gentle slopes having less than 10% slope gradient and narrow steep slopes of more than 30%, which made the ground form like stairs with their relative height of 25 m to 100 m. Average slope gradient of the area is 19%. The slope distribution by slope gradient class is shown in Figure III-1.1.1.

The gentle slopes have been cultivated, and the steep slopes are mostly covered with trees and shrubs. Limited areas around the top of Mt. Tampusu and Mt. Lengkoan are designated the protection forest areas.

Thirteen rivers originate from western hills, of which the biggest one is Mawalelong River with 22.6 km² of drainage area having perennial flow.

III-1.1.2 Geology

(1) East Area

The area mostly constituted of volcanic rocks from the Miocene, which is 7 to 26 million years ago. It is dominantly composed of breccia, lava, and tuff, which are heavily weathered to considerable depth. The ground surface consists of clayey weathered tuff or tuff breccia.

(2) South Area

Mountains on the western boundary are the young Quaternary volcanoes, Mt. Soputan and Mt. Manimporok. Sandy volcanic ash originated from the volcanoes covers the area widely. The southeast part of the area, Kaayuran Atas - Kawatak area, is composed of volcanic rocks of Miocene.

(3) West Area

The area is mostly covered with young volcanic rocks from Quaternary lava flows. An exception is the area around Pulutan and Passo villages, which is comprised of Tondano Tuff of Pliocene. Several layers of lava flow form specific ground features of alternating plateau and steep slopes. The top layer is composed of clayey weathered materials with andesite boulders.

III-1.1.3 Meteorology

The Tondano meteorological station of *BMG* is the only station measuring temperature, humidity, rainfall, wind, etc. in the area. Rainfall is observed at 4 stations of *PLN* and 4 stations of *BMG*, including Tondano.

(1) Rainfall

Annual rainfall records around Lake Tondano are tabulated below. Annual rainfall varies very much by year. The maximum rainfall in the past 7 years is 3,678 mm at Noongan and the minimum is 1,032 mm at Telap.

Annual Rainfall in the Watershed of Lake Tondano

Year	Unit:mm				
	Tondano	Luaan	Telap	Remboken	Noongan
1993	1,426.2	918.2	1,164.6	1,549.1	1,353.2
1994	1,490.9	1,526.3	1,818.6	1,711.7	2,028.7
1995	2,293.1	2,385.9	2,111.3	1,472.2	3,678.4
1996	2,582.3	2,207.6	1,985.5	1,815.3	2,973.8
1997	1,261.7	1,048.3	1,032.0	819.1	1,500.4
1998	1,953.9	2,201.9	1,862.0	1,211.4	2,560.7
1999	2,219.2	1,815.4	2,066.0	1,517.7	2,452.1
Average	1,831.3	1,729.1	1,720.0	1,442.4	2,363.9

Source: Tondano by BMG, and others by PLN.

Daily rainfall data are available only at Tondano. Annual number of the rainy day ranges from 133 to 250 days. August and September have fewer rainy days than other months. The highest maximum daily rainfall in the period 1990 to 1999 was 112.4 mm and occurred in January 1995.

According to the data, stretch of the rainy area observed a few kilometers range in normal showers and with rainfall duration of 2 to 3 hours. The rainfall intensity of showers is very high for the first 15 to 30 minutes then gradually lowers.

III-1.1.4 Hydrology

(1) Available Data

PLN is measuring the intake discharge to the Tonsealama hydropower plant, which could be regarded as the outlet discharge from the lake. *PLN* also has made the regular observation of the lake water surface at the two gauge stations at Toulour at the outlet of the lake, and at Telap in the middle of the east shore of the lake. However, no regular or continuous flow rate records are available of the in-flowing rivers to the lake.

(2) Out-flow from the lake

There are no continuous records of the flow rate of in-flowing rivers to Lake Tondano, which makes it difficult to estimate the water balance of the lake. *PLN*'s data of the intake discharge of the hydropower plant at Tonsealama is regarded as the out-flow from the lake. To research the water balance of Lake Tondano, the annual rainfall was compared with the outflow rate from the lake. Discharge from the lake ranges from 72% to 76% of annual rainfall except the year 1998 that was affected by El Nino, which occurred in 1997 and 1998.

III-1.1.5 Soil

(1) Soil Profile in each Area

Due to the different geological formation in the 3 areas of the Intensive Area, soil profiles are also different. In the South Area, the top layer of the soil is sandy volcanic underlain with loamy weathered tuff. The sandy volcanic soil is black with a thickness of more than 1 m and it originated from eruption of mainly Mt. Soputan. Sand content is very high and it is easily eroded when runoff forms rills. In the East Area, the soil of the top layer is clayey and brown or dark brown in color. Clay content is very high and the soil has high plasticity and sticky. Its origin is weathered old volcanic rocks of Miocene, composed of tuff and tuff breccia. In the West Area, the top layer of soil is clayey and mostly dark brown colored. Its clay content and plasticity are high and the soil is very sticky, so that it is resistant to erosion. Origin of the soil is weathered 'young volcanic rocks' of Quaternary. Typical soil profiles in each area are shown in Table III-1.1.1

(2) Physical and Chemical Characteristics

Physical and chemical properties of soil are different by area. A distinct difference is observed in the texture (size distribution) and plasticity. In the South Area, content of sand is more than 75% and clay content is less than 10%, while in the East Area, clay content is 50% or more but sand content is less than 30% on average. The soil characteristic in the West Area is between the two. The soil in the South Area indicates low plasticity, which in the East Area is high and that of the West Area is medium. The soil in the South Area shows lower moisture content and porosity than other soils, because it is consisted of sand.

Regarding chemical properties, pH of the soils is mostly similar, organic matter is higher in the East Area. Phosphorus availability (P-available) is very high in the South Area and exchangeable potassium content is high in the West Area, while cation exchange capacity (CEC) is the highest in the East Area.

(3) Infiltration Rate

An important soil characteristic affecting erosion is infiltration rate. The infiltration rate is very high in the area. In the South Area, the highest infiltration reaches 100 cm/hour, and it is at least 20 cm/hour, because of sandy soils. In the East and West Areas, it is also very high even though the soil is clayey. The reason is that soil structure is mostly blocky and is cracked heavily.

(4) Soil Type and Its Distribution

Based on the result of soil survey with help of geomorphology and existing soil map, the soil type was categorized into 10 types with emphasis sensitivity to erosion.

Soil Type in Intensive Area

Soil Type	Description
1	Alluvial deposit composes the soil in paddy, which occupies small area in the Intensive Area mostly along the lake.
2	Composed of volcanic origin alluvio-colluvium deposit, found in paddies in the south of the lake, but its distribution is limited in the Intensive Area.
3	Terrace or piedmont sedimentation composed of eroded volcanic materials and accumulated at the base of slopes.
4	Composed of Quaternary volcanic ash on piedmont. It is sandy volcanic ash of black color with 2.0 to 2.8% organic contents, and distributed at the lower slopes of Mt. Soputan.
5	Quaternary volcanic ash on hill slopes. It is found on the higher slopes of Mt. Soputan and its nature is similar to Soil Type 4.
6	Quaternary weathered material of lava flow composed of Andesite and Basalt, which originated from several volcanoes. It is distributed on the west of the lake and formed the ground surface like stairs.
7	Quaternary weathered material of lava flow composed of Obsidian, which is found only limited area in the West Area. It is originated from Mt. Kasuan.
8	Quaternary volcanic ash and lava on the steep slopes of volcanic cones, which is found on the steep slopes of young volcanoes, such as Mt. Soputan, Mt. Tampusu, and Mt. Kasuratan and Mt. Lengkoan, which is consisted of volcanic ash or lava.
9	Pliocene volcanic ash and lava on the steep slopes of volcanic cones, which is found on the minor volcanoes in Passo and Pulutan area in the south of the West Area. It originated from old Tondano volcano, which is consisted of weathered pyroclastic materials. It is mainly composed of clayey highly weathered tuff.
10	Highly weathered 'Old volcanic rocks' of Miocene, which constitutes boundary mountain ranges on the eastern side of the lake. It is composed of plastic clayey soils.

Distribution of the above-mentioned soil groups is shown in Figure III-1.1.2.

III-1.2 Socio-Economy

III-1.2.1 General Area Feature

The JICA Study Team has discovered a high degree of “richness” in the communities of the Intensive Area. The term “richness” in this case does not refer to the economic wealth of the community. Rather, it means there is a high level of holistic human development. For instance, the level of education is decent, the number of families under the extreme poverty line seems to be fairly small, and social, economic and political opportunities are equally available to both female and male population. Crimes and political instability are still minimal, and access to information and external societies is reasonably easy. On top of these, the area still embraces abundant natural resources.

The richness is mainly derived from environmental factors such as sufficient rainfall,

warm and humid climate, abundant clean water, fertile soil and the existence of sizable and useful lakes. The richness is also attributed to historical factors, including the absence of oppressive political entities throughout the history. The area has been playing the role as a hub for spice trading since medieval times and has enjoyed intensive socio-economic support from the Dutch and Japanese colonial governments.

Community, however, is no paradise. It has the common problems of economic underdevelopment. Urbanization with the pollution and deterioration of moral is visible. Community is famous for the high numbers of alcoholics and political corruption. Many local people expressed that the gap between rich and poor has been rapidly widening even though the gap seems to be relatively small at present. On top of these, the richness of natural resources is facing a high potential degradation due to the lack of elaborate conservation measures and management. The following sections will describe the general features of each area.

(1) East Area

The East Area is a narrow, steep area stretching along the east side of the lake. Administratively, the East Area includes Toulimambot, Eris and eastern Kakas Sub-districts. Most agricultural land is located on the slopes, and there are limited paddy areas along the creeks, irrigation canals and lake. The slopes have been designated to clove cultivation for decades. Because of the heavy dependence on one cash crop, which is known for the fluctuation of production level and price, the local economy is highly unstable.

During the last few decades, local people developed two other economic sectors in the area: fresh water fish production and furniture industry. The fish culture using floating cages and nets was introduced a couple of decades ago, and some people started investing resources gained from clove production into aquaculture. The capital from clove production is also used for the development of small-scale, home-based furniture industry in the area. There are several small furniture factories, most of which are a family business.

(2) South Area

The South Area is located at the east skirt of the Soputan mountain range, stretching until the steep edge of the Kawatak mountain range. Administratively, Langowan and Tompasso Sub-districts belong to the South Area. All villages are the satellites of either the town center of Langowan or Kawangkoan and have relatively short histories of intensive resettlement (between 50 to 80 years). Farming area can be found on the

plateau, and extensive pastures are also observed there.

There is a relatively large forest area around the peaks of mountain ranges. The forest, especially the private forest is subject to human activities, providing vital resources for local people. The area is a purely agricultural with very limited industries or other economic opportunities within the community.

(3) West Area

The West Area is located between the west side of the lake and the west border of Intensive Area. The middle part of the area is a rocky plateau, which continues from the peak of Mount Tampusu and ends abruptly at the lakeshore. The north and south parts of the plateau are flat, swampy areas used for paddy cultivation. The West Area includes Tondano, Remboken and the west part of Kakas Sub-districts. The plateau is designated for upland crop cultivation and pasture, and many people are involved in paddy production on the lowland. As in the East Area, some people are involved in the inland fishery of the lake.

The area has two non-agricultural industries: earthenware industry and tourism. People in Pulutan village, Remboken Sub-district have been producing earthenware since 1916. People employed simple production methods using open firing and a hand wheel. In 1977, the kiln use was introduced to local people by the Department of Industry, and two sets of brick, fuel wood updraft kiln were constructed. There are more than 50 households engaged in the cottage industry in Pulutan village.

By the road along the lake, there are a few leisure spots such as restaurants, boathouses and hot springs for tourists. In general, tourism is still underdeveloped due to the lack of investment.

III-1.2.2 Natural Resources

(1) Forest

In general, both protection and private forests in the Intensive Area provide local people with a vital source for their daily necessities. From the forest, local people acquire timber for their houses and non-timber products such as fruits, nuts, seedlings, sap for sugar and alcoholic beverages, materials for brooms, honey, herbs and wild animals. Forest is also used as a leisure object and resting area during farming and traveling.

Most survey respondents were able to describe the approximate location and present

condition of protection forest and private forest¹ near their villages. During the group discussions, all survey respondents stated that the number of trees in the Intensive Areas has been decreasing during the last few decades.

(2) Fuel Wood

According to the result of survey, local people in the Intensive Area use fuel wood for their domestic and productive activities. Almost 80 % of respondents said that they use fuel wood for cooking, and approximately a half of them use kerosene stove in addition to fuel wood. They usually collect wood both by foot and ox-drawn cart, but sometimes purchase it when the wood or time to collect it cannot be found. A bundle of fuel wood (0.5 – 1.5 kg) costs Rp. 175 – 500. Fuel wood collection for domestic use is summarized in the table below.

Fuel Wood Collection for Domestic Use

Sub-district	Volume/week	Kind of wood	Remark
Eris	10-15 bundles	Dried clove trees, <i>Kaliandra</i> , <i>Lamtoro</i> , other bush braches	Wood from agricultural land. Use kerosene stove. Mainly men collect wood.
Touli -mambot	50-60 kg	Dried clove trees, <i>Kaliandra</i> , <i>Nantu</i> , <i>Sengon</i> , <i>Sirih Hutan</i>	Wood from agricultural land & forest. Some people sell wood. Mainly men collect wood.
Kakas (E)	38-63 kg	Dried clove trees, <i>Kaliandra</i> , <i>Lamtoro</i> , bamboos, <i>Kayu Sombar</i> , <i>Piper</i> , <i>Tanjung</i> , excess timber	Wood from agricultural land & forest. Mainly men collect wood.
Langowan	40-240 kg	Dried clove trees, <i>Kaliandra</i> , <i>Lamtoro</i> , bamboos, <i>Dadap</i>	Wood from agricultural land & forest. Used for local wine production. Both men and women collect wood.
Tompaso	15-30 kg, or 0.13-0.25 m ³	<i>Kanonang</i>	Wood from agricultural land. Women and children collect wood
Remboken	30-150 kg, or 1 m ³	Dried clove trees, <i>Kaliandra</i> , <i>Lamtoro</i> , bamboos, cinnamon trees	Wood from agricultural land. Both men and women collect wood.
Tondano	40-60 kg	Dried clove trees, <i>Kaliandra</i> , <i>Lamtoro</i> , bamboos	Wood from agricultural land & forest. Most people use a kerosene stove near town center
Kakas (W)	45.7-52.5 kg	Dried clove trees, <i>Kaliandra</i> , <i>Lamtoro</i> , bamboos, <i>Kayu Sombar</i> , <i>Piper</i> , <i>Tanjung</i> , dried fruit trees	Wood from agricultural land. Mainly men collect wood.

Note: The quantitative volume of fuel wood consumption is an erratic estimate because survey respondents may not be familiar with the measuring unit as kg or m³.

¹ Private forest (*hutan rakyat*) in their term means a privately owned land that is or used to be an area with many trees. Although the area has already become agricultural land with a number of trees, local people still call the area "forest." It indicates that their land classification is based on both spatial and historical viewpoints, which also implies that local people believe that the area is supposed to be a forest. They also consider *hutan rakyat* an area targeted for reforestation activities implemented by the government.

In the area, fuel wood is also used for the production of local alcoholic beverage (*Captikus*) and red sugar from sugar palm, as well as the earthenware production in Pulutan village.

The earthenware industry in Pulutan village has been experiencing a severe shortage of fuel wood during the last few years. According to the interview, some producers had to stop their production due to insufficient fuel wood. The shortage is derived mainly from the increase of production.

(3) Non-Timber Forest Products

As the result of survey, non-timber forest products in the area are identified as follows:

Non-Timber Forest Products in Community		
Area	Non-timber forest products	Remarks
East	Durian, herbs, red sugar, <i>Saguer</i> , <i>Captikus</i> , honey, rats, wild pigs, deer, cuscus	Plenty wild animals in the protection forest, though outside the watershed
South	Herbs, fruits, red sugar, <i>Saguer</i> , <i>Captikus</i> , honey, rats	Major local alcoholic beverages production area, and many rats.
West	Durian, mangos, bananas, avocado, herbs, red sugar, <i>Saguer</i> , <i>Captikus</i> , rats	Many fruits in the private forest. Limited forest area as a whole

(4) Water Resources

During the survey, a number of water resources for local people were identified. They are used for drinking, irrigation, sanitation, inland fishery and leisure for local people. In the East area, most drinking water is from springs. There are both deep and shallow wells developed by the former Public Works Office, and local people have not experienced any problems or shortage of clean water in the East Area. However, during the group discussions, survey respondents pointed out that the volume of water discharge from springs has been declining over the last few decades.

In the South Area, there are a number of large springs that supply drinking water to three sub-districts (Langowan, Kakas and Tompaso) through water pipes. The Panasen river is relatively large, and local people use it for washing. They emit both liquid and solid wastes to the river, which flows into Lake Tondano.

In the West Area, people use water from wells as the major source for drinking. People who reside close to the forest area use spring water as well. Some of the springs are hot springs and used for bathing, tourism and irrigation. In general, the water discharge of the springs in the West Area is relatively small, and paddy field is the major consumer of spring water. Some people who are located near the lake pump up the lake water and use it for sanitation. They also use the lake water for drinking when wells dry up

during the dry season. A few respondents complain that they tend to get sick when they drink lake water.

(5) Natural Disasters

Flooding in the area occurs annually, and there are occasional landslides in certain areas with steep slopes. Small-scale forest fires and the eruptions of Mt. Soputan were also pointed out by survey respondents.

(6) Natural Resource Management at Community Level

The detailed socio-economic survey revealed that farmers pay great attention to soil conservation and management of their agricultural land. Based on the information from local people, soil conservation practices in the area can be classified into four types: contour ridging, terracing, intercropping and crop rotation. Farmers employ a simple and unsophisticated ridging on steep-slopes to prevent topsoil loss. The ridging technique was passed down from their parents, or farmers taught themselves through observation. Terraces were developed through the traditional mutual aid (*Mapalus*) executed long time ago. Intercropping and crop rotation, according to survey respondents, is used to maximize land use and slow down the decline in soil fertility. Farmers also practice fallow periods and graze domestic animals, mostly cattle during the fallow period. All these conservation practices are on an individual basis, and there is no organized soil conservation activities found in the area during the survey. Although observation revealed that some farmers practice line planting for their estate crops, no survey respondents considered the practice as a form of soil conservation technique.

Local people undertake community-based replanting activities. Replanting of trees is carried out individually on private agricultural land to maintain fuel wood, fruit production and shade for their personal use. The customary laws (*hukum adat*) regarding natural resource management that were found during the socio-economic survey for illegal cultivators were not found during the detailed socio-economic survey, except there is a traditional, unwritten rule that people should plant a few trees when they cut a tree.

Several survey respondents stated that the absence of a maintenance fund for regreening is a problem. There is no physical protection facility established for regreening, and seedlings are always free. People in Papakelan and Makalensow expressed their frustration because people from other sub-district were hired as laborers for regreening, but not them.

In terms of the maintenance of Lake Tondano, people in the target villages in Sub-district Eris, Kakas, Remboken and Tondano said that they try to control the increase of water hyacinths at the lake. They believe that the plant has a negative impact on fish cultivation in the lake because it hinders the growth of algae on which fish lay their eggs. People do volunteer work to remove the plant regularly, but they said the plant grows back soon or blown from the other sides of the lake. There have been no lake-wide cleaning attempts.

With regard to the most appropriate organization for watershed conservation, the comments from survey respondents can be summarized that the village government, sub-district government, district government and provincial government must work together. NGOs can potentially collaborate with government. The local people's mindset appears to be one of heavy dependence on their governments, and it is observed that the collective self-help and bottom-up initiatives are foreign to them. It is understandable since the country is so used to the Jakarta-led top-down approach during the last few decades.

(7) People's Awareness, Behavior and Attitudes towards Natural Resource Conservation and Forestry Extension Services

The significant number of local people, especially farmers are affected by or have observed forms of natural resource degradation in the area, according to the survey result. In addition to the personal experiences of negative impacts from the degradation, local people are usually informed about the environmental problems and watershed degradation through media and members of the community. The information, however, tends to be simplified and exaggerated, if not scientifically inadequate or politically manipulated. Based on personal experiences and additional information, local people form their awareness towards watershed conservation. The survey revealed that the level of awareness of local people reaches a certain level, which appeared in their comments during interviews. For example, approximately 90 % of survey respondents were able to identify various environmental problems such as the degradation of water quality of the lake, soil erosion, physical change of the lake, decline of forest and water resources, increase of water hyacinths and natural disasters. The important finding during the survey was that the level of awareness was not uniform among the population. Local leaders displayed a higher level of awareness than farmers.

The survey revealed that women's participation in conservation activities is lower than men. Many women respondents expressed their disinterest in conservation activities, except the conservation of clean water, because "they do not know about natural

resources.” The reason that women in the area have limited information about natural resources is because they tend to stay home and rarely interact with the resources, according to several women respondents.

Many local people do not know of the existence of the forestry extension services or officers (*PLP*), and some local people pointed out that forestry extension officers only visit the Head of Village when they come to their villages. They claimed that the purpose and activities of forestry extension services are unclear, and local people’s expectation toward *PLP* is high.

III-1.2.3 Agriculture

(1) Land Ownership

There is no existing statistical data about land status in the area at present. It is known generally that only a few people have official land certificate from the Land Agency (*BPN*), and most land ownership are documented in other forms such as *Letter-C* (a form of local land registration) and other form of registration at a village government office.

(2) Farming System and History

1) Farm labor and mutual community aid (*Mapalus*)

Farmers in the area, both owner farmers and tenant farmers are engaged in farm labor. According to the survey, approximately three fourth of farmers in the area work as a farm laborer. The population of “pure” farm laborers, who do not own or rent a piece of land for their farming and work only as a farm laborer, is unknown, but the empirical evidence based on the hearing from local people suggest that it is approximately one fifth of the total labor force in the area.

At the community level, the mutual community aid (*Mapalus*) is actively applied to farm labor. The compensation for laborers after the mutual community aid in the case of farming is usually provided in kind, whether a part of the harvest or food. The mutual community aid is most practiced for paddy production where intensive labor is required.

2) Farm finance

The revenue from a harvest is invested to the next harvest, in some cases through traders, which leaves limited income in the hand of farmers. Farm labor and other ad hoc cash earning activities are the source of income to support their livelihood. In spite of the existence of financial institutions and mechanisms, a

limited number of farmers use those financial services to finance their farming.

(3) Crop Production

1) Farming techniques

According to the result of groups discussions held at 7 sub-districts, farmers started using chemical fertilizers and pesticides extensively during the 1970s to 80s when the fertility of soil started to decrease and demand of farm products began to increase. Farmers usually use seed / seedlings from the previous harvest for certain crops and rarely use hybrid seeds for their production. Therefore, the advanced variety is slow to be introduced in the area.

2) Production level

The ten stone production survey revealed that cloves are the most important crop in the East Area as expected. Maize and paddy are also important crops in the area, especially for the household consumption. Other upland crops as groundnuts, cowpeas, onions, chilies, tomatoes provide critical source for living as well as some estate crops as coffee, vanilla, coconuts and various fruits. Domestic animals, especially fish at the waterfront villages are also identified as important agricultural products.

In the South Area, the primary crops are maize, paddy, cowpeas, onions and tomatoes. Secondary crops are groundnuts, leaf onions, soybeans and some vegetables as Chinese cabbage (*petcai*), cabbage, pumpkins and carrots. Tomato production is a prominent feature in the South Area.

The West Area produces the most agricultural products in terms of varieties. The primary crops are maize, paddy, groundnuts, tomatoes and various kinds of fruits including oranges, durian, mangoes and bananas. Sub-district Tondano produces a lot of cloves, ginger, fish, bamboo and timber near the mountains and the lake while Sub-district Remboken produces an indigenous green called *kangkung* and domestic animals particularly cattle.

(4) Marketing

Three types of marketing practice for farm products are employed in the Intensive Area, as shown below.

Type A Producer → Consumer
Type B Producer → Distributor → (Retailer) → Consumer
Type C Producer → Middlemen → Retailer → Consumer

Some marketing methods involve distributors (*Tibo* in local term) who will come to a farm gate and purchase farm products from farmers. Distributors are in many cases farmers themselves and are not well organized. The trade volume that a distributor handles is generally small. Middlemen are usually from outside their village, possibly from larger towns or cities as Tondano, Langowan, Kawangkoan, Tomohon or the city of Manado. The determinants for the types of marketing method are: a distance to public market and type of crop. Distributors and middlemen are involved in the trade for cash crops as cloves, vanilla or relatively high-value products.

III-1.2.4 Community-Based Organizations

(1) Local Administration

One of the most influential establishments at the village level is the village government.

All villages have a village parliament body called *LKMD* (Village Community Resistance Institution), which has the legislative responsibility and authority at the village level. *LKMD* is in the process of reformation at the time of the Study, and *LKMD* should be change to *BPD* (Village Representative Board), which has stronger decision-making power than *LKMD*, according to a local decree.

The Head of Village is supported by various personnel within the village government. The survey revealed that some of these positions are not filled in a few villages, either intentionally or unintentionally. Some Heads of Village claimed that the village does not have qualified personnel for the positions, and other confessed that the positions are not filled because the fund for the positions disappeared.

The detailed socio-economic survey included an analysis of the leadership of Head of Village using indicators of: a) the level of his/her understanding in the mission/vision of government, b) the degree of his/her understanding in the management system of village government and decentralization, c) the ability to explain his/her village development plans and implementations. The JICA Study Team concluded that leadership, the level of his/her education and incentives are directly proportional. Also, a head possess a strong leadership when he/she possesses skills in finding monetary compensations and physical aid for village programs.

(2) Local Organizations

1) Farmers' organizations

There are a number of farmers' organizations (*Kelompok Tani*) in the community. Each farmers' group has a board, leaders and 20 to 150 members, who hold regular meetings to discuss about their activities. Many farmers' groups have been established since the beginning of the Farm Enterprise Credit Program (*KUT*) in the late 1990s. This nation-wide governmental program aimed to provide farmers' groups with the farming capital in the form of credit.

A number of farmers' groups have existed before the *KUT* Program. Those groups were managed by the fund raised by the members, who pay the membership fees regularly and participate to the general meetings and activities. Their activities vary one group to the other, including the formulation of work plans, collective marketing of farm products, collective farm laboring (*Mapalus*), purchase of agricultural land for collective production, collective management of farm inputs, implementation of technical seminars, rearrangement of fish cages and nets, collective planting activities of estate crops, saving and credit activities.

There are fishermen's groups in the East Area, female farmers' groups in the South Area, and a furniture craftsmen group in Eris Sub-district. All of those organizations implement a regular rotating credit activity (*arisan*) among members. Most farmers' groups suffer from a chronicle shortage of work capital, lack of leadership and members' commitment, according to the survey.

2) Family welfare program (*PKK*)

Every target village has *PKK* led by a wife of Head of Village. Popular activities in a *PKK* group are the rotating saving, gardening, education and support for expectants and mothers, home industry and nation-wide social welfare saving program called *TAKESRA*. The survey revealed that the activeness and success of *PKK* heavily depend on the leadership of the board members and technical, political and financial support from the village government.

3) Village cooperative (*KUD* and non-*KUD*)

Village Cooperatives (*KUD* and non-*KUD*) are established to provide farm inputs, conduct marketing, provide farm capital, achieve technical advancement and production management at a village level. The survey revealed that a few cooperatives are active in the target villages, and majority is inactive due mostly to the lack of fund and leadership.

4) Church organizations

Local population considers the existence of church organizations important for their daily lives and has great influence to the welfare and development of the community. In the target villages, the church organizations are arranged in accordance with the religious sects. The major religious sectors in the village are: *GMIM* (Christian Evangelical Church in Minahasa), Pentecost, Advent, *KPGL* (Protestant Church Association of Minahasa) and Catholic. *GMIM* is the largest religious sect in the Intensive Area.

(3) Informal Groups

Rukun Keluarga (united kinship) is extremely popular in Minahasa. *Rukun Desa* (united village) and *Rukun Sosial* (social unity) are other forms of *rukun* participated in by the members of the whole village. The activities and events during the gathering are similar to *Rukun Keluarga*, but they are more organized and somewhat formal than the previous one.

The survey revealed that *Mapalus* emerges in the forms of *dana sehat* (health fund), *dana social* (social fund), *dana duka* (funeral fund), or *serikat/rukun gotong royon* (united mutual aid).

BIPRA (Church Board for Fathers, Mothers, Youths, Teenagers and Children) are a religious gathering of church members. Gatherings are organized in accordance with different gender groups, and participants will join worship activities, sports events and art affairs.

(4) Actual Situation (Venn Diagram and SWOT Analysis)

During the group discussions, local leaders participated to the Venn Diagram and SWOT Analysis.

Based on the series of Venn Diagram from 7 Sub-districts, most important community-based organizations/groups are *LKMD*, church organizations and Family Welfare Program (*PKK*). In addition to the three organizations and institutions above, farmers' groups and village cooperatives are identified as important ones in a few sub-districts.

Through SWOT Analysis, a few contradicting results of the analysis were identified (for example, Strength is appropriate personnel while Weakness is inappropriate personnel). A part of inconsistency is derived from the local difference and complex nature of organizations.

III-1.2.5 Gender

(1) Labor Distribution

The result of analysis for labor distribution among women and men revealed that, women in the area actually interact with key resources as water resources, soil at agricultural land, fuel wood and livestock. Most women involved fetching water, farming and processing, collecting fuel wood collection and taking care of domestic animals and are exposed to their environment, which enables them to observe the degradation and depletion of natural resources and affecting factors.

(2) Access and Control

Access and Control Analysis is one of the gender analysis tools to evaluate the equality among gender groups by looking at the choices available for each gender group. 68 % of the relevant female population in total at the target villages has fairly easy access to various sources and activities whereas it is 78 % for male. With regards to control, 75 % of females make decisions, while it is 68 % for male. The result shows that the mobility and activity of female population is restricted in the Intensive Area, due most probably to the reproductive responsibility of women while their decision-making power within the household is high.

(3) Participation

“Participation Analysis” is another tool of gender analysis aiming to understand the detailed arrangement of women’s participation to various daily activities. Participation Analysis revealed that being a laborer is the most common form of participation for women. Even when they participate in various activities, their participation as a decision-maker is limited to particular women, except in the cases of organization and house keeping. This finding implies the lack of women’s empowerment in the area, although they are relatively free to participate to daily activities as a laborer.

The functions of women as an information/knowledge provider seem to be limited to particular women during their participation in organizations, farming, fuel wood related activities and medical services. It may be attributed from the lack of women’s information, but also from the lack of their realization that their knowledge is a valuable and viable input for those activities. Women may have been participating to activities as an information provider without recognizing it.

(4) Women's Needs

Women's priority was analyzed. An RRA tool called Ten Stones Analysis was employed for this during the group discussions to determine their needs. Based on the survey result, the needs of women in the area are: a) capital, b) health, c) education, d) skills, e) drinking water, f) organization, g) economic opportunity, h) agricultural tools and technology, i) natural resource conservation, and j) fuel wood.

III-1.2.6 Farmers' Needs

Ten Stones Analysis was also employed to identify men's needs during the group discussions in the target Sub-districts. Based on the survey result, the needs of male farmers in the area are: a) capital, b) farm inputs, c) education, d) drinking water, e) primary seed, f) road, g) health, h) reforestation, i) irrigation, and j) livestock.

The comparison of the needs between men and women shows table below.

Ten Stone Analysis – Comparison between Women and Men

Rank	Women	Men
1	Capital	Capital
2	Health	Farm inputs
3	Education	Education
4	Skill	Drinking water
5	Drinking water	Primary Seed
6	Organization	Road
7	Economic chance	Health
8	Agricultural tools and technology	Reforestation
9	Natural resource conservation	Irrigation
10	Fuel wood or fuel	Livestock

The most pressing need identified by both women and men was capital. They noted that capital is the most critical yet lacking item in the area for managing and developing various undertakings in the framework of economic improvement of family income. Other issues with a high priority identified by both women and men were education, drinking water and agriculture for their basic needs.

A clear difference between women and men can be found in the second priority, where men pointed out that farming tools while women chose health. On the contrary, men selected health for the seventh priority and women define farming tools as the eighth. Also, only men mentioned the needs of primary seed, irrigation and reforestation, while only women pointed out the needs of skills, organizations, fuel wood and labor as their priorities.

When farmers were asked what kind of crops they would like to plant in the future, farmers were able to mention crops that they are cultivating at present. It implies that

farmers do not have enough information about species and varieties that would generate more income. The reasons for farmers having inappropriate information about valuable crops are still inconclusive, but it may be attributed from the improper agricultural extension services and lack of communication infrastructure. It might also be derived from the fact that the farmers' available capital is so limited that they are unable to explore new crops that might have a higher risk of failure. The conservative mentality of farmers also might affect the hesitation towards new crops.

The survey also intended to identify people's needs related to natural resources.

Natural Resource Ranking

Rank	For Domestic Use	For Income	Labor Requirement
1	Spring		Lake
2	Tree	Lake, Spring, Tree	Clove
3	Lake		Spring, Tree
4	River	Clove	
5	Bamboo	River	River
6	Bush	Bamboo	Bamboo
7	Paddy and estates, Sugar Palm	Sugar Palm	Sugar Palm

III-1.3 Land Use

III-1.3.1 Land Use Category

A detailed land use map for the Intensive Area has been prepared using a topographic map in a scale of 1/10,000. The category of this land use map has been decided on the basis of the former land use map in a scale of 1/50,000. In the following new category, "Planted forest" is further divided into "Planted forest (Timber)" and "Planted forest (Fuel wood)" by purpose of main usage. "Estate" is also divided into two categories on the basis of dominant tree crops. The category of "Bush" is newly established. The employed categories in land uses are: a) Natural / semi-natural forest, b) Secondary forest, c) Planted forest (Timber), d) Planted Forest (Fuel wood), e) Bush, f) Estate (Clove), g) Estate (Other tree crops, or mixture of various tree species), h) Mixture of estate and arable upland, i) Arable upland, j) Pasture, k) Paddy field, l) Swamp, m) Water body, and n) Settlement and others

III-1.3.2 Distribution of Land Use

The land use map has been produced on a basis of an interpretation of aerial photograph taken in May 2000, topographic maps, and a field survey. Then the result has been digitized.

Areas of each land use category are shown in the right table which is measured on the

digitized land use map.

A reduced land use map is shown in Figures III-1.3.1, III-1.3.2, and III-1.3.3 and a distribution of each land use category is described.

“Natural/semi-natural forest” occupies 9.5 % of the Intensive Area. It has been almost confined on the top of

mountains located on fringe of the Intensive Area. The largest one is on Mt. Soputan in the South Area. “Secondary forest” is distributed around Natural/semi-natural forest or along rivers. A large extent is observed on northeastern slopes of Mt. Soputan. It occupies 5.0 % of the area.

“Planted forest (Timber)” is distributed mainly in the southern part of the Intensive Area occupying 0.2 %. “Planted forest (Fuel wood)” is also sporadic but can be found in all the Intensive Area. It occupies 3.8 % of the area in total. It is especially concentrated in the West Area of the Intensive Area.

“Bush” is mainly distributed in small patches in the steep area of upper slopes, occupying 2.0 %.

“Estate (Clove)” covers 8.0 % of the Study Area. Large “Estate (Clove)” is found in the East Area. Contrarily, “Estate (Clove)” is distributed in rather small patches in the South and West Areas. “Estate (other tree crops, or mixture of various tree species)” is distributed all the Intensive Area covering 20.6 %.

Mixture of estate and arable upland is distributed all over the area and occupies 15.3 %. The large masses are located in the South Area. On the other hand, “Arable upland” is mainly distributed from the South Area to the West Area occupying 26.3 %. “Pasture” is confined in western edge of the West Area below Mt. Lengkoan. It occupies only 0.3 % of the area.

“Paddy field” occupies 5.4 % of the area. It is mainly distributed in plains on the fringe of the Intensive Area. “Swamp” occupies only 0.2 % of the area. Most of them are distributed along the shore of Lake Tondano.

Area of Each Land Use

No.	Legend	Area (ha)	Ratio (%)
1	Natural/Semi-natural forest	1,128	9.5
2	Secondary forest	600	5.0
3	Planted forest (Timber)	24	0.2
4	Planted forest (Fuel wood)	448	3.8
5	Bush	242	2.0
6	Estate (Clove)	950	8.0
7	Estate (Others)	2,444	20.6
8	Mixture of estate and arable upland	1,821	15.3
9	Arable upland	3,122	26.3
10	Pasture	36	0.3
11	Paddy field	638	5.4
12	Swamp	20	0.2
13	Water body	6	0.0
14	Settlement and others	406	3.4
Total		11,885	100.0

“Water body” is only 6.0 ha because Lake Tondano, the biggest water body of Tondano Watershed, is not included in the Intensive Area. But the West Area and East Area adjoin the lake.

“Settlement and others” occupies only 3.4 % of the area. As large settlements such as Tondano and Langowan are excluded from the Intensive Area, almost all the settlement areas in the Intensive Area are rather small. The main settlements are Tataaran and Kasuratan in the West Area, Tumaratau and Noongan in the South Area, and Touliang Oki and Tandegan in the East Area.

III-1.3.3 Distribution of Land Use in Three Areas

There are three areas in the Intensive Area and each area has a characteristic distribution of land use. Areas of each land use category by each area are shown in Table III-1.3.1.

(1) East Area

This area topographically consists of rather steep slopes and drainage density is high comparing with other two areas. Estate (Clove) (22.0 %) and Estate (Other tree crops, or mixture of various tree species) (20.5 %) are dominant land use. A large extent of Estate (Clove) is mainly distributed in the middle part of the area.

Though most of this area is developed for the estate and arable upland up to a dividing ridge, forest still remains in the upper slopes, for example on Mt. Kaluta (Lembean) in the northern part and Mt. Kaweng in the southern part. Natural/semi natural forest and Secondary forest occupy 11.9 % of the East Area. Planted forest (Timber) is also found on hills north to Mt. Kaweng.

Arable upland is sporadic among the estates occupying 11.0 % of the area. Settlement and Paddy field are located in the eastern fringe along Lake Tondano.

(2) South Area

This area mainly extends on the eastern slopes of Mt. Soputan and Mt. Manimporok. The part with the highest elevation is mainly covered with Natural/semi-natural forest (21.6 %), and Secondary forest is distributed just below the Natural/semi-natural forest covering 14.1 % of the area. Cultivated areas such as Arable upland are sporadically distributed among Secondary forest. Planted forest (Timber) is also distributed among the upper part of Secondary forest.

Lower area is mainly covered with Mixture of estate and arable upland and Arable upland in mosaic. The former occupies 21.7 % and the latter covers 25.2 % of the

South Area respectively. Settlements are distributed in a line along the lower fringe of the South Area. Paddy field is also distributed in lower plain sporadically.

(3) West Area

This area topographically consists of a complex of gentle plateaus and surrounding steep slopes in principle. The gentle slopes tend to be occupied by Arable upland, and surrounding slopes are mainly covered by Estate (Others). The northern part of the area where drainage density is rather high is also covered with Estate (Others). Arable upland covers 36.8 % of the area, and Estate (Others) covers 29.0 %. Estate (Clove) is found but only in a few locations with small patches (3.9 %).

Natural/semi-natural forest is confined on upper slopes of Mt. Tampusu, Mt. Kasuratan, and Mt. Lengkoan. It occupies 1.3 % of the area. Planted forest (Fuel wood) is distributed in many places occupying 7.0 % of the area. There distribute large ones on the northeastern slopes of Mt. Tampusu and on Pinasuan hills.

III-1.4 Forestry

III-1.4.1 Protection Forest Management

(1) Distribution and Maintenance

1) Boundary

There are 9 protection forest areas in the Study Area, and 6 of them are distributed within the Intensive Area. The names and the locations of the protection forests are shown in Figure II-1.5.1. Table III-1.4.1 shows the information on the

Area of Protection Forest			
N	Name of Protection Forest	Area (ha)	Length of Boundary (km)
1	Tampusu	28	1.8
2	Lengkoan	19	1.2
3	Lembean	101	5.3
4	Kawatak	91	6.1
5	Soputan	701	10.8
6	Kaweng	74	4.6
Total		1,014	29.8

establishment of the 9 protection forests in the Study Area. The boundary maps have been produced for each protection forest, but the records are sometimes vague, which leads to difficulty in confirmation of actual location of the boundary and in possession of the information by all stakeholders.

Mapping of the boundary of the protection forest in the Intensive Area has been carried out on topographic maps at a scale of 1/10,000 using the existing boundary maps, field observation, and hearing from forestry workers and local residents. As a result, each boundary has been interpreted and drawn on the maps. The area and length of boundary of each protection forest in the Intensive Area is

shown in the right table. 1,014 ha (8.5%) of the Intensive Area is assigned as protection forests. Total length of protection boundary in the area is 29.8 km.

2) Management

The responsibility for management of protection forest has been handed over to the District Forestry Service Office. The Forest Guards (*Satuan Polisi Kehutanan*) are posted in all sub-districts to conduct supervision of forest and forest products. Besides them, a mobile forest guard unit is organized in the Provincial Forestry Service Office. Unfortunately, it seems that the protection forests in the Intensive Area are not well managed by them because of the shortage of human resources (see Section III-1.9 for detailed information).

The Provincial Forestry Services Office conducted a monitoring for reforestation in fiscal year 2000, which is named *Identifikasi Tanaman Reboisasi di Kabupaten Minahasa* (the Evaluation of Reforestation in Minahasa). Four locations of reforestation areas were selected in the Intensive Area. The survey result is shown in the table below. All of them were planted in 90th but the ratio of surviving trees is very low.

The Condition of Assessed Reforestation Areas

No.	Locations	Planted Trees	Area of Sample Plot (ha)	Number of Remaining Plants	Ratio of Remaining Plants (%)
1	Mt Soputan (A)	Gmelina, Nantu, etc.	3.0	687	13.9
2	Mt.Soputan (B)	Gmelina, Nantu, etc.	2.0	464	6.0
3	Mt.Lembean (A)	Gmelina, Nantu, etc.	6.0	1,044	11.4
4	Mt.Lembean (B)	Gmelina, Nantu, etc.	2.0	427	12.8

Source: *Final report of Identifikasi Tanaman Reboisasi di Minahasa, Dinas Kehutanan Propinsi. Sulawesi Utara. 2000*

(2) Activities in Protection Forests

1) Reclamation

Some encroachment into the forest has been found in the Soputan Protection Forest. Figure III-1.4.1 shows the estimated encroached area in the Protection Forest. The total area of encroachment has been estimated at about 30 ha. About 40 residents of Ampreng, Tumaratas, and Raringis Villages seemed to be involved in the



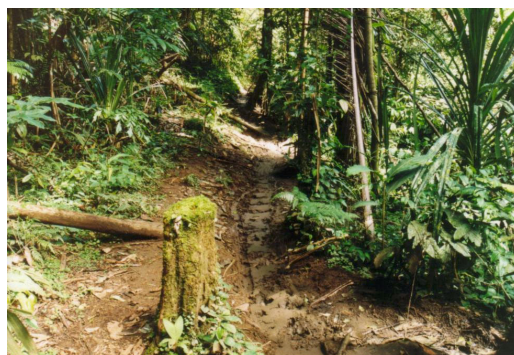
Sawn Timber at Soputan Protection Forest

event. Most of the encroachers come from Ampreng Village and most of them are subsistence cultivators. But their relation with the encroached lands varies. Some areas in the lower part have been cultivated for nearly 20 years, on the other hand, just few years in the upper part of the encroached area.

In June 2000, the District Forest Services Office organized a meeting with local leaders and about 40 illegal cultivators from the 3 villages to solve the illegal condition. Twenty one out of these encroachers signed the agreement to quit cultivation in the protection forest by December 2000. But many of them still remain cultivating crops in the encroached area.

2) Logging

Illegal logging has been often observed especially in the lower part of the Soputan Protection Forest and around the dividing ridge in the Lembean Protection Forest, where good forest stands still exist. The affected area by logging is roughly estimated as about 130 ha for the Soputan Protection Forest and 70 ha



Bullock Path for Dragging Timber

for the Lembean Protection Forest. Logging activities have been little observed in other protection forests. Its reason might be that the other forests with steep slopes have originally little good timber resources, or that the resources have already been cut over because of their small extent.

The field observation found that trees over 40 cm diameter were targets for felling. Logs are sawn into timber in the location by chainsaws and dragged out by bullock (see the photographs). Only thick parts of stem with good quality are sawn into timbers and rest of them with rather small diameter are just left there.

3) Other activities

Fuel woods are still important energy resource for local residents. There are several sources to supply fuel woods such as dead clove and coconut trees from estate, fuel wood plantation, as well as extraction from the protection forests. People in the South Area seem



Honey Collector below Mt. Soputan

to use trees from protection forest for fuel woods other than trees from private lands.

Some non-wood forest products are collected by local residents. Natural honey is the most preferable harvest from the forest (see photo). A honey collector says the amount of honey products is so small that most of the harvest is consumed locally and little appears in markets in urban areas. Some kinds of mushroom are also harvested by some villages of the Intensive Area. Small forest mammals such as rats and bats provide some income for the villagers.

(3) Possibility of the Establishment of Community Forestry

A community forestry was decided by the Ministry with Decision of Ministry of Forestry and Estate Crops No. 677/Kpts-II/1998.

Government officers say it is legally possible to establish community forestry in a protection forest. But there are some confrontations among several sectors of the officials of Forestry Services Offices on establishment of community forestry in a protection forest. It seems that the District Forestry Services Office and the Regional Forestry Services Office is rather negative about the establishment. They are afraid of accelerating further encroachment if the community forestry in protection forests is approved.

On the other hand, encroached farmers worry if they are asked to go out from the occupied lands immediately. It seems that they are positive to be included in a community forestry program if their right of cultivation is admitted. On 11 January, 2001 informal meeting with those farmers who have encroached into the Soputan Protection Forest was held at the village office of Ampreng. They are very positive about the idea of the JICA Study Team on people's participatory approach on the rehabilitation of the encroached area. They express their strong willingness to be involved in the program.

III-1.4.2 Forest in Private Lands

(1) Distribution and Usage of Forest Resources

The present land use maps show distribution of forest in private lands (outside of protection forest).

Most of the forests in private lands are fuel wood plantation. Main species are kaliandra (*Calliandra calothyrsus*) and gamar (*Gliricidia sepium*). These trees are planted in 1 m x 1 m in interval normally. Growth rate of kaliandra is 5-20 m³/ha/year.

There are some timber plantations of pine trees in south of Kakas Village of the East Area. Most of the forests are at harvest stage and cutting operation has been undertaken in some lots.

Besides them, there is no extensive timber plantation in the Intensive Area. Small plantations or individual planting in arable uplands or estates are commonly performed (see photo). Cempaka (*Elmerrillia spp.*) is the most preferable species.

The main usage of forest resources in private lands is for production of fuel woods and timbers. The trees of fuel wood forests are cut once 2 or 3 years by the needs of local residents, and new shoots regenerate from stumps. Most of the fuel woods produced from fuel wood plantations are domestically consumed.

Distribution of extensive timber plantation in the Intensive Area is limited. Small plantations or individual planting among farming land have been commonly found as mentioned before. Price of sawn timber by species is shown in the Table III-1.4.2. In case of cempaka, it costs Rp. 800,000 – 1,000,000 m³ in shops. In general, it takes 20~50 years for cempaka trees to grow up to commercial size (40 – 50 cm in diameter).

(2) Regreening (*Penghijauan*) and Private Forestry (*Hutan Rakyat*)

Private Forestry/Garden (*Hutan / Kebun Rakyat*) is controlled by the District Forestry Services Office. To confirm the actual implementation of regreening activities, 14 villages in and around the Intensive Area have been visited for interviews with local leaders. According to the results of the interview, about 25 – 50 % of initially planned number of trees have been planted in each private forest location. In several locations, farmers did not agree that their fertile land was shared for growing trees. Lack of extension services has been also pointed out. Farmers are not well informed of the benefit of private forest.



Fuel Wood Plantation of Kaliandra



Cempaka in Cultivating Lands

(3) Extension Services

There are about 60 extension forest workers in Minahasa District and some 15 staff concerning the Intensive Area. The activity of the extension workers are mainly implemented through greening program such as Private Forest/Garden (*Hutan/Kebun Rakyat*), UP-UPSA (Demonstration plot for conservation of natural resources), and Village Nursery. Unfortunately these extension workers are not active. Many local residents who have been interviewed mentioned that forest extension workers have rarely visited (see Section III-1.9 for detailed information).

III-1.4.3 Nursery

There are 3 nursery systems: government nursery, community or farmer group nursery, and private nursery in the Intensive Area.

Government nursery is mainly prepared for supplying seedling for the planting program of the government. Most of them are temporarily constructed for certain planting program and abolished when it has supplied all seedlings for the program. In this year (2000), the Provincial Forestry Service Office provides temporary bamboo nursery (20,000 seedlings) in Kanonang Village (Kawangkoan Sub-district) (see photo right).



Bamboo Nursery (Kanonang Village)

Community or farmer group nursery is managed by community or farmer group and subsidized by the government through village nursery program (*KBD, Kebun Bibit Desa*) which is one of Regreening (*Penghijauan*) Program. Photo (see photo below) shows works in a nursery. They are engaged in filling up earth in plastic bags.



Works in a Nursery

There are 3 people confirmed who are conducting private nursery in and around the Tondano Watershed. According to the interview with Mr. Wolter Tudju, one of owners of private nurseries, he buys seeds of cempaka (*Elmerrillia sp.*) for Rp. 250,000/kg. Mr. Franky Runtuwarouw, another owner, buys seeds of cempaka for Rp. 50,000/liter from local farmers. Grown seedlings are sold for Rp.500 – 600/seedling. They grow 30,000 – 80,000 seedlings a year. Normally, seedlings are grown in the nursery for

three months to one year.

Comparing these three nursery systems, government nursery and private nursery are managed better than community or farmer group nursery at present. Community or farmer group nursery is a part of Regreening Program, and it has a problem in efficiency as it is mentioned in previous section. On the other hand the entrepreneur of private nursery has to provide the fund for the business at his own risk. Funds are required for employing labor and purchasing materials such as seeds and plastic bags. It is concluded that, if extension services are enhanced, community or farmer group nursery is the best way for managing nurseries in terms of stability, people's participation, and technology transfer in a forestry field.

III-1.4.4 Useful Species

The useful tree species in and around the Tondano Watershed is listed in Table III-1.4.3. The table is made on the basis of the list of flora in Minahasa District provided by the District Forestry Services Office. According to the table, this area already has enough tree species with varieties of usage from timber to fruits and edible leaves. Introduction of new species does not seem to be necessary. Some alien species such as teak cannot adjust themselves to the climate of this region which has very short dry season. In fact, teak flourishes where there are four to seven dry months a year. It is said that there are tree species which can prevent soil erosion. However, researches on such kind of tree species are not enough, so that it is recommended to carry out further detail researches on them.

III-1.4.5 Fire Protection

There are some records of forest fire in and around the Intensive Area. Fire occurs only in years with unusually long dry season but the data are not available on the frequency of fire. The latest fire in and around the Intensive Area occurred on Mt. Soputan in 1997.

Fire protection is the task of all forestry offices but there is no particular organization for handling fire protection. There are only two forestry staffs who have been trained on forest fire in the District Forestry Services Office. In fiscal year 2000, the Regional Forestry Services Office receives some tools for fire protection and those will be distributed to the District Forestry Services Office. Those are 5 units of water pumps and hoses, 4 backpack pumps, 5 global positioning systems, 5 binoculars, 40 extinguish dresses, and 5 small chain saws.

III-1.4.6 Current Problem in Forestry

(1) Maintenance of Forest Boundary

As it is mentioned in previous section, the maintenance of the protection forest boundary is not well executed in a field and the data (survey result and maps) is also not well stocked. To maintain the boundary, re-survey and restructuring of boundary monuments are required.

(2) Encroachment

There are some encroached areas in the protection forest. To recover the function as a protection forest, it is required that the encroached area is covered with forest as much as possible with an agreement of all stakeholders.

(3) Illegal Logging

Illegal logging is seen in some protection forests. It must be prohibited by enforcement of forest patrol. Cut over places should be replanted.

(4) Forest Guards

The present system of forest guards does not function well. Re-structuring to create a new effective system is required with some additional training for forest guards.

(5) Fuel Wood Supply

Fuel wood supply seems to be in shortage in the South Area. Establishment of fuel wood plantation in private lands of the South Area is required. The West Area has presently less problem of fuel wood supply in terms of domestic usage because of abundant resources of fuel wood plantation. But it might have problem in the near future because the demand of fuel wood by pottery makers is recently increasing. In the East Area, certain ration of fuel wood is supplied from dead estate trees. It is not sure that fuel wood will be supplied from estate trees in the long term. Plantation of fuel wood might be necessary in the East Area in case of shortage in future.

(6) Timber Wood Supply

Timber resources are limited in the Intensive Area, though there are demands for timber from the wood industry in and around the area. One of the backgrounds of illegal logging might be the high demand of timber and a shortage of supply. Encouraging timber tree planting is recommended. It could contribute local economy. It may also contribute to discourage illegal logging in the protection forest.

(7) Private Forestry (*Hutan Rakyat*) Program and Extension Services

The Private Forestry Program is executed yearly by the District Forestry Services Office. Sometimes it is not fully accomplished. Some administrative development seems to be necessary. In addition, shortage of the number and knowledge of extension staff results in insufficient development of farmer's skill and knowledge in forestry sector through the activities. Restructuring of the organization and training system of extension workers is necessary.

(8) Nursery

Seeds and seedling supply system seems to be well established. Nurseries are run both by the government sector and private sector depending on their purposes. On the other hand, some farmers claim that they cannot obtain enough seedlings of trees even if they are willing to plant trees in their farming lands. Establishment of additional nurseries (even temporary one) with tight cooperation with the Private Forest (*Hutan Rakyat*) Program might be worth to meet the farmer's demands. Publicity of how to obtain seedlings from the existing nurseries is also required.

(9) Non-wood Forest Products

According to the District Forestry Services Office, the potential for development of sericulture and apiculture in the area has not been assessed yet. Apiculture would have high possibility in the Intensive Area. Research and a pilot project might be worthy.

(10) Fire Protection

Once fire has been extended, it is very difficult to extinguish it by manpower. One important measure is an education program within extension services. An alarm system in the early stage of the fire with cooperation of forest guards is also useful. Some manual tools to extinguish fire could be useful in the early stage of the fire.

III-1.5 Agriculture

III-1.5.1 Land Holding Size and Land Tenure

Based on the statistical data of farm size by Sub-district, the average farm size in the Intensive Area, is estimated at 1.30 ha, which is composed of 1.62 ha in the East Area, 1.09 ha in the South Area and 1.20 ha in the West Area.

III-1.5.2 Agricultural Land Use

The Intensive Area is divided into 3 Areas centering Lake Tondano from different

agricultural land use and agricultural practices: the East Area, the South Area and the West Area. Agricultural land use by respective areas is shown below.

Agricultural Land Use by Area

Land Use				Unit: ha
	East Area	South Area	West Area	Total
Estate (Clove)	731	19	200	950
Estate (Others)	684	269	1,491	2,444
Mixture*	461	742	618	1,821
Arable upland	368	859	1,895	3,122
Pasture	0	0	36	36
Lowland	388	125	125	638
Total Agricultural land	2,632	2,014	4,365	9,011

*: Mixture means the mixture area of upland crops and estate crops.

The agricultural land in the Intensive Area is classified into four areas from a viewpoint of slope. These are 0-8% sloped area (Flat), 8-15% sloped area (Gentle slope), 15-25% sloped area (Moderate slope) and more than 25% (Steep slope).

The present agricultural land use can be also classified into five categories considering agricultural practices, cultivated crops and trees. These are AGF-I which is tree/tree crop dominant agroforestry system, AGF-II, which is herbaceous crops dominant agroforestry system, AGF-III, which is inter-cropping agroforestry system, Upland herbaceous crop farming (trees and tree crops area are less than 5% of total field area, UF) and Lowland farming (LF). The area of each category by slope and Areas are summarized below, and details are presented Table III-1.5.1.

Farming Type in the Different Topography

Category					Unit: ha
	Steep slope	Moderate slope	Gentle slope	Flat	Total
AGF-I	1,721	1,168	0	0	2,889
AGF-II	13	691	642	410	1,756
AGF-III	167	1,701	100	0	1,968
Upland-F	0	74	766	920	1,760
Lowland-F	0	0	0	638	638
Total	1,901	3,634	1,508	1,968	9,011

Note Steep slope; slope more than 25%, Slope; slope 15-25%, Gentle slope; Slope; slope 8-15%, Flat; slope 0-8%.

In the steep slope area, AGF-I is mainly employed and occupies 90 % of total area. In the moderate slope area, AGF- III is dominant followed by AGF-I. In the gentle slope and flat area of upland, AGF-II and UF are mainly practiced. LF is practiced only in the flat lowland area. Agroforestry system covers 79% of total agricultural upland in the Intensive Area.

The farming category by the Area is also summarized in the right

Farming Category by the Area

Category				Unit: ha
	East Area	South Area	West Area	Total
AGF-I	1,682	229	977	2,888
AGF-II	190	658	909	1,757
AGF-III	273	464	1,231	1,968
UF	99	538	1,123	1,760
LF	388	125	125	638
Total	2,631	2,014	4,365	9,011

table. Generally Speaking, farmers are adopting reasonable farming type, such as AGF-I for erodible steep slope areas and UF for less erodible flat areas. However, unsuitable farming practices are also observed at scattered small areas.

In the East Area, the agroforestry system covers 95% of total agricultural upland area. AGF-I is predominant and occupies 78% of agricultural upland area, because a larger part of agricultural area belongs to steep-sloped area. AGF-II and AGF III cover 8% and 13 % of total upland agricultural area, respectively. The UF area is very limited and distributed in the steep slope area.

In the South Area, the agroforestry system covers 71% of the total agricultural upland area, and there is a little difference in covering area among each agroforestry system. The agroforestry system is also employed in the upland flat area and it occupies 39% of the upland flat area.

In the West Area. Agroforestry system covers 74% of the total agricultural upland area. AGF-III occupies the largest area followed by AGF-II. However, there is no big difference in the covering area among each agroforestry system. The UF area occupies 25% of the total agricultural upland and is mainly distributed in the flat and gentle slope area, and slightly in the slope area.

III.1.5.3 Crop Production

(1) Planted Area

The planted area of major tree crops by the Area is summarized below (Details are shown in Table III-I.5.2).

Planted area of Major Tree Crops by Area

							Unit: ha
Area	Coconut	Clove	Coffee	Other estate crops	Fruit	Hedge tree	Other trees*
East	83	846	55	47	64	48	616
South	49	196	19	10	19	46	334
West	54	424	69	53	146	101	972
Total	186	1,466	143	110	228	195	1,922

Other estate crops include cocoa, cinnamon and vanilla

Other trees include timber trees, trees fuel for wood and shade trees

In the Intensive Area, the major tree crop is clove. The clove gardens are relatively concentrated in the East Area, and the small-scaled clove gardens are scattered in the South and West Areas. Coffee, cocoa and vanilla are planted in a small scale, and scattered mainly in the slope area. Coconut is mainly planted in the hilly area and residential areas, and the coconut garden area is very limited. Fruit trees are mainly planted in the home garden and the area close to residential area. These tree crops and fruit trees are mainly planted in the agroforestry system. Therefore, some timber trees,

fuel woods and multipurpose trees are observed in the agricultural land, and their occupied area is estimated at 1,922 ha. Major trees are sugar palm, bamboo, *Albizia* and *Ficus spp.*

The planted area of major field crops is summarized in the right table. Details are shown in Table III-1.5.2.

Planted Area of Annual Crops by Area						Unit: ha
Area	Paddy	Maize	Groundnuts	Cowpeas	Cassava*	Vegetables
East	620	623	3	9	3	1
South	200	1785	19	83	1	155
West	200	2,935	301	37	29	185
Total	1,020	5,343	323	129	33	341

*: includes sweet potatoes

Maize is a dominant crop and cultivated under mono-cropping in the flat and gentle-sloped area, and under inter-cropping with tree crops in the slope area. Pulses such as groundnuts and cowpeas are cultivated as rotation crops. Groundnuts are mainly observed in the West Area, while cowpeas in the South Area. Vegetables such as tomato, leaf onion and chili are prevailing in the flat area and gentle-sloped area. Other vegetables are very limited. Cassava is generally planted along the farm border.

(2) Crop Yield

In the Intensive Area, the farm condition varies so much area by area and the crop yield also varies with the difference of cultural practices and field conditions. Based on the statistic data, the yield of main crops under the present normal condition is estimated as shown in the right table:

Crop Yield In the Intensive Area		Unit: kg/ha
Crop	Crop Yield	
Maize	2,900	
Groundnuts	1,080	
Cowpeas	900	
Tomato	7,000	
Leaf onion	14,000	
Paddy	4,800	
Clove	200	
Coconut	1,200	
Coffee	950	
Cocoa	900	
Vanilla	100	

(3) Crop Production

The amount of crop production is summarized in the right table.

The East Area presents the highest production of tree crops, but the lowest of field crops. On the other hand, the South Area indicates the lowest production of tree crops, but the second highest production of field crops.

Crop Production				Unit: t
Crop	East	South	West	Total
Coconut	100	59	64	247
Clove	169	40	83	292
Coffee	52	18	64	134
Cocoa	3	0	17	20
Vanilla	2	1	2	5
Maize	1,807	5177	8,512	15,496
Ground nut	3	21	325	349
Cowpea	8	75	33	116
Cassava	15	12	348	375
Vegetables*	7	1,085	1,295	2,387
Paddy	2,976	960	960	4,896

* Production is estimated by the yield of tomato.

(4) Present Farming Practices

At the flat or gentle-sloped area, the improved farming practices are employed. Maize is a dominant crop in all the area, and pulses are used as rotation crop, which supply nitrogen to the soil by atomospheric nitrogen fixation. But the planted area ratio of pulses is presently lower. The average cropping intensity is 1.3 to 1.5. The mechanization of farming is far behind mainly due to undulated land condition, and most farming practices are carried out by man power and draught animal, even in flat areas. From the viewpoint of soil erosion, these areas are well maintained as a whole.

At the moderate to steep-sloped area, a larger part of farmers employ the agroforestry system. In this area farmers apply soil conservation technology such as contour ridge farming, mulching, terracing and no-tillage cultivation for herbaceous crops. Ridging is practiced not only for herbaceous crop cultivation but also for tree crop cultivation. For terracing, some farmers make simple terraces using dried grasses and crop residues collected from the fields after harvesting. Generally farming practices in the slope areas are slightly extensive comparing with those in the flat area, and the farm input supply is flexible depending on price trend of farm input and output. From the viewpoint of soil conservation, these areas are mostly well maintained.

At the very steep-sloped area, small-scaled upland farming is sometimes observed, especially in parts of the East and West Area. Since these sloped areas have high soil erosion potential, the serious soil erosion would occur unless proper farming would be applied. At present, serious erosion is observed at the limited area only. When farmers want to increase crop production by the intensive farming practices, attention should be paid to soil conservation for keeping sustainable agriculture in future.

III-1.5.4 Livestock

Total head of livestock in related Sub-districts are shown in the right table.

Main livestock in Intensive Area is cattle, pig and chicken. The major varieties of cattle are *BACAN* (Mixed Bali) and PO (Prime Offspring). About 90% of cattle are used for draught and the remaining for beef production. Generally cattle is fed with concentrate (maize, rice bran, oil waste, etc.) and grass which mainly grows on temporary fallow field and roadsides. Pig and chicken rearing is at local residential area, and the Area is the center of duck rearing in the Minahasa District.

Livestock in Related Sub-districts	
Livestock	Head
Cattle	12,418
Horse	4,914
Pig	14,250
Goats	1,622
Chicken	300,419
Duck	23,130

Source: *Laporan Dinas
Peternakan 1999 Kab.Minahasa*

The farmers' awareness for cattle utilization is still low. Farmers use cattle only for draught. The facilities and funds are not sufficient for cattle development. To increase quantity and quality of livestock, it is indispensable to heighten knowledge of government staff and farmers.

III-1.5.5 Inland Fishery

(1) Outline of Inland Fishery

Lake Tondano has brought up several species of fish for a long time. However in recent years, natural fish resources have declined due to over fishing and deterioration of water quality of the lake. After introduction of fish cultivation technology using floating net cage by the Provincial Fishery Services Office in 1984/85, fishermen have changed their traditional fishing to the fish cultivation by net cage. And fish cultivation has increased rapidly year by year. In Lake Tondano, currently 482 fisherman households are carrying out fish cultivation using 5000-6000 net cages.

(2) Present Condition of Fish Cultivation

The average number of net cages per household ranges from 10 to 12. The size of a net cage is 30 m³ for each. Seventy percent of cultivated species is Tilapia (*Nila*) and 30% is Carp (*Ikan Mas*). The number of fish fry per cage ranges from 1000 to 1500 amounted to 30 kg. One cage of fish fry grows to 250 kg on average during a cultivating period, usually 3 to 4 months, and 400 kg of fish feed is consumed in this period. Generally 3 cultivation cycles are carried out in a year. There are no cooperatives specialized in fish cultivation activity, so that all of fish cultivation is operated individually.

(3) Government View and Regulation of Fish Cultivation

The Provincial Fishery Services Office recognizes water quality deterioration of the lake, but that it is not so serious for fish cultivation at present. The District Fishery Services Office has a development plan for increasing number of cages, upgrading of fishermen's skill, and expansion of marketing of the products.

There is no regulation on the basis of government law to carry out fish cultivation in Lake Tondano. The fisherman, who wants to start fish cultivation, should contact with the Head of Village and neighbors, and after getting their agreements he can start his fish cultivation. Now, the District Fishery Services Office is introducing the registration system including issuance of license card for fish cultivation by 2001. After introduction of this system, it is expected that actual fish cultivation condition in

the lake could be clarified.

(4) Necessity of Data Collection on Mechanism of Water Deterioration

At present, very limited data is available for the water quality of Lake Tondano. In particular, there is no data on the causes of water contamination of the lake where sewage water and agricultural drainage water directly flow. It is therefore difficult to judge whether the present situation of fish cultivation in Lake Tondano is critical or not from the viewpoint of water conservation of the lake. Prior to control of the fish cultivation, it is essential to collect the data on load of pollutants and to clarify the mechanism of water deterioration of the lake through establishment of monitoring and evaluation system.

III-1.5.6 Crop Budget and Farm Economy

(1) Crop Budget

The crop budget of major crops in the Intensive Area is almost the same as that in the Study Area (see Sub-Section II-1.6.6).

(2) Farm Economy

The right table presents the farm economy of average farmer for each Area estimated based on the results of farm household survey, the information from *BIPP* and the District Food and Horticultural Crop Services Office.

Farm economy Average Farm Household				
Unit: Rp 000				
Item	East	South	West	Whole Area
Gross Income				
Agriculture	8,114	6,932	7,079	7,375
Non-Agriculture	3,290	2,450	2,700	2,813
Total	11,404	9,382	9,779	10,188
Expenditure				
Living	6,700	5,560	5,830	6,030
Farm Cost	4,257	3,398	3,579	3,745
Total	10,957	8,958	9,409	9,775
Balance	447	424	370	414
Farm size (ha)	1.62	1.09	1.20	1.30

The gross income from agriculture ranges from 72% to 75% of the total income. There are no much difference in living expenditures among 3 areas, and the highest living expenditures occur in the East Area. The balance ranges from Rp.370,000 to Rp.447,000, and averages at Rp.410,000.

III-1.5.7 Agricultural Extension Service

Agricultural extension service is carried out by the Agricultural Information and Extension Service (*BIPP*). *BIPP* has 17 specialists and 234 extension workers (*PPL*) for food crop and horticultural crop sub-sector, 2 specialists and 114 extension workers

for estate crop sub-sector, 5 specialists and 63 extension workers for animal husbandry sub-sector, 4 specialists and 68 extension workers for fishery sub-sector. These officials cover whole Minahasa District. According to the RRA survey, farmers complain of the less visiting of extension workers, which is once a month or sometimes once a year mainly due to budget shortage for their activities.

III-1.6 Agroforestry

III-1.6.1 Major Trees and Crops

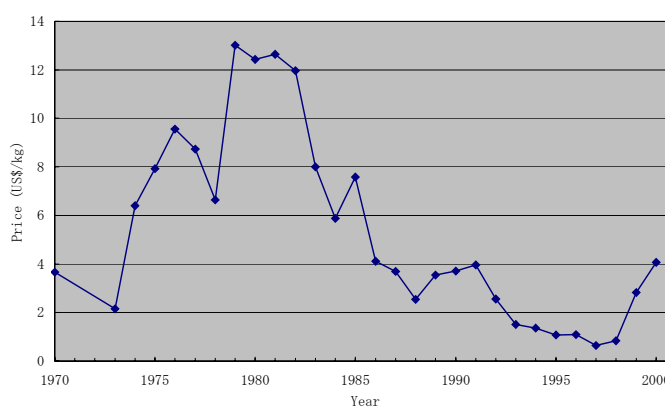
Major trees and tree crops introduced for the agroforestry system in the Intensive Area is shown in the right table. Table III-1.6.1 shows the trees and tree crops, which have a possibility of introduction to the agroforestry system.

Major Trees and Tree Crops

Estate crops	Fruits	Trees
Clove	Durian	Cempaka
Coconut	Mango	Albizia
Coffee	Avocado	Trema
Vanilla	Langsat	Mahoni
Cinnamon	Jack fruit	Nyatou
Cocoa	Citrus	Gliricidia
Sugar palm	Banana and papaya	Calliandra

Clove, coconut, coffee, vanilla, cocoa and cinnamon are the popular estate crops in the Intensive Area. Clove is the dominant species of estate crops followed by coffee and coconut. The planted area of other species of estate crops is so limited as compared with these three crops. Since the altitude of the Intensive Area is more than El.700 m, oil content of copra becomes low, therefore, coconut is cultivated for only fresh coconuts. The planted area of coconut is very small compared with that of clove, although the planted area of coconut in whole Minahasa District is comparable with that of clove. Clove is the main estate crop in the Intensive Area. Its planted area is gradually increasing from 1970's to 1986. After 1986, its planted area has been kept almost constant as shown in Table III-1.6.2. Because the price of clove showed a decreasing tendency from 1983, and it has been kept at very low price from 1992 to 1997 under government control as shown in the figure in the right.

The low price of clove makes the farmers lazy for maintenance of clove and discounting renewal of clove garden where the trees become too old to produce. Then a large number of trees are infected by



Trend of Price of Clove

disease and suffer nutritional problems. After late 1998, the price of clove was put out of government control and has been governed by the market. The price of clove is increasing from 1998 and becomes the same level of early 1980's in 2000. From 1999, farmers start to renew the old clove garden and to maintain it carefully. At present, the production of clove is 60,000 t per year against the demand of 100,000 t per year. Considering present situation of clove market, it could be said that the clove-based agroforestry system is hopeful in the Area. Sugar palm, which is extensively cultivated, has been also found in all over the Intensive Area.

In Indonesia, the most widespread agroforestry system is the rubber agroforestry which occupies over 2.5 million ha. The biodiversity levels of this system often approach those of natural and secondary forest, so that its soil conservation capacity is very high. However, since this system requires large area from economical point of view, it is very difficult to introduce it to the Intensive Area.

Major fruit trees are banana, durian, mango, langsung, avocado, jackfruit, rambutan, citrus and papaya. These trees are planted in the home garden and upland field close to the dwelling area. Banana and papaya are sometimes planted as the hedgerow crops. The orchard area is very less in the Area.

The popular trees used for the agroforestry system in the Area are *cempaka*, *albizia*, *Trema*, *mahoni*, *nyatou*, *Caliandra* and *Gliricidia*. *Kordia* and *Erythrina* are only found in the South Area. Although *Piper* and *Ficus* are autogenesis plant, they have been found in the agroforestry system in the whole Intensive Area. These trees contribute to soil conservation and are used for building and fuel materials. Recently, *Cempaka* and *Mahoni* are planted in the whole Intensive Area by the recommendation of the Forestry Service Offices. *Calliandra* and *Gliricidia* are also used as hedgerow trees. Bamboo is the most popular species in the existing agroforestry system and distributed all the Intensive Area.

III-1.6.2 Agroforestry System

In the Study Area, there have been found 10 types of agroforestry system under three categories. Out of them, the following 6 types of agroforestry system have been observed in the Intensive Area:

Type of Existing Agroforestry in the Intensive Area

Type	Woody Perennials					Herbaceous crops
	Woody tree	Estate crops			Fruit tree	
		Coconut	Clove	Others		
AGF-I(I-1)				Not Observed		
AGF-I (I-2)	△	△	⊙	X	△	△
AGF-I (I-3)				Not Observed		
AGF-I (I-4)	○	○	⊙	X	X	△
AGF-I (I-5)	○	○	○	⊙	X	○
AGF-I (I-6)	○	○	○	○	○	○
AGF-II (II-1)				Not Observed		
AGF-II (II-2)	△	△	○	X	△	⊙
AGF-III(III-1)				Not Observed		
AGF-III (III-2)	△	X	⊙	X	△	⊙

Note: Others include coffee, cocoa and vanilla

⊙ : Pre-dominant, ○: Dominant, △:Frequent, X: negligible

Since the Intensive Area is situated in the high altitude area (at El.700-1,000 m), there are no coconuts based agroforestry system.

(1) Tree Crop Dominant Agroforestry System (AGF-I)

1) One estate crop dominant agroforestry system (AGF-I Type I-2)

This type is mainly distributed in the steep-sloped to sloped area of the East Area, and partly in the South and West Areas. Clove is the main crop and some multipurpose trees and fruits are also planted at very low plant density. Recently, the timber tree species such as *cempaka* and *mahoni* have been planted in the clove garden with a density of 20 to 100 plant per ha. Herbaceous crops are planted between trees, but its planted area is very limited (5-20% of total area).



AGF-I (Type I-2)

2) Tree (woody trees and tree crops) dominant agroforestry system (AGF-I Types I-4, 5, 6)

This type is divided into multi-storey tree complex and upland annual crops being cultivated in the small area under tree crops or fruit trees. There are two types of multi-storey tree complexes; one is partially well-managed one, which occupies very limited area and distributed in the gentle-sloped area of Longawan, Remboken and Tondano and home yard area (Type I-5 and -6). The other is a poor-managed one (Type I-4), which is mainly distributed in the steep-sloped area of whole Intensive Area.

(2) Herbaceous Crop Dominant agroforestry System (AGF-II, Type II-2)

This system is mainly distributed in the gentle-sloped and the flat area. In a larger part of the Intensive Area, the clove-based AGF-II (Type II-2) is popular, and the coconut-based AGF-II (Type II-1) is very limited or negligible. In the clove-based AGF-II (Type II-2), the following are observed:



AGF-II (Type II-2)

- Transitional stage from the tree garden and secondary forest to the upland farm (some trees remain in the field).
- Planting of clove in the farm of maize/ pulses/vegetables.
- Planting of timber trees or fruit trees in farm of maize/ pulses/vegetables
- Hedgerow cropping using coffee, banana, cassava, *Gliricidia* and *Caliandra*.

In this system, the plant density of trees is very low (clove: 50 plants/ha, fruit tree and timber trees: 10-30 plants/ha). Banana, coffee, papaya, avocado, and langsat are also planted at the border of field, and *cempaka*, durian, and mango are planted in the field. In some farms, which are transitional stage from the tree garden or changed from the tree garden to the upland farm, there are found low or no productive trees.

(3) Inter-cropping System (AGF-III, Type III-2)

This system is mainly distributed in the moderate slope area. In a larger part of the Intensive Area, the clove-based AGF-III (Type III-2) is popular and the coconut-based AGF-III (Type III-1) is negligible. This AGF-III (Type III-2) is further classified into two categories. One is the well-managed agroforestry system and the other is the



AGF-III (Type III-2)

rudimentary one. The rudimentary agroforestry system includes a system changed from AGF-I and a transitional stage from the estate crop garden or the tree complex to the upland farm. In the well-managed system, clove is regularly planted with wide row considering the herbaceous crop cultivation. The plant density of clove is slightly lower compared (150-200 plants/ha) with that of mono-culture (200-300 plants /ha). Maize/pulse are cultivated between cloves row by row at a row interval of 70 cm to 100 cm for maize and 50 cm to 150 cm for pulses by the ridge row cultivation. The area of this system occupies only less than 10 % of the AGF-III area, however, its area is now increasing by planting clove at planned spacing in maize or pulses farm and by improving the rudimentary system at the time of replanting of clove tree. On the other

hand, in the rudimentary agroforestry system trees are not always planted regularly, so that the productivity of tree crops would be decreased compared with that of regularly planted tree crops. The random planting of trees disturbs the proper herbaceous crop cultivation under tree crops. Therefore, the rudimentary agroforestry system would result in the low productivity and require more labor force for herbaceous crop cultivation.

(4) Shifting Cultivation and Other Agroforestry System

The area of shifting cultivation is very limited and hardly found in the Intensive Area at present.

There are a large number of cattle in the related Sub-districts, and most cattle are used as a draft animal. Since there is a limited pasture in the Intensive Area, farmers should utilize a fallow for herbaceous crops in AGF-II and AGF-III as grazing land for their cattle. The fallow period of herbaceous crops ranges 2 to 4 months in a year. This operation could be regarded as one of agrosilvopastoral systems, and this system is mainly found in Langowan, Remboken and Kakas Sub-districts.

The Provincial Forestry Services Office would like to introduce the agrosilvopastofishery system, however, this system has not been popularized in the Intensive Area at present.

(5) Improper Agricultural Land Use in the Steep Sloped Area

There is steep sloped area along the road surrounding Lake Tondano. There can be found improper land use along the road of lake shore. These areas are formerly secondary forest or under tree dominant agroforestry system. Farmers cleared these lands for maize cultivation with less consideration on soil conservation.

Another improper land use can be found in Kawatak Village, of Langowan Sub-district and in Tandegan Village of Eris Sub-district. These areas are formerly secondary forest and old clove garden. Recently farmers cleared these fields for replanting clove or planting annual crops.

The present condition of these fields is shown in Table III-1.6.3 and summarized below.

Improper Land Use

Description	Kakas	Remboken	Tondano	Langowan	Eris
No. of place	6	3	7	1	1
Slope (%)	50-58	27-36	36	73	31
Area (ha)	2.2	0.9	2.2	14.0	1.5

(6) Alang Alang (*Imperata*) grassland

The total area of Alang Alang grassland is estimated at less than 10 ha in the Intensive Area. It is distributed in Tondano, Remboken, and Eris Sub-districts. The largest area of Alang Alang grassland is less than 1 ha. These areas would be easily improved by densely planting trees.

III-1.6.3 Agroforestry Extension Service

The District Forestry Services Office has 2 specialists (soil conservation and forest) and 64 extension workers for forestry extension, but only few extension workers are assigned for the agroforestry development. These officials cover the whole Minahasa District. Since agroforestry has been recognized in early 1980's as an important area of scientific inquiry, education and training in agroforestry lags far behind other agricultural and forestry disciplines, leaving a definite shortage of experienced, qualified trainers in agroforestry. There is no section for agroforestry development and no specialist for agroforestry development in District Forestry Services Office. Only limited number of officials in the District Forestry Services Office provide farmers with the proper agroforestry technique as a side job. *BRLKT* has established a demonstration farm of agroforestry at Remboken Sub-district for promotion of agroforestry system.

III-1.6.4 Current Problem of Agroforestry System

No farmers in the Intensive Area have raised complains against the existing agroforestry system in spite of low productivity. It is deemed that the agroforestry system in the area has short history, so that farmers can not adequately understand the merits of well-designed agroforestry system. When the farmers can get proper knowledge on agroforestry system, problems might come to the surface. By field observation, following problems can be pointed out.

- 1) Improper agricultural land use due to lack of information on soil conservation.
- 2) Rudimentary agroforestry system.
- 3) Poor maintenance for tree crops and herbaceous crops.
- 4) Lack of agroforestry extension service.

III-1.7 Present Soil Erosion Condition

III-1.7.1 Slope Distribution

Slope gradient distribution in the Intensive Area was analyzed on the topo-map of 1/10,000 scale. Its distribution is shown in Figure III-1.7.1. Average slope gradient is

29 % in the East Area followed by the South (25 % slope) and the West (19 % slope) as mentioned in Section III-1.1.

III-1.7.2 Erosion

(1) Sheet and Gully Erosion

In the intensive area, no gully erosion occurred. However, sheet erosion and rill erosion were found in 18 places of agricultural lands (see Table III-1.6.3), where crops are still small and no conservation practices have been applied. In the Tondano watershed, farmers are usually applying so-called traditional terrace (locally called litir/guludan), which is a mixture of removed weeds, root, and soil placed on the contour. It stops sheet and rill erosion on the sloped land with less than 30 % slope. The most severe erosion occurred at Tampusu.

(2) Road Erosion

In the East, minor side-slope failures found out where cut slope along the road was composed of highly weathered tuff breccia as shown in following table.

Road Erosion

Location	Type of Erosion	Possible Causes	Remarks	Extent of Erosion
Pass Eris - Watulaney	Slope failure	Too steep slope on highly weathered layer	Secondary road, 3 places of cut road side-slopes	1 place: severe 2 places: not severe
Paleloan	Slope failure	Unsuitable mining	Slope failure is expanding	Severe

Moreover, erosion of on-farm road surface was observed at 4 places. Although, rehabilitation works for these places are not required, since the erosion of them are not severe.

(3) Landslide and Slope failure

Below table shows observed slope failures and landslides, which are observed only in the East Areas. Because the East Area is composed of highly weathered old volcanic rocks and is inherently weak to the occurrence of landslides and slope failures. In Touliang Oki, a landslide occurs along the road.

Landslides and Slope Failures

Location	Type of Erosion	Cause	Extent of Erosion
Makalonsouw	Slope failure	Steep slope, highly weathered tuff breccia (Tb) layer	Not severe
Tounipus	Land slide	Steep slope, highly weathered Tb layer	Not severe
Touliang Oki	Land slide	Steep slope, highly weathered Tb layer	Not severe
Touliang Oki	Slope failure	Steep slope, highly weathered Tb layer	Not severe
Mt. Kamintong	Slope failure	Steep slope, highly weathered Tb layer	Not severe
Kaayuran Atas	Slope failure	Steep slope, highly weathered Tb layer	Not severe
Mt. Maimberg	Slope failure	Steep slope, highly weathered Tb layer	Severe

(4) Torrent Erosion

Torrent erosion, such as bank erosion and trace of severe bed erosion were identified in 4 rivers. These are shown in below table.

Identified Torrent Devastation in the Intensive Area

Location	Identified Problem	Possible Cause	Extent of Erosion
Tataaran	Debris flow hazard, Torrent bed erosion	Intensive land use of the catchment area	Severe
Tonsewar	Torrent bank erosion	Unsuitable land use of the torrent bank, Sandy volcanic soil	Slightly severe
Eris	Torrent bank erosion	Intensive land use of the catchment area	Not severe
River Panasen	River bank erosion, River bed erosion	Sandy volcanic soil	Severe

III-1.7.3 Estimate of Soil Loss

Soil loss was calculated for each cell of a grid of 4 ha (200 m x 200 m). The result is shown in Figure III-1.7.2. Average soil loss over the Intensive Area is computed at 19.1 t/ha/year as shown in following table. In the South, maximum soil loss is calculated 27.6 t/ha/year, since several elements have extremely steep slopes, and 6.3% of the area produces more than 100 t/ha/year of soil loss.

About 50% of the West and South Areas produce less than 5 t/ha/year of soil loss as shown in the table below, however, it is 28% in the East Area. Instead 36% of the East Area are categorized to 10 to 25 t/ha/year of soil loss.

Percent Area by the Amount of Soil Loss

Area	Estimated Soil Loss (t/ha/year)	Percent Area by Soil Loss Class (t/ha/year)					
		<5	5-10	10-25	25-50	50-100	>=100
All Area	19.1	43.7	11.6	22.8	12.6	6.8	2.7
West Area	12.5	48.8	13.1	23.1	11.6	3.0	0.5
East Area	20.4	27.6	10.4	36.4	18.4	4.7	2.5
Eris	23.3	23.6	9.6	36.2	21.5	6.0	3.2
Kakas	9.6	42.7	13.5	37.1	6.7	0.0	0.0
South Area	27.6	51.4	10.4	9.4	8.5	14.2	6.3
Soputan	25.7	51.9	10.4	9.5	8.0	14.4	5.9
Kawatak	37.4	50.0	10.2	8.8	10.9	12.9	8.2

III-1.7.4 Sedimentation

Sedimentation in the reservoirs in 4 check dams was researched. It shows that the accumulated sedimentation could be expressed as a function of catchment area as discussed in Sub-Section III-1.8.1.

III-1.7.5 Floods

At the beginning of December 2000, serious flood occurred over Minahasa District. Average daily rainfall in Minahasa District is usually less than 20 mm according to the rainfall record, however the rainfall from November 29 to December 1, 2000, reached more than 200 mm. In Manado, areas along the Tondano river inundated a few days with 0.5 m to 2 m deep water and thousands of houses were in the water. The flood was one of the worst in history. In the Intensive Area, residential area and paddy fields were inundated for two days with 1 to 2 m deep water at Leleko and Remboken. Water surface of Lake Tondano rose about 40 cm in these 3 days.

The causes of the occurrence of the flood in Manado are meandered channel in the lower reaches of Tondano river, decreased channel flow section by placed fishnets and built houses, expansion of residential area on the flood-plain in the lower reaches, addition to heavy rainfall.

III-1.7.6 Water Quality

Current condition of Lake Tondano is classified as 'eutrophic', which is characterized by the occurrence and fast growing population of aquatic plants, especially water hyacinth. This might be a result of relatively dense settlements in the watershed and intensive use of agricultural lands in the surrounding area of Lake Tondano.

III-1.8 Existing Soil Erosion Control Facilities

There are many existing soil erosion control facilities in the Intensive Area. To confirm the present condition of them, the inventory survey was carried out by visiting and interviewing method.

III-1.8.1 Check Dam

(1) Location

Seventeen existing check dams have been identified in the Intensive Area, locations of which are shown in Figure III-1.8.1.

(2) Type

Three types of existing check dams were observed. These are: (a) wet



Wet Masonry Gravity Check Dam at Touliang Oki

masonry gravity check dam, (b) earth fill check dam, and (c) gabion box check dam. Among them, the Provincial Irrigation Services Office has constructed a wet-masonry gravity check dam at Touliang Oki in 1997/1998. The remaining two types of check dams have been constructed by the Ministry of Forestry (*BRLKT* or the District Forestry Services Office).

(3) Condition

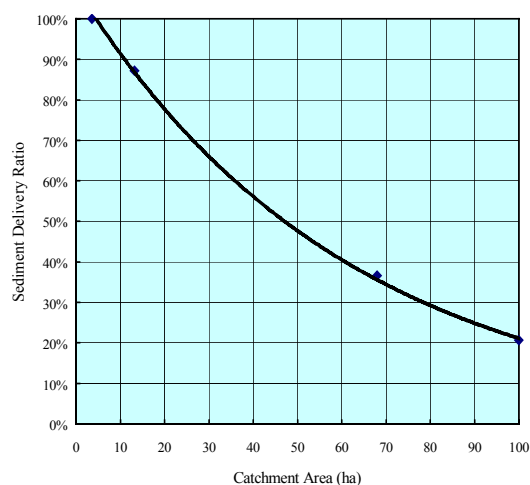
Through the site survey, there have been found several problems in the existing check dams. The most severe problem observed was the dam body damage at Touure. The other problems have been identified in the dam Leleko, Kasuratan, and Tontimomor, which are tabulated below (see Table III-1.8.1 for the details).

Identified Problems on Existing Check Dams in the Intensive Area

Name of the Dam	Dam Type	Identified Problem
Leleko	Earth fill check dam	A part of downstream slope of the dam body has slipped.
Kasuratan	Earth fill check dam	A part of downstream part of the spillway has broken-down.
Touure	Earth fill check dam	Dam body has collapsed.
Tontimomor	Gabion box check dam	Gabion dam body has been damaged.

(4) Sediment Yield and Sediment Delivery Ratio

A relation between sediment delivery ratio and soil erosion volume has been examined using the sediment yield of 4 existing check dams in and around the Intensive Area, where slope failure and/or landslide have not been observed. The right figure presents the developed relation between the sediment delivery ratio and the catchment area.



Surveyed Sediment Delivery Ratio

III-1.8.2 Soil Erosion Control Facility

(1) Location

In the Intensive Area, the Ministry of Forestry (*BRLKT* and the District Forestry Services Office) has provided soil erosion control facilities under the “Model Unit of Natural Resources Conservation Program” so-called *UPSA*. Below mentioned are the

types of support by the Ministry in *UPSA*:

- Terrace construction;
- Drainage system construction;
- Seedling supply; and
- Fertilizer supply.

Outside of *UPSA* model plot, soil conservation farming with simple facilities such as contour band (or contour cropping with high ridge) and traditional terrace (terrace prepared by crop residues) are broadly spread.

(2) Condition

The existing soil erosion control facilities are well maintained in the Intensive Area.

III-1.8.3 River Bank Protection Works

(1) Location and Type

In the West Area and East Area, a few river bank protection works have been identified. Most of them are made of wet masonry and provided in the settlement area to protect houses from the river bank erosion.

In the South Area, the sandy soil predominates. Thus, the river bank has low resistance against the erosion. In fact, severe river bank erosion has been observed at the Panasen river. To avoid the erosion, the former Ministry of Public Works has provided protection works made of gabion box as shown in the picture above.



Effective River Bank Protection Works at the Panasen River, H=2.5 m

(2) Condition

The condition of existing river bank protection works is good and is functioning well for the erosion control. There have been found river bank erosion at more several sites on the Panasen river, so that more river bank protection works are required.

III-1.8.4 Slope Protection Works for Hillside

(1) Location and Type

The protection works for hillside made of brushwood fence have been identified at two places of estate land in Eris.

(2) Condition

No problem is found for the existing slope protection works for hillside.

III-1.8.5 Slope Protection Works for Road

(1) Location and Type

Several retaining walls along the major roads have been constructed in the Intensive Area. The retaining walls are made of wet masonry.

(2) Condition

No problem has been found in the existing slope protection works for road.

III-1.9 Institutional Condition

III-1.9.1 Relevant Government Agencies

(1) North Sulawesi Provincial Forestry Services Office (Dinas Kehutanan Sulawesi Utara)

The current institutional capacity of the North Sulawesi Provincial Forestry Services Office is generally good in some departments, and the leadership and work practices in general reflect a reasonable amount of planning and good management practices. The current conditions in this office are reflected in the general level of awareness about the problems of the watershed, and the level of activity that becomes evident in a site visit. It is recommended that this institution play a leading role in project management and monitoring and evaluation. Data about personnel and equipment were already in existence and readily available at the time the survey was being undertaken. Enthusiasm among personnel was quite noticeable. This office also has evidence of some good skills among staff members such as GPS and computer operation.

There is at present some doubt about the future of this organization after decentralization is fully implemented, there is currently no organizational structure finalized for the beginning of 2001 and regional autonomy.

(2) Manado Office for Land Rehabilitation and Soil Conservation

The Manado Office for Land Rehabilitation and Soil Conservation is a technical implementation unit that operates under the central government infrastructure. It is basically an extension of the Directorate General of Land Rehabilitation and Social Forestry in Jakarta. The general structure and management of this office is good, every

person has a clear role assigned within the structure. The general attitudes displayed by the staff reflect good work practices, even in this time in which the future holds much doubt for them. The products that this office produces are of good quality, which also sheds some light on the quality of human resources. The staff of this office would be an asset for the regional government.

(3) Minahasa District Forestry Services Office (Dinas Kehutanan Minahasa)

The Minahasa District Forestry Services Office consists of a main office in Tomohon and around 25 lower level regional branch offices. The current institutional capacity of the Minahasa District Forestry Services Office is generally weak, and would require significant investment to bring it up to a reliable standard for forestry management. The current conditions in this office are reflected in the lack of data, and the general overall lack of awareness that becomes evident in a site visit. It seems that data that is generally available in personnel lists or equipment lists etc, is not in existence in this office. Enthusiasm of personnel to be involved was very low.

III-1.9.2 Decentralization

GOI has recently been decentralized, and within this decentralization process the districts have become the focal point of authority in governmental matters. Indonesia has entered a transition phase in which, there are many unanswered questions, and underdeveloped institutions to add to the burden of facing the challenges of the future.

At present many of the local government regulations in use are still based on the pre-decentralization laws and regulations. Now that the decentralization has taken place and the new laws and regulations have been provided at central level, local regulations and laws need to be developed to complete the process.

There will be a transition period of 3 years in which central government employees will still be paid by the central government funds, and the role of the central government will be minimized in the provinces, and gradually absorbed by the local government

Decentralization has prioritized the idea of community empowerment. It is expected that the community will play a much greater role in the management of government affairs.

Previously, in Indonesia, there was created, a situation in which all funds, and development efforts were channeled through the central government, and this resulted in a geographical concentration of development around a central point (Jakarta). The center grew rapidly while the provinces generally remained to a large extent,

underdeveloped. The most highly developed parts of the provinces were the central government infrastructure, which was heavily concentrated in provincial capitals. The districts remained on the whole underdeveloped.

This problem caused a rivalry between the central, and local governments, which has survived until this day. Now, in the beginning of 2001 the central government apparatus in the provinces was abolished, and the personnel and infrastructure are to be surrendered to the local government. The central government apparatus will be reduced to a minimum in the provinces.

The central government will have complete authority in several matters such as security and defense, customs and immigration etc., but the districts will have maximum control of their own territories, which is granted through decentralization, i.e. the transfer of legislative authority to the districts. This means the districts now are free to create their own institutions based on local needs, although some control in the development of these institutions is still exercised by the central government (Law No. 84 of 2000 about organizational structure of regional apparatus).

There are several aspects of local government that need to be coordinated at provincial level, one of them is the management of watersheds that extend across more than one district or urban area. For this reason, and to ensure equal treatment of all districts by the central government, a provincial level government is still very necessary.

The local government will be modified in a way that a number of essential services required at provincial level will be undertaken by minimized provincial offices. These essential services consist of management of inter local problems. The districts will assume all implementation responsibilities while the provinces will have authority in coordination, management, macro provincial planning, monitoring and evaluation.

III-1.9.3 Institutional Aspects of Watershed Management

(1) Relevant Agencies

The arrangements and responsibilities of the institutions involved in the management of Tondano watershed are currently unclear because of the preparations for decentralization and the current general state of the political atmosphere. At the moment, according to the existing laws and regulations, instructions and plans come from the central government, through the provinces, to the districts, and then to the local levels.

There is no one ministry who has a mandate with regard to the entire range of responsibilities required for good watershed management. This is the case throughout

Indonesia. In the Tondano watershed, management is currently split between two ministries: the former Ministry of Public Works – Water Resources (PU Pengairan), and the Ministry of Forestry. The former Ministry of Public Works was concerned mainly with distribution of water, and management of flows during times when water supplies become scarce (dry season). The Ministry of Forestry is concerned mainly with land rehabilitation and soil conservation, which is supervised through a planning system located in *BRLKT*. There are many other stakeholders in the watershed (government, social and private), however, many do not act directly in the interests of the watershed.

(2) *PTPA* and *PTPPA*

An integrated watershed management function operates through the Panitia Tata Pengaturan Air (*PTPA*) or Water Regulation Committee based on the Minister of Public Works Regulation No. 67 of 1993. This ruling applied to all of Indonesia. The regulation has been strengthened at North Sulawesi province level by Governors Decree No. 260 of 1995. The committee is responsible to the Governor and has the responsibility for management of water resources in North Sulawesi Province. It is attended by all province level government representatives including local and central government agencies. Leaders of the government electrical generation company (*PLN*), and the government (public) water supply company (*PDAM*) are also present. The community is represented by leaders of NGOs, and the head of a farmers association. The composition of the committee is heavily biased toward government officials. It is quite likely that community considerations do not carry much weight, nor would the community have any input other than the concern for equal distribution of water supply. There are no creative long-term management strategies employed. It is dominated by the needs of the former Ministry of Public Works – Water Resources.

PTPA is supported by a Panitia Pelaksanaan Tata Pengelolaan Air (*PPTPA*) in each major watershed area. Watershed areas are referred to as River Development Territories (*PWS*) and River Management Units (*SWS*). North Sulawesi is divided into 5 water resource management areas, 2 *PWS*s and 3 *SWS*s. *PWS*s are the Tondano watershed and the Limboto-Bolango-Bone Watershed. These two areas are considered as *PWS* due to the fact that they are in areas of high development or high development potential.

While *PTPA* has a stated holistic development foundation, this only applies at province level, and given the fact that this committee operates at such a high macro level, far removed from the actual conditions in the field, and given also the fact that it is populated mainly by officials, on the ground, its effectiveness is questionable. In

practice the lower level implementation network is *PPTPA*.

PPTPA, while being the perfect unit in scope is weak from the perspective of management, it operates with the watershed as its management unit which is good, but its responsibilities are restricted mainly to water quota allocations, and reactionary management measures, which at present are focused only on short term economic benefits, and disaster control measures (flooding). The major concern is not sustainability or any other environmental impact than water shortages that may come about as a result of dry season, or unexpected seasonal changes and fluctuations in supply. There appears to be no real integrated “forward looking” management strategies formulated for watershed conservation.

(3) Identification of Critical Land and Rehabilitation Procedures

The *BRLKT* office in Manado is the planning agency responsible for management of the forest, land and soil resources of the watershed. *BRLKT* creates a master plan for the watershed conservation (forests) based on a 10 year cycle.

BRLKT, based on its master plans, and knowledge gathered from other stakeholder institutions such as the various Local Government Services Offices, *BAPPEDA*, Camat, Lurah, and Kepala Desa creates a 1 year plan and recommend priority locations for rehabilitation and prepares the relevant rehabilitation programs. This plan is submitted to the district level Forestry Services Office who prepares implementation plans based on a 1 year cycle. The district plans should follow the master plans and recommendations from *BRLKT* precisely. The funding for implementation flows through the central Ministry of Home Affairs direct to the district, and is administered by the Bupati.

Identification of critical land is undertaken by the District Forestry Services Branch Offices who monitors the situation in the field to provide information about the destruction of forests, erosion and sedimentation problems.

The plans from the District Forestry Services Office are reviewed by *BRLKT* prior to project implementation, and projects are supervised as a monitoring exercise.

The District Forestry Services Office branch office staff should be involved in this process as implementation staff.

(4) Actual Situation

While the organizational characteristics are formally as is described above, in reality the current method of operation is very different. Information systems to support planning are almost non existent. The last plan made by *BRLKT* was in 1998, and was

in the form of a five-year work plan for rehabilitation of the Tondano watershed. The information that it was based on was very likely unreliable. There is also evidence that *BRLKT* and the Provincial Forestry Services Office has been involved in implementation, which is technically not within their scope of duties. In general, the formal arrangements are not followed precisely. This also applies to the District Forestry Services Office, who should plan and implement one year projects based on the master plan from *BRLKT*. In fact they act more like an independent agency with regard to project planning and implementation, and it seems very difficult to find evidence of recent re-greening projects that have been undertaken in the field. This problem is exacerbated by the fact that Decree No. 161 of 1996 from Minahasa District about the duties and working arrangement details of the Minahasa District Forestry Services Office does not make any reference to these plans and the need to coordinate with *BRLKT*.

The areas that are reported as critical land are only very rough estimates, the branch offices are not even in possession of a tape measure. Comparing the estimated areas from branch offices with the results of aerial photo interpretation and verification fieldwork by the JICA Study Team shows that estimates were generally inaccurate and exaggerated. This problem is likely more related to lack of equipment and infrastructure than direct human error.

III-1.9.4 General Government Institutional Problems

(1) Routine Operational Budget

The routine operational budget allocated to government offices is just not sufficient to maintain operations. The routine operational budget for the Province Forestry Services Office is around Rp.237 million per annum. There are around 600 employees in this office so this amounts to around Rp.400,000 per person per year. This size operational budget creates inefficiencies in that the activities of some employees obviously must be curtailed to enable others to undertake their full set of duties. Either that, or every employee limits his/her activities to that which can be accomplished by the budget. According to *BRLKT* staff of the Financial Administration section, there is only enough operational budget for 20 days of field work per year. This is inadequate to form good relations and a two-way dialogue with the community about development. The entire operational budget of *BRLKT* is around Rp.60 million per annum.

(2) Routine/Project Budget Balance

There is a major problem with the routine budgeting procedures also in that the balance between routine and project budgets is heavily biased toward projects. For example, in the Provincial Forestry Services Office the entire routine operational budget is around Rp.237 million while the total amount of budget allocated to project funding is around Rp.6.5 billion and total annual expenditure is approximately Rp.7.5 billion. Operational funding is only approximately 3 percent of total expenditure.

(3) Staff Mobility

In Indonesia, specifically in North Sulawesi, this is not the case, there are many environmental factors that influence the transportation problem. a) the government offices do not provide good vehicles to all staff that need them, b) the public transport system is slow and unreliable, c) the public transport infrastructure is limited in quality and scope, often to reach a specific site requires travel on unpaved roads or pathways that cannot accommodate a vehicle.

(4) Underdeveloped Information Systems

There is evidence that the government institutions do not have adequate information systems in place to support three major roles, a) information for on going watershed management, or watershed statistics, b) monitoring and evaluation information for project management purposes, and, c) community awareness. This is evident through the fears that were expressed about sedimentation of Lake Tondano. According to the popular view, the lake was filling with sediment at the rate of about 1 meter per year on the lake bed. The results of a bathymetry undertaken by the JICA Study Team on the lake indicated that no sediment was severe when compared to the results of earlier bathymetry. Estimations of erosion also tended to be exaggerated. There is a need for significant information systems and human resource developments in this field.

(5) Form of Extension Services

There is a strong tendency for extension services to be viewed only as training services for farmers, in which only internal farmer matters are considered important, such as increasing productivity in a certain field. The extension services need also to present new methods to farmers, with conservation in mind. Farmers must be sufficiently reassured to be confident enough to begin using new methods. *BIPP* or the Agricultural Extension Services Information Center currently has a good system. However, they do not work with forestry, and their programs are not generally related to conservation. The District Forestry Services Office runs extension services, but

their human resources are very limited in number and quality. The forestry extension services need significant upgrading through improved methods development and services for agroforestry development, institutional development, community empowerment and construction of physical measures against erosion and sedimentation.

(6) Sustainable Funding for Conservation Programs

In the Tondano watershed, it has been shown that the problems related to improper land-use and encroachment in protection forests are often driven by economic needs, i.e. the people, for example, are forced to use improper or outdated farming practices for short term gains, or should encroach on the forests in order to meet their daily basic needs. Often incentives are needed to encourage upstream users of water (farmers/encroachers etc.) to modify their practices or find alternative ways to generate income. At present, there is no linkage or system developed which adequately addresses this problem. Ideally some form of levy or fee needs to be introduced. This study has been limited to primarily the forestry services, and therefore has not dedicated much time to the problem of incentives as water regulation is the mandate of Public Works (Dinas PU – Pengairan). However, an important part of the development of the conservation committee will be finding adequate funding to support its mandate. This can be undertaken in a number of ways or combination of ways, for example:

- Watershed conservation levy applied to all households in the watershed and collected through the village government (a sustainable watershed is important to all inhabitants).
- Water users levy (through Dinas PU) and applied through water regulation (a portion of which could be allocated to conservation projects through the committee).
- Polluter pays programs (based on aqua-culture based taxes etc.)
- Fertilizer and chemical products sales taxes (remembering that eutrophication of the lake could be a result of overuse of fertilizer)

However, a more in depth study of this problem would be implemented through the proposed institutional development plan, (Strengthening of Watershed Conservation Capacity at University of Manado) and necessarily based on committee inputs.

III-1.9.5 General Non Government Institutional Problems

(1) Community Awareness

Community awareness of the problem from the entire watershed perspective. Again

the example of *PTPA* statement that after a recent greening project, farmers waited a couple of days, and then pulled all the trees out. This is an indication also that villagers may not see the actual benefit in a community sense, but only in a localized village sense. This may be related to the lack of contact that villagers on average have with the outside world.

(2) Apathy

There is likely a considerable apathy among the villagers about their conditions. In this area the people are not really living in abject poverty, but in general their daily needs are fulfilled with a little extra to spare. There are however, some villages that have specific problems related to environmental factors. But, the villagers are generally well fed and happy, and nature provides them with everything they need, including a naturally occurring alcoholic beverage that literally grows on trees. Farmers drink this regularly and they seem to be quite happy with their lot. The other major concern for villagers is religion, which is a very important ritual, but the messages they receive from it are not likely to increase their appreciation for the environment. The dominant idea is likely that God will always provide.

(3) Watershed Management Coordination

Although it is unlikely that a watershed management authority with broad reaching powers would be successful in the current conditions, there is also no forum through which government officials from various stakeholder institutions can get together to establish technical approaches to conservation that are mutually supportive, and to eliminate overlap. An institution to coordinate the technical approach to services provision is currently unavailable. Main objective of the institutional development plan would be creation of the plan necessarily based on committee inputs.

III-1.10 Environment

III-1.10.1 Land Use

The hills and the volcanic mountains in the east of the area are almost completely utilized for cloves, however, which have not been maintained resulting in a variety of bushes to grow well. Recently, several clove plantations in Touliang Oki and Kaweng start to clean up the bushes and grasses as the price of clove becomes higher. In the south of the Intensive Area, lacustrine and volcanic plains are entirely used for rice fields. The gentle slopes of the foot of volcanoes are used for the dry land crop cultivation.

Sloped volcanic hills in the west of Lake Tondano are used for the dry farm land, particularly maize. The steep lands along the lake in Paleloan, and from Urongo to Passo are recently opened for maize planting or residents. For instance, in Leleko, the steep lands with 40% slope along the lake have been exploited for maize planting to the top of the slope. It resulted in the slopes along the road becoming critical due to erosion, and a part of eroded materials went to the lake.

III-1.10.2 Meteorology and Hydrology

Meteorology and hydrology in the Study Area and the Intensive Area are mentioned in Sections II-1.2 and III-1.1, respectively.

III-1.10.3 Forest Ecosystem

(1) Terrestrial Ecology

In the watershed of Lake Tondano, forests, plantation and agricultural areas, residential and coastal areas form interdependent ecological system, meaning that disturbance in one system could disturb others. The four forest territories, i.e. Kaluta, Tampusu, Kasuratan, and Manimporok, as the 'key sites' in the watershed of the Intensive Area contribute to maintain ecological integrity of the ecosystem in the watershed of Lake Tondano.

However, for genetic resources conservation purposes, the forest areas are too small to compare with the recommended minimum area. Moreover, the forests in the watershed are fragmented, which look like islands in the agricultural lands and residential areas.

Most of flora and fauna species are left only to certain forest areas, and they become specific to these forests. The preserved flora and fauna species are observed in each forest area and they are threatened by extinction. It means the forests are very fragile to change and a little change will threaten the species living there. Those forests are ecologically essential places for the biodiversity conservation in the Intensive Area.

(2) Flora and Fauna

Total number of community of the major plant is 21 species in Kaluta forest at the phases of seedlings, saplings, poles and trees. It is 25 species in Kasuratan forest, 21 species in Tampusu forest, and 22 species in Manimporok forest. There are 16 species of the major bird community structure in the Intensive Area. For the threatened species of birds, it appears that they still exist in spite of small forest area.

Total number of bird species in the four forest areas are 41 species and 2 species of squirrels, in which there are 8 protected species, 18 rare species, 1 threatened species and 1 nearly threatened species. Based on the threatened status of the fauna, the four forest areas possess protected and almost extinct *Macropigya amboinensis*.

(3) Floristic and Faunistic Structures

Regarding the species diversity of flora, the species richness in Manimporok, Kasuratan forests is higher than that in Kaluta and Tampusu forests. However, the species evenness is similar with any species in the above four forests. Although the observed species diversity of the four forests is not high, the vegetation quality could be categorized as good judging from the Shannon Diversity Index.

The species diversity of fauna indicates that Tampusu forest possesses the highest fauna richness followed by Kasuratan, Kaluta, and Manimporok forests. For the species diversity, Tampusu forest is the highest followed by Kasuratan, Kaluta, and Manimporok forests. The fauna diversity in the four forests is good by the Shannon Diversity Index.

(4) Threat to Biodiversity Extinction

The biggest threat and pressure on the natural vegetation are developed by land clearing for estate crops and agriculture, tree cutting, non-target forest harvesting, relative distance between forest and residential areas, steepness of lands, etc. The easier the access to reach the forest, the worse the threat on the forest. In contrast, the steeper the slope, the safer the forest from damage despite being adjacent to the estate crop locations, roads and residential areas observed in the steep areas of Tampusu forest. In fact, the forests in the Intensive Area remain on the very steep lands and on the top of the mountain at present.

(5) Species of Commercial Importance

The number of species of commercial importance is counted at 77 species in the Intensive Area as shown in Table III-1.10.1. The flora in threatened status is counted at 25 species and that of fauna is 24 species. Table III-1.10.2 shows the threatened species of flora and Table III-1.10.3 shows threatened species of fauna.

(6) Species with Potential Nuisances and Dangerous

Introduced species invades in several areas. *Eichhornia crassipes* (water hyacinth) has become a big problem for Lake Tondano. *Imperata cyiindrica* (Bushes) also invades agricultural areas. *Leucaena glauca*, which was introduced to eradicate the bushes,

expands in the coconut plantation. *Piper aduncum* colonizes many abandoned agricultural lands. *Spathodea campanulata* invades the forest area in Mount Tumpa. The colonies of *S. campanulata* are seen as the islands in the estate crops managed extensively.

III-1.10.4 Agro-ecosystem

(1) Flora

The types of plant community in the East Area consist of the cultivated plants in the estate (such as clove, vanilla, etc.), paddy field, and mix garden. In addition, there are natural vegetation of bushes and grasses.

The most dominant plant communities in the South Area are rice plants in the paddy field followed with maize and horticultural plants in the dry upland. Estate crops are mainly planted in the yard together with the fruit plants.

The vegetation in the West Area could be categorized into cultivated vegetation, such as estate crops, maize, vegetables and rice. Natural vegetation consists of wild plants and trees.

(2) Vegetation Profile

Typical vegetation profiles in the Intensive Area are presented in Figure III-1.10.1, III-1.10.2, and III-1.10.3. Figure III-1.10.1 shows the vegetation profile of the East Area from the high land to Lake Tondano. The vegetation comprises the natural forest- vanilla/clove garden- maize- paddy rice- water hyacinth.

Figure III-1.10.2 shows the vegetation profile of the South Area from the western part to the southern part. Natural vegetation dominate in the western part consisted of trees of mahogany, gardenia, *Ficus septica*, palm, golden wood, *Pinus merkusii*, and *Ficus minahassae*. Paddy fields occupy the flat land. To the south, there are also clove trees with the boundary of the secondary forest.

Figure III-1.10.3 presents the vegetation profile of the West Area from Tampusu hills to Lake Tondano. The vegetation profile is grass field on the top of the hill, then mix vegetation- maize- rice field (Tampusu)- residences (Leleko)- mix garden- maize- natural vegetation rice field (Leleko)- water hyacinth.

(3) Fauna

1) Wild and domestic animals

Maximum number of species is found in Makalonsouw located near protection

forest. There are five mammal species, four reptile species, two amphibia species, and 15 bird species. On the contrary, in Eris, only three species of animal in the rice field, such as rats, herons and sparrows are reported. Domestic animals in the Intensive Area are cow, horse, pig, dog, goat, cat, chicken, duck, and goose.

2) Pests, natural enemies and diseases of plants

In the East Area, pests and natural enemies are observed in clove, coconut, coffee, vanilla, banana, paddy rice, corn, red bean, avocado and chilly pepper. Percentage of infection is 30% on both of *O. rhinoceras* on the coconut trees and *C. meinnalis* on the paddy plants. Others are low. In the South Area, *Crocidolomia binotalis* is observed on *Brassica rugossa* with the percentage of infection of 30%. Other pests are low. In the West Area, percentage of infection by all pests is low, except (*O. rhinoceros*) on the coconut plant.

Typical plant disease in the East Area is clove leaf fall with 80% or more infection percentage. Other diseases are found on vanilla, maize, and red bean but percentage is low. In the South Area, diseases of plants are observed on the red bean, tomato, and *Brassica rugossa*, however, percentage of infection is low. In the West Area, several plant diseases are found on clove, maize, green onion and chilly pepper with low infection percentage, while other plants are not infected.

III-1.10.5 Aquatic Ecology

(1) Plankton

In Lake Tondano, there have been found 18 genera of phytoplankton of 4 classes and 12 genera of zooplankton of 3 classes.

(2) Benthos

In spite of difference in number of individuals of each species, the benthic organisms in all Intensive Area do not show any dominance and possess high diversity indices. This condition is supported with the high evenness indices, except for Toulimembet and Eris.

In Toulimembet, the number of individuals of each species supporting the community is not identical. Eris is categorized as the poorest site in terms of benthic organisms, where only one individual was recorded. It may be caused by the presence of dense

fish cages. The artificial feed for the fishes in the floating nets fallen on the bottom decomposes, as a result the deleterious water quality at the bottom would drive benthic organisms in this area to extinction.

(3) Nekton

Fish living in Lake Tondano comprise the non-cultured fish and cultured fish in the floating net. The fishery production of the lake has decreased in last 5 years, particularly for non-cultured fish. However, there is also other fish production from the floating net culture contributing to the increase in total fisheries production of Lake Tondano.

Non-cultured fish usually inhabit near the shore of the lake that provides good habitat, shelter, and natural food. However, placing the floating nets along the shoreline of the lake reduces the habitat of non-cultured fish. The dense aquatic plants in some areas of the lake contribute also to the decline of fisheries production.

(4) Aquatic Plants

Aquatic plants in this study cover the floating plants and the bottom-rooted plants. The water hyacinths are mainly concentrated around the area of fixed net fish culture, and their distribution is largely influenced by wind that push them to the margin area of the lake. The population of water hyacinth is very small in Paleloan, Eris, Toulimembet, Kaweng, where fish culture activities are prospering, and in Remboken, the center of lake tourism.