THE STUDY
ON
CRITICAL LAND
AND
PROTECTION FOREST REHABILITATION
AT TONDANO WATERSHED
IN
THE REPUBLIC OF INDONESIA

Volume I

MAIN REPORT

PART I GENERAL INFORMATION AND BACKGROUND

CHAPTER I-1 INTRODUCTION

I-1.1 Authority

This Final Report was prepared in accordance with Clause V of the Scope of Work for the Study on Critical Land and Protection Forest Rehabilitation at Tondano Watershed (the Study) agreed between the Japan International Cooperation Agency (JICA) and the Directorate General of Land Rehabilitation and Social Forestry (DGLRSF), Ministry of Forestry and Estate Crops (Presently renamed as Ministry of Forestry: MOF), the Republic of Indonesia on September 20, 1999 as shown in Attachment-1.

The Report presents all the results of Master Plan Study for the Study Area and Feasibility Study for the Intensive Area, which were executed from end of February 2000 to end of March 2001.

The Report consists of the following four (4) separate volumes:

(a) Main Report, Volume I
(b) Appendices, Volume II
- Appendix A Aerial Photography and Topographic Mapping
- Appendix B PCM Workshop
- Appendix C Natural Conditions
- Appendix D Socio-Economy and Rapid Rural Appraisal
- Appendix E Land Use
- Appendix F Forestry

(c) Appendices, Volume III

- Appendix G Agriculture and Agroforestry
- Appendix H Soil Erosion and Sedimentation
- Appendix I Capacity Building and Institutional Development
- Appendix JProject Implementation and Cost Estimate
- Appendix K Environment
- Appendix L Project Evaluation

(d) Maps and Drawings, Volume IV

I-1.2 Background of the Study

The Tondano watershed is located at the northern part of North Sulawesi Province. The Tondano watershed is largely divided into the upper watershed and lower watershed by Lake Tondano. In the upper Tondano watershed, there are 40 rivers/streams including the Panasen river and the Saluwangko river, which flow into the lake. These rivers/streams serve as water sources for the lake, irrigation for surrounding agriculture land and domestic water for villages nearby. The lake largely contributes to the public benefits such as water supply to Manado, peak-cut of floods, and inland fish cultivation, using its reservoir function.

The Tondano river, which is a main river in the lower watershed, originates in Lake Tondano. It is harnessed by the 3 power stations of Tonsealama, Tanggari No.1 and Tanggari No.2 power stations. These power stations supply electricity to major cities in the eastern part of North Sulawesi Province. The Tondano river, therefore has vital functions for economic activities and people's lives in the North Sulawesi Province. Presently, there is a construction plan for No.4 power station in the river, which is regarded as a high priority project in North Sulawesi Province.

It was reported that the Tondano watershed would face severe soil erosion due to steep topography, erosible soils, high intensity rainfall, improper land use, and unskilled farming technique. In particular, it was feared that the sedimentation of Lake Tondano would be sufficient to gradually lower public benefit. It was, therefore, urgently required to provide substantial countermeasures against such severe soil erosion and heavy sedimentation to keep the Tondano watershed in suitable condition and to maintain proper reservoir function of Lake Tondano.

Under this background, the Government of Indonesia (GOI) requested the Government of Japan (GOJ) to extend the technical assistance for the Study in October 1997. In reply to this request, GOJ sent to Indonesia the Preparatory Study Team in September 1999. After confirmation on the possibility, scope and contents of technical

assistance on the Study, the Minutes of Meeting for the Scope of Work for the Study were made between the Preparatory Study Team and DGLRSF on September 20,1999.

I-1.3 Subject Areas

I-1.3.1 The Study Area

The Study Area is 54,755 ha of Tondano watershed located in the North Sulawesi Province in Indonesia, for which the Master Plan Study has been performed.

I-1.3.2 The Intensive Area

The Intensive Area has been identified from areas directly influencing the sedimentation of Lake Tondano, as major results of the Master Plan Study, for which the Feasibility Study has been conducted.

I-1.4 Objectives of the Study

The objectives of the Study are to a) execute the Master Plan Study for the Study Area, aiming at review and recommendation on the existing land use plans, b) conduct the Feasibility Study on the critical land and protection forest rehabilitation for the Intensive Area identified through the Master Plan Study for Tondano watershed, aiming at alleviation of risks of watershed degradation by sustainable land use in Tondano watershed, and also to provide a technology transfer for the counterparts during the Study period

I-1.5 Works Performed for Master Plan Study (Phase I)

I-1.5.1 1st Field Work in Indonesia

The field work was performed for 3 months from February 29, 2000 to May 28, 2000, although Mr. I. Ikeshima was responsible for Aerial-Photo Shooting, had started the preparatory work for aerial-photo shooting since February 22, 2000. Prior to the actual commencement of field work, the JICA Study Team held meetings on the Inception Report with DGLRSF in Jakarta on March 2, 2000 and the Working Committee in Manado on March 4, 2000. In these meetings, the proposed schedule and procedure of the Study were agreed in principle as shown in Attachment-2.

The 1st field work for the Study Area was carried out by the JICA Study Team in collaboration with the counterparts who have been dispatched from the Office of Land Rehabilitation and Soil Conservation in Manado (*BRLKT*). The field work included (a) survey on natural, agricultural and socio-economic conditions, (b) the zoning for

the Study Area, (c) the basic concept for proposed critical land and protection forest rehabilitation plan, and (d) preliminary identification of the Intensive Area. The 1st field work was also extended to include technical observations such as bathymetry (sounding) and water quality tests for Lake Tondano. In parallel with these works, the aerial photo shooting was carried out for the study area on a subcontract basis. The topographic mapping has been conducted using the results of aerial-photo shooting. The details of the aerial photography, bathymetry and topographic mapping are given in Appendix-A.

The results of field activities mentioned above have been compiled in the Progress Report. Its contents were discussed with DGLRSF in Jakarta on May 17, 2000 and the Working Committee at Manado on May 20, 2000. As a result, it has been in principle agreed by them as shown in Attachment-3.

I-1.5.2 1st Home Work in Japan

After having reported the results of the 1st field work to JICA and discussion with DGLRSF and the Working Committee, the JICA Study Team prepared the Interim Report based on the results of further analysis of data collected, and also considering the suggestions and comments given in the said meetings. The Interim Report contains the basic concept and strategies for the watershed conservation plan for respective zones and the result of identification of the Intensive Area.

I-1.6 Works Performed for Feasibility Study (Phase II)

I-1.6.1 2nd Field Work in Indonesia

The 2nd field work has been actually started from explanation of the Interim Report with DGLRSF at Jakarta on September 27, 2000. In this meeting, not only the officers from Ministry of Forestry but also other donors were invited, and eventually the representatives of GTZ, FAO and KOICA attended the meeting. Subsequently, a similar explanation was provided to the Working Committee at *BRLKT* office on October 3, 2000. As a result of these meetings, the contents of the Report were agreed various parties as shown in Attachment-4.

Prior to the Working Committee meeting, a workshop was held at the Bupati Minahasa office on October 2, 2000. It had 72 participants including representatives of Camat and farmers. In the workshop, the farmers' representative appealed to GOI to strengthen the supply of nursery trees and the provision of training tree cultivation farmers.

After explanation of the Report, the JICA Study Team commenced the field investigation for the Intensive Area. In the investigation, the Intensive Area was demarcated on 1/10,000 topographic maps to confirm its boundary. Soil survey, environmental impact assessment and rapid rural appraisal were conducted on the sub-contract basis. Their results have been fully incorporated into the preliminary watershed conservation plan for the Intensive Area. In particular, the results of rapid rural appraisal have been carefully reviewed and reflected on the plan taking into due consideration the people-oriented element of WACSLU.

The preliminary watershed conservation plan for the Intensive Area consisting of forestry management and rehabilitation plan, agriculture and agroforestry improvement plan, soil erosion control plan, institutional development plan and community empowerment plan, was based on the results of preliminary analysis and examination analysis of data collected. The scenario of project evaluation has also been prepared considering current conditions of Tondano watershed. These have been compiled in the Field Report. The Report was discussed with the Working Committee at Manado on January 15, 2000 and DGLRSF in Jakarta on January 17, 2000. As a result, it has been in principle agreed by them as shown in Attachment-5.

I-1.6.2 2nd Home Work in Japan

After having explained contents of the Field Report and the Minutes of Meeting to JICA, in-depth analysis and study were conducted for the collected data. Based on these analysis and study results, the appropriate watershed conservation plan including implementation plan was prepared. The watershed conservation plan consists of the forestry management and rehabilitation plan, agriculture and agroforestry improvement plan, erosion control facility development, institutional development plan, community empowerment plan, and monitoring and evaluation system development plan.

The physical watershed conservation measures containing the forestry management and rehabilitation plan, agriculture and agroforestry improvement plan, erosion control facility development, are shown in the watershed conservation plan map. The proposed watershed conservation plan was evaluated from financial, economic and institutional points of view, to prove its viability and soundness. These results were compiled in a form of Draft Final Report.

I-1.6.3 3rd Field Work in Indonesia

The Draft Final Report was sent to DGLRSF on April 27, 2001, prior to

commencement of the 3rd field work from May 7, 2001 to May 19, 2001. The meetings for the Report were held at Manado on May 10, 2001 and at Jakarta on May 15, 2001. In these meetings, the contents of the Report were thoroughly discussed with the officials of forestry services offices and the Working Committee members, so that the Report was in principle agreed by them. The Minutes of Meeting for the Report is given in Attachment-6.

In addition, the seminars were executed at Manado on May 11, 2001 and at Jakarta on May 16, 2001. The objectives of the seminar were to further deepen the results of the Study on Critical Land and Protection Forest Rehabilitation at Tondano Watershed, and to transfer to the officials and people concerned, the survey method and planning method employed for formulation of the Watershed Conservation Plan.

I-1.7 Working Committee

DGLRSF convened a Working Committee in Manado upon commencement of the Study. The Working Committee consists of the head of Regional Office for Forestry (*KANWIL*) as chairman, head of Office of Land Rehabilitation and Soil Conservation (*BRLKT*) as secretary, head of Forest Inventory and Mapping Office (*BIPHUT*), head of Coconut Research Center (*BALITIKA*), staff of Regional Development Planning Agency (*BAPPEDA*), Regional Environmental Impact Agency (*BAPEDALDA*), Provincial Forestry Service Office (Dinas Kehutanan, Tingkat I*),* District Forestry Service Office (*Dinas Kehutanan, Tingkat II*)*,* Natural Resources Conservationist Groups (*KPSA/LSM*)*,* and NGO *Wanuata Waya* as members. Details of the Working Committee members attended are given in Attachments-3 and -6.

I-1.8 Technology Transfer

During the field work, the JICA Study Team provided the following counterparts with technology transfer:

JICA Study Team Members and Assigned Counterpart Personnel

Position	JICA Study Team	Counterpart Name
Project Management	Hitoshi SHIMAZAKI	Mr. Komar
Watershed Management	Youichi KISHI	Mr. Komar/Mr.Noldy Tiwon
Land Use/Forestry	Isao SAKAI	Mr. J.P.Lonta/Mr.Sudjatmiko
Agroforestry	Genshichi WADA	Ms. Meiske Pitoy/Ms.Selfie Turan
Agriculture	Kunihiko OHNO	Mr. Alex
Socio-Economy	Shinichiro TSUJI	Ms. Elli
Institution Development	Steven SCHMIDT	Mr.Baskoro
Aerialphoto/Mapping	Isao IKESHIMA	Mr. Ojom Somantri
Design and Cost Estimate	Jun TSURUI	Mr. Prayitno Heri
Project Evaluation	Hiroshi HASEGAWA	Mr. Eko

The technology transfer to counterparts was mainly made by each expert of the JICA Study Team through "on-the-job training". A main feature of technology transfer was that the participatory planning method has been transferred to the staff of Regional Forestry Service Office (*KANWIL*), Office of Land Rehabilitation and Soil Conservation (*BRLKT*), Provincial Office for Irrigation (*Dinas Pengairan, Tingat I*), Regional Development Planning Agency (*BAPPEDA*), District Forestry Service Office at Minahasa (*Dinas Kehutanan, Tingkat II*), through execution of PCM workshop, details for which are given in Appendix-B.

I-1.9 Acknowledgement

During the field works in Indonesia, the JICA Study Team received generous assistance and cooperation from the counterpart personnel dispatched from the Regional Forestry Service Office (*KANWIL*), the Provincial Forestry Service Office (*Dinas Kehutanan, Tingkat I*), and the District Forestry Service Office at Minahasa (*Dinas Kehutanan, Tingkat II*), the Office of Land Rehabilitation and Soil Conservation (*BRLKT*), and also kind cooperation extended by DGLRSF, other government agencies and donor agencies in Jakarta as well as the North Sulawesi Province. Without such assistance and cooperation, the Study could not have been completed successfully. The JICA Study Team would like to express thanks to all those agencies and people concerned.

CHAPTER I-2 ECONOMY, FORESTRY SECTOR, POLICIES AND SIMILAR STUDIES

I-2.1 National and Regional Economy

(1) National Economy

The Indonesian economy has steadily grown until 1996 at an average annual growth rate of around 7% since 1969, through the implementation of two Long-Term Development Plans (*PJP: Pembangunan Jangka Panjang*). Each Long-Term Development Plan is a 25-year plan, and is further divided into consecutive 5-year Development Plans, called *Repelita*. The Long-Term Development Plan, Phase I was completed on March 31, 1994, and then the Phase II was launched, but was disrupted due to the national economic crisis started in July 1997.

The national economic crisis, which was triggered by the drastic devaluation of the currency in late 1997, greatly affected the Indonesian economy, so that its economic growth rate dropped to –13.6% in 1998. As a result, Indonesia has returned to a low-income country. This economic crisis caused an increase of unemployment and poverty, and also the raising of the inflation rate. Unemployment reached 6.7 million in 1998, about 7% of the whole labor force. The economic situation in the rural areas has become worse than that in urban areas due to the run-off of jobless people to the rural area. However, the Indonesian economic has gradually been improved, and the economic growth rate in the first quarter of 2000, which is still predicted, has arrived at 2%.

The new government was inaugurated in October 1999. It has not made any publication of its own economic development program so far. But, in '*Garis-Garis Besar Haluan Negara* (*GBHN*) or the General Guideline for the National Development, *MPR* (People Consultative Body) has already determined the principles of economic development. These include: a) the promotion of free market mechanism, b) the promotion of healthy and fair competition, c) the promotion of economic justice, d) the promotion of public transparency and e) the development of national economic competitiveness.

Between 1993 and 1999, the GDP per capita increased from Rp. 2.3 million to Rp. 4.6 million at the current market price. But it decreased by 1.3% at a constant market price. The contribution of forestry sub-sector to GDP increased from 1.5% in 1997 to 1.7% in 1998. However, it decreased to 1.6% in 1999.

Between 1993 and 1999, the manufacturing sector contributed to GDP significantly.

In 1999, its economic contribution has reached to 25.8%, followed by the agriculture, livestock, forestry and fishery sector (19.4%).

(2) Regional Economy

The Gross Regional Domestic Product (GRDP) of North Sulawesi Province increased from Rp. 2,806 billion in 1993 to Rp. 3,890 billion in 1999 at the constant market price basis. The average economic growth in the province between 1993 and 1999 was 5.8%. Region's economy grew fast between 1994 and 1996, but after 1996, it gradually declined to -2.4% in 1998 due to the economic crisis. The decline was relatively mild in North Sulawesi compared to the average decline at the national level, for unknown reasons.

In 1999, North Sulawesi's GRDP has contributed to the whole Indonesian GDP at a rate of 1.1%, while the population of the province has shared 1.4% of the country's total population.

According to the statistics in 1999, the agricultural sector accounted for 28.0% of GRDP, followed by the service sector, which contributed 19.1% of GRDP. The contribution of forestry sector to GRDP has increased constantly from 2.3% in 1993 to 3.7% in 1999.

I-2.2 Forestry Sector in Indonesia

MOFEC sets forth a vision to actualize management of forest and estate crop resources for the prosperity of people. In this vision, an emphasis was given to development of community capacity and distribution of benefits of forest and estate crops in a fair, efficient and sustainable manner through a participatory, integrated, transparent and responsible management system.

In order to realize this vision, MOFEC has prepared strategies so that working and development investment should move in the direction of increasing community capacity and institutions, efficiency of use of resources, fair distribution of benefits and sustainability of development. With these strategies, MOFEC states the following development policies for forestry and estate crops, and now MOF succeeds in them:

(1) Core Policy

1) Develop the forestry and estate crops sector in a sustainable way.
2) Realize integrity and synergism in the implementation of forestry and estate crops principled on ecological, economic and social sustainability, aiming at realizing forests and estate crops for people.

3) Carry out a shift in development policy from concentration on timber management to concentration on multipurpose forest management.
4) Strengthen the competitive power of forest and estate crops commodities through increasing product quality and efficiency with support to co-operative or other community economic institutions, and partnership businesses that promote the increase of manufactured goods for foreign exchange.
5) Organize forest and estate crop land utilization to increase growth through even distribution, increasing investment and the competitive power for small and medium businesses and co-operatives.
6) Perfect institutions, regulations and laws that reflect the communities' rights as well as developing a forest and estate crops management information system.
7) Intensify and integrate the implementation, supervision and close guidance, and structural supervision including community supervision that is supported by giving consistent guidance and a legal framework as well as national discipline.

(2) Operational Policy

1) Accelerate the fixing of permanent forest areas, and the availability of land for the development of estate crops and other non-forestry sectors.
2) Improve the quality and productivity of national forest areas, private forests and community forests, estates, and improve the management of conservation areas and nature reserves, protection forest, hunting parks as well as the ecosystem.
3) Continue the increase in development of industrial forest plantations and forest rehabilitation, especially in burnt areas.
4) Consolidate products and continue development of forestry and estate crops which have been achieved so that assets which have already been developed can produce optimally, which is directed towards actualizing a complete agribusiness and forest business of an economic scale. Support the ability to handle processing and marketing of forest and estate crop products through carrying out intensification, rehabilitation, diversification and extensification.
5) Reinforce and increase community institutional capacity as well as giving opportunity and role to communities, co-operatives, and small and medium businesses in the forestry and estate crop sector, to amongst other activities ,utilize flora, fauna and natural tourism places.
6) Create sustainable farmers groups, both in the forestry and the estate crops

sector, through supporting local farmers to establish co-operatives or other community economic institutions, with a supportive business climate and the availability of credit funds, as well as equal partnership, so that local community have access to capital, production, distribution and markets.

7) Increase the ability of provincial governments, the role of youth and women in developing forestry and estate crops.
8) Protect forests and estate areas, forest and estate products and other natural resources from fire danger, encroachment and stealing of forest and estate crop products, through participation of communities (prosperity approach), in the form of formal, non formal and local NGO empowerment.
9) Improve the role of research and development as well as increasing human resource abilities for development of forest and estate crops, through giving importance to adoption of local technology, which is environmentally friendly and easy to use.
10) Create community industrial estate areas in each development location and create estate crop production centers that are carried out with the principle of economic co-operation, in order to support the development of integrated economic areas.
11) Adopt a sustainable forestry system with priority to use eco-labeling for forest and estate crop products.
12) Increase the implementation of supervision and guidance, especially in the framework of accelerating the creation of a clean and authoritative government that is free from influence of collusion, corruption and nepotism, as well as improving the way of working and openness.

As the quantitative targets for the two years of 1999/2000 and 2000/2001, MOF gave development of 110,000 ha for private forests and rehabilitation of 200,000 ha for forests and critical lands.

I-2.3 Forestry Sector in North Sulawesi Province

The Regional Forestry Service Office and Provincial Forestry Service Office have prepared working plans for land and forest rehabilitation, following the development policies. The details of these working plans are given below.

(1) Working Plan of Regional Forestry Service Office

This office which was merged into the Provincial Forestry Services Office in January 2001, had prepared a working plan of rehabilitation of Tondano watershed 1997/1998 - 2001/2002. This plan includes such components mentioned below.

1) Main activities

- Watershed rehabilitation

  Project plan, community forest design, seed supply, planting multipurpose tree species, terrace construction and rehabilitation, planting in critical land and demonstration plot of *Cempaka* tree.

- Regreening (*Penghijauan*)

  Demonstration plot for conservation of natural resources and/or sustainable farming system (*UP-UPSA/UPM*), village nursery (*Kebun Bibit Desa, KBD*), private forest/garden (*Hutan/kebun Rakyat*), terrace rehabilitation (*Rehabilitasi Teras*), and constructing soil conservation measures such as check dam, gully plug and absorption well.

- Reforestation (*Reboisasi*)

2) Supporting activities

- Institution building: building and training of farmer group, village cooperation, student, boy scouts, NGOs, and field/technical staff.
- Spreading information: spread of information by TV, radio, mass media, leaflet, brochure and integrated extension.
- Planning: preparation of 5-year activity plan and annual activity plan.
- Monitoring and evaluation: monitoring of monthly, three-monthly and annual activities, evaluation and reporting.
- Supervision and controlling: coordinating meeting, field supervision, and project controlling.

(2) Working Plan of Provincial Forestry Service Office

The Provincial Forestry Services Office has developed a work plan for 2000/2001. The activities to be implemented in Tondano watershed in this plan are:

- Inventory of reforestation achievement
- Development of protection forest of Mahawu for ecotourism
- Planting of bamboo trees in protection forest of Mt. Soputan
- Maintaining a protection forest boundary of Mt. Klabat by planting kembang sepatu (Hibiscus Rosasinensis) in hedge grow.

There is also a cooperation program between the governor of North Sulawesi and the governor of Jakarta, which will probably be started this year. Activities of the program include the development of a bamboo forest (1,000 ha a year), rattan forest (500 ha a year), apiculture (honeybee cultivation for 200 unit), and ecotourism.

I-2.4 Latest Policy and Laws Concerned

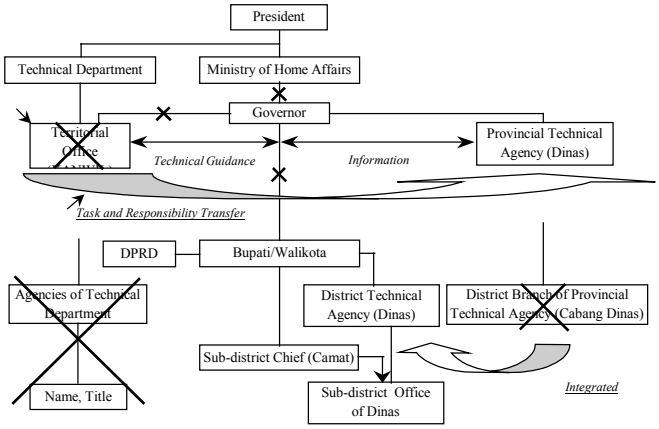
I-2.4.1 Administrative Decentralization

The current local government structure and local autonomy in Indonesia are based primarily on the law No.5 from 1974. The law illustrates the basic structure of public administration at all levels and defines the status, form, responsibilities and tasks of local governments. The law provides districts/municipalities with the rights to pass and issue local laws and regulations. Districts/Municipalities have a certain discretionary power over their personnel and budget, but intensive control and supervision of the central and provincial government limit the autonomy. The provincial, district and municipal governments are considered administrative entities of the central government.

In 1992, GOI passed a regulation PP 45/92, which stipulates substantial political and administrative decentralization in the country. It indicates that the number and forms of responsibilities must be transferred to districts/municipalities, and the regulation confirms the dominant role of the Ministry of Home Affairs in decentralization. After the enactment of PP 45/92, the Ministry of Administrative Reform (*MENPAN*) launched an experimental program, the District Autonomy Pilot Programme (DAPP) in 1994. In 1996, Minahasa District was chosen as one of the pilot local governments for DAPP.

After reviewing DAPP, GOI passed the law No. 22 and 25/99 in 1999 to apply DAPP to all districts/municipalities in the country. According to the law, *KANDEP* and Cabang Dinas will be integrated into District Technical Agencies (Dinas), and autonomous technical units are to be directly managed by a district/municipality. Heads of District/Municipality, namely Bupati and Walikota no longer report to their governors but to the locally elected assemblies (*DPRD*). The main point of structural change in the regional government according to the law is shown below.

The Structure Change of Regional Government According to Law 22 of 1999



Source: Study Team based on AF-SPL Technical Report

The decentralization process is designed to accompany fiscal decentralization. A portion of the revenue from forestry, mining, fishery, oil, gas, and land/building taxes will be shared with local governments as shown below.

Fiscal Decentralization

Source of Revenue	Central Government	Region
Land and Property Tax	10%	90%
Land Purchase and Building Permits Revenue	20%	80%
Forestry, Mining and Fishery Royalties	20%	80%
Oil and Gas Royalties	85% oil, 70% gas	15% oil, 30% gas

However, this simplistic decentralization process is not simple in practice due to the existence of three forms of decentralization devised through Law 5/1974. They are decentralization, de-concentration and co-administration (*Tugas Pembantuan*)[1].

To identify which responsibilities/tasks of *KANDEP* and Cabang Dinas are subject to be transferred to, delegated to or implemented by District Technical Agencies (Dinas) under Law 22/25 1999 is an extremely complex job. In general, the decentralization process after the enforcement of the law has been gradual in the country. In respect to the decentralization of *KANWIL*, it was merged into the Provincial Service Office in January 2001.

Another element for the sluggish decentralization process is the delay of human resource development at the district/municipality level. The decentralization program has a component of capacity building for districts/municipalities through the undertaking of de-concentration and co-administration. It aims to provide opportunity for local governments to gain experience in taking responsibilities and implementing government services. In reality, additional de-concentration and co-administration aggregates the complexity of determining tasks to be devolved.

The Authority of Local Legislative Branch (*DPRD*), for which the heads of district/municipality are accountable, is still weak. As a result, the accountability and responsibility of local governments remains underdeveloped. Therefore, political decentralization is a must for successful administrative decentralization in this respect. These general trends and obstacles of decentralization are evident in Minahasa District and Manado Municipality.

BRLKT, the Indonesian counterpart agency of the Study, would fall into a category of

[1] *Decentralization, which is often called "political decentralization" in international literature, means transferring legislative authority, responsibility and tasks from a higher level of government to a lower autonomous level. The transfer always has to be accompanied by the transfer of personnel, money and necessary equipment. De-concentration means the delegation of administrative tasks from a central ministry to its field offices or line agencies in the region. If local governments implement tasks on behalf of the provincial or district department offices, it is called co-administration.*

specialist organization known as technical implementation unit (*UPT*). *UPT* can be classified into 2 units: *UPT* Wilayah and *UPT* Daerah. *UPT* Wilayah is attached to *KANWIL*, thus in line with the technical department of central ministry, whereas *UPT* Daerah is attached to regional specialist offices known as Dinas. Therefore, the function of *UPT* has dual dimensions. One is the function as a specialist organization for the department, and the other is as an implementation unit for regional government. However, in Minahasa District, since being chosen as one of the pilot local governments for DAPP, the structure is different. There was no UPT Daerah.

On one hand, the implication of decentralization in respect to *BRLKT* as *UPT* Wilayah can be summarized as the reinforcement of tasks delegation and responsibility transfer to *UPT* Daerah. Since the principles of decentralization in Indonesia are the reduction of departmental influence at the regional level, the functions and responsibilities of *BRLKT* as *UPT* Wilayah are subject to be cut down. On the other hand, decentralization implies the need for institutional integration of *BRLKT* at the Daerah level, especially in Minahasa where there is no UPT Daerah due to DAPP. *BRLKT* Daerah is urged to expand its institutional capability so as to be able to accommodate the additional functions and responsibilities from Wilayah. However, it seems that operation of *BRLKT* as a function of the Central Government will need to remain for sometime, considering the current level of development of *UPT* Daerah, this has been clarified by high level officials at the Ministry of Forestry. *BRLKT* will remain attached to the Central Government and will assume a planning and coordination role to coordinate activities undertaken by the District Forestry Services Office until the capacity is developed in *UPT* at regional level.

It is important to note that the regional technical implementation unit consists of 2 levels: province and district. According to the decentralization principles, the emphasis has been put on the administrative decentralization at the district governments, rather than the provincial government. It reinforces the strengthening of *BRLKT* Daerah at the district level. The new Provincial Forestry Services Office structure has allowed for a *UPT* to be established in Tomohon with a similar range of duties that *BRLKT* currently is responsible for.

The decentralization also implies the importance of local government's involvement in implementation. The local stakeholders, such as governor, head of district and municipality play a key role in supporting Dinas financially and politically.

I-2.4.2 Basic Stipulation for Forestry and New Forestry Law

In 1967, GOI passed a law No. 5, which became the basis of forestry law in the country.

In 1999 after long debate and anticipation for a decade, a new forestry law was passed. Law 41/1999 was formulated based on recognition of the obsolete nature of the old law. On a whole, the new forestry law contains more detailed guidelines for forest management than the previous one.

A major difference between the old and new laws can be found in the detailed measures for forest protection. Article 50 and 51 are examples of the thorough regulatory guidelines of the new forestry law.

Another prominent difference between both laws is that the new law recognizes the existence of customary law forest and the rights of people in the communities, though in Minahasa District, GOI is yet to determine the customary law forest. There is another category called "private forest (*Hutan Rakyat*)." located in the private land. The size of the private forest recognized by GOI reaches 39,078 ha in Minahasa, of which 3,539 ha (9%) exists in the 11 sub-districts in Minahasa.

The private forest is either man-made or natural forest mainly for the purpose of fulfilling the local needs for forest products. For man-made private forests, GOI provides subsidies in some cases.

I-2.4.3 Comparison among Forestry Law, Agrarian Law and Customary Law

Sharp discrepancy between the forestry or agrarian law and customary law (*Hukum Adat*) can be found in the formality of rights. The principle of forestry or agrarian law, as all official laws in the country, stands on the public rights, whereas for the customary law, there is no distinction between public and personal rights. Thus GOI provides official guidelines and restrictions based on official land rights, which are not applicable to the customary land whereby the land rights are protected and managed in private.

In the new forestry law, the stipulations over a customary forest were recognized. GOI provided customary communities with the management rights of their forests. For this, the conflict between the forestry law and customary law was alleviated to such an extent that the privately realized rights in respect of utilizing and maintaining the customary forest became legitimate.

It does not mean, however, that the discrepancy between the government authority and community rights was completely eradicated. Even though the agrarian law recognized the customary land rights, the rights remain informal since there is no formal registration system or certificate for the customary land rights. The co-existence of "legitimacy" and "informality" over the customary rights creates an administrative dilemma. For example, it will be unclear for GOI to determine over

which forest the community has the management rights since the ownership rights over their forests are informal. When the community fails to identify the location and boundary of their customary law forest, which would be the majority of cases given the informality of their land rights, the state would have no choice but to dictate the determination of the forest and formalization of land rights. GOI, in this sense, still has an authority in the decision-making. More detailed regulations for determining customary communities and customary forests are underway, but the inconsistency between law (formality) and customary rights (informality) will present a great challenge to legislators.

I-2.5 Similar Projects / Studies

There are some similar projects /studies in Sulawesi. These are a) Watershed Management Technology Development Project in South Silawesi, b) Limboto-Bolango-Bone Basin Water Management Master Plan, c) North Sulawesi Water Resources Management Plan, d) Tondano Watershed Management Plan, and e) Sulawesi Rainfed Agricultural Development Project. Through review and/or inspection of these projects /studies, effect of watershed conservation facilities, cause of critical land occurrence, and need of extension services have been identified. These findings have been drawn upon during the preparation of appropriate watershed conservation plan for the Tondano watershed.

PART II MASTER PLAN STUDY FOR THE STUDY AREA

CHAPTER II-1 THE STUDY AREA

II-1.1 Location and Administration

The Study Area lies within the geographical tract between 1°07'~1°31' North latitude and 124°45'~125°02' East longitude. More specifically, the Study Area extends to the southern part of Manado City, the capital of North Sulawesi Province. Its physiographical area, which is wedge-shaped, is 54,755 ha. Lake Tondano, of which the area is 4,638 ha, is located at southern part of the Study Area.

Administratively, the Study Area belongs to the Minahasa District consisting of 11 Sub-districts and 146 Villages, and Manado City consisting of four Sub-districts in North Sulawesi Province.

II-1.2 Natural Conditions

II-1.2.1 Topography and Geology

(1) Topography

The Study Area has predominantly undulating topography. The area is characterized by volcanic landscapes. Several volcanoes are still active and have erupted several times during the last 20 years.

Manado, the capital city of North Sulawesi Province, is located at the mouth of the Tondano river in the northwest corner of the Study Area. The northern part near Manado comprises the lowest part of the Study Area. Elevation of the area becomes higher toward the south. The area between Airmadidi and Tondano is rugged and deeply dissected, where the rivers have eroded weak volcanic rocks and have developed very deep valleys with steep slopes on both sides. The southern area, south of the Mts. Mahawu-Makaweimbein line, is regarded as an old drainage area of Lake Tondano, and ranges from an elevation of 680 m at the lake water level to El.1,500 m.

The highest point of the Study Area is El.1,990 m at Mt. Klabat located at the northeast corner followed by Mt. Soputan of El.1,556 m located at the southwest corner. The high points on the dividing ridges around the drainage area are mostly volcanoes, including Mts. Klabat and Soputan (active).

Gradient of the land varies from flat to 35° slope. One-third of the Study Area is less than 5° slope, and 1/4 of the area is more than 15° slope, most of which are located at

the dividing ridges along the watershed between Airmadidi and Tondano. Figure II-1.2.1 shows the topographic characteristics of the Study Area.

The drainage pattern of the area is mostly dentritic, which resembles the branching of a tree, over the area. The total length of the streams is 744.3 km and drainage density, length of stream per unit area, is estimated at 1.29 km/km^2.

Lake Tondano is located in the southern part of the area. In the north and south of the lake, there expands wide flat land. The lake is an old crater resulting from a paroxysmal eruption of a big Tondano volcano during the late Tertiary to early Quaternary periods. The lake originated by the filling of a longitudinal rift valley on the crest of Minahasa geanticline.

(2) Geology

The geology of Sulawesi Island is of great geotectonic importance, as it forms the link between the East Asiatic Island area on one side, and the festoon of the great Sunda Mountain system on the other side.

Sulawesi Island can be divided into 5 distinctive terrain categories. Quaternary Minahasa-Sangihe Volcanic Arc comprises the north part of Sulawesi where the Study Area is situated. It is characterized by an acute and extremely convex volcanic belt, stretching from Sangihe Island in the north and terminating at Una-una Island in the south. Quaternary volcanic activity is found only in the Minahasa section.

The Study Area is composed of four main geologic formations: Lacustrine and Fluviatile deposits (Qs), Young volcanic rocks (Qv), Tondano Tuff (QTv), and Older volcanic rocks (Tmv) as shown in Figure II-1.2.2.

II-1.2.2 Meteorology and Hydrology

(1) Meteorology

The meteorological stations are located at Kayuwatu and Tondano. These stations record temperature, humidity, rainfall, wind, etc. In addition to them, rainfall has been observed at the stations of Airmadidi, Kakas, Luaan in Tondano, Remboken, Telap, and Noongan.

Kayuwatu in the lower area receives more rainfall than in the higher area around the lake. The mean annual rainfall is 2,738 mm at Kayuwatu and between 1,442 mm to 2,364 mm around the lake. Figure II-1.2.3 shows distribution of the rainfall stations in the Study Area.

The monthly rainfall distribution shows that rain falls throughout the year. However,

rainfall is more from October to June than from July to September. Annual rainfall has varied from 1,310 mm to 3,900 mm at Kayuwatu, and from 838 mm to 2,893 mm around Lake Tondano since 1980.

The monthly mean temperature in Manado ranges from 25.3 °C to 26.7°C, while that at Tondano ranges from 21.9°C to 22.5°C. The monthly humidity varies from 75% to 89% at Kayuwatu, and from 85% to 91% at Tondano.

The average monthly wind velocity varies from 0.7 m/s to 1.7 m/s at Kayuwatu and from 0.6 m/s to 2.4 m/s at Tondano. The dominant wind direction is north to north-west from November to April, and south to south-east from June to September. October and May are turning points of the wind direction.

(2) Hydrology

1) In-flow to the lake

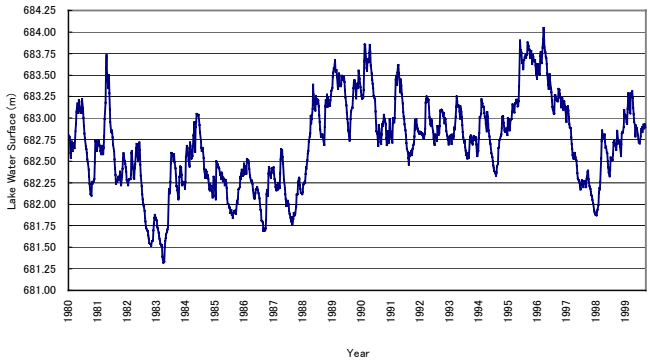
There are no continuous flow rates data available except monthly data in 7 streams for one year. Three-fourths of the streams flowing into the lake have less than 2.5km^2 of catchment area. Rainfall distribution is different locally around the lake. Although the flow rate data differs by sampling timing after rain, discharge per unit area has been roughly estimated at 0.007 m^3/km^2/s for minor streams to 0.032 m^3/km^2/s for major streams.

2) Out-flow from the lake

PLN has observed intake discharge for the hydropower plant. According to the observation data, monthly average intake discharge was 9.37 m^3/s to 11.07 m^3/s for the period of 1986-90, and 5.28 m^3/s to 9.90 m^3/s for 1996-99. Out-flow from the lake measured by Molenaar in 1999 shows variation of 1.5 m^3/s to 11.2 m^3/s at Toulour. The annual average outflow was 6.4 m^3/s.

3) Lake water surface level

The lake water surface is largely influenced by rainfall. The lake water surface fluctuated from El.681.3 m to EL.684.0 m in the last 20 years from 1980 to 1999 as shown in following page.



Variation of Water Surface Level of Lake Tondano

4) River flow of the Tondano river

Discharge of the Tondano river has been measured at Kairagi gauge station, of which the drainage area is 467 km^2, including 282 km^2 of the Lake Tondano watershed. Monthly discharge ranged from 5 m^3/s to 22 m^3/s.

5) Water balance in the watershed

In the Lake Tondano watershed, the intake of the Tonsealama hydropower is considered as an annual yield. The yield rate of the Lake Tondano watershed has been estimated at 70% - 80% of total rainfall, excluding observation data of the extraordinarily drought year of 1998, while the yield of Tondano river watershed at Kairagi is reported at 45% by *PU*.

II-1.2.3 Soils and Vegetation

By referring to the Indonesian soil classification system, the soils in the Study Area can be classified into four soil units; a) Andosols, b) Glumusols, c) Latosols and d) Regosols. Their covering area and the hectarages are shown in the following table.

Soil Classification in the Study Area

Soil Group	Area (ha)	Area (%)	Distribution Area
Andosols	4,816	9.7	Kakas, Eris
Glumusols	8,837	17.8	Tomohon, Tondano, Toulimambot
Latosols	8,489	17.1	Pineleng, Kodya Manado
Regosols	27,504	55.4	Airmadidi, Kauditan, Remboken, Tompaso, Langowan
Total	49,646	100.0	

Source : Pola RLKT DAS Tondano 1998
Area is adjusted using the measured Study Area excluding water body.

Regosols occupy about 50% of the Study Area and is distributed in the northeastern part and southern part of the Study Area. Glumusols are observed in the northern part

of Lake Tondano and cover 18% of the Study Area. Latosols cover 17% of the Study Area and are distributed in the northwestern part of the Study Area. Andosols area is 10% of the Study Area and extends over the eastern side and southern side of Lake Tondano. Figure II-1.2.4 presents the distribution of soil characteristics in the Study Area.

According to the soil analysis carried out by the Soil and Meteorology Research Center, moderately fine to fine textured soils are distributed in the larger parts of the Study Area, and medium textured soils are distributed in the limited area of the east side of Lake Tondano. Drainage capability varies with the land use system. In the paddy field area, drainage capability of soil is poorly and/or very poorly drained. On the other hand, that of the soils in upland or slope area is classified into well drained.

Soil pH value in the Study Area ranges from 4.7 to 6.0, a larger part of soil is classified into slightly acidic to acidic. Cation exchange capacity (CEC), which is one of the indices of soil fertility, ranges from 12 to 52 meq/100 g of dry soil. CEC values of a larger part of the soil in the area range 20 to 30 meq/100 g. These values show that nutrient holding capacity of the soil is relatively high. In addition, organic carbon and nitrogen content of the soils are relatively high and C/N-Ratio of the soils is 10. These values also show that these soils are very fertile and have high productivity.

From the viewpoint of soil erosion, Regosols, Latosols and Grumusols could be classified into less erodible soils. On the other hand, Andosols could be classified into relatively erodible soils. Some areas of Andosols, which are lying on the eastern side of Lake Tondano, could also be classified as erodible soils from their soil texture.

Some 50% of the Study Area is covered with industrial tree crops such as coconut, clove, coffee and cocoa and multi-purpose trees such as *Glyricidiea* and *Albizia.* Some 10% of the land is forest and shrubs. Therefore, more than 60% of the land is covered with tree-vegetation. Some 10% of the land is lowland field covered with paddy plants. Upland annual crops with fruit trees, industrial tree crops and trees cover the other areas, where plant density of trees is very low. More than 60% of the area is covered with tree-vegetation and less than 40% of the area is covered with herbaceous plants-vegetation.

II-1.3 Socio-Economic Setting

II-1.3.1 Population

In 2000, 194,524 individuals resided in the Study Area of Minahasa District. For Manado Municipality, 143,722 people lived in the Study Area in 2000. The population in the Study Area of Minahasa has increased by 0.99% annually between 1990 and

2000, while the growth rate in the Manado part was 1.98%. Manado as a whole has been experiencing rapid population growth. Between 1990 and 2000, the average annual growth rate in the city was nearly 4%[1].

II-1.3.2 Labor Force

The majority of labor force (approximately 60%) is involved in agriculture in the 11 Sub-districts at Minahasa. For Manado, one third of the working population is engaged in the service sector. The size of the informal sector in the area is unknown, but it is believed that a significant number of the population is engaged in informal economic activities, such as street vendors, unlicensed taxi drivers or non-formal service providers.

II-1.3.3 Economy

The GRDP growth rate at Current Market Prices (CuMP) in Minahasa was 12.9% in 1993, 16.8% in 1994, 25.5% in 1995, 20.9% in 1996, and 59.5% in 1997. During this GRDP growing, the Indonesian Rupiah depreciated significantly, and the adjusted GRDP growth rate (Constant Market Prices at 1993 price level or CoMP) is far lower. The GRDP growth rate at CoMP in 1996 reduced to 6.08% and fell further to 2.12% in 1997. Agriculture is the leading sector in Minahasa, contributing approximately 34% of the total GRDP in 1998. The GRDP per capita of Minahasa in 1998 was Rp. 3,595,086 at Current Market Price (Rp. 4,877,796 for the national average). The adjusted GRDP per capita (at CoMP) was Rp. 1,641,314 (Rp. 1,847,061 for the country).

The GRDP growth rate at Current Market Price in Manado was 16.4% in 1994, 21.0% in 1995, 20.0% in 1996, and 47.7% in 1997. The growth rates at CoMP were: 10.6% in 1994, 10.7% in 1995, 2.7% in 1996, and 0.3% in 1997. There are three major sectors in Manado: service, transportation and communication, and trade, hotel and restaurant. The GRDP per capita of Manado in 1998 was Rp. 3,748,333 at Current Market Price. When it was adjusted to CoMP in 1993, the GRDP per capita was Rp. 1,792,121.

II-1.3.4 Local Financial System

There are a number of formal banking institutions in the area. For farmers in Minahasa, the major provider of financial resources for agriculture is the trader. These traders

[1] *Based on the demographic data, "Development Risk Map I – Demographic Aspect" was completed as shown in Figure II-1.3.1.*

provide farmers with farm inputs and credit in exchange for the purchase of farm products from the farmers.

At the village level in Minahasa, credit often flows inside multi-dimensional social networks among people of long established connections. In addition to the personal credit system, there are local moneylenders whose interest rates are usually higher than the market rate. Some villagers in Minahasa utilize the moneylenders in the case of immediate cash needs. There is also a relatively organized credit scheme at the village level called *arisan* in local term or the ROSCA (Rotating Saving and Credit Association)[2] in international literature.

II-1.3.5 Infrastructure

In the area, there are a number of market facilities, most of which are a simple, outdated complex for the trade of consumer goods. Although the physical conditions of most market outlets are poor, they play a key role as a focal point of local economy.

Solid domestic wastes in the area are mostly disposed of in holes and either buried or burnt. Garbage collection services, carried out through either governmental or private collection agencies, are limited to urban areas. The majority of households in most villages have a private toilet at their residents.

Roads and transportation in the area are relatively well developed[3]. The average ratio of households with electricity in the 11 Sub-Districts at Minahasa was 71.6% in 1999. In Manado, it was 73.5% in the 4 Sub-Districts.

II-1.3.6 Culture and Religion

People in Minahasa identify themselves as Minahasans. They recognize their unique culture, and distinguish themselves from people in the other parts of the archipelago. Minahasans, contrary to their strong tribal identity, have been adjusting their way of life to the existing political, economic and cultural environment at each period of their history. Underneath their flexibility, there is, however, a persistent traditional way of life and belief.

Minahasans speak seven indigenous languages of the Malayo Polynesia language group, four of which are spoken in the Study Area. Manado-Malay, which is spoken in Manado, has become a common means for oral communication in Minahasa.

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[2] *A ROSCA calls regular meetings, and the members of association make contributions in cash, which is put in their fund. The fund is given to a host of the association, and the turn of a host will be rotated for coming meetings. ROSCA is popular not only in District Minahasa but also in urbanized Manado.*

3 Based on the demographic data, "Development Risk Map II – Access Aspect" was completed as shown in Figure II-1.3.2

The majority of Minahasans are Christian. At present, explicit and organized religious discrimination or overt religious conflicts are minimal in the area.

II-1.3.7 Customary Law (*Hukum Adat*)

Despite modern strives in Minahasa, customary law called "*hukum adat*" still governs many matters of Minahasans' daily lives. Customary law is considered as a legitimate contract law within the judicial system in Indonesia.

Below are the main characteristics of customary law.

- Unwritten principles and rules that govern daily activities/events within a community
- *Decisions based on consensus*
- *No distinction between real and personal rights, movable and immovable property, civil and criminal deficits, and public and private laws*
- *Guidance for resource distribution/sharing among community members and rules for inheritance practices.*
- *Guideline for land tenure and land use*
- *Partly diminishing, changing and continuing simultaneously during the modernization*

The significant feature of customary inheritance can be found in the practice of collective ownership. For example, when children inherited their parents' piece of land, they often did not divide the land but rather, they took over the land as a group of heirs. As a result, a piece of land had several right holders. Customary inheritance and collective property ownership have been shifting to modern and individualistic practices in some parts of the study area, particularly in the urban areas such as Municipality Manado and a few towns in Minahasa. But customary inheritance is widely practiced around Lake Tondano.

II-1.3.8 Land Rights

According to the agrarian law, two types of land are recognized: the government land and righted land. The government land is a land with no land rights. GOI, however, does not have an ownership over the land but an authority to manage the land. In Minahasa, most government land is either forest or former colonial plantations.

The righted land is a land whereby someone possesses land rights. The land rights are classified in 4 major categories: ownership right (*hak milik*), exploitation right (*hak guna-usaha*), building right (*hak guna-bagunang*), and use rights (*hak pakai*). According to the law, a right holder can be not only an individual, but also a group of

people.

Besides the formal land rights, the customary land rights are recognized in the law. A land with customary land rights is called customary land (*tanah adat*). Customary land is a land that has been occupied, used or owned by private parties for decades under the customary rules. Because of its informality, the government has been promoting the conversion of customary land to formally registered land since 1960. However, many right owners have not acquired the official land rights because they feel that the benefit and advantage of proceeding to the official land rights acquisition is marginal.

The table below shows the summary of present land status in Minahasa. There is no existing data that indicates the size of each type (A to H) in the Study Area.

Present Land Status

Land Status	Conditions of Land		Use	Type
Righted land	Officially registered	Cleared	Farm, resident	A
		Not cleared	Production forest	B
			Private forest	C
		Managed by the state	Protection land	D
	Managed thru *adat*	Not cleared	Customary law forest (*kalakeran*)	E
		Cleared	Farm, resident (*kalakeran* or *pasini*)	F
Governm-ent land	Illegally used by private parties		Farm, resident or production forest	G
	Managed by the state		State forest and others	H
	Managed by community		Community forest	I

II-1.3.9 Tribe and Social Unit

Minahasans can be divided into seven linguistic/territorial groupings that correspond to the language groups. In a juridical sense, these tribal groupings no longer exist: however, people still use these categories to identify themselves in terms of their origin and language.

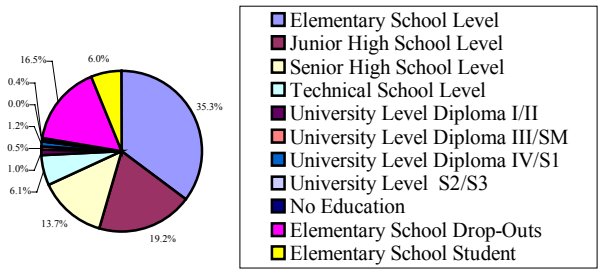
The tribal groupings are subdivided into *walak* (group). *Walak* is composed of a number of related villages. The villages within *walak* are often extended communities, which the residents migrated to from the same "mother village" in the past. The social and mental bonds among the members of *walak* still exist today, except in relatively larger towns in the area, it has diminished.

A lower social unit is a village (*desa*), and unlike *walak*, it is an official jurisdiction. The smallest social unit is a household or family (*rumah tangga*). As a statistical term, a *rumah tangga* means a nuclear family with a head of the household. But as an ordinary term, it includes extended families.

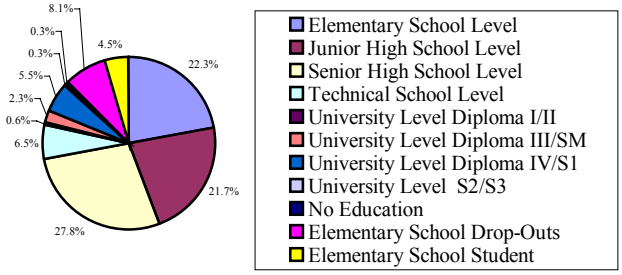
II-1.3.10Education

Minahasans in general are known to be well educated.

Highest Education Level in Minahasa (10 years old or above), 1998



Highest Education Level in Manado (10 years old or above), 1998



All sub-districts in the area have at least one senior high school. District Minahasa has a total number of 4,772 teachers, and Municipality Manado has 3,839 teachers. The number of pupils per teacher in both Minahasa and Manado is fairly low. The illiteracy rate in the area is significantly low.

II-1.3.11Health

All Sub-districts have at least one public health center. All sub-districts have drug stores where people can purchase modern medicines, and few people practice traditional healing methods to date. The number of doctors in response to the total population differs from one Sub-district to the other. Kakas, Eris and Pineleng lack doctors. There are significant numbers of female doctors in the area.

The infant mortality rate for less than 5 years old was estimated 41 per 1,000 at Minahasa in 1997. Estimated life expectancy in Minahasa was 64 years old.

II-1.3.12Poverty

Among sub-districts, the ratio of poverty families differs significantly from one place to the other, according to the official statistics from the Bureau of Statistics in

Minahasa. Since the statistics appear to be unreliable with unrealistic figures, which are the poverty ratio above 80%, the poverty level in the community is unknown.

II-1.3.13 Gender Issues

Minahasa women are known to be relatively independent. It is derived partly from their religious background. Minahasa women are major executors of domestic work, and the majority of breadwinners are men. However many women in Minahasa are involved in farming directly and indirectly. Directly in a way that women actually engaged in farm production, such as planting, weeding, harvesting and processing. Many Minahasa women are indirectly responsible for farming, meaning that women are involved in the marketing of farm products and aid for their husbands/farm laborers by serving food and drink at the field.

Many Minahasa women today are engaged in other type of non-domestic, non-agricultural occupations both on a full-time, but more on a part-time basis. Many educated women have particular interest in community organizations and associations, including the *PKK* (Family Welfare Programme) or Christian organization. However, the level of women's participation in a village seems to be spontaneous.

II-1.3.14 Farmer Behavior towards the Conservation of Lake Tondano

In 1997, a team of researchers from Sam Ratulangi University in Manado conducted research on farmer behavior in respect to the conservation of Lake Tondano[4]. The team took 60 samples randomly from 3 villages within the Tondano watershed area for in-depth interviewing. The results of the research showed that: 1) a number of farmers did not hold the correct understanding and positive attitude toward Lake Tondano and its surroundings, 2) the attitude of some farmers were inconsistent in comparison with their natural and behavioral understanding, 3) the usefulness of the lake was well understood and positively viewed by most farmers, although the conservation aspects were not fully understood.

Since the applied interviewing method is unknown, it is difficult to determine the reliability of their data. However, the finding in the discrepancy between the farmers' understanding on the usefulness of the lake and their behavior toward its conservation is understandable since few organized conservation efforts have been undertaken in the area.

[4] *Tuyuwale and Benu "Analisis Perilaku Petani Dalam Hubungannya Dengan Kelestarian Danau Tondano", 1997*

II-1.4 Land Use

II-1.4.1 History of Land Use Development in Tondano Watershed

Before contact with Europeans in 16th century, it is assumed that the Study Area was mainly covered with tropical rainforest. Produce of cultivation in Minahasa was mainly concentrated to the different species of yam, banana and taro.

After Portuguese introduced maize in 1560, shifting cultivation occurred. From the 16th century onwards, maize, sweet potato and rice became increasingly important. In Minahasa, the annual food crops were grown in a system of shifting cultivation, which required the period of fallow for at least three years and even up to ten years. During the 16th - 17th centuries the area was described as a pathless wilderness with small cultivation patches of rice and vegetables, or clumps of fruit. Up until the 19th century, the Tondano watershed was still covered with dense forests. Agricultural land were limited to the areas surrounding the villages.

The colonial policy of the 19th century changed traditional land use and land tenure system dramatically. At the beginning of the 19th century, forced cultivation of perennial crops became important. The Netherlands had discovered that coffee, an important produce in the world market, grew exceedingly well in the highlands of Minahasa. The government monopoly on coffee began in 1824. The production of coffee in Minahasa in 1822 was only 5,360 lit., but up to 201,000 lit. per year in the 1830's. And it reached up to the highest point of 1,809,000 lit. in 1856. In the late 1850's the farmers who had to work hard for slight returns protested with an attitude of non-cooperation (*merajuk*). They destroyed ripe coffee beans, which caused abrupt production decrease after the peak in 1856. The amount in 1862 reached only 508,128 lit.

On the other hand, coconuts were extensively planted in the low altitude areas and the cultivation became more important towards the end of the 19th century. Coconut cultivation with its low-input technology was easily incorporated into traditional cultivation technology.

Cloves were introduced to the area by the Netherlands in 1890. Since the 1950's, it became a commercial crop and was well distributed in the region. The total area of the clove plantation in the region was 5,538 ha in 1962 and increased up to 35,804 ha in 1991. Cloves were the most important cash tree crop in the period of 1973 - 1989 during which the price soared and became the main source of income for the farmers. Thus it contributed to the economic development of the area. During this period the expansion of the clove plantation and other food crops caused extensive deforestation in the area and thus soil erosion occurred. Since 1989 the clove price has fallen. Most

of the clove plantations are still in existence but many clove have been abandoned. (Some researcher said that 60% of the clove estates were abandoned.). Some have already been converted to other crops such as vanilla, cacao, or inter-cropped with food crops and vegetables.

As described above, the Tondano watershed has experienced a dramatic change of land use system since contact with Europeans. Especially after the 19th century the land has been widely disturbed by the intensive mono-cultural cropping system, which is easily affected by the world market and the situation is still continuing even now.

II-1.4.2 Existing Land Use Plan and Zoning Guideline

(1) Regional Spatial Plan (*Rencana Tana Ruang Wilayah,RTRW*)

A general overview of Spatial Plans on a national level, provincial level, and district level are shown in Table II-1.4.1. The mechanism of decentralization and autonomy of regional government is more emphasized in a national development program, and regional spatial plans are used as a guideline for development planning.

Recommended zoning of Tondano watershed by *RTRW* is summarized in Table II-1.4.2. This table is composed based on *RTRW* of North Sulawesi Province prepared by *BAPPEDA I* and *RTRW* of Minahasa District prepared by *BAPPEDA II*. In these spatial plans, areas are divided into protection zone and cultivation zone in principle. The protection zone has a main function for environmental protection. According to *RTRW* of North Sulawesi Province, Mt. Klabat and Mt. Manimpoko (a part of Mt. Soputan) are selected as forest zone for protecting their lower areas, then, Mt. Mahawu and Mt. Soputan are for sensitive natural disaster zone. In addition, Tondano river and Lake Tondano are selected as riverbank protection zone and lakeshore protection zone respectively. In *RTRW* of Minahasa District, some other places are selected for protection zone as they are shown in Table II-1.4.2. On the other hand, cultivation zone has a function of agriculture and other utilization. *RTRW* of Minahasa District aims at the regional development, therefore, selects industry zone, tourism zone, and mining zone. Those are included within the cultivation zone.

The protection zone in the *RTRW* seems to be reasonably selected with equal consideration for mountain areas and waterfront areas, and present good example for zoning. On the other hand, the agriculture area should be further classified rather than one cultivation zone in accordance with land capability for soil erosion and hydrological cycle, if a watershed conservation plan for sustainable land use is planned. In addition, the Master Plan of JICA Study Team aims sustainable land use on the emphasis of forestry and agriculture, zoning for industrial development such as

industrial or tourism zones is not subject to consideration.

(2) Master Plan of Water Resources Management of Tondano Watershed (Irrigation Office of Public Works - *PU Pengairan*)

Zoning of Irrigation Office of Public Works (*PU Pengairan*) has also been reviewed in Table II-1.4.2. The zoning criteria also follow the same law as the spatial plans. As the objective of the plan of irrigation office is water resources management, protection zone in and around water resources is designed in detail. Besides riverbanks and lakeshores, all water springs (in radius of 200 m) are nominated as the protection zone. Because of the objective of this plan mentioned above, classification of the zoning of inland areas has less consideration compared with waterfront areas.

(3) Land Rehabilitation and Soil Conservation Plan of Tondano Watershed (*POLA RLKT-DAS TONDANO)* by *BRLKT*

Pola RLKT is a general long-term plan for land rehabilitation and soil conservation (25 years) of a watershed. This plan consists of a) recommendation of land use zone, b) recommendation of land rehabilitation and soil conservation, and c) critical level order of sub-watershed/watershed.

Based on its function, the watershed is divided into three zones:

- Protection Zone
- Buffer Zone
- Cultivation Zone (for perennial crops, annual crops, and settlements)

Criteria, which have been used for determining recommended land use is based on three factors. These are climate/rainfall, soil type, and slope. Each factor has been classified and has had a score as shown in Table II-1.4.3. These three factors have been overlaid and the scores have been summed. Based on the scores, the area or zone has been determined as follows:

- Protection Zone: > 174
- Buffer Zone: 125 – 174
- Cultivation Zone: < 124

It should be confirmed to avoid confusion that buffer zone in this zoning does not literally mean a buffer area for protection, but an area identified as having an intermediate grade in the evaluation process.

As a result of the process, the Tondano watershed has been classified into three recommended land use zones and the distribution was mapped on a scale of 1/100,000. The area of each zone is presented in the right table.

Area of Land Use Zone in Tondano Watershed

No.	Function	Area	
		ha	%
1	Protection Zone	9,295	21.25
2	Buffer Zone	14,965	34.20
3	Cultivation Zone	16,070	36.74
4	Lake	3,420	7.81
	Total	43,750	100.00

Source : Pola RLKT DAS Tondano

The method adopted in this zoning is simple and adequate for evaluating present natural condition from the viewpoint of soil conservation. Moreover, such a quantitative evaluation is easily understood by others. However, there are some problems with it. Firstly, this method heavily depends on only slope gradient considering the present condition of a few data accumulation on rainfall and more or less uniform distribution of soil in the Study Area. Secondly, present land use is not considered in this method. To actualize any conservation plan, present land use condition should be essential and the starting point of implementation.

(4) The New Forest law

The new forest law specifies that no one is allowed to cut trees within a radius or distance up to:

1) 500 m from the edge of a lake
2) 200 m from the edge of water resources and alongside rivers in a swamp area
3) 100 m from alongside of rivers
4) 50 m alongside of streams
5) 2 times the depth of a ravine from the edge of a ravine

(5) Concept of Action Plan of Tondano Watershed by *BAPPEDA I*

BAPPEDA I has compiled a concept of action plan for integrated management of the Tondano watershed. The concept describes the planned activities that should be implemented in an integrated way. The proposed executing agencies are indicated. Details are shown in Table II-1.4.4.

II-1.4.3 Selection of Land Use Category

(1) Existing Land Use Category

There are several legal classifications of land use for different purposes that have been used in Indonesia. Among the various classifications, the following 7 classifications are common.

1) Malingreau and Christiani (1982)

Remark: Prepared for land cover/land use classification applying to remote sensing data

2) Balsem and Buurman (1989)

Remark: Prepared for Land Resources Evaluation and Planning Project (LREPP). MOF adopts this classification in preparing land use information for field technical plan of soil conservation and land rehabilitation recommendation.

3) Regional Physical Planning Programme for Transmigration (*RePPProT*, 1990)

Remark: To identify suitable area for transmigration. This classification is more or less similar to Balsem & Buurman Classification.

4) Center for Soil and Agroclimate Research (*PUSLITTANAK*- BOGOR, 1993)

Remark: Prepared as a guideline for Semi-detailed Soil Survey of the Priority Areas in the Second Land Resource Evaluation and Planning Project (*LREPP II*).

5) Kucera (North Sulawesi Water Resources Agency - Public Works, 1993)

Remark: Prepared for integrated resource surveys of proposed irrigation area in North Sulawesi. It is based on the Malingreau and Christiani classification.

6) National Land Agency (Badan Pertanahan National: *BPN*, 1997)

Remark: Prepared for land use mapping in Indonesia conducted by this agency. The method is based on the Regulation of Ministry of Agriculture, the Head of National Land Agency No.1/1997.

7) Central Bureau of Statistics (Biro Pusat Statistik: *BPS*)

Remark: Used for agricultural statistics.

In addition, *BRLKT* prepared the land use map for the Study Area in 1999. The legend of the map has 7 categories, i.e. forest, shrub, estate, arable upland, paddy field, sago palm, and settlement. The category seems to be fairly selected to adapt the present land use distribution of the area based on the Balsem and Buurman classification.

II-1.4.4 Land Use Category in the Study Area

The present land use map of this Study has been prepared to analyze present land use for a further watershed conservation plan. Considering the purpose of the Study and the existing classifications mentioned above, it is considered that the "Balsem and Buurman" and the "National Land Agency" clsssifications present a good standard for the land use categories of this Study because of their well- balanced categorization for forest vegetation and cultivated land. The categories for the present land use have been selected based on the "Balsem and Buurman" system, which is adopted by MOF, but does not contradict "National Land Agency". The selected categories are as follows:

- Natural / semi-natural forest
- Secondary forest
- Planted forest
- Estate
- Mixture of estate and arable upland
- Arable upland
- Pasture
- Paddy field
- Swamp
- Water body
- Settlement and others

II-1.4.5 Distribution of Each Land Use Category

A present land use map has been produced at a scale of 1:50,000 on the basis of an interpretation of air photographs taken in 1991, topographic maps, and a field survey.

Areas of each land use category are shown in a table below which is measured on the digitized land use map. A reduced land use map has been produced as shown in Figure II-1.4.1 and a distribution of each land use category is described.

Natural/semi-natural forest was defined here as a tree stand of continuous canopy with a comparatively large crown. Although it is named as a "natural" forest, certain areas have been already affected by selective cutting of valuable timber trees. It occupies 6.8% of the Study Area. It is almost confined on top of mountains located on the fringe of the Study Area. Larger ones are on Mt. Klabat in the northeast and on Mt. Soputan in the south.

Secondary forest was classified from natural/semi-natural forest by its open canopy or comparatively small crown. This area was supposed to be once in-tensely cut and then re-generated. It is distributed around natural/semi-natural forest or along rivers. It occupies 2.3% of the area.

Area of Each Land Use

No.	Legend	Area (ha)	Ratio (%)
1	Natural/Semi-natural forest	3,745	6.8
2	Secondary forest	1,738	2.3
3	Planted forest	71	0.1
4	Estate	22,267	40.6
5	Mixture of estate and arable upland	8,067	14.7
6	Arable upland	5,562	10.2
7	Pasture	82	0.2
8	Paddy field	5,960	10.9
9	Swamp	267	0.5
10	Water body	4,684	8.6
11	Settlement and others	2,812	5.1
	Total	54,755	100.0

Planted forest is sporadic in small patches in the Study Area occupying 0.1% of the area. Some planted forest for fuelwood consists of legume species such as sengon (Paraserianthes sp.) and gamar (Gliricidia sp.). Although there are many planting activities and there exist many small scale planted forests in the Study Area, those are too small in their area to be described as planted forest on the map. Moreover trees are very often planted as single trees among cultivated lands and those planted areas are included in the following category such as Estate or Arable upland.

Estate and Arable upland was classified according to the density of trees or tree crop canopies. Cultivated land with tree coverage of more than 75% is included into Estate and less than 25% into Arable upland. Land between 25% and 75% belongs to a mixture of estate and arable upland. Estate covers 40.6% of the Study Area. It is continuously distributed in the northern and eastern part of the area. A mixture of estate and arable upland is distributed all over the area and occupies 14.7%. Large masses are located on the western hills and southern hills of the Area. On the other hand, Arable upland is mainly distributed from west to south of the Study Area, occupying 10.2%.

Pasture is confined to the western edge of the area below Mt. Tampusu and Mt. Kasuratan. It occupies only 0.2% of the area. Although small pastures have been found all over the area, those have been included in Arable upland because most of them are used as pasture phase within a system of cropping rotation.

Paddy field occupies 10.9% of the area. It is mainly distributed in plains on the north and south shores of Lake Tondano. Comparatively small paddy fields have been found in small valleys all over the area. As a nature of paddy field, all of them are terraced and have little possibility of becoming a source of soil erosion. On the contrary, paddy

fields located downstream of rivers can act as sediment traps.

Swamps occupy only 0.5% of the area. Most of them are distributed along the shore of Lake Tondano. Water body occupies 8.6% of the area. The biggest component is Lake Tondano. Water hyacinth (*Eichhornia crassipes*) is propagated in the lake. It has been observed that clams of the aquatic plant drift toward the outlet of the lake.

Settlement and others occupy 5.1% of the area. The main settlements are Manado in the northern tip of the area, Tondano in the middle, and Langowan in the south. Small towns and villages are distributed all over the area especially in southern half of the area around Lake Tondano.

II-1.4.6 Slope Gradient and Land Use

A slope gradient map is shown in Figure II-1.4.2. The map has been produced on the basis of the topographic map with a scale of 1:50,000 and the Terada method has been adapted. In the method, square grids have been drawn on the base map and the number of the contour lines within an inscribed circle of the grid has been counted. Then calculation has been carried out following the expression shown below. 15 second of latitude and longitude, which corresponds to about 463 m around the Study Area, has been used as a grid unit.

$$Degree(\%) = N \times I \times 100 \,/\, D \times S$$

where,

- N : the number of the contours in a circle
- I : interval of altitude between each contour line (25 m)
- D : diameter of a circle (9.26 mm)
- S : scale of the base map (1/50,000)

Steep slopes (more than 40% of slant) are distributed on Mt. Klabat in the north, on Mt. Soputan and Mt. Manimporok in the south, along the eastern edge of the Study Area, around Mt. Masarang and Mt. Tingtingon in the middle, and along the upper valley of Tondano river. On the other hand, flat areas (less than 8% slope) are distributed in the northern part of the area, the north shore of Lake Tondano, and southern part of the Study Area.

Comparing the land use map and the slope gradient map, the relation between slope gradient and land use has been analyzed. Most of the steep slope areas seem to be covered with forests (Natural/semi-natural forest or Secondary forest).

II-1.5 Forestry

II-1.5.1 Forest Classification and Afforestation Programme

(1) Legal Definition and Classification of Forest

The New Forest Law (RI Law No. 41/1999) defines "forests" as follows.

According to its status, two kinds of forests are determined:

1) State forest (*Hutan Negara*): which is located on land bearing no ownership right. Customary forest (*Hutan Adat*) located in the traditional jurisdiction area is also classified into state forest.
2) Right forest (*Hutan Hak*): which is located on lands bearing ownership right.

Based on its function, a state forest is divided into three categories.

1) Conservation forest (*Hutan Konservasi*): which has the main function of preserving specific characteristics of flora and fauna diversity and its ecosystem.
2) Protection forest (*Hutan Lindung*): which has the main function of protecting life supporting systems such as water supply, preventing floods, controlling soil erosion, sea water intrusion, and maintaining soil fertility.
3) Production forest (*Hutan Produksi*): which has the main function of producing forest products.

At present, only protection forest among state forest is distributed within the Study Area.

(2) Reforestation and Social Forestry Programme

Under the New forestry law (law No. 41/1999), land and forest rehabilitation is an aspect of forest management. Rehabilitation activities could be done in all forests except in nature reserves and the core zone of national parks. Rehabilitation is carried out through two kinds of planting projects and three activities as follows:

1) Projects
- Reforestation (*Reboisasi*)
- Regreening (*Penghijauan*)

2) Activities
- Tending (*Pemeliharaan*)
- Enrichment planting (*Pengayaan tanaman*)
- Application of soil conservation through vegetative and mechanical means on critical and non-productive lands

The rehabilitation activities that can be carried out in state forests are called

reforestation, while outside of state forests they are called regreening.

Tending and enrichment planting are considered parts of reforestation and regreening activities, which maintain and improve the quality of planted areas with proper silvicultural treatment. In addition, reforestation and regreening include not only planting methods but also non-vegetative methods such as check dams and terracing.

From the viewpoint of social forestry, there are two kinds of official activities. Those are private forestry (*Hutan Rakyat*) and community forest (*Hutan Kemasyarakatan*). The private forest is undertaken outside of state forests and considered as a part of regreening. On the other hand, the community forest is established inside of state forest areas. The policy was formulated for improving the community participation in forestry development.

II-1.5.2 Forest Management

(1) Management of Protection Forest and Reforestation

1) Distribution of protection forest

The distribution of protection forests is shown in Figure II-1.5.1. All are distributed on top of mountains in the fringe of the Study Area. Approximate area of the protection forest in the Study Area is 3,207 ha, which corresponds to 5.6% of the Study Area.

The area and condition of the protection forest in and around the Tondano watershed is shown in the table below (the area also includes outside of the Study Area).

Protected Forest Condition in and around the Tondano Watershed in 1998/1999

No	Location	Area (ha)	Good Condition (ha)		Damaged Condition (ha)	
			Primary forest	Secondary forest	Bush	Dry land/ Other use
1	Mt.Klabat	5,670.00	3,939.40	1,100.00	0.00	630.60
2	Mt Mahawu	550.00	230.00	320.00	0.00	0.00
3	Mt.Masarang	144.79	86.23	58.56	0.00	0.00
4	Mt.Tampusu	309.00	309.00	0.00	0.00	0.00
5	Mt.Lengkoan	351.00	351.00	0.00	0.00	0.00
6	Mt.Lembean	2,700.00	1,884.00	0.00	210.00	605.52
7	Mt.Kawatak	980.00	124.12	0.00	441.26	414.62
8	Mt.Soputan	13,440.0	6,236.06	4,400.80	1,650.00	1,153.14
9	Mt. Kaweng	417.86	-	-	-	-

Source : Statistics of Dinas Kehutanan Dati I Sulawesi Utara, 1999.
Sub BIPHUT Manado, 2000.

The table shows that certain areas of the protection forest are recognized as damaged forests. According to the Provincial Forestry Service Office, damaged condition means that the forest has been disturbed by people in their several activities such as illegal cutting, shifting cultivation, and others.

Restructuring of Protection Forest Boundaries in Tondano Watershed

No.	Location	Years of Restructuring
1.	Mt. Klabat	1996/1997
2.	Mt. Mahawu	1986/1987
3.	Mt. Masarang	*1996/1997
4.	Mt. Tampusu	1985/1986
5.	Mt. Lengkoan	-
6.	Mt. Lembean	1977/1978
7.	Mt. Kawatak	-
8.	Mt. Soputan	-
9.	Mt. Kaweng	*1996/1997

Source : Sub BIPHUT Manado, 2000
**: Newly established*

Now, restructuring of the boundaries is going on as shown in the right table.

2) Management of protection forest

A reforestation program of the protection forest (*Reboisasi*) was carried out by Provincial Forestry Service Office (*Dinas Kehutanan Tinkat I*). The results that have been achieved during the period from 1976 to 1999 in and around Tondano watershed are presented in Table II-1.5.1. In the 1970's and 1980's pine (possibly *Pinus merukusii*) was the main species, but from the late 1980's Nantu (*Palaquium oblongifolium*) then Gmelina (*Gmelina spp.*) became the main species.

The latest planting activity of reforestation project in the Tondano watershed was conducted in the fiscal year of 1998/1999. An area of 100 ha was planted. At present, there is no more reforestation program carried out by the Provincial Forestry Service in this area except the tending of 100 haof the planted trees mentioned above.

The reforestation was handed over to the District Forestry Service Office (*Dinas Kehutanan Tinkat II*). However, there is no afforestation activity by the office at this time.

(2) Regreening (Penghijauan)

This program is conducted by District Forestry Service Office. The result of the regreening program in the Tondano watershed in the fiscal year of 1999/2000 is shown in Table II-1.5.2. The activities are private garden/forest for 40 places, Village nursery for 6 places, and demonstration plot for conservation of natural resources for 3 places. Besides them, check dams were constructed for 5 places. *UP-UPSA* is for

demonstrating how to implement soil conservation and how to apply the techniques in a farmer's land. The applied techniques consist of physical ones (terracing, bank, ridge) and vegetative ones (planting trees).

Originally, regreening and private forest were different programs in their purposes. Regreening aims at critical land rehabilitation, while the private forest aims at improving local residents' welfare through planting economically valuable trees. But practically it seems that the private forest is executed as a part of the regreening program by the office.

(3) Local Resident's Participation Programme and Social Forestry

1) Community forestry (*Hutan Kemasyarakatan, HKM*)

The policy that is formulated by GOI for improving community participation in forestry development is community forestry (*Hutan Kemasyarakatan, HKM*) (Decision of Ministry of Forestry and Estate Crops No. 677/Kpts-II/1998). The communities located close to the state forest are given concession rights to manage the forest based on their need, capability, and knowledge. The development of community forestry shall be conducted parallel to the development of local community institution through a cooperation unit. GOI provides associate staff who may come from NGOs, universities, or an extension agent.

Community forestry has not been established in the Tondano watershed because of the limited distribution of the protection forest.

2) Private forest/garden (*Hutan/Kebun Rakyat*)

Another local resident's participation program is private forest/garden (*Hutan/Kebun Rakyat*). Private forest/garden aims at improving local residents' welfare through planting economically valuable trees.

During a field survey, some private forest/garden sites were visited. At the sites, Cempaka (*Elmerrillia spp.*), Mahogany (*Swietenia macrophylla*) coffee and cacao were planted intermittently (about 4～5 m in interval) in a maize field. Cenpaka trees have achieved 7 m in height 7 years after planting. The planted trees have grown 1.5～3.0 m in height after 3 years in another site. Achievement of the private forest/garden in the fiscal year of 1999/2000 is already mentioned in the previous section.

3) Regreening assistance funds (*INPRES*)

A steering committee of regreening and refresh program at national level, designed the Regreening Assistance Funds to the farmer f or planting. GOI provides funds for helping farmers who wish to, and are capable of, implementing a planting program. The participants have to organize a regreening farmers group and the funds will be given to the *KTP* directly. Assistants of the forestry office will supervise *KTP* technically and administratively. The groups, which can get the fund, are selected by the District Forestry Service Office.

In the Study Area, the funds are used in the regreening program in which the private garden/forest, village nursery, demonstration plot for conservation of natural resources (*Unit Percontohan Usaha Pelestarian Sumberdaya Alam*, *UP-UPSA*), and terrace rehabilitation are implemented.

(4) Forestry Extension Services

Based on Government regulation *PP No. 62/1998* concerning a delegation of government affairs in forestry to district government, forestry extension service was fully delegated to the district government. In the Tondano watershed, extension services are mainly carried out by senior forestry extension staff (8 people) and junior forestry extension staff (56 people) who belongs to the District Forestry Service Office. Among them, 59 staff receive salary from GOI and 5 staff are funded by individual projects.

The staff conduct extension service about regreening and reforestation activities. Training for the extension staff is mainly conducted by the Forestry Training Office.

(5) Seeds and Seedlings Supply System

There is no permanent nursery operated by GOI in the Study Area. A temporary nursery is prepared in a place close to the planting site for each planting program instead. Main species grown in the nursery are Gmelina, Nantu, and other multi-purposes species (MPTS) such as jack-fruit trees, and durian.

Private enterprises also run several nurseries. Generally, the species grown in these private nurseries are Cempaka, Mahogany, Sengon, and Nantu. The price of seedling grown in the nursery is around Rp.700 - 1,000 per single seedling. They also supply seedlings to the government by request.

(6) Fire Protection

Forest fires that occurred in and around the Tondano watershed in 1997 are listed in the right table. It is assumed that the most likely cause of the fires was spreading from farming lands where farmers burn the ground as a preparation for planting crops.

Forest Fire Occurred in and around Tondano Watershed in 1997

No	Location	Area (ha)	Description
1.	Mt. Mahawu	75.00	Secondary forest
		96.00	Primary forest
2.	Mt. Soputan	95.41	Pine forest
		425.00	Reforestation area
		1,711.18	Primary forest
		1,108.77	Alang-alang grass

Source: Statistics of Dinas Kehutanan Dati I Sulawesi Utara, 1999.

The District Forestry Services Office conducts activity for forest fire protection. The office trains local people near the forest on how to prevent forest fire. When forest fires occur in this area, people are asked to give their assistance in controlling forest fire. Tools for extinguishing fire are supplied by GOI.

II-1.5.3 Existing Forest Resources and Its Usage

(1) Forest Resources

Distribution of forests in the Study Area is very limited mostly on top of the mountains with steep slopes and most of them are designated as protection forests. Firewood plantations are found in private lands. Main species are kaliandra (*Calliandra calothyrsus*) and gamar. There is no extensive timber plantation in the area. Small plantations or individual planting among farming land are commonly found. Cempaka is the most preferable species.

Besides forest products, forest area is one of the important areas from a viewpoint of conserving bio-diversity. In cooperation with the University of Sam Ratulangi, the forestry office conducted some inventory surveys of the protection forest. Inventory of flora and fauna of the protection forest is listed in this report.

(2) Usage of Resources and Forest-related Industry

In the Study Area, there are some industries consuming forest products, mainly wood products. Most of them are relatively small enterprises of housing factories, furniture factories, pottery makers, brick makers, etc. According to the result of interview survey of them, most timbers seem to come from outside of the area such as Bolaang Mongondow District. On the other hand, fuel wood for the industry can be obtained in the Study Area. Old coconut trees and dead clove trees are main sources for fuel wood. This fact shows that timber resources of the Study Area are limited or exhausted, but

fuel wood resources can be supplied from agricultural lands at present. Moreover many local people still rely on fuel wood for their daily life.

(3) Reclamation of Forest Area

Comparing the two 1/50,000 maps of present land use (distribution of forest area) and the latest boundary of protection forest, serious encroachment into the protection forest has not occurred. But past reforestation (*Reboisasi*) activities, which were executed for the rehabilitation of protection forest, indicate there was some disturbance within the protection forest. Existence of damaged condition forest, as mentioned in Sub-Section II-1.5.2, also implies the existence of forest disturbance, although the cause of the damage is not clear. Moreover, the fact of restructuring of the protection forest boundary implies an existence of some encroachment into the forest by human cleaning. It is assumed that the new boundary was made to confirm rights for local people.

According to the result of some interviews among local farmers on forest reclamation, there is some encroachment into the protection forest for reclaiming new cultivation lands and also because of illegal tree cutting.

Although extensive encroachment is not observed inside the present boundary, the facts above show that encroachment pressure such as illegal forest reclamation and tree cutting is rather high in the Study Area.

II-1.5.4 Current Problem in Forest Management

(1) Organization and Human Resources

Many tasks are handed over to the District Forestry Office in current decentralization, but the District Forestry Office does not have enough human resources to execute newly handed over duties. The District Forestry Office has some 60 extension workers and some 50 forest guard respectively, but the lack of management and technical skills makes difficult to conduct efficient extension tasks and forest control.

(2) Management of Protection Forest

1) Reclamation of forest seems to be carried out in some areas of protection forest. Local farmers need lands to be cultivated for food crops but there is no more available land in the private lands. Because of lack of human resources, the Forestry Services Offices cannot control this phenomenon well.
2) The other problem at present is how to protect the reforestation areas from local people's inconsiderate activities. The grown trees are cut down for fuel

wood, while the planted areas are re-occupied for cultivation.

3) Natural phenomena of unusually long dry season causes drought and then tree death. A certain area of reforestation has been lost by fire.

(3) Forests in Private Lands, and Other Issues

1) Shortage of the number and knowledge of extension staff results in insufficient development of farmer's skill and knowledge in the forestry sector through regreening activities.
2) Timber resources are limited in the Study Area, though there are some demands for them from industry within the area. It is not a desirable situation for local the economy.
3) In preventing and protecting forest against fire, there are some constraints such as lack of tools and forest fire extinguisher and low community initiative.
4) According to the District Forestry Services Office, the potential for development of natural silk cultivation and apiculture in the area has not been assessed yet.
5) Fuel wood supply seems to be enough at present. Further trend of the supply is not predictable. The balance of demands and supplies should be carefully observed.

II-1.6 Agriculture

II-1.6.1 Land Holding Size and Land Tenure

Based on the statistics of farm area and number of farm household by related Sub-district, an average land holding size is estimated at 1.26 ha, composed of 0.15 ha of lowland, 0.57 ha of arable upland and 0.54 ha of estate land. The result of farmers' interview survey carried out at 5 villages by the Study Team shows that average farm size is about 1.4 ha, ranging from 1.2 ha to 1.6 ha. Out of this average farm size, about 64% is own land, 19% is hired and 17% is the farm land cultivated jointly by some persons (*Tomoyo* land).

II-1.6.2 Agricultural Land Use

On the basis of the land use survey, the land use of agricultural land in the Study Area is summarized below.

Agricultural Land Use in the Study Area

Unit: ha

District		Lowland Field	Upland	Mixed Area*	Estate	Others**	Total
Minahasa	Area	5,973	5,237	6,935	21,361	121	39,626
	Share(%)	15.1	13.2	17.5	53.9	0.3	100.0
Manado	Area	21	0	745	1,558	0	2,324
	Share(%)	0.9	0.0	32.1	67.0	0.0	100.0
Total Area	Area	5,994	5,237	7,680	22,919	121	41,950
	Share(%)	14.3	12.5	18.3	54.6	0.3	100.0

** Mixture of Upland and Estate ** Pasture and Fish pond*

Some 95% of the Study Area lies within Minahasa District. About 50% of the total agricultural land is used for estate crop cultivation. Larger part of the estate crop area is distributed on undulating or hilly area and mountain foot, especially dominant in northern Sub-district Airmadidi and Pineleng. Upland and mixture area (mixture of upland and estate land) accounts for 31% of total. In the estate crop area and mixture area, several types of agroforestry systems have been practiced as mentioned later. Larger part of the upland area is located around Lake Tondano. The other upland area is scattered among the estate area. Both types of land use system are much mixed or overlap each other. Paddy field occupies 14% of total agricultural land and is mainly located around Lake Tondano.

II-1.6.3 Crop Cultivation

The area of major crops harvested in the Study Area are estimated as follows:

Harvested Area of Major Crops in the Study Area

Item	Paddy	Palawija	Vegetables	Fruits	Estate crops	Total
Area (ha)	10,663	14,005	1,097	124	19,614	45,503
Share (%)	23.4	30.8	2.4	0.3	43.1	100.0

Source: Laporan Tahunan Dinas Pertanian Tanaman Pangan, Kab. Minahasa 1999

Estate crops occupy the biggest area (43%), followed by palawija and paddy. Major estate crops are coconut, clove and coffee. Coconut is mainly cultivated in the northern part of the Study Area, and clove is popular in central and eastern part of the area (north and east side of Lake Tondano). Out of palawija, maize is predominant and others include groundnuts, cassava, sweet potatoes, etc. Maize occupies 97% of total palawija area and is cultivated through the year with no distinct cropping season. Varieties of maize are Manado Kuning (58%), Kalingga (27%) and Hybrida (5%). Palawija are mainly planted on flat to gentle sloped area or mountain foot, and sometimes maize is also inter-cropped with coconut or clove gardens. The double cropping of paddy cultivation has been carried out in 60% of total paddy field. Leading varieties of paddy plant are IR 64 (24%), Citanduy (19%). There is no distinct cropping season of paddy cultivation.

The harvested area, yield and production of food crops in the Study Area are shown in Table II-1.6.1, and summarized below shown below:

Crop Production of Food Crops in the Study Area

Unit: ha for area, t for production, and kg/ha for yield

Location	Lowland paddy	Upland paddy	Maize	Cassava	Sweet potato	Ground-nuts	Green-garm	Soya -bean	Total
Area	9,946	53	13,387	69	46	213	0	12	23,726
Yield	4,984	3,604	2,725	16,771	6,575	1,082	1,824	1,058	
Production	47,477	191	35,946	1,059	263	227	1	13	

Source: Laporan Tahunan, Dinas Pertanian Tanaman Pangan Kab. Minahasa

The yield of food crops in the Study Area is relatively high compared with the average yield of North Sulawesi Province and Indonesia. It is owing to favorable precipitation, relatively fertile soils and fewer meteorological disasters, despite a relatively high rate of crop diseases. However the yield of palawija planting under the tree or tree crops is comparatively low due to its unfavorable conditions. Generally the amount of fertilizer application is low and chemical control of pest is not sufficient. Mechanization of farming lags behind.

Harvested area, production and yield of estate crops in the Study Area are shown in Table II-1.6.2) and summarized below.

Production of Estate Crops (1998)

Item	Coconut	Clove	Coffee	Vanilla	Nutmeg	Cocoa
Area (ha)	14,270	4,181	576	322	158	107
No of trees	1,919,430	857,000	582,180	650,200	31,970	109,380
Productive tree	1,882,060	839,610	525,450	584,760	27,140	81,930
Production (t)	16,690	592	548	206	Na	23
Yield (kg/ha)	1,169	142	951	640	Na	215

Source: Dinas Perkabunan Kab. Minahasa

Major estate crops are coconut and clove. The yield of coconut is a little higher compared to the average yield of Indonesia. However there are many old trees, of low productivity compared with mature trees, and now is refreshing time of coconut garden. The yield of clove has declined recently due to poor crop husbandry because of decrease of market price.

Although total vegetables area amounts to only 2.4% of total agricultural land in the Study Area, collective vegetable areas are observed especially near the town area. Main vegetables are red shallot, leaf onion, chili, tomato, cabbage, Chinese cabbage and carrot. In spite of fruit cultivation area being only 0.3% of total, there are a variety species, such as pineapple, banana, mango, papaya, langsat, rambutan, avocado, durian, mangostin etc. Fruit trees are planted mainly in home garden around the residential area except banana, which is scattered all over the hilly and mountainous area. Main fruit area is observed in Airmadidi District along the Manado-Bitung road.

No sericulture is observed in this area.

II-1.6.4 Livestock

Domestic animal population in Minahasa District in 1998 is shown in Table II-1.6.3 and summarized in the right table.

Animal Population In Minahasa District

Domestic Animal	Population (heads)
Cattle	46,410
Horse	9,840
Goat	7,430
Pig	119,310
Local chicken	1,150,740
Duck	42,630

Source: Laporan Tahuman 1998/99 Dinas Peternakan

As a reflection of local custom, the population of pigs is remarkably high in spite of a sharp reduction by pig cholera in 1996. Most cattle are used as draught animals for cultivation and considerable number of horses are used for transportation in the town area.

Population of each type of animal varies by Sub-district. Cattle are distributed almost evenly over the area. The horse population is relatively high close to town areas. Sub-districts of Tomohon, Pineleng and Airmadidi are centers of pig raising. Poultry production is popular in the whole area, especially in Sub-districts of Kauditan, Tomohon and Langowan. In Minahasa District in 1998, meat production was about 8,790 t and egg production was about 1,987 t, both of which show a decreasing tendency in recent few years.

II-1.6.5 Inland Fishery

Fishing in the Study Area is carried out mainly in Lake Tondano. In addition, small scale fishing is also carried out at some reservoirs and rivers. Besides, some types of fish cultivation are observed in small fishponds scattering at lowlands or valleys, parts of paddy fields, etc. In the related Sub-districts, the number of inland fishermen is about 1,000, and some 2,000 farmers run fishing as a side job.

Inland Fishery and Cultured Area In Related Sub-districts (1997)

Place	Area (ha)
Fishery Area	
Lake	4,315
Reservoir	35
River	74
Fishery Farm	
Fresh water	154
Paddy field	251
Brackish water	17

Source: Dalam Angka 1998 Kabupaten Minahasa

Recently the fish production by traditional method has decreased year by year because of over-fishing, over-catching of fry, overgrowing of aqua-weeds (water hyacinth and other weeds), and water pollution caused by domestic waste. In addition, because of serious drought in the area, fish production by traditional fishing sharply decreased in

1998. Cage cultivation at lake-coast is gradually developing in stead of traditional method. Main fish species in Lake Tondano are carp, payangka, tilapia, gabus, gurame, and mujair.

Fish cultivation at small fishpond and paddy field has also declined in recent years due to the increasing of production cost, reducing fish stock and serious drought in 1997 and 1998. At present, inland fishery area and fish farm in the related Sub-districts in 1998 are shown below.

Fish production in Lake Tondano in recent years is as follows:

Fish Production in Lake Tondano

Unit: t

Cultivation Method	1990	1995	1996	1997	1998
Traditional Fishing	1,610	2,130	1,550	1,430	780
Floating net	120	1,490	1,520	1,280	1,350
Total	1,730	3,620	3,070	2,710	2,130

Source: Dinas Perikanan Tondano

Fishery office reported that Lake Tondano has a high potential for fish cultivation. However, the fish production in the lake is generally stagnant because of low quality and quantity of seeds, low level of fishing skill, insufficient infrastructure for fish cultivation, lack of funds, deteriorating lake water condition, etc. Generally fisherman could not continue their exertion, because of deficiency of fund to prepare large nets, the economic crisis, the slow fish growing due to the low quality of seeds, etc.

Markets of fish are opened at Tondano, Remboken and some villages, sometimes fish is brought to Manado and Bitung.

II-1.6.6 Farm Economy and Crop Budget

According to the farmers' interview survey, average yearly income is Rp 9.3 million and expenditure is Rp. 7 million. Income from agriculture is about 58% and non-agricultural income is 42% of total income respectively, while living expenditure is about 85% and farm cost is 15% of total expenditure respectively. Balance amounts to about Rp. 2.3 million per year.

The farmers' interview survey indicated that farmers consume some 40 kg of fuel wood per week on average.

The crop budget of main crops is summarized below.

Crop Budget of Major Crops

Unit: Rp.1,000

Item	Coconut	Clove	Coffee	Maize	Groundnut	Coepea	Vegetable	Paddy
Gross value	1,200	6,000	5,700	2,900	4,320	4,098	7,000	4,800
Input cost	1,130	4,315	3,060	2,548	3,140	2,868	7,258	3,305
Labour cost-1	650	3,115	2,060	1,648	1,800	1,568	6,058	2,225
Labour cost-2	480	1,200	1,000	900	1,340	1,300	1,200	1,080
Net Return-1	550	2,885	3,640	1,253	2,520	2,531	7,943	2,575
Net Return-2	70	1,685	2,640	353	1,180	1,231	6,743	1,495

Net return 1: Total Return- Paid Cost, Net Return-2: Total return- Total Cost

II-1.6.7 Marketing

The marketing of agricultural commodities is predominantly practiced by local trader. In the case of paddy, a larger part of products are collected by local collector and transported to rice mill, then polished rice is sold at market. A part of paddy is sold through *KUD* and sold directly to consumers at the market by farmer. Maize is mostly sold to collector and partly sold directly to consumer. Vegetables are firstly collected by local collector, and then sold to trader who brings it to city market, but considerable amount of vegetables are directly transported to local market. Clove is firstly collected by local collector and sent to local factory or Jakarta through the collector and/ or trader. Coconut is also collected local collector/trader and sent to factory in Manado.

Major markets in the Study Area are located at Tondano, Langowan and Kakas Sub-district around Lake Tondano. The market at Tondano opens from Monday to Saturday, and the market at Langowan and Kakas are held three days a week.

II-1.6.8 Agricultural Extension Service

Since 1997 agricultural extension services have been integrated by the Agricultural Information and Extension Center (*BIPP*). Each agricultural sub-sector prepares yearly basic action program of extension and sends it to *BIPP*, and *BIPP* conducts several services directly to farmers by following the action program in their territory. The total number of agricultural extension workers employed by Minahasa District is 451. For the related Sub-district, 161 officials are working as of 1999, about 15 persons per Sub-district. Only 30% of extension workers have received higher education.

Extension service is mainly carried out by door to door service, classes at the extension office and group

Number of Extension Workers in the Study Area

Sub-district	Number
Head office	46
Sub-district	405
Langowan	20
Kakas	18
Tompaso	9
Remboken	8
Tomohon	25
Tondano	16
Tuolimambot	12
Eris	8
Kauditan	16
Airmadidi	17
Pineleng	12
Total	161

Source:BIPP

discussion. In 1999 more than 100 agricultural training programs were completed for farmers of several sectors. Major programs were provided for cultural practices and chemical control of pests and diseases of food crops, estate crops, livestock and fisheries. In addition several kinds of agricultural information were delivered to farmers through extension offices. However their activities are not sufficient in visiting frequency to avoid farmers having complaints against present extension works.

In the related Sub-districts, there are 56 village-level cooperatives (*KUD*), however these cooperatives hardly function for local farmers. In addition, credit systems for farmers such as *KUT* and *KPP* are not handled well due to the lack of funds. Thus farmers have established 1,005 farmers' groups by themselves under the support of the government. These farmers' groups have been formed to increase income and upgrade farmers' ability. Farmer's groups are divided into 4 groups, which are beginner, advanced, medium, and skilled, based on the grading system of *BIPP* such as 1) the ability to develop technology, 2) the ability to multiply basic assets, 3) the ability to corporate between farmers, 4) the ability to be aware of agreement and 5) the ability to formulate a plan.

Condition of Farmers' Group in Related Sub-districts

Item	Condition of Farmers' Groups				
	Beginner	Advanced	Medium	Skilled	Total
Total	877	114	14	0	1,005
Share (%)	87.3	11.3	1.4	0.0	100.0

Source: Laporan Tahunan 1999 BIPP Kab Minahasa

From this grading system, most of them (87%) are still classified into the beginner class and none of them into the skilled class due to a shortage of guidance and running costs to maintain farmer's organizations.

II-1.6.9 Current Problem in Agricultural Activities

(1) General

Minahasa District Agricultural Service Office (Dinas Pertanian Tanaman Pangan) points out the following current problems in agriculture of the District:

1) The paddy field in the District still does not function well, and the productivity of paddy is still stagnant.
2) The irrigation system is not appropriate because only 35% of paddy fields are irrigated at present.
3) Farmers are still obliged to use the traditional farming system due to the lack of information on modern agricultural technologies.
4) Mass guidance action for agricultural intensification (*BIMAS*) programme

does not sufficiently function at the field level.

The farmers' interview survey for the 100 farm households by the JICA Study Team elucidated that farmers have several constraints under the present agricultural and marketing conditions. Major constraints are biological damage, high production cost, low soil productivity, labor shortage for the agricultural production, and the low price and large price fluctuation of agricultural commodities for the marketing condition. For these constraints, farmers have proposed some countermeasures such as prevention of soil erosion, improvement of extension system, and improvement of road condition.

(2) Soil Erosion caused by Clove Cultivation

It is often said that clove cultivation, which was introduced to the slopes around Lake Tondano from the 1970s to the 1980s, caused serious soil erosion throughout the area in those days. The interview survey with aged farmers involved in clove production proved that serious soil erosion actually occurred due to clean cultivation method applied for clove and heavy rain. They observed the river water became dark and the eroded soil flowed into Lake Tondano.

From the end of 1980 to the 1990s, soil erosion settled down, because the price of clove decreased so much and thus farmers were no longer motivated to carry out intensive management for clove cultivation. Though they still have kept clove trees in their fields, the tree population has declined and a part of the area has gradually returned to forest due to insufficient management. However they have intentions of cultivating cloves again if the price rises in the future. Most farmers now recognize the importance of soil conservation for crop cultivation on sloped areas.

II-1.7 Agroforestry

II-1.7.1 Type of Agroforestry System in the Study Area

The cultivated area of major crops in the Study Area is 45,500 ha as described in Sub-Section II-1.6. Estate crops account for 43% of the total area, but these are mostly mixed with herbaceous crops or other tree crops, and mono-culture of estate crop area is very limited. Many trees, tree crops and fruit trees are observed in upland field. It means that agroforestry system has already been introduced into the majority of the Study Area. It could be surmised that serious soil erosion problem occurred at few decades ago, might put spurs to incorporation of agroforestry system into the Study Area.

There are 3 categories of agroforestry system (farming system) identified in the Study

Area. These are tree crop dominant agroforestry system (AGF-I), herbaceous crop dominant agroforestry system (AGF-II), and inter-cropping system of herbaceous crops with tree crops, namely no dominant species (AGF-III). Each category of agroforestry system in the Study Area could be further classified to yield a total of 10 types according to the crops and plant density of each crop planted in the identical field as shown in the following table.

Type of Existing Agroforestry in the Study Area

Type	Woody perennials					Herbaceous crops
	Woody tree	Estate crops			Fruit tree	
		Coconut	Clove	Others		
AGF-I (I-1)	△	◎	△	X	△	△
AGF-I (I-2)	△	△	◎	X	△	△
AGF-I (I-3)	○	◎	○	X	○	△
AGF-I (I-4)	○	○	◎	X	X	△
AGF-I (I-5)	○	○	○	◎	X	○
AGF-I (I-6)	○	○	○	○	○	○
AGF-II (II-1)	△	○	△	X	△	◎
AGF-II (II-2)	△	△	○	X	△	◎
AGF-III (III-19)	△	◎	X	X	△	◎
AGF-III (III-2)	△	X	◎	X	△	◎

Note: Others include coffee, cocoa and vannila
◎ : Predominant, ○: Dominant, △:Frequent, X: negligible

The type of agroforestry system varies area by area. The distribution of each type of agroforestry system in the Study Area is shown in Figure II-1.7.1 and Tables II-1.7.1 and II-1.7.2.

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

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

The estate crops dominant agroforestry system is mainly distributed in the northern part of the Study Area and the eastern side of Lake Tondano. In the estate crop dominant area, coconut is dominant in the northern area, northern part of Airmadidi Sub-district and Pineleng Sub-district. Cloves increase to the south and become dominant at the southern part of Airmadidi Sub-district.

2) Tree dominant agroforestry system (AGF-I Types I-3, -4, -5, and-6)

The tree crop dominant agroforestry system (Woody trees and Tree crops) is divided into a) multi-story tree complex, and b) upland annual crops cultivated under tree crops and fruit trees. The multi-story tree complex is a combination of tall, medium, and short trees. There are two types of the multi-story tree complex. One is the partially well managed one (AGF-I Types I-5, -6) which is now still distributed in the small gentle slope area of Airmadidi, Tompaso, Remboken,

Tondano and Langowan. The other is the poorly managed one (AGF-I Types I-3, -4), which is mainly distributed in the slope area.

An example of poorly managed tree dominant agroforestry system is the old coconut garden planted in 1950's to 1960's. The spaces among the coconuts are too irregular for herbaceous crop cultivation. The irregular shape of cropping area, irregular planting of coconuts and small space for herbaceous crops interferes with proper crop husbandry and leads to problems such as the increase of labor requirement for farming activities and the decrease of plant density. These also cause uneven distribution of solar radiation for the herbaceous crops. As a result, the crop yield of herbaceous crops becomes low. The same phenomenon is observed in some clove gardens.

Figure II-1.7.2. shows the prevailing tree crop dominant agroforestry system in the Study Area. In this system trees are randomly planted and the herbaceous crops are also irregularly planted, resulting in the problems mentioned above. On the other hand, in the well-managed agroforestry system where trees and herbaceous crops are regularly planted, the remaining space is effectively utilized for herbaceous crop cultivation. It is recommended that seedlings of coconut and clove be planted in a regular pattern when the gardens are refreshed.

(2) Herbaceous Crop Dominant Agroforestry (AGF-II Types II-1 and -2)

The herbaceous crop dominant agroforestry system is mainly distributed in the south-eastern part of the Study Area. This agroforestry system is further classified into the following 3 types:

- Planting of coconut or clove in farms of maize, pulses or vegetables;
- Planting of trees (*Cempaka)*, fruit trees (mango, banana and papaya) in maize or groundnuts field, with multipurpose tree (*Gliricidia*) as a hedgerow crop; and
- Hedgerow cropping using banana, cassava and *Gliricidia*.

Normally, agroforestry dominated by herbaceous crop is observed at the border of the field or as hedgerow plants. Sometimes, old and non-productive trees are observed in the field under extensive cultural practices. The herbaceous crop dominant agroforestry systems are mainly employed in the flat to gentle slope area.

(3) Non Dominant Crop Agroforestry System (AGF-III Type III-1, and -2)

The third category of agroforestry systems is the non dominant crop agroforestry system mixing herbaceous crops with coconut or clove. In this system, coconut or clove is regularly planted at wide row spacing to allow herbaceous crop cultivation

(Figures II-1.7.3 and II-1.7.4), In this system, herbaceous crops are intensively cultivated and the production of tree crops is comparable to that of mono-culture. The plant density of these tree crops is similar to that of mono-cropping, but spacing is different. For example, under the coconut mono-cropping, spacing is 9 x 9 m (125 plant per ha) but under this system plant spacing becomes 15 x 5 m (130 plant per ha). Maize is cultivated between coconut rows at the row width of 70 cm. According to the Coconut Research Centre (*BALITKA*), a coconut yield of the mixed cropping system is almost the same as mono-culture, and the planted area of maize occupies approximately 80% of field. Its production is estimated at 70% of that of mono-cropping. From these findings, it is recommended that this system should be applied for flat and gentle sloped area.

(4) Shifting Cultivation and Other Systems

The Minahasa District Agricultural Service Office reports that shifting cultivation is presently carried out on less than 50 ha in total in the whole Minahasa District area. In the Study Area, it accounts for further small area accordingly.

Silvopastoral and/or agrosilvopastoral systems are observed for very limited area in the Study Area.

II-.1.7.2 Evaluation of Existing Agroforestry Systems

The existing 10 types of existing agroforestry systems in the Study Area are evaluated by the production of crops, possibility of application of new cultural practices and resistance to soil erosion. The following table shows the evaluation results for each type of agroforestry system:

Characteristics of Each Type of Agroforestry System

Type	Productivity					Resistance to Soil Erosion	Application of New Practice
	Trees	Estate	Fruit	Herbaceous	Evaluation		
I - 1	Negligible	High	Negligible	Negligible	Medium	Medium	Relatively difficult
I - 2	Negligible	High	Negligible	Negligible	Medium	Medium	Relatively difficult
I - 3	Low	Medium	Negligible	Negligible	Low	High	Difficult
I - 4	Low	Medium	Negligible	Negligible	Low	High	Difficult
I - 5	Medium	High	Negligible	Negligible	High	High	Easy
I - 6	Medium	Medium	Medium	Medium	High	High	Relatively easy
II - 1	Negligible	Low	Negligible	High	High	Medium	Easy
II - 2	Negligible	Low	Negligible	High	High	Medium	Easy
III - 1	Negligible	High	Negligible	Medium	High	Medium	Easy
III - 2	Negligible	High	Negligible	Medium	High	Medium	Easy

Productivity of AGF-I Types I - 5, - 6, AGF-II Types II -1, - 2 and AGF-III Types III-1, -2 is high, however, resistance to soil erosion is not so high except AGF-I types I-5 and -6. On the other hand, the productivity of AGF-I Types I - 3 and - 4 is low, but the resistance to erosion is very high.

II-1.7.3 Extension Service

Extension service of agroforestry system is carried out by District Forestry Service Office. At present, there is very limited staff for agroforestry development. Only a few staff of the District Forestry Service Office practice extension work at project base.

Office of Land Rehabilitation and Soil Conservation (*BRLKT*) is now promoting agroforestry for rehabilitation of forest and soil conservation. It has established three demonstration plots in and around the Study Area (Palasten in Remboken District, Kayuuwi in Kwangkoan District and Rumoong Atas Tareran District). Coconut Research Institute (*BALITKA*) is also recommending a coconut based agroforestry system for the flat to gentle slope area of Minahasa District, aiming at the increase of agricultural income by effective use of land resources and soil conservation. The coconut Research Institute has established a demonstration plot close to the Study Area (Molompa in Tombata District).

II-1.7.4 Current Problem in the Study Area

The farmers interview survey shows that no farmers in the Study Area have raised complaints against the existing agroforestry system. It is deemed that insufficient time has passed since the introduction of agroforestry systems for the farmers to adequately understand which is the more effective agroforestry system. In the existing agroforestry systems, there are some improper cultural practices such as food crop cultivation under irregular planted trees and extensive maintenance of tree crops. In some areas unsuitable agroforestry systems are employed. For example, low productive agroforestry system applied for high land resource area, or low soil conservation agroforestry system is applied for the area of high soil erosion potential. Selection of an appropriate agroforestry system is extremely important, not only for optimal crop production but also for conservation of environmental conditions. To deepen the farmers' knowledge on the appropriate agroforestry system, it is required to strengthen through the extension service.

II-1.8 Present Conditions of Watershed

II-1.8.1 Previous Studies

BRLKT prepared a master plan, which is called *POLA,* on land rehabilitation and soil conservation for Tondano watershed in 1986. In 1996, *PU* estimated erosion in Tondano Lake watershed for planning of check dams in the drainage basins. In 1996, Hikmatullah also studied soil erosion hazard for 26,200 ha of Tondano Lake watershed.

All of the above studies applied the Universal Soil Loss Equation (USLE) to estimate soil loss of the watershed and results varied from about 12 to 235 t/ha/year depending on the land use.

II-1.8.2 Soil Erosion

(1) Erosion as a Historical Fact

As stated in Sub-Section II-1.4.1, the Netherlands East Indies introduced coffee production in Minahasa in the 1820s and it increased dramatically in the 1830s. Land clearance before planting coffee trees might result in severe soil erosion from the slopes. Toward the end of 19th century, cultivation changed into coconut, and then clove in 1890.

Clove became popular as an spice crop in 1920, and then it became a commercial crop from 1950. Clove was the most important cash tree crop in the period of 1972–89. In this period, extensive land clearing or deforestation occurred on the slope around the lake and severe erosion led to high sediment yield because the land surface was cleared for transplanting and harvesting. In 1989, the price of clove fell suddenly and since then the farmers have been discouraged from clove cultivation, leading to a reduction of erosion. Clove plantations still exist, but most are left without care, abandoned, or diversified to other crops.

In Eris, on the east shore of Lake Tondano, local people reports that, the lake shore line before the 1980s was several meters inside the present shore line and boats could travel in the Eris river, which has now changed into an approximately 1 m wide concrete lined drain. About 15 years ago, Ministry of Forestry constructed a small earthen check dam in the upstream of the Eris river and since then sediment has accumulated in the reservoir. Sediment occupies about 2/3 of the reservoir area at present. It indicates that erosion was very severe and extensive during the clove cultivation boom before 1990.

(2) Possible Type of Erosion Hazard in the Area

There are several types of erosion including surface soil loss on farmland and forestlands, slope failure along rivers, roads, and hill-slopes, and scouring in the rivers. Possible types of erosion in the area are categorized as follows by its origin.

Possible Type of Erosion Hazard

Range of Erosion	Possible Type of Erosion
Point source:	Riverbed erosion (degradation) River bank erosion (slope failure/landslide/mass movement) Road slope erosion (slope failure/landslide/mass movement) Slope failure/landslide/mass movement on hill slope
Non-point source:	Soil loss from farmlands and forestlands

(3) Tolerable Slope Gradient by Type of Erosion Hazard

1) Potential debris flow and bed degradation

Riverbed degradation proceeds gradually by stream flow and is accelerated by debris flow. Gradual riverbed degradation may occur in the upper reaches of the streams since unstable deposits have accumulated on the riverbeds. The most important factor affecting the occurrence of debris flow is the slope gradient of the riverbed in the study area, because other factors (size of the bed materials, topography of the area, and rainfall distribution) are similar over the area. Occurrence of debris flow could rise sharply when riverbed slope exceeds 25% if unstable deposit is on the riverbed.

2) Slope failure possibility

There are traces of minor landslides in the Study Area in addition to minor slope failures on the east side of the lake and around Mt. Mahawu. Geologically, all the area except the eastern shore of the lake is composed of similar young volcanic products. The Study Area may have little chance of occurrence of landslide except minor slope failure by heavy rains.

River bank: Most riverbanks in the upper reaches seem to be stable, since the weak foundation rocks have been eroded deeply and little unstable soil remains on the riverbanks. On the contrary, minor slope failures on the river banks would occur in the lower reaches of the rivers in Noongan sub-basin and on the foothills of Mt. Klabat, where sandy volcanic soils deposits occur.

Cut slopes along roads: Though most cut slopes are less than 6 m, placed on steep slopes, slope failures occurred only around Mt. Mahawu. Cut slope failures were

observed where the gradient was more than 25% and the farmland above the slopes extended to the shoulder of the cut slope.

Natural slope failure: Minor natural slope failures, were observed in only three places on the slopes with gradient of 40-45%, though the slopes in the whole area are steep and composed of volcanic soil strata, and receive heavy rain.

Erosion hazard on farmlands and estates: Possibility of soil loss enlarges with increasing gradient. Soil loss might occur when the slope exceeds 8%. It could occur when the slope exceeds 15%. The possibility of erosion will increase when the slope exceeds 25%. However in the estate, soil loss could be lower than in the farmland considering the canopy effect on energy reduction of raindrops. For estates, tolerable slope on erosion hazard could be relaxed consequently. Therefore, soil conservation practice has to be considered in farmland when the slope gradient exceeds 8%. In the case of estates, it is 15%. Based on above discussion, selection of an erosion hazard area has been determined as in the following table.

Tolerable Slope Gradient by Erosion Type

Type of Erosion	Places to be occurred	Tolerable Slope
Erosion of non-point source (spread land)	In farmlands	more than 8%
	In estate and forestlands	more than 15%
Erosion of non-point source (linear source)	Rivers bed/ bank erosion in Noongan sub-basin, Klabat sub-basin	Specific area
	Slope failure along roads	more than 25%
Erosion of point source	Slope failure/landslide	more than 45%

(4) Soil Loss Tolerance

Soil loss tolerance (SLT) is defined as the maximum level of soil erosion that will permit a high level of crop productivity to be maintained economically and indefinitely. If the soil loss is more than SLT, measurements to reduce the soil loss should be taken into consideration until a level of equal or less than the soil loss tolerance has been reached.

Judging from the proposed guideline for Indonesian soil (Arsyd, 1989), SLT to the area could be 15.6 to 32.5 t/ha/year. Meanwhile, *BRLKT* indicates a tolerable soil loss of 13.5 t/ha/year.

(5) Area with Potential for Critical Soil Degradation

Area with potential for critical soil degradation is specified based on the criteria discussed above and it is shown in Figure II-1.8.1, which was processed by evaluating

above factors of debris flow, river erosion, slope failure on slopes, slope failure on road slopes, and soil loss. The actual condition, confirmed through the field observation, is backing the conclusion on the map.

II-1.8.3 Preliminary Estimate of Soil Loss

(1) Method

Soil loss was estimated by USLE shown below.

$A = R\,K\,L\,S\,C\,P$

where, A: Computed soil loss per unit area per year (t/ha/year)
R: Rainfall and runoff factor
K: Soil erodibility factor
L: Slope length factor
S: Slope steepness factor
C: Cover and management factor
P: Support practice factor

(2) Determination of Values of each Factor

R factor was calculated by the Lenvain formula below using rainfall data collected.

$Rm = 2.21 \times (Rain)^{1.36}$

where, Rm: Monthly rainfall erodibility
Rain: Monthly rainfall in cm

K-factor depends on the characteristics of soil and was determined from soil maps. S-factor was determined from slope gradient on the topographic map. L-factor was measured on the topo-map and confirmed by field observation. C-factor was based on recommended values with some modification by field observation.

Determination of Slope Length

(3) Soil Loss Estimate

A soil loss distribution map is shown in Figure II-1.8.2 estimated on the minor sub-basin basis. Average soil loss over the whole Tondano watershed is 24.2 t/ha/year with a maximum of 87.6 t/ha/year and minimum of 5.2 t/ha/year.

(4) Comparison with other soil loss estimates

In the current study, average soil loss has been estimated at 24.2 t/ha/year. On the other hand, *BRLKT* reported soil loss of 145.5 t/ha/year in 1986, which reflects the situation

amid the clove boom. The study by *PU*, which was for the check dam construction, showed a very high value of soil loss of 235 t/ha/year in 1996, since they may have simply applied recommended values of the factors for USLE. Hikmatullah computed soil loss by USLE in 1996 and concluded that land area with soil loss of less than 12 t/ha/year occupied 94% of the total area under present land use conditions.

The difference between the above calculations would reflect the situation of the watershed. In addition, it depends on the accuracy on the factor values selected, especially for L, C, and P factors. The factors have to be determined through careful observation of the site condition.

II-1.8.4 Sediment Transport and Sedimentation

Although sedimentation is a result of erosion, eroded materials do not always go to the streams or lakes directly. Most eroded material remains on the surface often being caught by vegetation or settled in depressions during transport.

(1) Sediment Yields and Sediment Accumulation

BRLKT estimated annual sediment delivery of 107,441 t to Lake Tondano. PU estimated annual sediment delivery of about 6,400 t from 16 rivers. Hikmatullah estimated total suspended load from 11 streams at 7,538 t. Molenaar observed discharge and suspended sediment in seven rivers in 1999. Using his observation, total sediment yield was estimated at 7,441 t/year.

In comparison with the above four studies, *BRLKT*'s result is extremely high compared with the other three results. *BRLKT* used USLE for soil loss estimate and sediment delivery factor for calculation under the 1980's site condition, while the other three studies are based on direct measurement of discharge and sediment concentration after 1995.

Since the sediment by wash load consists of fine particles, it might settle even on the place far from the shore. On the contrary, as shown in the delta that has developed at the river mouth of Panasen river in the south side of the lake, bed load and sediment load consisted of rather coarse materials deposit near the mouth of the rivers.

(2) Sounding of the Lake (Bathymetry)

Sounding of the lake to determine depth and lake capacity was performed by *PLN* in 1994, PU in 1996 and JICA Study Team in 2000. The sounding results of PU show only water depth, so it is difficult to compare them with the other studies. Comparison of the *PLN* and JICA Study Team results, show approximately the same lake depth and

capacity as detailed in Figure II-1.8.3. From these results, it could be said that there was no severe sedimentation in Lake Tondano at least for 6 years from 1994 to 2000.

(3) Sediment Properties

Hikmatullah reported properties of the bottom sediment in Lake Tondano. In shallow parts, the sand fraction of the sediment was more than 27% and clay was less than 42%. In deep places sand was less than 7% and clay was more than 61%. Organic matter content was 3 to 7%, and pH was between 3.1 and 6.4.

II-1.8.5 Floods

(1) Lower Reaches

The Tondano river channel meanders and contains bottlenecks in its lower reaches. Flow in rainy season tends to be choked at the narrow sections and the lowlands are inundated. Recent concentration of the population to Manado has resulted in expansion of the city area and the lowlands along the river have been used as residential areas. According to the PU's report, there was extensive flooding in Manado City in 1996 to a depth of over two meters in some areas. Floodwater receded after about three days. Flooding caused considerable damage to property and disrupted life in the city.

(2) Around Lake Tondano

Major flooding occurs in paddy areas and a part of Tondano town north of the lake. Because the area originates from lacustrine deposits with less than 1/900 gradient, and the lake water surface varies more than 2 m, the wide and flat area along the lake is inundated. People living north of the lake are thus suffering from lack of access to clean water and poor hygiene.

Parts of the paddy field area in Noongan sub-basin south of the lake is inundated, caused mainly by the raised riverbed in the pond of intake weirs by sedimentation and narrowed flow sections of bridges.

II-1.8.6 Water Quality

Several studies have revealed that the water quality in Lake Tondano is declining through development and increasing population around the lake.

Whitten et. al. (1987) reported the chemical composition of surface water of the Lake, at TSS 1.5-2.1 mg/lit., pH 6.3-7.5, and BOD 0.7-1.9 mg/lit.. Hikmatullah (1996)

reported the chemical composition of the water, pH 7.1-7.7, low electrical conductivity, low phosphate and sulfate content, and relatively high levels of nutrients, which could stimulate growth of aquatic plants in the lake. According to the annual report of *BRLKT* (1998-99), average water temperature was 25-27^{o}C at a depth of 1.5-2.5 m, pH 7.3, DO 5.7 mg/lit, and COD 26.7 mg/lit. The lake condition was reported as declining from Oligotrophic to Eutrophic.

In the current study, water quality test showed that COD was 20.1 mg/lit, BOD 12.0 mg/lit, turbidity 2.86, and TSS 3.9 mg/lit.

Though the values vary with quantity of in-flowing water, the above data show that water quality of the Lake is deteriorating. The reasons are supposed mainly due to in-flow domestic waste water, accumulated eroded organic soil on the bottom of the Lake, excess feed from fish culturing, and excess use of pesticide and fertilizer.

II-1.8.7 Influence to Hydropower Generation

There are 3 existing hydropower stations on Tondano river: Tonsealama, Tanggari-1 and Tanggari-2. It would be said that output at these stations has declined due to severe sedimentation in Lake Tondano. A study was therefore conducted to determine whether hydropower generation at these stations has actually been influenced by sedimentation in the lake or not. The study result indicates that hydropower generation would have hardly been influenced by sedimentation in the lake as judged from the position of outlet which is higher than the lake bottom power generation would therefore depend only on the water level of the lake, directly relating to rainfall.

In order to prove the above result, the topographical situation between outlet and lake bottom and the relations among basin mean annual rainfall, water surface level of the lake and inflow discharge to Tonsealama hydropower station are discussed hereinafter:

(1) Outlet Position of Lake Tondano

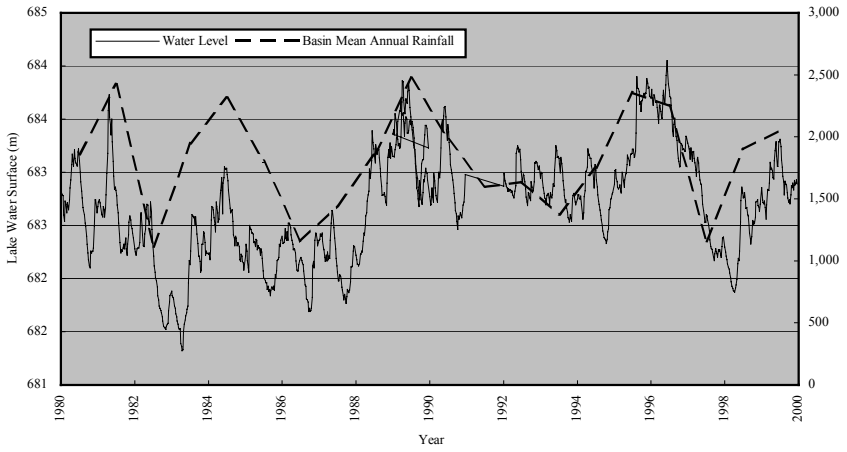
According to topographic survey and bathymetry, the outlet of the lake is positioned at El.681.1 m, which is about 23 m higher than its bottom. In other words, the effective water depth of the lake for hydropower generation is above El.680.00 m and below that is dead storage where most sediment would be accumulated due to the sharply sloped lakeshore. This means that sediment in the lake would hardly influence the inflow discharge to the Tonsealama, Tanggari-1 and Tanggari-2 hydropower stations.

(2) Relation between Basin Mean Annual Rainfall and Water Surface Level of the Lake

There are 6 rainfall stations in the catchment area of Lake Tondano operated by either PLN or BMG. These are Kakas, Langoan, Noogan, Papakelan, Telap and Tondano. The basin mean annual rainfall was calculated by simply averaging the rainfall observed at these rainfall stations because they have evenly distributed locations and because of the rather small and narrow catchment area.

PLN has observed the water surface level of the lake on a weekly basis since 1980. The basin mean annual rainfall and water surface level are plotted on the same figure as shown below:

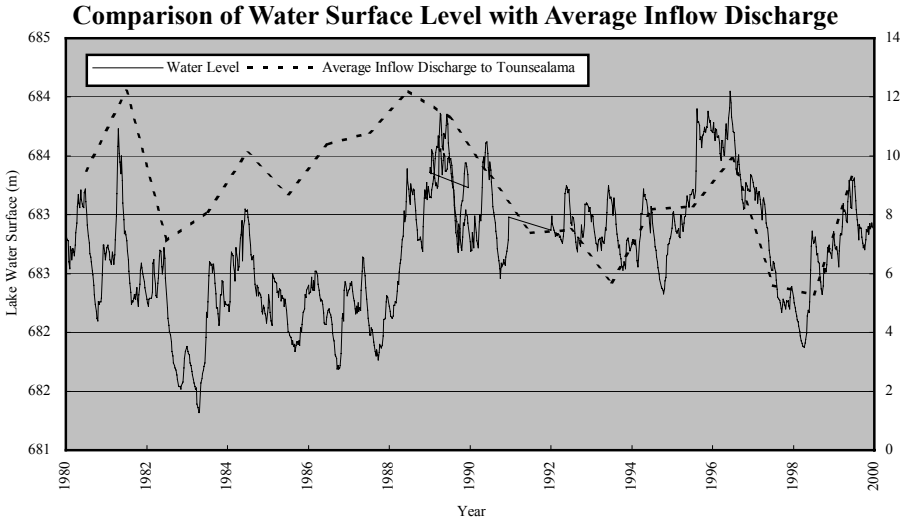
Comparison of Basin Mean Annual Rainfall with Water Surface Level



As can be seen in this figure, there has not been much difference in the fluctuation pattern of both.

(3) Relation between Water Surface Level of the Lake and Average Inflow Discharge to Tonsealama

PLN has also recorded the inflow discharge to Tonsealama hydropower station since 1971. This data and water surface level data, are compared for the period from 1980 to 1999 as shown below:



This figure indicates that both parameters show a similar fluctuation pattern. The higher the water surface level is, the larger the inflow discharge, and vice versa.

In the 1980s, average inflow discharge was slightly larger than in 1990s. The reason of larger inflow discharge in the 1980s was that only the Tonsealama hydropower station was available whilst in the 1990s, all three power stations of Tonsealama, Tanggari-1 (constructed in 1988), and Tanggari-2 (constructed in 1997), were available, which would lead to smaller inflow discharge to generate the required power demand.

II-1.8.8 Current Countermeasures against Erosion Hazard

(1) Soil Conservation Farming

To reduce soil erosion from the agricultural land, soil conservation farming practice is extensively applied in the area, though it is required to be improved. In the estates, 60 to 70 % of the area supports agroforestry such as cultivating maize under the tree crops, mixed with tree crops of coffee, cocoa, tree for fuelwood, etc. The remaining 30 to 40 % of the farmed area is mono-culture estate, or left under various trees and grasses growing thick without care. In any case, the ground surface is well covered with vegetation resulting in good soil conservation.

Typical soil conservation practice employed in the vegetable cropping area of Rurukan is high bed cultivation on contour. The furrows are of sufficient capacity to store runoff from each bed and to accumulate eroded soil.

(2) Erosion Control Works

There are a few structural works applied in the Study Area. Several check dams have been constructed around the lake and have two purposes; storage of water for irrigation and trapping of sediment. Of these, the largest is located in Touliang Oki river

constructed by former *PU* for sediment control in 1997. *PU* has also constructed small earthen dams in Eris river and other rivers for irrigation since the 1980s. They have trapped sediment effectively, even where the purpose was to store water.

In the south part of the lake, there is gabion protection work to protect the bridge from bank erosion and riverbed degradation in the lower reaches of Panasen river.

II-1.9 Watershed Management

II-1.9.1 Usable Resources in Tondano Watershed

Watershed management is the process of formulating and carrying out a course of action involving the manipulation of resources in a watershed, to provide goods and services without adversely affecting the soil and water base. In addition, watershed management should involve the social, economic, and institutional factors operating within and outside the watershed area.

All watersheds contain many kinds of natural resources – soil, water, forest, wildlife, minerals, etc. In developing and managing a watershed, the use of some natural resources will be complementary while others will be competitive. The key is to use these resources as efficiently and perpetually as possible, with minimum disturbance to the watershed as a whole.

(1) Soil and Land

The area is mostly underlain and covered by unconsolidated material as the product of volcanic activity, hence, soils are considered to have high to very high infiltration capacity resulting in groundwater recharge. Because of this, overland flow or runoff may not occur in a few hours of rainfall, and the opportunity for surface erosion is low. Besides, fertile volcanic soil needs minimum fertilizers.

About 3/4 of the area of Tondano watershed is farmland at present. Farmers have used sloping land for tree crop production without considering soil conservation for a long time. On the other hand, simple soil conservation farming with high beds or contour ridges is applied in crop farming at present, though it is required to be improved.

(2) Water

Lake Tondano and Tondano river serve as important water resources for irrigation, drinking, hydropower generation, inland fisheries, and also function as recreation sites for inhabitants. Water demand forecast of Tondano river basin shows that water availability in quantity is still higher than water demands. Regarding water quality, most reports show that water in Lake Tondano contains high organic matter and is

declining to a eutrophic condition.

(3) Forest and Estate

Forest has the functions of regulating hydrological regime, maintaining eco-systems, and maintaining land fertility. Estates, which are composed of tree crops, could be considered as quasi-forest areas, since the estates are similar to forest in that they have planted trees.

Forest area is only 9% of the Tondano watershed area, since the study area has been developed for cash tree crops farming. Natural forests remain only in the higher elevation, mainly around Mt. Klabat, Mt. Soputan, Mt Mahawu, and Mts. Pinandelan and Tang range.

On the other hand, estates of tree crops, mainly coconut and clove, occupy 56%, and they range mostly over the northern half of Tondano watershed and east of Lake Tondano.

(4) Minerals, Geothermal Energy, etc.

Kaolin mining occurs in Langowan and quarry materials including stone, sand and gravel, and limestone are mined in the area. On the mountain foot of Mt. Tompusu, a geothermal power plant is under construction using pressurized vapor in volcanic zone. Another geothermal power generation is planned around Tompaso town.

Panoramic landscapes around Lake Tondano with several volcanoes and hot springs are good resources for tourism promotion. The cool climate and volcanoes, especially Mt. Mahawu, attract local population as a hiking spot and local people use the springs.

II-1.9.2 Current Problem on Watershed Management

Reduced forest area and increased critical land generally have negative effects on watershed management, such as decreasing available water, deteriorating eco-system, and declining land fertility.

Though the problems on erosion and sedimentation are below critical level at present, potential problems as below were found out in the field observations.

(1) Land Use

A part of the coconut and clove estate area has been applied with agroforestry and soil conservation practices. However, there are indications of a return to bad land use practices. Because of the recent low price of clove, most clove estates have not been

well maintained leaving trees and grass growing thick. Ironically, this contributes significantly to soil conservation. Since the low price of clove has led to this condition, it is likely that some people would apply the most efficient farming practice, i.e. without soil conservation, if the price of clove returns to a profitable level. This brings about a dramatic increase in erosion and sedimentation to the problem levels seen previously.

(2) Water Resources

A degraded watershed results in a reduction of available water, increased flood flows, concentrated runoff duration, high turbidity of runoff, etc. In the Study Area, these problems are not remarkable at present due to thick covered vegetation, high infiltration rate of the soil, and soil conservation practices. However, if the topsoil layer were to erode, the situation would worsen resulting in the water resources becoming unreliable. In those areas composed of inherent low infiltration soil that maintains a high infiltration rate due to developed root systems, water resources might become unreliable if the vegetation is changed.

(3) Water quality

Water from Lake Tondano is used for domestic supply for Tondano and Manado. However, the lake water shows very high COD comparing with the standard value and the lake is classified as 'eutrophic' based on its fertility or nutrient loading, phyto-plankton counts, and organic productivity. This is because of the relatively dense settlement and intensive land use for agriculture around the lake. The fact indicates that water would become inappropriate for drinking purposes in the near future.

II-1.10 Emvironment

II-1.10.1 AMDAL

GOI enforced the environmental impact assessment (EIA) in 1996. It is called *AMDAL* (*Jenis Usaha atau Kegiatan Yang Wajib Dilengkapi Dengan Analisis Mengenai Dampak Lingkungan*), which demands EIA for the development activities.

AMDAL mentions the kinds of work or activity that need EIA in the forest rehabilitation and watershed management projects which are listed below.

Kinds of Activity EIA Needed

	Activities	Scale/Area
I. Forestry field		
1	Development of Safari Garden	> = 250 ha
2	Development of Zoo	> = 100 ha
3	Forestry Exertion Authority	All size
4	Sago Forest Exertion Authority	All size
5	Industrial Plants Forest Exertion Authority	> = 10,000 ha
6	Bamboo Forest Exertion Authority	All size
7	Exertion of Natural Tourism in	
	- National Park	> = 100 ha
	- Natural Tourism Park	> = 100 ha
	- Hunting Park	> = 100 ha
	- Botanical Forest	> = 100 ha
	All the activities appropriate to the Conclusion of Forestry Department no. 167/Kpts-II/1994	
II. Public Work		
1	River normalization	
	Medium city	>= 5 km
	Village	>= 10 km
2	Water	>= 500 lit./s
III. Relocation and Forest Cleared Settlement		
1	Settlement and relocation activities	> = 1500 ha

II-1.10.2 Existing Environment Assessment in the Study Area

The report 'North Sulawesi Water Resources Management Plan' mentioned that many of the original natural habitats on the alluvial plains and in middle watersheds in North Sulawesi have already been converted to agricultural use, urban area, or logged over, due to population pressure around the important and accessible resources (such as along the coast, near lakes, large rivers, and fertile plains). Environmental degradation in the upper watersheds is evident in the high sediment loads and often-poor water quality in the rivers and some of the lakes in the province. Many rivers have weirs constructed on them, which impede fish passage along the river. The biophysical impacts of structural water resource management projects in those areas, which are already converted to man-made environment, will be considerably less severe compared to areas that are still in pristine condition.

Sam Raturangi University is conducting a study about environmental issues of Lake Tondano. The study will be completed at the end of the year 2000. The study includes biological, physical, and cultural aspects.

II-1.11 Related Government Agencies and People's Organizations

II-1.11.1 Related Government Agencies

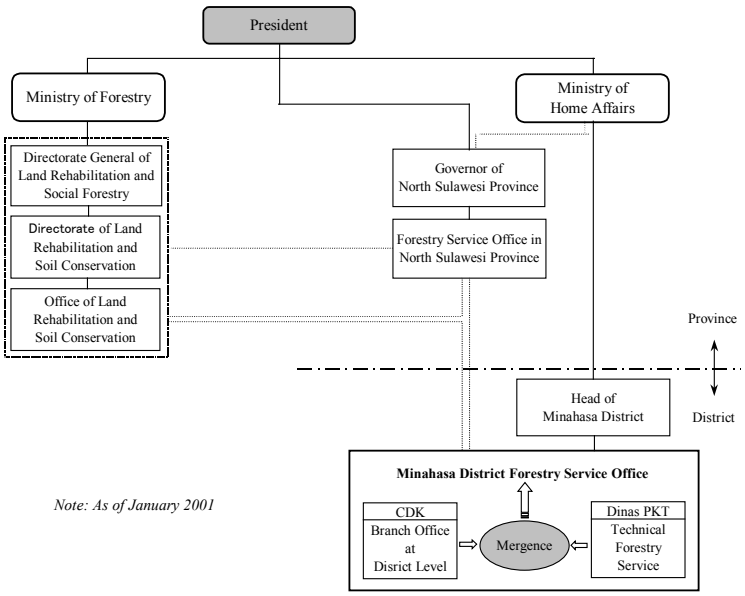
The Directorate General of Land Rehabilitation and Social Forestry (DGLRSF) of Ministry of Forestry (MOF) presently acts as a counterpart agency to the JICA Study Team, and also as a coordinating body in relation with other governmental and non-governmental organizations concerned for the smooth implementation of the Study. When the project implementation is started, however, the Minahasa District Forestry Service Office will serve as an executing agency according to the current decentralization policy. However, there may be a plan to establish a new unit to serve a project implementation function due to the weak management ability of the District Office. This institutional matter is still unstable presently.

The major government agencies related to the Study are explained hereinafter. Major duties and functions of respective agencies are given in Table II-1.11.1.

(1) Relation among Government Agencies on Forestry related to the Study

Presented on the following page is a showing chart relation among relevant government agencies to the Study since reform of the cabinet and promulgation of the decentralization policy. By following the decentralization policy, the district branch office of the Provincial Forestry Service Office in North Sulawesi Province and Technical Forestry Service Office have been merged into Minahasa District Forestry Service Office. Minahasa District Forestry Service Office is thus responsible for all the administrative activities on forestry at a district level.

Relation Chart among Government Agencies related to the Study



Note: As of January 2001

On the other hand, *BRLKT* was previously subordinate to the Regional Forestry Service Office of MOF in North Sulawesi Provision, but is now within the Directorate of Land Rehabilitation and Soil Conservation.

(2) Ministry of Forestry (MOF)

In November 1998, Ministry of Forestry and Estate Crops (MOFEC) was reformed by merging the Directorate General of Estate Crops of Ministry of Agriculture into the Ministry of Forestry under the reform plan of central government. In November 2000, however, the Ministry of Forestry (MOF) was restored. The structure of MOF as of January 31, 2001 is given in Figure II-1.11.1. MOF has 3 Directorate Generals, 2 support agencies, and 3 special purpose centers. The Secretariat General provides administrative support, and the Inspectorate General supervision and control while the Directorate Generals implement department policy and programs. The agencies provide specialist support for the department in, for instance, such fields as research and development, education, training and extension. The Secretariat General is divided into bureaus, typically for planning, personnel, finance, general affairs, law and organization, and public relations. The Inspectorate General has a Secretariat and 4 Regional Inspectorates. Each Directorate General consists of a Secretariat and a number of Directorates. The Directorates consist of an Administrative Division and Sub Directorates divided into several sections. The organizational structure of the support Agencies and Center is less uniform, depending on the purpose and function of Agencies. The Minister of MOF is supported by 5 Senior Advisors.

(3) Directorate General of Land Rehabilitation and Social Forestry (DGRLSF)

DGRLSF is one of 5 Directorate Generals of MOF. DGRLSF consists of 5 Directorates, 5 Divisions, 14 Sub Directorates, 15 Sub Divisions, and 39 Sections as shown in Figure II-1.11.2. *BRLKT* belongs to the Directorate of Land Rehabilitation and Soil Conservation of DGLRSF.

(4) Regional Forestry Service Office (*KANWIL*)

The Regional Forestry Service Office was a territorial office of MOF, but it was merged with the Provincial Forestry Service Office in January 2001.

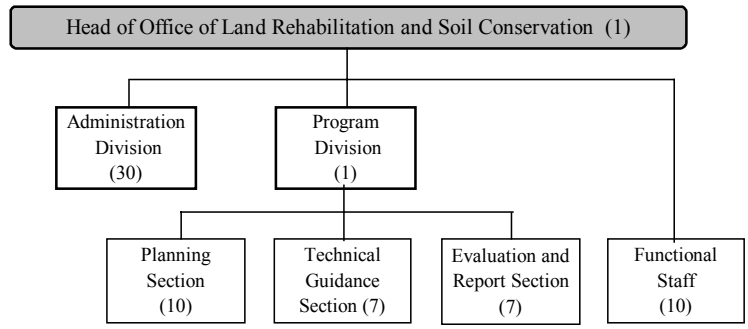
(5) Office of Land Rehabilitation and Soil Conservation (*BRLKT*)

BRLKT is a technical implementation agency of MOF and responsible for DGLRSF. *BRLKT* administers land rehabilitation and conservation activities in the river basins of 26 regions in Indonesia.

BRLKT will also provide technical support to the Forestry Service Office in Minahasa District.

The organizational structure of *BRLKT* Manado consists of a Head of Center, 2 Divisions, 3 Sections and 10 Functional Positions as shown below. The number of staff including the Head is 66 in total, as of January 31, 2001.

Office of Land Rehabilitation and Soil Conservation



Figures parenthesized mean the number of staff. *Note:As of January 2000*

(6) Provincial Forestry Service Office in North Sulawesi Province

The Forestry Service Office in North Sulawesi Province belongs to the Provincial Government. The organizational structure of the Forestry Service Office as of January 31, 2001 is composed of one Division, 5 Departments, 5 Sub Divisions, 19 Sections, and 4 Branch Offices as shown in Figure II-1.11.3.

(7) Forestry Service Office in Minahasa District

The Forestry Service Office in Minahasa District administratively belongs to the District Government, which is presently strengthened under the decentralization policy. The organizational structure of Forestry Service Office in Minahasa District as of January 31, 2001 is composed of one Division, 6 Sections, 8 Sub-Sections, and a number of Functional Forestry staff. Also, the Technical Implementation Unit and Branches are subordinate to the Office. Figure II-1.11.3 shows its organizational structure.

(8) Major Current Problems

Due to the decentralization policy, authority has been gradually transferred to the District level. However, District Offices still use the previous regulations/decrees because the new ones have not yet been issued. In addition, it is deemed that the District Office would need capacity building to elevate the management ability, especially for project implementation.

II-1.11.2 Community Organizations in Minahasa

Community organizations in Indonesia can be classified into two types according to their origins of establishment. The first type is community organizations that are established mainly through government initiatives. The second type is established through community self-effort.

The government implemented several programs to establish government-initiated organizations in every village. Generally, the government-initiated organizations have a characteristic of top-down management. Annual budget for those organizations is provided from the central government as a part of village development fund. The table below shows the number of those organizations in the Study Area.

Number of Community Organization and Village with Comm. Org. 1997

Sub-district	# of Total Village	Social Welfare Group (# Village)	Youth Org. (Karang taruna) (# Group)	Scout Group (Pramuka) (# Village)	Women Group (PKK) (# Village)	Village Security Org. (# Village)
Langowan	28	28	28	0	28	28
Kakas	20	22	20	19	20	7
Tompaso	11	11	11	11	11	10
Remboken	11	11	11	3	11	10
Tomohon	34	34	33	33	33	32
Tondano	17	17	17	17	17	4
Toulimambot	14	0	14	12	14	9
Eris	7	7	7	7	7	3
Kauditan	19	19	19	19	19	11
Airmadidi	20	20	20	20	20	8
Pineleng	17	16	17	13	17	2
Total	198	185	197	154	197	124

Source: Hasil Evaluasi dan Analisa Hasil Pembangunan Kabupaten Minahasa Tahun 1997/1998

There is an association called *LKMD* (*Lembaga Ketahanan Masyarakat Desa*). The purpose of *LKMD* is to assist the head of village by providing advice on development planning or arrangements for village programs and solution to problems, if any. The members of *LKMD* consist of informal local leaders, including customary leader, retired principals, teachers, church leaders, and former village head. Village officials and representatives of women groups are often listed as members of *LKMD*.

In the Study Area, all villages have *PKK* and youth organizations, except one village in Kecamatan Tomohon. The activeness of these organizations heavily depends on their leaders, most of who are the head of village or his/her spouse. There are some in active *PKK* and youth organizations that virtually exist only by name.

Scout organizations are usually established through the leadership of school at different levels (elementary to university). Thus, the number of scout organizations often corresponds to the number of school in the area.

To guard a village and its residents against disturbers or criminal actions, the

government created security organizations led by head of village. The members of security organizations are selected from the residents in the village. Tondano Sub-district has the lowest percentage of security organization per population and Langowan Sub-district has the highest number.

Community-initiated organizations are often established through the leadership of religious groups. Local population groups themselves by age and sex as a child group, teenager group, youth group, women group and men group. The activities of these groups involve worship and other religious events. These religious organizations are structured in certain hierarchy, comprising the lowest level groups at the village level to the highest level (regional level and central level). The fund for their activities comes from the members, but direct expense often comes from church.

II-1.11.3 Voluntary Organizations in Minahasa

In the agricultural communities, there are voluntary organizations known as mutual community aid. Mutual community aid are informal, institutionalized organizations called upon on an ad-hoc basis. The community, usually with the leadership of certain personnel, encourages the member of the village to participate in activities such as collective agricultural work, regular social gatherings for *arisan*, family or kinship ceremonies, worship and others social activities. Mutual community aid is also used for collecting a social fund to provide financial support to needy families in the community.

According to the Wahongan study report, mutual community aid is fading out in North Minahasa and has survived in Central and South Minahasa. The weakening of mutual community aid activities is accompanied by a shift from labor-intensive mutual community aid to social gathering. Some factors affecting the shift especially in the North are: increasing education level, dissemination of modern technology and prevalence of monetary market. However, mutual community aid activities still occur in wedding and funeral activities in North Minahasa. The role of women is increasing in this new pattern of mutual community aid.

There is another voluntary organization known as voluntary labor service. The voluntary labor service is called upon for public works such as the rehabilitation of village roads, churches, village halls, and school facilities. Usually the leaders in the village or religious sector mobilize the community members for voluntary work. The participation of labor service, though voluntary, is seen as a duty for community's common good. Each head of family in the village feels peer pressure. When he or she cannot participate in the labor service, someone else from the family must replace

them. Women prepare meals or snacks for the participants of labor service.

II-1.11.4 Cooperatives and User Organizations in Minahasa

With the initiation of Indonesian government, *KUD* (Village Unit Cooperatives) was established for mainly the distribution of agricultural inputs and marketing of agricultural products. *KUD* buys farm products from its member farmers and sell them to the government. In this sense, *KUD* activities are the key component in the national food distribution policy. Regardless of their membership, farmers can purchase farm inputs from *KUD*, including fertilizers, insecticides and seeds.

Number of KUD and Cooperatives by District in Minahasa, 1997

District	KUD	Non KUD	Total
Langowan	4	7	11
Kakas	7	7	14
Tompaso	2	1	3
Remboken	3	4	7
Tomohon	9	32	41
Tondano	6	43	49
Toulimambot	5	6	11
Eris	5	5	10
Kauditan	8	49	57
Airmadidi	4	14	18
Pineleng	3	2	5
Total	56	170	226

Source: Pendataan Profil Kecamatan, 1997

Recently, the establishment of *KUD* was called to a halt. Instead, specialized cooperatives have been established. The specialized cooperatives are known as non-*KUD*, and include producer cooperatives, marketing cooperatives, multi enterprise cooperatives, and credit cooperatives.

In 1985, the government established Farmer Water User Association (*P3A*) in Minahasa in accordance with the technical irrigation development plan. The association aims at the proper management in the construction and maintenance of irrigation facilities and water. In general, the associations have a greater number of members in areas with extensive wetland cultivation. The government officials often control the associations dominantly with weak participation of water users (farmers). In many instances, the associations are still inactive and have not implemented institutionalized programs or projects in Minahasa.

Number of Water User Association in Minahasa 1997

Sub-district	Number
Langowan	0
Kakas	2
Tompaso	1
Remboken	0
Tomohon	8
Tondano	0
Toulimambot	0
Eris	1
Kauditan	4
Airmadidi	0
Pineleng	0
Total	16

Source: Pendataan Profil Kecamatan, 1997

II-1.12 NGO Activities

There are a number of non-governmental organizations (NGOs) in North Sulawesi, according to NGO lists issued by the Social and Politic Directorate, Regional Social Office, and Regional Environmental Impact Prevention Agency (*BAPEDALDA*). In general, the NGOs are still underdeveloped; most of them have little or no permanent staff possibly with a few temporary staff members or volunteers who participate in certain activities, if any, on an ad hoc basis. The numbers of staff members vary from one NGO to the other, depending on the amount of funds and number of activities. Based on our telephone survey, most NGOs in the table above are inactive and existing only by name.

A number of NGOs in the area during the last decade were established in connection with a program known as *KUT* (Farm Enterprise Credit Programme). The government launched *KUT* after the economic crisis in Indonesian, and the program aims to give credit for farmers as agricultural capital. The government delegated to NGOs to channel credit to farmers. Most NGOs established through *KUT* failed mainly due to the delinquency of their credit. Many of them were established prematurely and recklessly and often lack organizational capability to manage their security. Only a small numbers of these organizations could have been able to endure for a long time, and the majorities are inactive at present.

The relationship between NGOs and the government in general is fair as long as the NGOs' activities do not contradict government policy or government interests. The fair relationship between NGOs in the area and the government does not mean that they have been collaborating with each other. In general, the government just accepts the existence of NGOs without providing any institutional or program support to them.

CHAPTER II-2 BASIC APPROACH TO THE MASTER PLAN STUDY

II-2.1 Findings Obtained through Survey and Investigation

The Study has started to grasp the present condition of Tondano watershed. As a result, it has been recognized that the severe soil erosion in the Study Area and sedimentation in Lake Tondano do not presently occur as discussed in detailed in Chapter II-1. The critical land, which is defined as having no or minimal production function due to damage, according to the Field Technical Plan for Land Rehabilitation and Soil Conservation, is currently very limited in the Study Area. The protection forest, which occupies 6.7% of the Study Area, does not present severe damage, although it has been encroached, and thus fulfills at least functions of soil and water conservation now.

However, there would be still a possibility of soil erosion in the Study Area judging from steep and undulating topographic conditions, development possibility/risks and expansion possibility of improper farming practice. In particular, clove cultivation would have a risk of soil erosion unless appropriate farming practice is applied. The interview with farmers as well as Minahasa District Forest Service Office revealed that serious soil erosion occurred at the time of peak clove cultivation in the 1980's. At present, clove cultivation is inactive due to lower market prices. Its cultivation area is mostly covered with grass, which results in less soil erosion. But, it is clear that clove cultivation would be activated when its market price becomes attractive for farmers.

Some improper farming activities have been observed on very steep parts of the Study Area. These would bring about soil erosion, although they are presently only occurring on a small-scale. It is reasonable to expect that such land misuse would be expanded by population pressure.

The water quality test results show that the lake water has increasingly deteriorated mainly due to in-flow domestic wastewater, accumulated eroded organic soil on the lake, and excess feeding of fish culture.

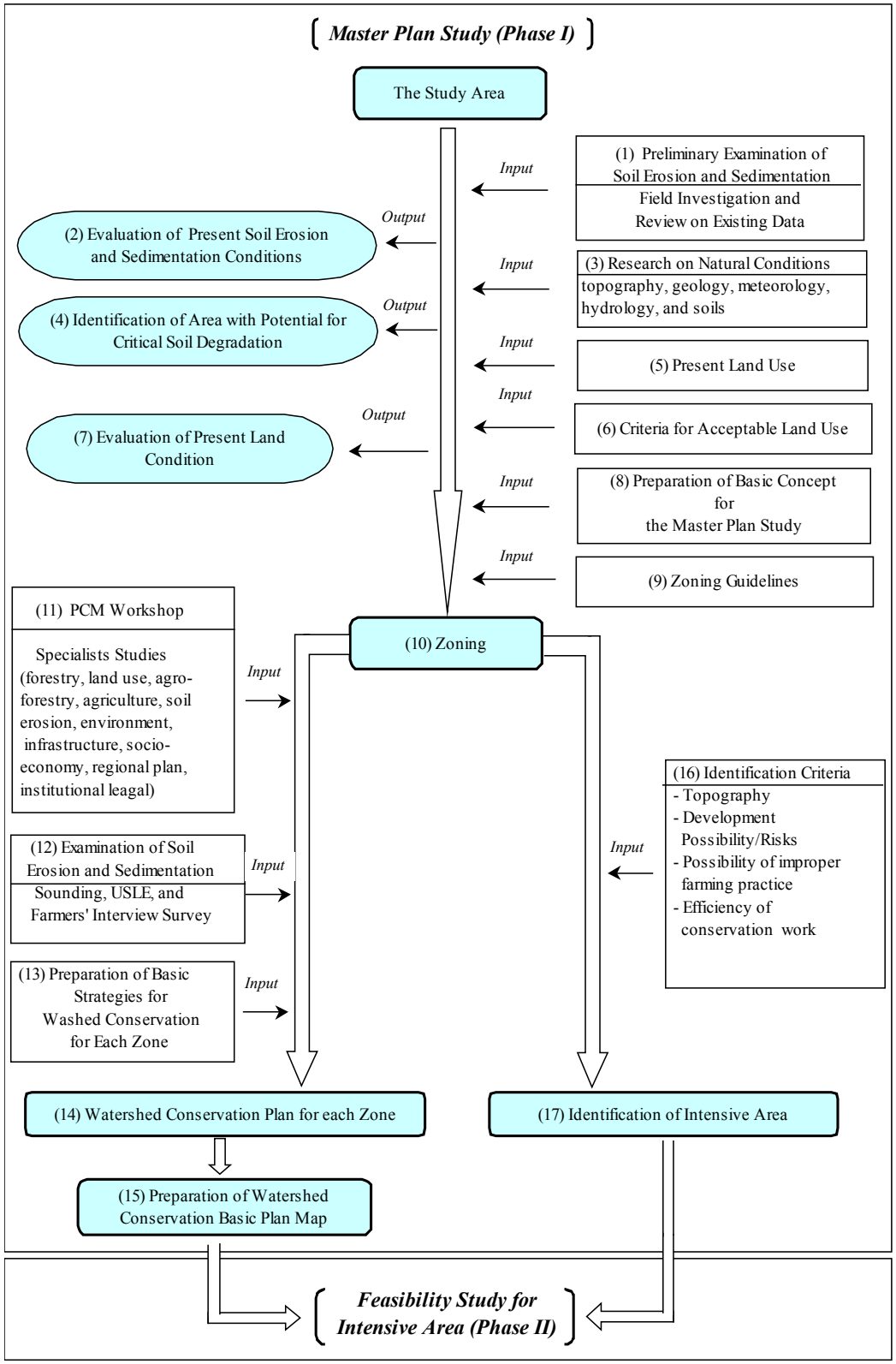
On the other hand, there is a development plan for the *KABIMA* (Kauditan-Bitung-Kema) industrial zone in North Sulawesi Province. In this development plan, Tondano watershed is expected as a hinterland area for supporting this development plan, especially for water supply.

From these findings, it has been duly confirmed that the Study Area would have a high potential of watershed degradation, which would lead to serious sedimentation in Lake Tondano, and also that the sound condition of Tondano watershed is essential for regional development.

II-2.2 Basic Approach to the Master Plan Study

All the activities executed based on the basic approach to the Master Plan Study is briefly mentioned below:

Basic Approach to Master Plan Study



(1) Preliminary Examination of Soil Erosion and Sedimentation (Input)

The present condition of soil erosion and sedimentation at Lake Tondano will be preliminarily made through site inspection and review on the existing data.

(2) Evaluation of Present Soil Erosion and Sedimentation Conditions (Output)

The present soil erosion and sedimentation condition will be evaluated from the results of examination mentioned above. In case there will not find serious soil erosion in the Study Area at present, a study should be made for a possibility of soil erosion from topographic conditions, development possibility/risks and expansion possibility of improper farming practice.

(3) Research on Natural Conditions (Input)

Rainfall, soil, topography and vegetation are key factors in influencing soil erosion. Rainfall data will be collected from meteorological stations in and around the Study Area. Soil characteristics will be determined based on existing soil maps. Topographical characteristics such as slope gradient and slope length will be basically studied by a set of 1:50,000 topo-maps. In particular, slope gradient will be measured by counting the number of contour lines in the element having a side length of 465 m each on latitude and longitude directions on the topographic map. Slope length will be determined by measuring number of ridges in each element on the topographic map and confirmed by field observations. Vegetation, which is a decisive factor of the amount of erosion, will be confirmed by field observation.

(4) Identification of Area with Potential for Critical Soil Degradation (Output)

A map of area with potential for critical soil degradation will be developed by means of overlaying maps showing the natural conditions mentioned above.

(5) Present Land Use (Input)

The legend for the present land use of the Study Area will be selected based on the "Balsem and Buurman Classification", which is also adopted by MOF. The legend to be selected will be a) Natural / semi-natural forest, b) Secondary forest, c) Planted forest, d) Estate, e) Mixture of Estate and Arable upland, f) Arable upland, g) Paddy field, h) Swamp, i) Water body, j) Pasture and k) Settlement and others. A present land use map will be prepared.

(6) Criteria for Acceptable Land use (Input)

To prevent the area from deterioration, the criteria for land use should aim to minimize

the soil loss in Tondano watershed. The criteria will be prepared with prerequisite of employment of erosion control measures appropriate to the slope gradient.

(7) Evaluation of Present Land Condition (Output)

Present land use will be evaluated in accordance with the criteria for land use. The field condition under present land use will also be discussed based on the results of the site inspection.

(8) Preparation of Basic Concept for the Master Plan Study (Input)

From the results of study on the present watershed condition, the basic concept for the Master Plan will be prepared taking into due account the risks caused by watershed degradation

(9) Preparation of Zoning Guidelines (Input)

Zoning guidelines will be worked out in consideration of the basic concept for the Master Plan. The zoning guidelines would consist of main elements supporting the basic concept, criteria of zoning and evaluation on each criterion. In evaluation on each criterion, a map showing distribution of each criterion will be prepared, and an evaluation map will be developed by overlaying them.

(10) Zoning (Output)

Zoning will be carried out on the basis of this evaluation. Triple overlaid areas seem to have high priority to be protected in watershed conservation. Double overlaid areas have second priority for conservation measures. The Study Area would be classified into some zones such as Protection Zone, Buffer Zone, Farming Zone, and Settlement Zone. A zoning map will be prepared.

(11) PCM Workshop (Input)

Through the PCM workshop, a project framework for "The Study on Critical Land and Protection Forest Rehabilitation at Tondano Watershed in the Republic of Indonesia" will be formulated.

(12) Examination of Soil Erosion and Sedimentation (Input)

1) Estimate of soil erosion by USLE

Soil loss in the Study Area will be estimated using the Universal Soil Loss Equation (USLE, Soil Loss = RKLSCP, where, R: rainfall and runoff factor, K:

soil erodibility factor, L: slope length factor, S: slope steepness factor, C: cover and management factor and P: support practice factor).

In the use of USLE, careful attention will be paid to the determination of factors mentioned above, to estimate more accurate soil loss. Out of 6 factors, R, K and S-factors could be rather mechanically determined from hydrological data, soil map and topographic map. But the remaining L, C and P-factors are closely related to the cropping schedule and farming practice, and thus should be determined by careful field observation.

2) Farmers' interview survey

The farmers' interview survey will be conducted among 100 householders in 5 villages scattered throughout the whole Study Area. The survey aims to grasp the living conditions, household economy, farm area per farm household, cultivated crops, harvested area of crops, marketing, etc. In this survey, the farmers will also be questioned about soil erosion condition on their farm land and consumption of fuel wood.

3) Sounding (Bathymetry) in Lake Tondano

A sounding (bathymetry) in Lake Tondano will be carried out, to grasp its sedimentation condition by means of comparison with existing results of sounding (bathymetry). As of now, there are 3 results of sounding (bathymetry) in Lake Tondano in the hands of the JICA Study Team. These are results of sounding by *PLN* in 1990 and 1994, and by *PU* in 1996.

(13) Preparation of Basic Strategies for Watershed Conservation for each Zone (Input)

Under the basic concept for the Master Plan, basic strategies for watershed conservation will be prepared for each zone taking into consideration the results of field investigation, study on data collected and PCM workshop.

(14) Preparation of Watershed Conservation Plan for each Zone (Output)

A basic watershed conservation plan for each zone will be prepared based on the basic strategies.

(15) Preparation of Basic Watershed Conservation Plan Map (Input)

Mapping of the basic watershed conservation plan will be made taking into account the zoning and conservation plan for respective zones. The map will show the various conservation plans for respective zones.

(16) Identification Criteria (Input)

The Intensive Area will be selected from the catchment area of Lake Tondano as the results of discussion with MOF and the Working Committee. Prior to identification of Intensive Area, the identification criteria will be established.

(17) Identification of Intensive Area (Output)

The Intensive Area will be identified from the Study Area in accordance with the said criteria.

CHAPTER II-3 WATERSHED CONSERVATION BASIC PLAN FOR THE STUDY AREA

II-3.1 Basic Concept of Watershed Conservation Basic Plan

In the Inception Report, the basic concept for the Master Plan was ascertained as "(to) seek for the comprehensive solutions to the problems (in respect to Tondano watershed management) from not only the technical point of view, but also taking into consideration the socio-economic, environmental, cultural and judicial aspects. Also, the Report proposes that the Master Plan for the Tondano watershed management should be prepared from the viewpoint of middle- and long-term land use through discussion with the government agencies. Based on these concept and proposal, a series of consultation meetings have been held among related organizations, agencies, individuals and the JICA Study Team, to deepen mutual understandings on the Study. The participatory research methods along with the thorough technical investigations have been employed for the Study, aiming to unify the opinions on problems and their countermeasures for the Study Area.

The Study has confirmed the importance of the Tondano watershed area. People in the area with two large cities of Manado and Bitung, are largely blessed with the water from Lake Tondano for their drinking water, electricity generated by hydroelectric plants, fishery products, leisure and economic activities including farming, aquaculture and tourism. In addition, the Study has recognized that Tondano watershed is indispensable for industrial development of *KABIMA* as a supporting water source. The Study has also verified the uniqueness of the watershed area, displaying its potential and fragility simultaneously. On one hand, the watershed embraces a great potential as a source of development. On the other hand, the watershed faces enormous risks of degradation, such as soil erosion and sedimentation. Because of the economic and social contribution of the lake, North Sulawesi Province, community organizations and foreign donors are keenly concerned with the conservation and maximum utilization of the watershed.

The area has a long history of human habitation with extensive farming and settlement. Since colonial times, the introduction of cash crops such as cloves, coffee, cocoa and coconuts has been prevalent in the area, which had caused the watershed degradation. Although the intensity of cash crop cultivation seems to be relaxed to a certain extent at present, the potential of future degradation is rather higher than before given the situation, in addition to the physiographic and meteorological features, where the waves of industrialization and global capitalism have been approaching the area. Improper land use can be provoked considering the given situation.

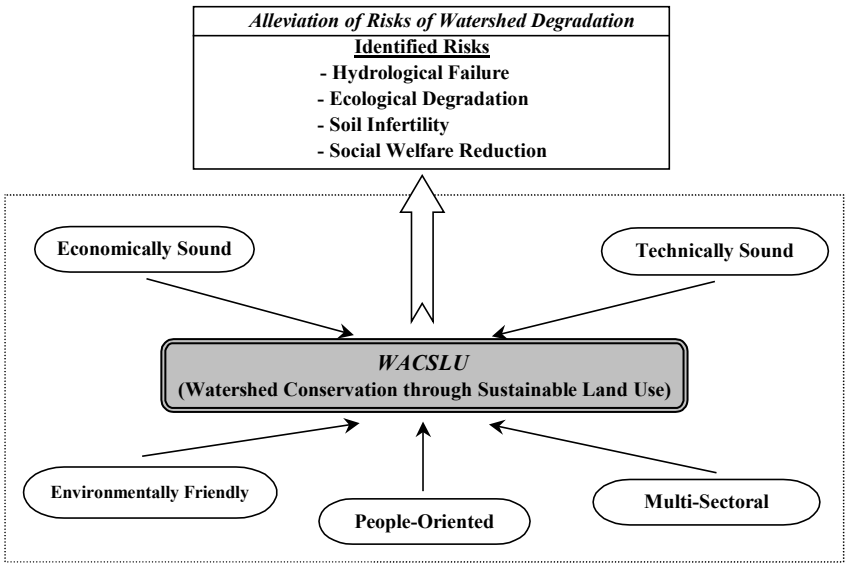
Watershed degradation, when it occurs in an area, results in the marked change in the hydrological behavior of a river and groundwater system, which will be consequently followed by the inferior quality, quantity and timing of water flow within the watershed. Watershed degradation also leads to accelerate ecological degradation, which in turn creates environmental problems and social welfare decline. Watershed degradation, therefore, reduces the productivity/fertility of land and water, and economic opportunities of the population.

The results of the field work and consultation meetings with the stakeholders inspired our creativity for forging the solutions, and the JICA Study Team has elaborated the basic concept of the Master Plan in line with the research approach described above. ***"Sustainable Land Use"*** has been selected as the banner of our Master Plan with an emphasis on comprehensive measures to enhance the hydrological function of the watershed and to prevent further environmental degradation. During this reporting period, the JICA Study Team has identified the promotion of sustainable land use as the most effective approach to alleviate the potential watershed degradation because land use directly relates to the source of problems.

The JICA Study Team has identified the five elements of watershed degradation: hydrological failure, ecological degradation, soil infertility and social welfare reduction. In order to alleviate the risks of each element, the JICA Study Team has worked out a plan based on a concept of *"**Watershed Conservation through Sustainable Land Use (WACSLU)**"*.

Image of WACSLU

The concept of WACSLU consists of five elements as shown below.



(1) People-Oriented

WACSLU puts people first. The plan has been worked out considering villagers as not only the beneficiaries, but also the major driving force for watershed conservation. Active participation and empowerment of villagers are indispensable for WACSLU as people can help themselves in a bottom-up manner. The socio-economic aspects should therefore be emphasized in the plan.

(2) Technically Sound

WACSLU emphasizes the importance of appropriate technologies for watershed conservation. In selection of appropriate technologies, consideration shall be given to the combination of modern technologies and indigenous knowledge, so as to be easily handled by people. However, the scope of WACSLU is not limited to application of technologies. The dissemination of sustainable land use technology through the enhancement of extension services should be also considered as a key to watershed conservation.

(3) Economically Sound

WACSLU is concerned with the economic sustainability of land use. The land use that is economically sustainable can provide people with incentives for the implementation of the plan. WACSLU seeks the economic benefit for villagers both in the short and long runs.

(4) Multi-Sectoral

Successful watershed conservation requires an integrated approach. Forestry, agriculture, public works, planning, education, and others from both public and private sectors should work hand in hand for the promotion of sustainable land use. WACSLU emphasizes the collaboration among concerned agencies and individuals from different sectors.

(5) Environmentally Friendly

WACSLU embodies environmental sustainable watershed management. A well-managed watershed guarantees a good hydrological regime, a sustainable ecological system, and proper land conditions. WACSLU converts critical lands into environmentally appropriate conditions and expands forest functions in the area.

II-3.2 Proposed Zoning of the Study Area

II-3.2.1 Zoning Guideline and Method

The purpose of this Master Plan is to achieve ***sustainable land use*** by preventing the creation of critical lands. Critical lands should be considered from the viewpoints of both vegetation and land productivity (including water resources). It should also be considered, of course, that sustainable land use is for local residents in the Study Area. Zoning of the Study Area is thus done taking into account the purpose mentioned above. The flow of zoning process is shown in Figure II-3.2.1. Considering the land evaluation system adapted by *BRLKT*, a simple scoring method has been employed for this zoning.

On the basis of the study of the present condition of the Study Area, it was considered that the main elements, which support ***sustainable land use*** in the area, were these three as follows:

1) Sound hydrological condition
2) Sound ecosystem
3) Soil fertility

Therefore, in addition to potential for soil degradation evaluated using 3 indicators i.e., rainfall, slope gradient, and soil type, 2 other criteria, sensitivity of hydrological cycle and fragility of ecosystem, have been taken to reflect these important factors to the Master Plan aiming at sustainable land use.

1) Sensitivity on hydrological circle
2) Fragileness of ecosystem
3) Potential for soil degradation

Then evaluation on each criterion has been carried out in the following process.

1) Distribution of sensitive area on hydrological circulation

The identification of hydrologically sensitive areas such as headwater in steep slopes and river shore is selected. The distribution is shown in Figure II-3.2.2.

2) Distribution of fragileness of ecosystem

A few studies have been carried out to describe the ecosystem and bio-diversity of the Study Area. Areas covered with natural vegetation are assumed to have a comparatively high bio-diversity and these areas are rather fragile and sensitive to human disturbance. Although most of the Study Area has been affected by human activities, a less disturbed area is selected as an area with high bio-

diversity on a basis of the land use map shown in Figure II-1.4.1. Those are Natural/semi-natural Forest, Secondary Forest, and Swamp.

3) Distribution of area with potential for critical soil degradation:

The identification of potential critical areas for soil degradation has been made on the basis of slope gradient, rainfall, soil type, and geological aspect. The result is shown in Figure II-1.8.1. Criteria used for determining recommended land use in *POLA RLKT* e.g. climate/rainfall, soil types, and slope is included and reflected in this criteria.

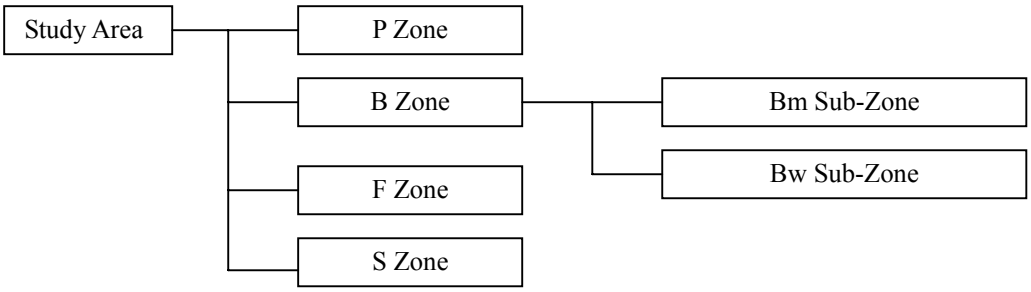
After producing the three maps mentioned above, they were overlaid and an evaluation map of the sensitivity area for sustainable land use was produced. In the map, areas of these criteria have been identified as highly sensitive areas.

The study area was then zoned on the basis of this evaluation map. Areas making all these conditions have the highest priority for protection in watershed management. Then double overlaid areas have second priority for conservation measures. At this time, not only a result of the evaluation map but also continuity of the area and present boundary of protection area should be considered for effectiveness of the Master Plan. It should also be kept in mind that areas alongside rivers are designated for protection from tree cutting by the new forestry law.

II-3.2.2 Zoning of the Study Area

A map showing all these conditions mentioned in the previous section is provided as Figure II-3.2.3. Sensitive areas for watershed conservation have been identified. Most of them are distributed along a fringe of the Study Area. A zoning map has been prepared using the evaluation map, as shown in Figure II-3.2.4. The Study Area has been classified into four zones: P Zone, B Zone, F Zone, and S Zone. The B zone has been further divided into Bm Sub-Zone and Bw Sub-Zone (See following figure). P Zone and B Zone have been selected on the basis of the evaluation map and other factors mentioned in Sub-Section II-3.2.1. On the other hand, the rest of the Study Area has been designated as F Zone and S Zone. Demarcation of F Zone and S Zone is on the basis of present land use. The characteristics of above-mentioned zones are summarized in following table.

Structure of Proposed Zoning



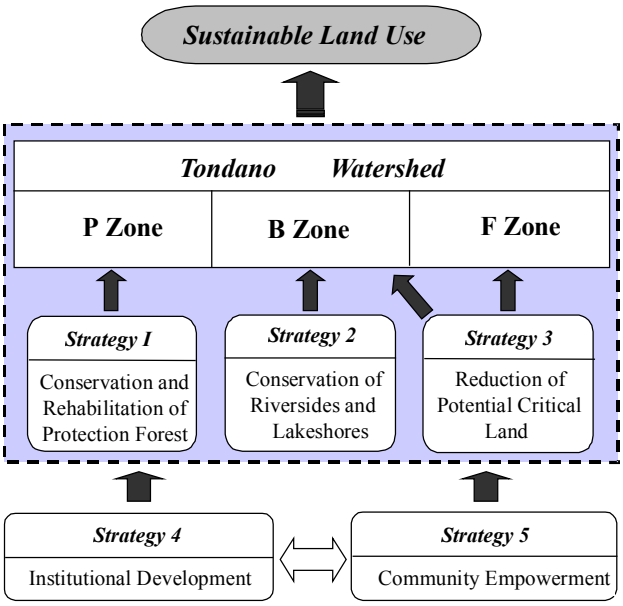
Characteristics of Proposed Zoning Categories

Zone	Characteristics	Area (ha)
P Zone	Protection is the main consideration. Slope gradient is more than 40%. Mainly covered with forest vegetation.	4,361
Bm Zone	Agricultural use with care about land conservation is acceptable. Slope gradient is between 8 and 40%. Mainly used for agroforestry and agriculture.	19,479
Bw Zone	Conservation for waterfronts is main consideration. Shore of Lake Tondano and river banks are included.	3,266
F Zone	Intensive agriculture is acceptable. Slope gradient is less than 8%. Mainly used for cultivation.	20,183
S Zone	The area for settlement.	2,828
	Total	50,117

II-3.3 Strategies for Watershed Conservation Basic Plan

Based on the principles and objectives of WACSLU, the strategies for watershed conservation plan, have been identified as illustrated below.

Strategies of WACSLU



As can be seen in the above illustration, the proposed strategies are:

(a) P Zone
- Strategy 1: Conservation and rehabilitation of protection forest,

(b) B Zone
- Strategy 2: Conservation of riversides and lakeshores,
- Strategy 3: Reduction of potential critical land,

(c) F Zone
- Strategy 3: Reduction of potential critical land,

and Strategy 4: Institutional development and Strategy 5: Community empowerment will be applied for all Zones, to fulfill Strategies 1 to 3 effectively.

II-3.4 Watershed Conservation Basic Plan for Respective Zones

II-3.4.1 Basic Plan of Watershed Conservation Measures

(1) Soil Loss Tolerance Limit

As mentioned before, the Study Area, especially the Lake Tondano watershed does not experience severe soil erosion at present. But the lower watershed has slightly higher soil loss according to the estimation by USLE as shown in Figure II-1.8.2. Therefore, the soil loss for these areas shall be so reduced as to meet the following tolerance limit:

Guide for Determining Tolerable Soil Loss for Indonesian Soils

No.	Soil Properties and Substratum	TSL*	
		(mm/year)	(t/ha/year)
1	Very shallow soil overlying rock	0	0
2	Shallow soil overlying rock	no data	
3	Very shallow soil overlying weathered rock (unconsolidated)	0.4	5.2
4	Deep soil overlying rock	no data	
5	Shallow soil overlying weathered rock	0.8	10.4
6	Moderately deep soil overlying weathered rock	1.2	15.6
7	Deep soil with impermeable subsoil overlying weathered substrata	1.4	18.2
8	Deep soil with low permeable subsoil overlying weathered substrata	1.6	20.8
9	Deep soil with moderate permeable subsoil overlying weathered substrata	2.0	26
10	Deep soil with permeable subsoil overlying weathered substrata	2.5	32.5

**: Tolerable Soil Loss*

(2) Physical Measures

Watershed conservation intends to maintain the functions of forest and anticipate problems to prevent possible critical lands from deteriorating. Physical measures are characterized as offering results in a short period and which perform more efficiently when employed together with non-structural measures. In the area, however, only a

few structures have been constructed due to high construction costs. To save construction cost and to minimize maintenance and rehabilitation cost, it is proposed to employ structures made of locally available materials such as stone, bamboo, and logs. Several structural measures for conservation practice have been researched. The following table shows physical measures reducing potential erosion hazard.

Extent of Factors affecting Erosion Hazard Potential

Type of Erosion	Type of Measures
Soil loss from farmland	Soil conservation farming practice, terracing, gully protection, agroforestry, intercepting drains
Soil loss from estate	Terracing, agroforestry
Riverbed degradation	Cross structure on riverbed, check dams
Slope failure by riverbank erosion	Riverbank revetment, slope protection works, cross structure on riverbed, check dams
Debris flow, Lahar	Check dams
Slope failure on road cut slope	Slope protection works, intercepting drains
Slope failure on natural slope	Vegetation increase, slope protection works

(3) Soil Conservation Measures at Farm Land and Estate

Soil loss from the land surface occurs by a different mechanism than other kinds of erosion. It is caused by a combination of runoff and raindrop impact. The raindrop impact is a significant driving force on the soil loss. To reduce soil loss from sloping areas, soil conservation farming and supplemental practices are necessary depending on the gradient of the land surface, based on the following criteria:

Suitable Surface Soil Loss Control Measures/Land Use

Type of Conservation Measures	Surface Slope (%)				
	<8	8-15	15-25	25-40	>40
Annual crop farmlands	Soil conservation measures are not necessary	Soil conservation farming necessary and agroforestry applicable	Agroforestry with moderate land cover; Careful soil conservation farming with simple erosion control measures	Agroforestry with thick land cover ;Physical erosion control measures with soil conservation farming	Not suitable for farmland; remain permanent vegetation (Forest, etc.)
Estate and Pasture	Soil conservation measures are not necessary	Soil conservation measures are not necessary, but agroforestry applicable	Agroforestry with moderate land cover; Soil conservation measures:	Careful soil conservation farming with complete erosion control measures: Agroforestry with thick land cover	Not suitable for farmland; remain permanent vegetation (Forest, etc.)

(4) Agroforestry System

As a larger part of the Study Area is undulating and sloped agroforestry is one of the

most effective systems for soil conservation and increasing soil fertility and productivity. At present, agroforestry has already been introduced into the Study Area, but it is still primitive and certain improvements are required.

As mentioned in Sub-Section II-3.2.2, the Study Area has been divided into four zones: P Zone, B Zone, F Zone and S Zone. Out of them, the agroforestry system will be applied for P Zone, B Zone and F Zone.

The agroforestry system in the Study Area has a short history. Therefore farmers do not have adequate knowledge on more effective agroforestry systems. Suitable agroforestry systems should be determined based on the physical condition, required agricultural practices and soil conservation technology, social condition and the characteristics of each type of agroforestry system, as stated below:

1) Physical condition such as topography, soil characteristics and possibility of soil erosion,
2) Required agricultural practices and soil conservation technology, such as required vegetation, necessity of hedge crops and ridge row cultivation, and possibility of application of new technology,
3) Social condition such as access to the field and commodities, and
4) Characteristics of each type of agroforestry system such as productivity of each category of crops, level of soil erosion protection, and application of new cultural practices for herbaceous crops.

The evaluation of each component and the suitable agroforestry system for each area are shown in Tables II-3.4.1 and -2. Table II-3.4.1 shows that all the agroforestry systems are applicable for flat to gently sloped areas, but the higher productivity systems are recommended for this area. On the other hand, choosing an agroforestry system for sloped areas should be done with an emphasis on its ability provide resistance to soil erosion. The recommended agroforestry system by area is presented in Table II-3.4.3. Final selection of agroforestry system should be made by considering farmers' requirements and/or communities' requirements.

II-3.4.2 P Zone

(1) Strategy

Strategy 1 (Conservation and Rehabilitation of Protection Forest) has been applied for this Zone. Most of the existing protection forests are included in this zone. Although the protection forests in the Study Area are limited to small areas, it is important to revitalize the existing ones and prevent further deforestation. Thus from the outset, the

emphasis is put on the conservation and rehabilitation of protection forests as a crucial strategy for sustainable land use.

The first priority of this zone is to maintain a well-stocked forest stand. Enforcement of law, reforestation, and planting with people's participation such as community forestry (*Hutan Kemasyarakatan*) are possible strategies.

(2) Basic Conservation Plan

Based on the above-mentioned strategy to be applied to watershed conservation, the following schemes have been proposed.

1) Reforestation

The scheme for rehabilitating protection forests is called reforestation. The responsibility of this program is now handed over to the District Forestry Service Office. A review of the results of past reforestation shows that a certain area of the planted forest has already been lost by fire, cut down by farmers, and others. Educating local residents and capacity building for the staff of District Forestry Service Office are essential.

2) Enforcement of regulation

All protection forests are strictly protected to prevent any kind of deforestation activities in principle. Laws and regulations relating to protection forests are intended to be enforced by forest guard and police. Another approach is to educate the local residents not to disturb the protection forests through their understanding of the importance of the forest. Forest extension staff will have an important role in this process.

3) Community forestry

There is no community forestry established in the Study Area because the area of the protection forests is very limited and most of them seem to be distributed on steep slopes where is not suitable for social forestry activity. But this scheme may be adapted to some reclamation areas in the protection forests to prevent further destruction of the forests. Education of local residents should be carried out in parallel with the introduction of community forestry, and technical assistance by the government is also expected.

As one of the countermeasures to prevent further destruction of the forest, it is proposed to employ social forestry system by participation of inhabitants in this area. As inhabitants expect some returns from social forestry, it is recommended

to employ the agroforestry system, which has the same function of forestry for prevention of soil erosion and increasing waters storage. As the area is located on steep slopes, the tree/tree crop dominant agroforestry system, which is highly resistant to soil erosion, but not so high in productivity (Type I -3. -4), is recommended as shown in Table II-3.4.3.

4) Conservation facility

As mentioned previously, no distinctly damaged portions which need physical treatment, have been found in this one according to the preliminary field investigation in Phase I.

II-3.4.3 B Zone

Most areas within Tondano watershed are privately righted lands. Given this unique feature of the watershed, an innovative strategy is necessary in order to promote sustainable land use. The identified strategy was to expand areas with a "forest function," which means to provide the land with the capacity to hold water, prevent soil erosion, and increase soil fertility. Since the potential critical land is located in private areas, the means to promote proper land use should not be limited to reforestation but should also include technologies to enhance forest-like functions in agricultural and abandoned land.

B Zone in the Study Area is divided into Bm Sub-Zone and Bw Sub-Zone.

(1) Bm Sub-Zone

1) Strategy

Strategy 3 (Reduction of Potential Critical Land) has been employed for this Sub-Zone. Bm Sub-Zone is distributed below P Zone and has a function of "buffer" for P Zone. B Zone extends to the east and west sides of Lake Tondano and northern part of the Study Area. Some activities involving slight disturbance of ground surface and vegetation are acceptable with care. Agroforestry, proper farming practices, and planting with people's participation such as private forests (*Hutan Rakyat*) are possible strategies.

2) Basic Conservation plan

a) Private forest

Regreening (*Penghijauan*) and private forest (*Hutan Rakyat*) are government schemes for planting in private lands. These programs include not only planting itself but also civil engineering methods such as check dam. This program is a

very good opportunity for the education of local residents for propagating the importance of sustainable land use and reducing critical lands, because it can show the good effects of planting in the land of local residents. The Regreening Assistant Fund is provided by GOI, and this fund can be used to accelerate the planting activities of local residents. Agroforestry to be applied for private forests is discussed later.

b) Agroforestry

In Bm Sub-Zone, the area adjacent P Zone contains a similar vegetation type as that of the P Zone. Generally slope becomes more gentle with distance from P Zone, and the limitation for land use also decreases. Bm Sub-Zone is topographically divided into two areas. One is the sloped area adjacent the P Zone, and the other is the private forest area with gentle slope. In the sloped area near the P Zone, there will be a high potential for soil erosion under inadequate land use and improper farming system. Therefore, a proper land use plan should be established in these areas.

Right forest area

Some of the private forests are under good management and keep good forest capacity and productivity, but some of them are under poor management or no management and keep poor forest capacity and poor productivity. As the forest area is very small in the Study Area, only 9% of the total area, it is important to keep such existing forest areas. The forest area under good management is recommended to be kept as a forest area, while the forest area under poor or no management should be improved. For this purpose, it is applicable for poorly managed forest to adopt an agroforestry approach, as it will have the same function as forest in terms of soil erosion and water retention. The suitable type of agroforestry system for sloped area is multi-story tree garden (Type I -3, -4, -5) and for gently sloped area, multi-story tree garden (Type I-5) and/or non-dominant crop agroforestry system (Type III-1, -2).

Sloped area and the area around P Zone

The sloped area has a high potential soil erosion and, therefore, the land-use system which is resistant to soil erosion should be employed. The suitable agroforestry system is a tree/tree crop dominant type, especially a multi-story tree garden (Type I-3, -4 and -5). Vegetation in the area surrounding P Zone should be tree (tree crop) vegetation. Since P Zone is distributed in the steep sloped area, B Zone surrounding P Zone is also generally in the steep sloped zone.

Therefore a multi-story tree garden type agroforestry system is recommended for the areas adjacent P Zone. When annual crops or vegetables are cultivated in a sloped area, special technique are required for prevention of soil erosion such as contour ridge cultivation and hedge cropping. At present, agricultural production in the sloped area is stagnant and at a low level compared with the flat area because of land condition, poor crop management, poor access to the field, and long distance from settled areas. It is important to increase access by improving road conditions and constructing new roads for farmers to improve soil conservation and crop production. Though it is important to employ proper land use and proper farming system, it is also important to prevent soil erosion by physical and technical approaches such as construction of check dam and formation of terrace.

Gently sloped area and flat area

Generally, the slope decreases with distance from P Zone and limitation for crop cultivation also decreases by departing from P Zone. As potential of soil erosion in the flat or gentle sloped area is low, the highly productive agroforestry system, which is not highly resistant to soil erosion, could be employed. In the area, all the types of agroforestry system except herbaceous crop dominant agroforestry are applicable. Considering the characteristics of agroforestry type, the multi-story tree garden (Type I-5, -6) and non-dominant crop agroforestry (III-1, -2) could be recommended.

Fuel wood consumption in the Study Area is estimated by a farmers interview survey at some 40 kg per farm household per week and most farmers mainly collect this from their fields, estates and bushes. Therefore, it is recommended to employ multi-purpose trees for their agroforestry system not only to supply fuel wood but also to supply organic carbon to soil and to protect soil erosion. Especially, it is strongly recommended to employ hedgerow cropping by using leguminous trees, which increase soil fertility by fixing atmospheric nitrogen and supplying organic carbon.

c) Watershed conservation facility

Measures against soil loss from estate and arable upland

The proposed structural measures are infiltration trenches, grassed waterways, diversion ditches, contour dikes, intercepting ditches, and terracing drains.

Measures against slope failure

Slope failure is distinguished from landslide by its characteristics. Slope failure generally occurs suddenly with small indication, in sandy soils on steep slopes, since it is largely influenced by rainfall intensity. In the area, slope failure is distinct on the cut slopes along the road, especially on the slopes around Mt. Mahawu. On the other hand, it is care on the natural slopes in spite of a steep gradient. Most slope failures along the road are caused by misuse of slope shoulders; expansion of cropping land to the slopes and layout of channels on the shoulder. To reduce the misuse of the shoulders, it is proposed to teach the farmers not to use the shoulder for cultivation and to make the road boundary clear. In critical sections, it is recommended to construct low stone masonry walls along the toe of slopes.

Improvement of roads

Field observation has revealed that the existing minor roads need repair or rehabilitation because damaged surfaces of the road was disturbing traffic movement. Farm roads in estates sometimes bring about gully erosion in the estates. It is therefore recommended to place coconut logs on the road surface to reduce such erosion.

Infiltration ditches

Infiltration ditches are narrow trenches constructed along the contours to collect run-off and to conserve moisture for trees and tree crops. The trenches are to be constructed as a continuous line across an entire slope, over shorter distances, or for individual plants.

(2) Bw Sub-Zone

1) Strategy

Strategy 2 (Conservation of Riversides and Lakeshores) has been applied for this Sub-Zone. Bw Sub-Zone is distributed along the shore of Lake Tondano and alongside main rivers in the Study Area. Green belt, planting with people's participation such as private forests (*Hutan Rakyat*), and agroforestry are possible strategies.

2) Basic Conservation plan

a) Green belt along waterfront

Riversides and lakeshores usually have high bio-diversity and also play an important role in the daily life of local people. The method for creating green

belt should be carried out with people's participation approach because these areas of riversides and lakeshores are one of the most intensively used areas in the Study Area.

b) Agroforestry

In this Sub-Zone, agroforestry systems should be introduced considering topography and width of basin. Agroforestry is generally employed for wide basins along the lake. It is proposed firstly to establish green belt along the edge of the lake, except in swamp areas, and secondly, to employ the agroforestry system considering the land conditions. Tree/tree crop dominant agroforestry is recommendable; for the area, close to the settlement area, Type I-6 is recommended, and for the other area, Types I-3, and -4.

c) Inland fishery

Changing a view into the waterbody of Lake Tondano, the water quality of the lake has recently deteriorated due to human activities in and around the lake. The development of fish cultivation in cages at the lakeshore would be one such activity because a considerable amount of residual feed and fish dung would contaminate the lake water. Therefore the control of increasing cage cultivation in the future is an important countermeasure for the protection of water quality of the lake.

d) Watershed conservation facility

To strengthen and improve river channels against erosion, it is proposed to apply structural measures along with vegetative measures. The proposed measures are a) revetments to protect riverbanks from lateral erosion, cross structures fixing riverbed against riverbed degradation (vertical erosion), and b) check dams to regulate riverbed slope to stop channel and lateral erosion and occurrence of debris flow.

In minor ravines in the upper reaches with small discharge, water flow should be controlled by simple measures constructed using local materials such as soil, stones and boulders, brushwood, bamboo and logs.

II-3.4.4 F Zone

(1) Strategy

Strategy 3 (Reduction of Potential Critical Land) has been applied for this Zone. This zone distributed mainly on the south and north shore of Lake Tondano and the northern

edge of the Study Area. Intensive farming is acceptable but propagating proper farming practices such as contour farming is a possible strategy. Agroforestry systems are also applicable, but careful consideration shall be given to higher productivity to gain farmer acceptance since farming activities are presently conducted.

(2) Basic Conservation Plan

1) Agroforestry

In this Zone, intensive agriculture is acceptable, especially on flat areas. The farming pattern varies from area to area depending upon the natural and social condition. On flat areas, mono-cropping or mixed-cropping of annual crops under multiple cropping system is recommended. Agroforestry is also applicable. A suitable agroforestry system in the flat area would be the herbaceous crop dominant type (II-1, -2) and non-dominant crop type (III-1, -2). To provide fuel wood and maintain soil fertility, hedgerow cropping of leguminous trees is recommended.

In the sloped area, the non-dominant crop agroforestry system (III-1, -2) and tree/tree crop dominant agroforestry system (I-5, -6) are recommended.

2) Agriculture

Advanced farming practices for paddy and vegetables are now used in the area. However, other annual upland crops, especially maize, are extensively cultivated areas and the yields are low. Upland cropping over a large part of the area employs soil conservation techniques such as contour cultivation and hedgerow cropping, but these are still areas for improvement. As extensive maize cultivation sometimes accelerates soil erosion and decreases soil fertility, this farming practice should be improved for sustainable agriculture. For improving farming practices, it is necessary not only to increase yield but also to consider sustainability of agriculture. It is very effective for soil conservation and increasing soil fertility to employ contour ridge and hedgerow cultivation using multi-purpose *Leguminosae* trees.

In the larger part of the Study Area, coconuts and clove tree plantings are undergoing renewal. It is believed that the serious soil erosion that occurred for a few decades was caused by land clearance for planting clove and clean cultivation of clove. Therefore, it is recommended that planting of clove should be carried out without land clearance and after growing of cover crops, cereals or pulses. Clove seedlings should be cultivated in a clean circle at early growth but

never under totally clean cultivation. In addition, employment of ridgerow cultivation could be effective.

3) Watershed conservation facility

As mentioned in Sub-Section II-3.4.1, no soil conservation measures would be generally required since the slope gradient for this zone is gentle.

II-3.4.5 Watershed Conservation Basic Plan Map

The watershed conservation basic plan for the Tondano watershed has been prepared based on the strategies and conservation plans for each zone, as shown in Figure II-3.4.1.

Watershed conservation basic plan for the Tondano watershed has been formulated to protect the area from excective erosion. The watershed conservation basic plan has been mapped in accordance with the strategies and conservation plan for respective zones; P Zone, Bm Sub-Zone, Bw Sub-Zone, F Zone and S Zone. The conservation methods for respective Zones are mentioned below. Details are given in Table II-3.4.4.

(1) P Zone

P Zone consists of natural and secondary forest and is located mostly on very steep slopes (>40% gradient).

The purpose of P Zone is to maintain the forest function of runoff control, maintaining the original ecosystem, and maintaining land fertility. Control of runoff is due to high water holding capacity and high infiltration rate of the soil layer developed by the root system and accumulated fallen leaves.

The way to keep the function of the forests is to keep the forests from disturbance and to rehabilitate if necessary.

(2) Bm Sub-Zone

The Bm Sub-Zone consists of estates and arable uplands, some of which have been developed as agroforestry. The Sub-Zone occupies sloped areas, more than 15% gradient in estates and more than 8% gradient in arable uplands. Both slope limits are necessary for controlling erosion.

The purpose of the Sub-Zone is to minimize erosion hazard by conserving the forest functions of runoff control and maintaining land fertility.

The way to keep the Sub-Zone is as follows. First, maintain and increase tree

vegetation on the slopes of more than 25% gradient. Secondly, facilitate erosion control measures, including agroforestry, on slopes of 8 to 25% for arable uplands and 15-25% for estates.

(3) Bw Sub-Zone

Bw Sub-Zone consists of vegetated lands and wetlands, parts of which are forests and/or cultivated lands. The Sub-Zone occupies sloped areas along the river.

The purpose of the Sub-Zone is to keep the farmland and the slopes from erosion hazard and to reduce sediment yield to the lake and streams.

The way to keep the Sub-Zone is to provide a vegetational belt on the riverbanks and around the Lake. Also erosion control structures will be laid in the channels.

(4) F Zone

F Zone is considered to be acceptable for any type of land use without any particular concern for erosion hazard. Most of the Zone is used for paddy fields. The Zone occupies the area with less than 15% gradient in estates, and less than 8% gradient in arable uplands and paddy field.

The purpose of the Zone is to mainly produce farm products, including estate crops.

The way to keep the Zone is to sustain the productivity of existing farmlands by minimum erosion control measures if necessary.

II-3.5 Institutional Development

(1) Strategy

Strategy 4 (Institutional Development) has been applied. All development plans described above require a catalyst for their implementation. One of the means of implementation is institutional development. Institutional development means the improvement of organizational and inter-organizational capability to be able to analyze present conditions, identify problems, design programs, implement projects, monitor the progress and evaluate achievements. It requires structural development, policymaking, legal re-arranging and capacity building including training, managerial reengineering and financial restructuring. These developments need to be achieved not only within one specific organization, but also with cross-sectoral mechanisms consisting of several organizations and stakeholders.

It is important to stress that the institution for the implementation of this Master Plan should be multi-sectoral: various sectors (forestry, agriculture, public works, planning,

judiciary, education, industry and community development) should work collectively and develop a multi-sectoral institution for the promotion of sustainable land use in the area. As previously explained, one of the main pillars of WACSLU was the multi-sectoral approach since the multi-dimensional human activities have been prevailing in the Study Area. The institution, thus, needs to be inter-sectoral.

A specific development plan in respect of institutional development is explained as follows.

(2) Basic Development Plan

1) Structural development

A working committee has been formulated for the Study, and it functions as an advisory entity. The committee has provided its members with an arena for exchanging ideas and different viewpoints. For the implementation of the Master Plan, stress was put on the importance of the expansion of the committee possibly through the integration and/or coordination with existing inter-organizational establishment, such as *PPTPA* and *Tim Pembinc TKT I*.

The implementation of the Master Plan needs to involve regional and local governments. Related regional technical agencies should be part of the committee and supporting groups, governor, head of district, head of municipality and other local political leaders should play key roles in initiating and overseeing the implementation.

The Forestry Services Offices and the local community are particularly important given the progressing administrative decentralization in the country. Representatives from academe, schools, private sector and civil society (i.e., NGOs) should be involved and give input on their capacities.

2) Policymaking

In order for the multi-sectoral team to function, there has to be a clear guideline through which participating organizations can understand the direction and rationale of program implementation. For this, a policy with a clear vision and objectives needs to be formulated. The policy to be formulated should be endorsed by appropriate personnel with the description of the adequate task distribution and responsibility allocation.

3) Legal rearrangement

For an institution to operate, proper laws and regulations need to be put in place so that actions to be taken have proper legal bindings. Following the principles of new forestry laws and decentralization laws passed in 1999, local regulations and decrees should be issued for the implementation of the Master Plan.

4) Capacity building

For the effective and efficient promotion of sustainable land use in the watershed, each executing organization or group needs to improve its organizational capacity, including technical expertise, managerial capability, morale and financial capability. Specific activities for capacity building are: training (particularly technical training for extension workers and management training for managers), policy formulation, strategic planning, reallocation of managerial responsibilities, financial revitalization, incentive creation and the improvement of infrastructure (e.g., vehicles and office appliances).

II-3.6 Community Empowerment

(1) Strategy

Strategy 5 (Community Empowerment) has been applied. Institutional development is not the only vehicle needed for implementation. To carry out countermeasures/development components in protection, buffer and farming zones, active support and contribution from local population and groups are indispensable. The members of communities should be mobilized for the implementation because they are the ones who own and manage the potential critical land in Tondano watershed. Thus, a bottom-up approach, instead of a top-down approach, should be applied. For this, stress is placed on the importance of community empowerment to increase the capability of community organizations and local leaders.

The challenge that a community empowerment plan often faces is the lack of incentives of local people to participate to the programs. Therefore, a proposed plan should provide materials and operation funds necessary for the initiation of micro realization, as well as seed money for the micro credit component. These incentives should be carefully recommended concerning its sustainability. The materials should be inexpensive and locally available, and the credit fund should be managed and grow sustainably.

Nonetheless, the empowerment of local people and their participation is closely linked with institutional development. As a result of institutional development, when carried

out properly, government agencies and other organizations should be able to acquire the capability to encourage local people to join in the promotion of watershed conservation. The following is the concrete development plan of community empowerment.

(2) Basic Development Plan

1) Organizing watershed conservation groups

The promotion of sustainable land use needs collective actions. To empower the local population through organizing individuals is essential. The villagers can create new community groups for watershed conservation activities, or they can utilize existing community groups, when available and appropriate. Organizing collective actions for conservation might require certain external inputs, such as community organizers, training or physical investment. Implementers and supporters of the Master Plan shall be able to provide these inputs when needed.

2) Micro planning for sustainable land use

An empowered community should be able to develop its own plan for the promotion of sustainable land use. Creating a micro plan requires a systematic process, including the identification of problems, needs assessment, prioritizing, formulation of logical framework and designing a plan of operations, all of which shall be executed in a participatory manner. Micro planning requires the unity of the community, commitment, leadership and skills. Implementers and supporters of the Master Plan shall be able to provide assistance to communities in these respects.

3) Environmental education and awareness raising

Based on the result of the Master Plan Study, the perceptions and attitudes of local population towards watershed conservation holds a key to the successful promotion of sustainable land use. Therefore, to encourage favorable perceptions and attitudes shall be part of community empowerment. Extension workers, local teachers and religious leaders should be mobilized for technical as well as behavioral education and training.

4) Gender and conservation

Through international literature, it has been revealed that natural conservation and gender relations in many societies have a close connection. It is important to examine the implications of gender and sustainable land use at the Tondano

watershed, and design and initiate actions to maximize women's contributions to conservation and minimize any adverse impacts of gender relations on watershed conservation.

II-3.7 Monitoring and Evaluation

As mentioned in Section II-1.8, the Study Area does not currently experience severe soil erosion, and accordingly Lake Tondano is not undergoing serious sedimentation, nevertheless, the water quality of Lake Tondano has deteriorated. The Study Area has also been recognized to be sensitive to soil erosion because of the prevailing steep topography, soil characteristics, and risks of re-occurrence of improper farming practices.

In order to predict and prevent heavy soil erosion and further deterioration of the water quality of Lake Tondano, it is proposed to establish a monitoring and evaluation system in the Study Area. The items to be monitored are as follows:

(1) Hydrology

1) Flow rate of in-flow rivers to the lake

Purpose : to evaluate improvement of hydrological regime by the conservation works
Criteria : reduced peak flood flow, delayed flood peak, increased base flow
Place : East Touliangoki Check dam, Eris river
South Panasen river (several stations)
West Remboken
North Toubeke
Measurement : continuous measurement using automatic recorder

2) Sediment concentration in the rivers

Purpose : to evaluate improvement of hydrological regime by the conservation works
Criteria : reduced sediment concentration,
Place : East Touliangoki check dam, Eris river
South Panasen
West Remboken
Measurement : concentrated measurement for several continuous days including a rainy period at least twice a year

3) Rainfall distribution

Purpose : to evaluate rainfall distribution and reduced runoff by the conservation works

Criteria : reduced runoff rate, uneven distribution of rainfall

Place : East Touliangoki river, Eris river (2 stations for each river)
West Remboken (5 stations)
South is difficult because of too large of an area of drainage basin

Measurement : continuous measurement using automatic recorder (pluviometer)

4) Sedimentation in the existing check dams

Purpose : to evaluate the effectiveness of the conservation works in erosion control

Criteria : reduced sedimentation

Place : East Touliangoki Check dam, Eris river
West Remboken

Measurement : concentrated measurement for several continuous days including a rainy period at least twice a year

(2) Water quality

Purpose : to monitor water quality of the lake

Criteria : comparison to the national standard

Place : In-flow rivers: Panasen (several sites including downstream Langowan and Tompaso towns) and several minor rivers preferable

Outflow : Toulour

In the Lake : 2 to 3 points in the lake, at each point at a few different depths

Measurement : regular sampling every 3 months

Measuring items : Temperature, TSS, Transparency (by Secchii disc), pH, Dissolved Oxygen, Total-CO2, Total-N, Total-P,

The monitoring and evaluation system should be operated under the responsibility of *BRLKT* which shall prepare a monitoring and evaluation report twice a year and submit it to the committee which is discussed in Section II-3.5.

II-3.8 Basic Considerations for Implementation Plan

In order to attain sustainable land use, various conservation measures have been discussed and proposed for respective zones in accordance with five strategies. These conservation measures would be conducted in line with priority in implementation. In other words, it is advisable that these would be carried out by classifying them into three categories based on priority in implementation. In particular, the followings are the most urgent works, which could be made by the relevant agencies presently:

(1) Protection forest in the Study Area is limited to a small area, and it is reported that it has experienced certain damage due to illegal encroachment. If this damage is confirmed, rehabilitation and/or introduction of community forestry shall be considered urgently, to avoid further damage.

(2) The market price of clove is gradually rising. Extension services shall be thus essential prior to commencement of clove cultivation by farmers.

(3) Extensive farming practice is presently conducted at certain places, especially for the west side of Lake Tondano. Agricultural extension services shall be made urgently, to prevent further soil erosion.

(4) Structural development shall be conducted as early as possible, to enable systematic and timely implementation.

(5) A monitoring system shall be established and operated by a government agency like *BRLKT* to predict or quantity the effects of increasing soil erosion and/or sedimentation in Lake Tondano.

CHAPTER II-4 DEMARCATION OF THE INTENSIVE AREA

II-4.1 Criteria on Demarcation of the Intensive Area

According to the Minutes of Meeting on the Scope of Work for the Study on Critical Land and Protection Forest Rehabilitation at Tondano Watershed made between *DGLRSF* and JICA on September 20, 1999（Attachment-1）, the criteria to identify the Intensive Area has been determined as follows;

1) Suitable size and continuousness of the area;
2) Steep topographic condition;
3) Severe erosion area;
4) Possibility of positive community participation; and
5) Others

On the other hand, the results of field work and subsequent office work show that the Study Area does not face severe soil erosion at present, and there is correspondingly low sedimentation in Lake Tondano. However, it has been confirmed that the Study Area would be very sensitive to soil erosion due to steep topography, soil condition, development risk and expansion of improper farming practice. Taking into due consideration these findings, the basic concept in the Master Plan Study for the Tondano watershed has thus been determined as WACSLU which aims at alleviating risks of watershed degradation such as hydrological failure, ecological degradation, soil infertility and social welfare reduction.

Since the present watershed conditions of Tondano are totally different from the reported ones, it is necessary to modify the identification criteria mentioned above. In consideration of the present watershed conditions and the basic concept of the Master Plan, the modifications of the criteria have been made as follows:

The Intensive Area should be selected from the catchment area of Lake Tondano considering the importance of Lake Tondano in regional economic development, which is a conclusion of discussion with MOF and Working Committee (Attachment-4). On the other hand, the result of zoning shows that the Bm Sub-Zone would be characterized as the highest potential area of soil erosion. The Intensive Area has therefore been roughly selected from the Bm Sub-Zone influencing Lake Tondano, and then identified based on the following modified criteria:

1) Steep topographic condition;
2) Development possibility/risks;
3) Possibility of improper farming practice; and
4) High potential of conservation work.

The “suitable size and continuousness of the area” and the “severe erosion area ” have been omitted from the identification criteria, because of scattered locations of potentially critical land and no current severe erosion in the Study Area. The “steep topographic condition” is still a key factor for the identification of an Intensive Area since it highly influences the occurrence of critical land. Therefore, the original factor has been used as an identification factor. The “development possibility/risk” has been taken from a socio-economic viewpoint, instead of the “possibility of positive community participation”. The “development possibility/risk” consists of development risks based on population density and development risks based on accessibility. The population density and accessibility criteria are based on the primary assumption that the greater the risk of development, the higher the potential of a critical land. The criteria of “possibility of positive community participation” has been omitted, because it has been confirmed through the interview survey of 100 households that about 85% of householders are very anxious about soil erosion and are actively engaged in soil conservation. The “possibility of improper farming practice” has been applied in consideration of extensive farming activities and lessons learned from the past experience that improper farming practice of clove would cause serious soil erosion. The “high potential of conservation work” has been taken to bring about greates reduction in soil erosion and occurrence of critical land by application of conservation work.

II-4.2 Demarcation of the Intensive Area

In accordance with the modified criteria, the Intensive Area has been identified as shown in Figure II-4.2.1. The identified areas are briefly explained as follows:

(1) Rough Selection by Zoning

As mentioned above, the Intensive Area was roughly selected by focusing on the Bm Sub-Zone directly influencing Lake Tondano. The area was then selected using the criteria decided above.

(2) East Area of the Intensive Area

According to the zoning, the east side of Lake Tondano is mostly covered by P Zone and Bm Sub-Zone. These areas have been selected mainly from the criteria of steep topographic condition and possibility of improper farming practice. These areas have steep slopes and are widely cultivated with clove although it is presently inactive due to the low marketing price. However, when the marketing price of clove is raised, clove cultivation will be active. It means that there is a

high possibility that soil erosion might deteriorate unless proper farming practice is applied. Accordingly, this East Area has been entirely identified as a part of the Intensive Area. Tondano, Toulimambot, Eris and Kakas Sub-Districts are included.

(3) South Area of the Intensive Area

The South Area of the Intensive Area becomes steeper toward the south. There are some comparatively large villages, and there have been activities found causing enlargement of the farming area. If proper farming practice is not disseminated, the area may face severe soil erosion. From such site conditions, P Zone, Bm Sub-Zone and a part of F Zone are included within the Intensive Area. A part of F Zone has been identified because prevention of encroachment on the protection forest should be studied from not only Bm Sub-Zone, but also surrounding F Zone. Langowan and Tompaso Sub-Districts are included.

(4) West Area of the Intensive Area

The West Area of the Intensive Area is covered by small-scaled protection forest and Bm Sub-Zone. These areas are undulating to steeply sloped. Such sloped areas are, in part, extensively farmed for maize, and possibility of development due to their close location to Tondano and Tomohon. Therefore, All Bm Sub-Zone, P Zone and a part of farming zone are identified as a part of Intensive Area. Since improper farming is present the efficacy of conservation work would be expected although it is necessary to confirm efficacy in the next stage. Tondano and Remboken Sub-Districts are included.

II-4.3 Detailed Delineation of the Intensive Area on 1/10,000 Topographic Maps

In demarcation of the Intensive Area on the 1/10,000 topographic maps, its boundary has been determined using hydrological boundaries and nearby clear landmarks such as road for clear-cut shape. The total area of the re-demarcated Intensive Area was estimated at 11,885 ha and includes the following Sub-districts:

Area and Administration of Intensive Area

Location	Area (ha)	Administration (Sub-districts)
East Area	3,339	Toulimanbot, Eris, Kakas- East,
South Area	3,400	Lamgowan, Tompaso
West Area	5,146	Kawangkoan, Kakas-West, Remboken, Tondano
Total	11,885	