

Experience and Lessons Learned Brief for Lake Toba

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Introduction

Lake Toba is Indonesia's largest lake, located in the province of North Sumatra, 176 km to the west of the provincial capital, Medan. Lake Toba can be reached by car from Medan within three hours. By plane, Medan is only 40 minutes away from Singapore and two hours from Jakarta, the capital city of Indonesia.

As the largest volcano-tectonic lake in the world, the lake is 87 km long from northwest to southeast and a width of 27 km. Located 904 meters above sea level and the maximum depth of 505 meters, the lake is one of the country's important tourist destinations. The natural beauty of Lake Toba has been internationally recognized. The lake's blue waters, gracious residents and fascinating Batak culture draw tourists from all over the globe to the remote destination of Lake Toba¹

In the middle of the lake, laid the wedge-shaped island called Samosir, thought to have been created by subsequent upheavals from the older lake bottom between 0.6 to 0.1 million years ago. This spectacular island is one and half times larger than the entire Republic of Singapore. Traveling from the lake's shore to the island of Samosir is a great adventure for visitors.

The Lake Toba catchment area covers 3,658 sq km, of which the lake surface accounts for 1,103 sq km. The remainder of the catchment area can be classified as 43% hilly and 30% mountainous, with peaks over 2,000 m above sea level. Biophysically, the cool and refreshing environment, clean air, fertile soil of the region made it an ideal place for human settlement. No wonder that centuries ago the ancestors of the Batak ethnic chose it as their permanent site for settlement. It was here that their descendant developed into the five ethnic Batak groups, namely the Angkola-Mandailing, Karo, Pakpak-Dairi, Simalungun and Toba. Samosir Island and the Toba lakeside is the site of the original Batak culture, containing invaluable historical objects and artifacts, art and culture. In fact, Batak culture is still alive and present here, preserved in its original form.

The unique geographical position also contained a range of economically significant sources of livelihood for the population, mainly derived from the abundant fresh water resources and the dense tropical rain forests. Today, the concentration of the human settlements scattered all over the Lake Toba watershed are about 366, in the form of small villages to medium towns.² Figure 1 shows the watershed and administrative boundaries of Lake Toba.

¹ Annette Souder, The new faces of development assistance, US Council of State Government News, June/July 1999, page 14.

² Environmental Impact Management Agency (BAPEDALDA) of North Sumatra Province, General Guidance for the Control and Management of Lake Toba Region

Figure 1: The watershed and administrative boundaries of Lake Toba



2. Background

Lake Toba is located at the center of a topographic culmination some 300 km long, as presented by the contour lines between 100–1,000 m in the topographic map of North Sumatra. This topographic culmination is called the Batak Tumor that runs parallel to Sumatra Island and Lake Toba is located at its very center. This 300 km long Batak Tumor is dissected a little west of its center by the 1,625 long Sumatra Fault that stretch from the Sunda Strait to Banda Aceh. The origin of Lake Toba was first explained as a volcano-tectonic depression (Bemmelen 1949) and later explained as the result of a series of caldera formations combined with faulting (Nishimura, 1984 and Hehanussa, 2000). The lake water body is 1,103 km² in

area, Samosir islands in the lake has a land area of 647 km² and a smaller Pardapur island is 7 km². The lake length is 87 km, its circumference measures 294 km.

The lake basin area is surrounded by precipitous cliffs with elevations ranging between 400 to 1200 m above the lake water. The latitude and longitude of the lake water area range between E 98°30'; S 3°05' and E 99°20'; S 2°40'. The surface water temperature range between 24.0 to 27.6°C.

One single large river, the Asahan River, drain the lake water to the Strait of Malaka in the east. The lake water is located at about 904 meters above sea level. The depth measured by cable method by Stehn in 1939 reported a maximum depth of 529 meters, while recent measurements with acoustic echo sounder method recorded a maximum water depth of 505 meter (Hehanussa and Takara 2003). This 24 meters discrepancy in water depth could be due to measurement method. The 1939 measurement was done by cable method. The measurement in 2003 by echo sounding is considered more accurate. During this last (2003) measurement it was observed that many parts of the lake bottom shows a broad and flat bottom, relative deeper in the north while shallower in the south. The annual lake water level fluctuation is 1.5 meter although a lake level drop of 2.5 m due to extensive hydropower production was reported in the late 1980's. The discharge from Lake Toba through the Asahan River was measured up to 102 m³/second.

Evaporation is a critical factor in water balance calculations of a lake; they were measured in three stations, Palipi, Gurgur Balige, and Pulau Tao (Anonym, 1990). Measurements in Pulau Tao show average evaporation that varies between 3.5-5.5 mm/day. Evaporation measurements in Haranggaol were lower because of the wind velocity, temperature and humidity are different then pulau Tao.

2.1 Biophysical features

Biophysical features of the lake and its drainage basin is scarce and restricted to several field measurement in the past. They include:

➤ Biological features

Flora

- Emerged macrophytes: *Nelumbo nucifera*, *Nymphaea* sp.
- Floating macrophytes: *Eichhornia crassipes*, *Lemna minor*, *Azolla pinnata*, *Spirodella polyrhiza*
- Submerged macrophytes: *Patamogeton malaianus*, *P. polygonifolius*, *Myriophyllum spicatum*, *Ceratophyllum demersum*, *Hydrilla verticillata*, *Chara* sp.
- Phytoplankton: *Amphora*, *Cocconema*, *Asterionella*, *Synedra*, *Gomphonema*, *Orthosira*, *Navicula*, *Mastogloia*, *Pleurosigma*, *Nitzschia*, *Genicularia*, *Botryococcus*, *Synechococcus*, *Anabaena*, *Oscillaoria*

Fauna

- Zooplankton: *Cyclops*, *Cladocera*
- Benthos: *Macrobrachium sintangensis*, *Brotia costula*, *Thiara scabra*, *Melanoidestuberulata*, *Melanoides granifera*, *Anentome helena*, *Lymnaea brevispira*, *L. rubiginosa*, *Physastra sumatrana*, *Corbicula tobae*
- Fish: *Tilapia mossambica*, *Aplocheilus pachax*, *Lebistes reticulatus*, *Osphronemus goramy*, *Trichogaster trichopterus*, *Channa striata*, *C. gachua*, *Clarius batrachus*,

C.nieuhoffi, C.sp., Nemachilus fasciatus, Cyprinus carpio, Puntius javanicus, P.binotatus, Osteochilus nasselti, Lissochilus sp., Labeobarbus sora, Rasbora sp.

➤ Biomass

Table 1: Submerged macrophytes [g (wet.wt.)/m²]

Station	Potamogeton sp.	Myriophyllum spicatum	Others	Total
Lotung	2,470	130	< 25	2,600
Onan Runggu	2,800	150	0	2,950
Parbalooan Urat	1,833	310	520	2,663
Tongging	1,947	157	< 25	2,104
Lumban Sitorus	150	1,640	0	1,750

2.2 Hydro-meteorological features of the lake and its drainage basin

Table 2: Climate data at Balige

	Mean Temp. (°C)	Precipitation (mm)
January	19.1	174
February	20.1	167
March	20.9	187
April	20.5	193
May	21.0	133
June	20.7	104
July	21.2	71
August	21.0	116
September	21.0	132
October	20.4	215
November	20.5	188
December	20.2	199
Annual	20.6	1,879

after Nontji, 1990

Solar radiation: 15.7 MJ m²/day

The pattern of wind speed and direction varies, in January to April the wind speed can reach 4m/s, in June 8.8 m/s, and in October 7.1 m/s. If strong wind blows in June to October, big waves as high as 1.8 m may be induced.

Surface water temperature are: Haranggaol: 27°C; Tigaras: 27; Tomok: 26; Simanindo: 27; Pangururan: 27; Nainggolan: 27; Parapat: 27; Porsea: 26°C.

Measurements for pH & COD (in mg/L) at seven stations along the coast of Lake Toba are: in Lotung: 8.4 & 6.7; Situmeang: 7.9 & 6.8; Bukit: 8.4 & 9.3; Tongging I: 7.0 & 6.3; Tongging II: 7.9 & 7.0; Onan Runggu: 7.6 & 7.0; Parapat: 8.2 & 8.0.

2.3 Geo-physical features of the lake and its drainage basin

The geology of Lake Toba has been a challenging topic to study. The formation of this lake is the result of a mega-volcanic-activity during the Quaternary Era or the last two and a half

million years of the earth's geological history. From a very broad analysis, this phenomenon was the result of two major plates collision beginning during the Eosen Era or 65 million years ago. These plates are the Indian Ocean or the Australian plates in the southwest and the Asian Plate located in the northeast. This plate collision produced a long subduction zone that was accompanied by a volcanic chain along Sumatra-Jawa-Nusa Tenggara up to the Moluccas islands. In Sumatra it resulted in a large and long transform fault, the Sumatra Fault Zone (SFZ). This is a 1700 km long fault, exposed from the Bay of Lampung in the south to the Aceh region in the northern end of Sumatra Island. Lake Toba is not dissected by this SFZ but is located some 20 km kilometer north-east of this fault, while the Batang Toru and Renun Rivers are located and flowing along the fault.

Two major explanation of the lake geohistory was explained as (a) the product of one single gigantic explosion or (b) product of multiple events. Each of these two hypotheses was again divided or has smaller branches of its explanation. There were lively debates on the geological timing of the event, whether they occurred recently (i.e. less than 75,000 years ago) or were they the result of a series of geological up-doming, blasting, faulting, sedimentation, and up-wrapping which took place since two million years ago.

Lake Toba was lately been reported as the largest caldera lake in the world. This conclusion was based on a report by van Bemmelen who stated the lake as a volcano-tectonic depression. According to the hypothesis by van Bemmelen, the lake history started with the formation of a Batak Tumor with an oval shaped, 300 km by 150 km region, located between the present Wampu River in the north and the Barumon River in the south. The up doming produced a region with elevations up to 2,000 m shown by top of mountains such as Mt. Sibuatan (2,457 m) in the NW, Mt. Pangulubao (2,151 m) in the east, and Mt. Surungan (2,173 m) in the SE, and Mt. Uludarat (2,157 m) in the west.

Combined with previous scientific studies by Marel 1947, Tjia 1976, Karig 1978, Hamilton 1978, we came to the conclusion that the formation of Lake Toba was not a single event but a combination of complex of events. It was the product of a series of events occurring east of the Sumatra Fault. Other similar results were also encountered in study sites in the Lampung area and Maninjau. These series of events occurred are closely related to the deep seated occurrence of the Sumatra Fault starting two million years ago.

2.4 The watershed and jurisdictional features

The Lake Toba watershed covers an area of 3,704 km² embraces a part of the areas of five Kabupaten (District) level government administrations, i.e. Kabupatens Tapanuli Utara, Toba Samosir, Simalungun, Dairi and Karo. The landuse (1999) is dominated by scrub (41%), followed by forest (22%), paddy field (14%), settlement (11%), grass (8%) and dry land (4%). Within the Lake Toba region, there are areas reserved specifically for conservation purposes which function as water resorption, air pollution control, ground stabilization and soil erosion prevention.

Kabupaten Toba Samosir which contributes its twelve kecamatans (subdistricts) governs the largest portion of the watershed (64%), followed by four kecamatans of Kabupaten Tapanuli Utara (21%), five kecamatans of Kabupaten Simalungun (10%), one of Kabupaten Karo (3%) and one of Kabupaten Dairi (2%). The twenty three kecamatans of the five districts that are included in the Lake Toba watershed are:

- Sianjur Mula-mula, Harian, Simanindo, Pangururan, Palipi, Onanrunggu, Onanrunggu Timur, Lumbanjulu, Porsea, Silaen, Laguboti and Balige of Kabupaten Toba Samosir;
- Silimakuta, Purba, Dolok Pardamean, Sidamanik and Girsang Sipanganbolon of Kabupaten Simalungun;
- Doloksanggul, Muara, Lintongnihuta and Siborong-borong of Kabupaten Tapanuli Utara;
- Merek of Kabupaten Karo; and
- Sumbul of Kabupaten Dairi.

2.5 The past social and economic development history and trends

Lake Toba basin contributes a sizeable share in the regional if not the national economy. The natural beauty and the richness of Batak culture have given rise to the tourism industries which provide economic benefit to the communities living in and around it. The unique geographical position of Lake Toba reserves a number of economic potentials for the benefit of the wide range of communities, especially as a source of bountiful fresh water and lush tropical forest which attract the interest of big industries to invest in the areas.

The watershed population

The communities living in the Lake Toba watershed belong to the population of 366 villages within five kabupatens. Based on 1999 statistic the population living in the watershed is 590,861. The lowest population density of 18 persons per sq. km is recorded at the sub-district (kecamatan) Sumbul of District (Kabupaten) Dairi and the highest 355 person per sq. km is in kecamatan Balige of Kabupaten Toba Samosir. Population density higher than 200 persons/km² is recorded in kecamatans along the routes of economic activities, especially along the trans Sumatra highway. There is no clear indication how it was determined, but the North Sumatra provincial government states that the majority (63%) of Lake Toba basin population belong to the poor category.

Agricultural activities

Farming, cash crops production, fishery, animal raising and tourism industry are the main economic activities in the Lake Toba basin. The potential that has proven to support the life of the population is food crop production. The agricultural sector still remains the mainstay for the majority of people living in the Lake Toba basin. The rice fields within the watershed cover an area of 41,123 hectares (1999). With an average yield of 5.2 tons of dry rice per ha the basin could reach a production of approximately 250.000 tons of dry rice annually. Rice growing is common in all the kecamatans, but the center of productions are in kecamatans Porsea, Lumbanjulu, Balige and Silaen of Kabupaten Toba Samosir; kecamatan Doloksanggul of Kabupaten Tapanuli Utara and kecamatan Sidamanik of Kabupaten Simalungun. During the economic crisis of 1997 the agricultural sector was the mainstay for the population, especially when the tourism industry also went down.

The communities living on dry lands grow cash crops, particularly coffee, coconut, cloves, pili nut and cinnamon bark. The total cash crop production area in the basin is 8,640 hectares. Coffee is the most important crop of all since it is grown in all the kecamatans and to some extent it is the source of income on which the life of a family depends. It is estimated that

coffee growing provides job opportunities for more than 27,000 families and a production of 4,000 tons of coffee beans annually. Animal raising, especially pig, cow, buffalo, and poultry is done in a family as a side job.

Fishery

Fishery is an activity done by communities of five kecamatans located directly on the shoreline and is undertaken in two ways, fishing in open waters and fish culture in floating cages/nets. The total caught from the open waters is close to 1,500 tons per year, consisting mostly of six fish varieties, namely *Cyprinus*, *Tilapia*, *Oreochromis*, *Puntius*, *Clarias*, and *Ophyocephalus*. Since 1996 the total catches has been declining by 5.13% annually. This decline is probably caused by the growing in the number of fish predators and the decrease in the natural fish sustenance in the lake.

Fish culture in floating cages or 'karamba' in local language is practiced by the individual farmers as well as by the private enterprises, mostly foreign investment companies. It is suspected that the leftover of the palletized feed used in the fish culture, individuals and well as the companies, has polluted the lake water. Once there were 1,382 floating cages owned by domestic and foreign companies in record, of which 862 (or 62%) were in Kabupaten Simalungun, the remaining 520 (or 38%) in Kabupaten Toba Samosir. The fish cages owned by the individual farmers of the five kabupatens included in the Lake Toba watershed are 1,694 unit, mostly located in the Kabupaten Toba Samosir (75%). The number of fish cages has been increasing sharply during the last few years, especially those owned by the foreign investors. It is estimated today there are 150,000 of such cages are floating in the lake waters. The cage size owned by domestic and foreign companies is averagely 6x6 meters whilst those owned by individual farmers is averagely 2x2 meters.

Tourism

From the esthetics point of view, the attractiveness of Lake Toba lies in the internationally renowned natural beauty. Seen from almost any angle the charm of the lake make a man like being spelled with a feeling of ecstasy. The beauty of each corner of the lake Toba, the array of green hills that make up the Bukit Barisan mountain range dressed with adorning waterfalls are nothing new to this North Sumatra tourist attraction. The island of Samosir and the coastline of Lake Toba are the birthplace of Toba Batak culture and home of invaluable historical and cultural relics. It is in this place that the Batak culture is alive and manifested in its genuine form. Modernization has caused population migration and today there are more Batak living outside the region than those whose who remain in the vicinity of Lake Toba. Yet, this home town remains the core of their identity as Batak in spite of their living in far away places.

The total population of the five main tourist spots in Lake Toba consisting of Tomok/Simanindo, Balige, Porsea, Ajibata and Parapat is 102,477 persons or 17% of the total population of the entire Lake Toba watershed. The tourism industry has pushed the development of 168 hotels, from the traditional Batak home-stay up to four stars hotel. Although no systematic record was made, the crisis that later rammed Indonesian economy made the number of tourists visiting Indonesia plunged drastically bringing with it a dullness in the corollary business, both in trades and in services.

Industry

The Lake Toba basin economic potential was revealed since 1982 with the development and operation of PT Inalum, an aluminum smelting plant which needs a great amount of electric power produced cheaply from the Asahan River hydroelectric generator. PT Inalum is a joint venture company between the Government of Indonesia and Nippon Asahan Aluminum Co. Ltd of Japan with an initial capital of 411 billion yens or equal to approximately USD 2.4 billion. The share composition is 41.8% by the Indonesian government and 58.2% by the Japanese company.

PT Inalum which keeps two headquarters - Kuala Tanjung in the downstream at the smelting plant and the Asahan River at the power generator – produces 225,000 tons aluminum ingot per year while the power generator produces a total of 603 MW of electricity in two plants (Sigura-gura: 286 MW and Tangga: 317 MW). In order to produce 450 MW of electricity and to propel the eight turbines in the two generating plants a water discharge of 105 m³/second must be provided for by the Lake Toba. PT Inalum provides at least 2,500 job opportunities for the local population.

The exploitation the basin's forest potential began in 1985 when PT Inti Indorayon Utama (IIU) put up a pulp and rayon processing plant taking its raw materials from the forests in six kabupatens: Dairi, Karo, Simalungun, Tapanuli Utara, Toba Samosir and Tapanuli Selatan. The capital invested for the plant amounted to USD 40 million and is located in the village of Sosorladang, Kecamatan Porsea, Kabupaten Toba Samosir. The selection for the plant location was made at the central government level. Indorayon is 62% owned by the Singapore-registered Asia Pacific Resources International Holdings Ltd. which is listed on the New York Stock Exchange. The other 38% of Indorayon is owned by the investing public, cooperatives and a number of shareholders from Finland.

The operation of Indorayon was based-on the Joint Decree signed by the Research Minister and Environmental Minister to give the green light for the plant's construction and operation in 1986. Indorayon has produced 1.8 million tons of pulp within ten years, during the period of 1988 to 1998. Whereas from 1993 to 1998 it has produced 0.25 tons of rayon fiber as the raw material for textiles. These productions were estimated to have consumed around 10 million cubic meters of wood.

For its business operation PT Indorayon secured a total of 269,060 ha forest concession covering forest areas in Kabupatens Tapanuli Utara/Toba Samosir 167,943 ha, Tapanuli Selatan 41,818 ha, Dairi 31,627 ha, Simalungun 22,533 ha and Tapanuli Tengah 5,139 ha. It is not clear what portion of the concession area belongs to the Lake Toba watershed. What is obvious is, the total concession area awarded to PT Indorayon is fourfold the area of Lake Toba watershed forests, while the total number laborers employed from within the basin is 7,294 persons, or a mere 3% of the population of Kabupaten Toba Samosir who live within the Lake Toba watershed.

2.6 Institutional and Managerial Features

Based on Act No. 22 year 1999 on Regional Autonomy, the North Sumatra Province is responsible to coordinate certain issues involving two districts or more. In this case, the management of Lake Toba involves five Districts that shared the watershed: Toba Samosir; Tapanuli Utara, Simalungun; Karo, and Dairi plus two other Districts located at the down

stream of Asahan River that has indirect influences on Lake Toba, namely Asahan and Tanjung Balai.

The level of institutional development and managerial capacity

The official institutions that are supposed to be responsible for the preservation of the Lake Toba region are the provincial government of North Sumatra and the local governments of the five Districts in Lake Toba region, in this case the BAPEDALDA of North Sumatra (provincial-level Environmental Impact Management Agency) and the BAPEDALDAs of the five districts. Up till now, BAPEDALDA's activities still focused on the study of the environmental condition of the Lake Toba region whilst to coordinate the preservation efforts moreover to initialized the partnership with other organizations have not been performed yet.

The level of interest group and community awareness and involvement

Environmental problems are the problems of all components of the stakeholders. Cooperation at the local level between the communities, NGOs and other environmentalists has to be supported with community empowerment as the foundation of the preservation efforts in Lake Toba region. There are numbers of successful implementation of community programs at the local level, supported by local government, the national and international NGOs also international agencies such as UNESCO. The pilot project of the community-based watershed management that was conducted by LakeNet in association with LTHF is one example. The other examples that could be recognized are:

The cooperation between the BAPPEDA (Planning Board) of the Kabupaten Tapanuli Utara with Hanns Seidel Foundation (HSF) in reforestation of critical land with the planting of coffee and cinnamon tree in the area of nine hectares in Palipi village; the use of water hyacinth for cattle food (pigs) and composting in Pangururan village, Samosir island; and solid waste management of Muara town in the southern part of Lake Toba. All of those activities involve the local community and has been contribute to the improvement of both the environment and community's income.

In the last recent years, UNESCO have supported three local NGOs in Lake Toba region, i.e. YAPIDI (the Pijer Podi Foundation), YES (the Sumatra Eco-tourism Foundation), and GKPS (the Simalungun Protestant Church Organization). YAPIDI work on 'Human resources participatory development in Sikodon-kodon and Tongging villages' project, which focused on micro credit, organic farming, tree planting and training for women groups. This NGO prepared to get involved in the development of community radio under UNESCO communication project in Indonesia. YES proceeds with its activity in improving the economics through conservation of critical land in Paropo village, a town in the northern part of the lake shoreline that was also included in the LakeNet's watershed management pilot project. GKPS made a good progress in its 'Environmental preservation in Nagori Sihalpe village'. The success of the village's tree planting won the first award in the Kabupaten Simalungun's Environment Day and received a badge of appreciation from the President of Indonesia. Success is also on organic farming, cage fishing and waste management in the villages.

There are certainly some more activities at the grassroots level in Lake Toba region that has been implemented by other NGOs or community groups. Unfortunately, there is no record on the numbers of active NGOs in Lake Toba region moreover an adequate documentation or

reporting system of their programs as a reference. For those reason, in early 2000, UNESCO has sponsored a national workshop on ‘Strengthening communication and local capacities for community-based participatory environmental management of Lake Toba’ in Samosir Island. This workshop was administered by LTHF, 20 out of 70 participants are representatives of local NGOs. The rest were representatives of universities, LIPI (Indonesian Researches Institute), local government agencies, press and international agencies i.e. UNDP and UNESCO.

Community-based management of Lake Toba

In 2001, LakeNet partnered with the LTHF to implement a pilot project on community-based watershed management program for Lake Toba. The one-year demonstration program was conducted as part of a six-year old sister lakes exchange partnership with Lake Champlain in the U.S. The Lake Toba-Lake Champlain Sister Lakes Partnership began in 1996 with an exchange visit to Indonesia by the coordinator of the Lake Champlain Basin Program (LCBP) at the invitation of the Lake Toba Heritage Foundation (LTHF). The exchange program was coordinated by LakeNet, a U.S.-based nonprofit organization dedicated to conserving lakes throughout the world.

Vermont Agency for Natural Resources (VTANR), in collaboration with LakeNet applied for and was awarded a second grant in the amount of \$40,000 through a special CSG/US-AEP initiative to help bridge several exchange programs into an implementation phase. With this bridge funding, project partners conducted a pilot program to demonstrate ways of developing and implementing a community-based watershed action plan. The project activities as implemented include:

- Selection and training of 10 environmental cadres to serve as local leaders on environmental initiatives related to Lake Toba.
- A two weeks in-country study tour for the environmental cadres to East and Central Java to observe and to study community mobilization efforts and commitment-building in constructing, financing, managing and maintaining low cost community-based sewer systems, the new low-cost composting technique in Malang, and the harvesting & utilization of water hyacinths in Cirebon and Yogyakarta.
- Completion of clean lake activities along 5 km of the lake’s shoreline in five communities. More than 770 people participated in these activities, some of which involved strenuous labor and difficult working conditions.
- Training in environmental education & awareness for teachers from six Districts in the Lake Toba area using a specifically developed ‘hands-on learning’ Water Module.
- Formulation of community action plan through community meetings, involving 188 community members in identifying and discussing environmental problems and concerns of Lake Toba.
- Awareness campaign through distribution of 25,000 copies of an information brochure in Indonesian language to promote environmental awareness.

The most important results of the implemented actions include:

- The clean lake activities by volunteers, which included the removal by hand of large patches of water hyacinths, opened up landing areas for local fishing and ferry boats that

had been inaccessible for almost three years, at the same time they reduced invasive plant populations.

- The study tour and on-the-job training (through participation in community meetings, clean lake activities, teacher's training and brochure distribution) resulted in the effective in-country transfer of knowledge to the environmental cadres. Many of the cadres have demonstrated their ability to help implement and sustain activities begun during this project.
- Teachers and representatives of three universities in the Lake Toba region gained important environmental knowledge and educational materials.
- Detailed resource inventory maps and action plans were completed in five communities using a participatory approach.
- New issues of concern on Lake Toba were identified for the first time, such as the increase in the number of fish farms on the lake and their potential impact on water quality.
- Citizens and the community as a whole gained awareness by participating in community meetings and clean lake activities.
- Boat operators gained awareness of their role in environmental stewardship of Lake Toba as a result of meetings held with this important stakeholder group.
- Local partners learned the benefits of involving people and working with the community in planning and implementation activities.
- Long-term, if fully implemented, the project can be expected to have social, economic and environmental impacts as improved sewage systems, invasive species reductions, trash reduction and improved local capacity will improve Lake Toba and community health, as well as facilitating poverty alleviation.
- Publication of results on the Lake Toba Online website and through LakeNet's electronic forum of more than 900 members on lakes around the world.

In terms of stakeholders' participation in this project, a total of almost 1,000 community members were involved in the clean lake and community meetings aimed for the formulation of community action plans. Participants included boat operators, farmers, fishermen, small traders, vendors, housewives, and hotel owners. The ten environmental cadres were chosen from grassroots participants and were central to all activities. Women were specifically targeted to involve in the community meetings. The fact that 33% of the participants were women is a significant achievement due to the very paternalistic local culture. The women proved to be very active and outspoken in the community discussion and made real contributions to the local action plans. Many community members made in-kind contributions to the clean lake activities. Government officials from the local Police and sub-district (kecamatan) office were involved in the clean lake activities. The Mayor of the City of Malang and his staff provided all of the facilities needed during the study tour of the environmental cadres from Lake Toba. The Governor of North Sumatra gave his support to the environmental cadres before they departed for the study tour. Other NGOs at the national and provincial level were also taking part in this project. The Hanns Seidel Foundation (HSF) provided the trainers and the environmental education training materials for schoolteacher. Three researchers who were involved in formulating an environmental education book for the elementary school children trained the teachers from the six districts of Lake Toba. Local

universities surrounding Lake Toba sent their representatives to the three days teachers' workshop.

There is a big potential for community participation in the efforts to sustain Lake Toba drainage basin. The critical point lies in where and how we could improve the awareness and understanding about the aspects of ecosystem sustainability and to bridge the community awareness with a real action toward sustaining the lake ecosystem which at the same time also renders benefit for the improvement of social economic condition of the community. This means an integrated program between social economic improvement and sustainable environmental development. The fact where community members from varying backgrounds, schoolboys and girls, hotel owners, fishermen, traders, farmers, etc. join together in various environmental activities such as regreening, garbage collection and water hyacinth clearing, and environmentally sensitive farming practice are all positive indication to increase the community awareness and involvement.

3. Biophysical Environment

The changes in Lake Toba region such as the reduction of the water level and pollution of the lake directly affected the social and economic situation of the region, but most important put a great threat to the biophysical environment.

3.1 Past and current conditions

The changes in Lake Toba region such as the reduction of the water level and pollution of the lake directly affected the social and economic situation of the region, but most important put a great threat to the biophysical environment.

Currently only 70 out of 202 rivers that discharge into Lake Toba flow continuously all year round. According to historical data studies by Sastromijoyo, 1990, the discharge from Lake Toba have shown a decrease during three phases:

- Period 1920-1932, average inflow discharge to Lake Toba was 110.4 m³/s
- Period 1957 - 1975 average inflow discharge to Lake Toba was 104.4 m³/s
- Period 1976 - 1988, average inflow discharge to Lake Toba was 90 m³/s

Water level of Lake Toba suffers a continuous decline. Statistical data from 1982-1998 recorded by the Provincial Office of Department of Mining and Energy in North Sumatra indicate a drop in the water level, yet not as big as what the community indicates. In January 1984 water level reading indicates 905.14 m above sea level, in September 1998 it is 902.66 m, which means a drop of 2.48 m. Even in July 1998 the level reads as low as 902.28 m, or a drop of 2.86 m.

The rainfall data are discontinuous so that they are poor quality to prove whether there has been any significant change, but indications are that a decline of the order of 10% may well have occurred (Anonym, 1990). Other factors such as land use change may have contributed an important part to the change.

The first topographic sketch map of the lake region was measured in 1887 by F. van Brenner and van Mechel. In 1909 and 1913 the Porsea and Siruar region which are regions around the Asahan River draining the lake, were washed by severe floods. In conjunction to these

events, in 1915 the Batu Bongbong near Siruar that obstructed the Asahan river outflow was blasted away. Next, in 1918 it was first planned by the Dienst voor Waterkracht en Electriciteit to construct a hydropower plant in the Asahan River.

3.2 History of lake degradation

Pollution from domestic waste has affected the water quality of the lake. In the 1970's there were no signs of water hyacinths on the lake but since 1990's they were observed floating in the Parapat area. Secchi disk reading of the water column in the center of the lake in 2001 was 11 m while in the Bay of Parapat near the Ajibata harbor it was less than 2.8 meters.

Local government/farmers have introduced fish of "alien species" that will infiltrate (swim) into the whole lake area. These alien species may have to adapt to their new environment. Adapt might also mean 'will dominate' the ecosystem. The other additional problem came from the cage aquaculture. The fish food poured into the lake adds up the water pollution problems. Fish cage culture started to develop since mid 1990 and has contributed to the pollution of the lake water. In the year 2003, along the north Bay of Sigapiton, in Tomok, Simanindo, and Pangururan at Samosir Island, and in Haranggaol were extensive fish cage culture developments.

The water quality in Lake Toba during the last few years has been obviously deteriorated. The oil content of the lake water reached the level of 7.5-35 mg/l. Biologically, the lake water pollution obviously indicated by the evidence of pathogen bacteria such as faecal coliform of 1,000 mpn/100ml and total coliform of 20,000 mpn/100 ml of water³

A water quality measurement study conducted by the Environmental Impact Management Agency (BAPEDAL) in collaboration with the Bogor Institute of Agriculture in 1993 indicated a degradation of water quality in several beaches, particularly the waters in the vicinity of Tigaraja-Ajibata, Tomok and Pangururan (on the island of Samosir) and at the kecamatan of Balige (in Kabupaten Balige). In 1994, water quality in the surrounding rivers exceed a level of pollution with a measured amount of 28 mg/l BOD (5 mg/l is considered good) and is estimated to increase 1.5 times by the year 2010. The level of pollution in the lake along the shore is 6.9 mg/l to 52.2 mg/l BOD and is estimated to increase 1.5 times by 2010.

It was found out, additionally, that in Ajibata and Tomok oil slicks were spreading up to a radius of 150 meters from the beaches. From the aesthetics point of view, this has made the beaches less attractive. Although the pollution caused by fuel and oil residues from water transportation does not produce too significant impact, yet it is estimated that about 14.2 m³ of this stuff is spilled into the lake annually. There are about 190 boats operated in lake Toba with the average capacity of 40 persons per boat. Another indicator suggesting the water quality degradation in the lake is the growth of aquatic plant especially water hyacinth in a number of places. Water hyacinth and other aquatic plants indicate that eutrophication process of the lake water is on-going especially near the shorelines.

³ Parlagutan Siahaan, Pesan danau Toba (Message from Lake Toba bulletin), September 1999, page 8

The provincial government has identified major problems areas to be considered in Lake Toba region i.e.:⁴

- Water quality and water balance due to the operation of industries and water use by inhabitants. Due to the low level hygiene behavior of the inhabitants, the untreated domestic wastes are channeled directly into the lake.
- Land use and land tenure. Land use has been practiced in disregard of the conservation principles which have led the land condition to becoming more critical and more susceptible to erosion. Farming practices disregard conservation technology aspect led to the production of fertilizer and pesticide residues from agricultural activities. Land tenure by the marga (clan) has made it difficult in practicing soil conservation measures and sustainable land use.
- Air pollution due to toxic gas emission from industrial plants and smoke produced by forest fires and trash burning for land clearing. During the dry season forest fires are not infrequent and trash burning is generally practiced in land clearing for estate crops development, industrial forestry concession, animal shepherding, etc. These activities produce air pollution, land and water system degradation and finally natural disaster in the form of flooding and landslide, and extinction of flora and fauna.

3.3 Lake and drainage basin resource conflict

Two major industries in the drainage basin have, by many especially the communities living around the lake, been accused as the most responsible party to cause the drop in the water level of the lake. The traditional fishermen are the ones suffering most from the drop of lake water level. The aquatic plants and shrubs in the shoreline which form the fish habitat wilt and dead due to lack of water. Fish goes farther into the deep water making it difficult to catch with the traditional hook or net. The community fish cages are not functioning because they are now hanging in the open air. One to two kg of fish is what the fisherman can catch in one day, which used to be five to seven kg. This condition has encouraged the growth in number of poverty enclaves throughout the basin.

Deforestation

Forest clearing by PT Indorayon for raw materials in its industry has been accused as the main reason for the drop of water level in the lake. As an example, the community pointed out that the company cleared up to 3,000 out of 4,000 ha of pine forest in the kecamatan Ronggur Ni Huta, Samosir and in its place is now young Eucalyptus growth about three to four years old. The community claims that eucalyptus consumes water more greedily, therefore it does not behave like a water catchment area, and rather it is the other way around. This conclusion was, however, denied by the Forestry Research Center at Pematangsiantar who instead says that broad-leafed plants such as eucalyptus, having a smaller number of stomata, are using less amount of water compared to the needle leafed ones such as pine tree. The impact, however, has not been studied comprehensively; it deserves one in the future. One important aspect to look into pertains to the changes in soil quality due changes in its uses.

During its operational decade Indorayon has practiced negligence to matters concerning pollution and environmental hazard, including the social economic aspect of the surrounding

⁴ Coordinating Board for Lake Toba Basin Ecosystem Conservation, General Policy for Lake Toba Basin Ecosystem Conservation, January 2003, page 28.

community. A number of cases could be cited, including the leakage in tank containing toxic gaseous chemical in 1993 where approximately 5,000 people from the neighboring villages suffered and had to flee from their villages; uncontrolled disposal of waste materials from the plant causing strong nauseating smell has drawn thousands from Porsea community to pledge that the plant operation be closed down. The downstream communities claim that yields from rice field and fresh water fish culture are continuously declining because the Asahan River on which their economic activities depend is heavily polluted. Rejection by local population because of the smell produced by the factory have temporary closed the plant. The plant was temporary shut down and is now reducing its total activity to only producing pulp with a promise to provide better waste water treatment plant.

The Indorayon plant required 400,000 cubic meters of water per day for processing, which was taken from the Asahan River. The used water was returned to the Asahan River, undoubtedly mixed with various toxic materials derived from the processing chemicals and substance originated from the wood, as well as substance produced from the reaction of both sources of chemicals. Of particular concern are toxic substances of the AOX category (Absorbable Organic Halides), such as dioxin, pentachlorophenol and trichlorophenol. These are the sources of substances in the liquid effluent.⁵

Apart from the above toxic substances, during the processing of pulp, rayon, and the production of process chemicals, various gases and vapors were released into the air, the majority of which were toxic and foul-smelling. Although at that time the most objectionable effect felt by the community was the odor, over the long term, the toxic effect is the most alarming. The majority of gasses released from the pulping process is collectively known as Non Condensable Gasses (NCG), especially H₂S and MMC (Methylmercaptan).

Water use

It is not only Indorayon, the community as well as other stakeholders also accused PT Inalum hydroelectric as another party responsible for the drop in the lake water level. Electricity is the soul for PT Inalum. Aluminum smelting needs a great deal of electric power generated from the Sigura-gura and Tangga plants which rely solely on the Asahan River, Lake Toba's only discharge outlet. The problem is, the discharge of the Asahan River cannot be arbitrarily spurred without any detrimental effect to the water level in the lake.

From the technical aspect, to operate eight turbines in order to generate 450 MW of electricity, the Asahan hydroelectric needs a discharge of 105 m³/second and this requires that the lake water level stays at 905.5 m above sea level. In mid July 2002 the level records as low as 902.5 m, a critical level for Lake Toba. To prevent further decrease in water level the Asahan hydroelectric used only 80 m³/second of water which means idling some of the turbines. The generated electricity becomes less than 450 MW, consequently the ingot production drops to 180,000 tons per annum or 80% of capacity. That is why the company claims that they are operating at a loss because they are unable to produce at full capacity.

The biggest advantage obtained by the communities in North Sumatra from the existence of Inalum is the improvement of infrastructures that in turn encourage the regional development in several support sectors. When the hydroelectric plant was under construction the only access for heavy machineries and the giant turbines was through the port of Belawan. As a

⁵ The impacts of PT. Inti Indorayon Utama's Operations on the Environment of Lake Toba, LTHE, 2000, page 6

consequence, major improvement to the road connecting Belawan and the upper part of the Asahan river had to be made. To enable to hold big trucks and trailers lugging heavy containers and machineries new bridges with hundreds of tones of capacity were built. The construction of PT Inalum site was accompanied with the development of a new, 200 ha town called Tanjung Gading some 16 km from the smelting plant at Kuala Tanjung. Tanjung Gading was built from zero on a swampy land area. With a total of 1,340 housing units Tanjung Gading helped to develop the east coast of North Sumatra. Presently the approximately 10,000 population of the new town has provided employment to many on a place which used to be secluded and very lonely.

Apart from the aforementioned advantage, the hope for the communities around Lake Toba to obtain cheap electricity to enable them develop small scale and home industries, is seemingly difficult to materialize. The Asahan hydroelectric was expected to deliver the excess energy to the communities of Porsea, Parapat and Balige besides selling it to PLN Region II. However, as a result of the drop in water level in Lake Toba, the reverse is happening, PT Inalum buys 60 MW of electricity from PLN every month. It has been twenty years since PT Inalum started operation in 1982, the Toba communities remain unchanged, their home economy is still dependent upon rice cultivation.

Cage aquaculture

Obviously, cage aquaculture in Lake Toba during the last couple years continues to expand and intensify, most of them are owned by foreign investors. From the economic stand point especially under the recent economic crisis in Indonesia it is often viewed as desirable as it can generate employment, income and food, support for other activities also increase the local government income. On the other hand, cage aquaculture has its disadvantages too. Wastes from cages are freely released into the environment, potentially interacting with the entire water body. Intensive cage culture, when unregulated, can cause severe environmental problems. Cage farms in lakes and reservoirs are thus vulnerable, both to general pollution and to self-inflicted water quality-related problems, not to mention the social conflict due to social inequity. Appropriate regulation, based on a much better understanding of the technical, environmental and socio-economic conditions is needed. From several community meetings that have been held, community members especially the boat owners and drivers questioned the existence of 'karamba' in five locations of Kabupaten Simalungun and Kabupaten Toba Samosir. They estimated that about 10 tons of fish food per day is poured into the lake.

Domestic wastes

Maintaining a clean environment is one aspect of the Lake Toba watershed management program which is highly related to the behavior of the people in the surrounding communities. The way the community treats its environment depends on its level of understanding and knowledge. Due to the low level of hygiene behavior, the community channeled household waste directly into the lake including most of the hotels and restaurants located in the shoreline of the tourist area. The scene of a family using the lake water for drinking, washing, bathing and defecating at the same spot is common in many areas. From the research of Lake Toba water quality in 1993, it was concluded that human settlements are the dominant source of pollutant, ranged between 47% to 58% in all four potentially polluted zones. Lake's pollution due to the untreated domestic wastes is household's and community issues, and, thus requires recognition of specific situational social and cultural factors.

4. Management Environment

4.1 Lake management programs and processes

In the recent years a management committee concept has been offered several times by many parties including the government, private sector, NGO even the community group all for the purpose of improvement in the management and environmental preservation in Lake Toba basin. But, as it turned out, it is not easy to make the concept into reality because of various different perception and conflict of interest among the stakeholders. The establishment of management committee in Lake Toba is so important if a coordinated preservation and collaborated efforts among the various parties is to be achieved.

In the absence of such management committee it will be difficult to build a common vision among the stakeholders and the environmental preservation effort will work partially, regardless of who is taking the initiative, the government, NGO, private sector or the community group. As a result, the impact of the effort is negligible or none at all. The natures of the activities which are generally a crash program indicate the absence of a planned and sustainable program implementation.

Establishment of Coordinating Board for Lake Toba Basin Ecosystem Conservation (CBLTEC)

Apart from the pros and cons for the establishment of a management committee, in May 2002 the Governor of North Sumatra through a Letter of Decision No. 062.05/245/K/ 2002 named a Coordinating Board for Lake Toba Basin Ecosystem Conservation. The Board consists of the related government agencies, provincial as well as kabupaten, and the representatives of two NGO's, namely LTHF from the national level and Yayasan Peduli Samosir Danau Toba (YPSDT) or 'the Samosir Lake Toba Foundation' from the provincial level. Two kabupaten level administrative governments are added into the membership together with the five kabupatens within the Lake Toba drainage basin area. These two are Kabupaten Asahan and the municipality of Tanjung Balai. The responsibility of the Coordinating Board includes the formulation of the general policy and coordination of efforts and initiatives taken by the different component of the stakeholders; monitor the environmental impact and the rehabilitation effort; and mobilization of community participation.

To assist the Coordinating Board, the Governor also formed a Technical Advisory Committee with members consisting of representatives from provincial level technical agencies, representatives from a number of universities and research institutes, and the Asahan River Authority. It is hoped that the Coordinating Board could help to solve the possible conflicts arising from the different interests among different stakeholders involved in the Lake Toba drainage basin. Figure 2 & 3 shows the organization structure of the Coordinating Board and the Technical Advisory Committee.

As of today a well planned comprehensive program and systematically implemented is non existent. The newly appointed Coordinating Board for Lake Toba Basin Ecosystem Conservation, however, has formulated a general policy for Lake Toba ecosystem conservation which is intended as a reference and guideline for the stakeholders in planning and implementing pollution control and environmental rehabilitation program. The General Policy for Lake Toba Basin Ecosystem Conservation was formulated based on the Governor's Letter of Decision No. 660/067.K. Whether the programs as formulated in the general policy were applicable will remain a question because it seems there is a need for a preparatory

process which may take a certain length of time. At the very least, the formation of the Coordinating Board and formulation of the general policy are indications that the regional government political wills which hopefully could be regarded as the initial step towards the Lake Toba conservation efforts.

Figure 2:

Organization Structure of Coordinating Board for Lake Toba Ecosystem Conservation

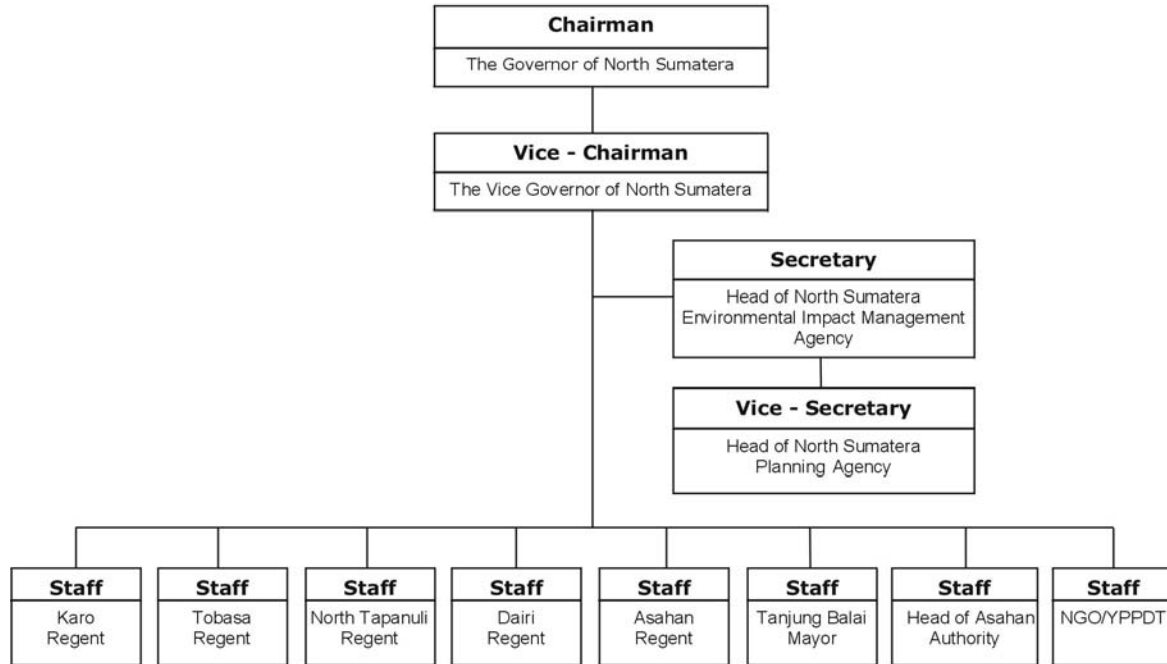
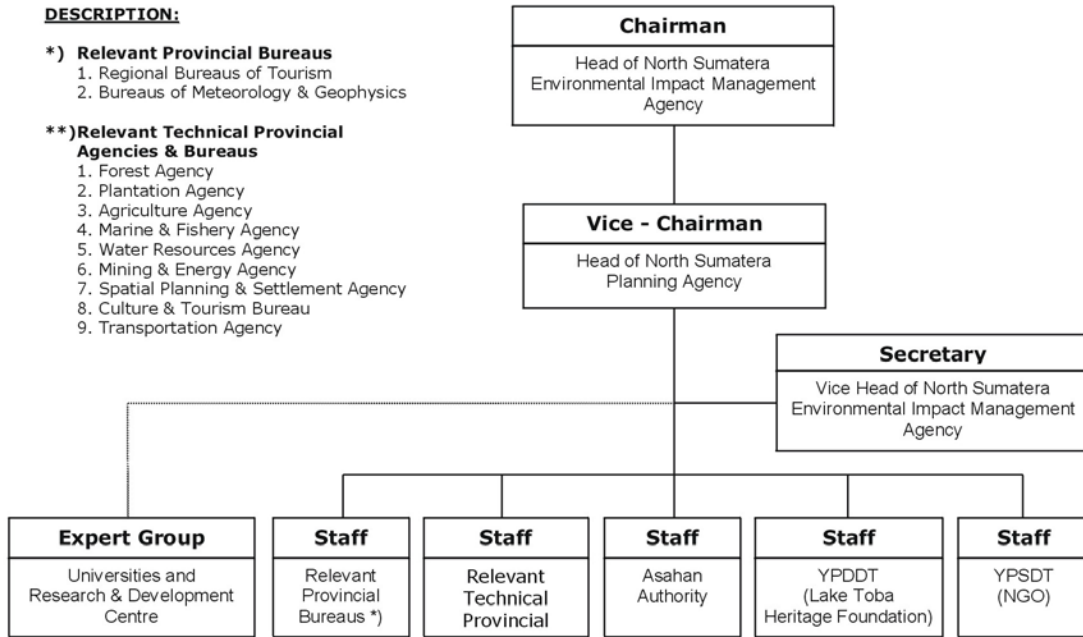


Figure 3:
 Technical Advisory Committee



4.2 Reduction of lake stresses

Legislative framework

Though small and quite preliminary as it may seem, the efforts toward environmental preservation is beginning to take place through the issuance of a number of regulations at the central as well as the regional government levels. At the national level, Law No. 23 Year 1997 on the Environmental Management serves as the umbrella for the formulation of environmentally related regional level regulations. This Law stipulates the right, the role and responsibility of the community, the authority in environmental preservation, the requirements in environmental arrangement, solution to environmentally related disputes, investigation and stipulation pertaining to violations and consequences.

In 1999, an inter-departmental team from the central government led by the Department of Tourism, Art and Culture worked out a draft of a Presidential Decree on Lake Toba Basin Management. LTHF was invited as resource and reference party. It was quite unfortunate, though, the Presidential Decree failed to get presidential signature because when the draft was introduced for socialization to the stakeholders it met with a variety of different perception regarding its future implications.

At the provincial level, the government has issued a regional Government Regulation No. 1 Year 1990 on the Lake Toba Basin Management which stipulates the prohibition to build a construction with a radius up to ten meters from the shoreline.

In order to limit the fast growing aquaculture owned mostly by foreign investors, the government had issued Presidential Decree No 96 of the year 1998 concerning the prohibition of foreign investment for aquaculture in inland waters.

Limitation in water use

To ward off the accusation as being the main cause for the drop of Lake Toba water level, PT Inalum says that they are using water within the limit of the prescribed amount. The hydroelectric generator is activated only if the water level reads 902.40 m above sea level and higher. To ascertain this PT Inalum has built a regulating dam at Siruar, 12 km from the mouth of the Asahan River at Porsea. The Siruar gate also regulates water level so as not to exceed 905.50 m, otherwise many villages around the lake would be inundated. The Asahan Authority as the representative of government is strictly controlling water use within the limit of 80m³/second.

Change in the management of PT. Indorayon

The controversial PT Indorayon later changed its name into PT Toba Pulp Lestari (PT TPL). The change of the name is in compliance with the central government decision taken in a cabinet meeting May 2000 to close down the rayon production and to continue the pulp industry. PT TPL promised to change its management style to be more environmentally sensitive; more willing to work together with the local community by allowing them to practice mutually beneficial intercropping. PT TPL is also willing to accept and support independent institution with expertise to supervise the use of the natural resources. But above all, PT TPL will set aside 1% of its net revenue from the sales of the product for the Toba Samosir government to be used for the environmental management. Supposing the annual

pulp production is 200,000 tons at a price of USD 350 per ton. The Kabupaten Toba Samosir government will receive USD 700,000 per year. This amount is well above the genuine regional revenue, a clearly tempting offer in a time of economic crisis such as it is now.

Construction of Parapat-Ajibata wastewater treatment plant

Parapat is one and the busiest tourist center in Lake Toba region. The tourist area of Parapat located on the shores of Lake Toba has an area of 140 hectares. The total residents of about 21,000 people not including the tourists themselves increases the problems of sewage from households and businesses. Almost all of the untreated household waste disposed directly into the lake. The quality of water has been reduced to the point that it is necessary to institute immediate steps to solve the problem with the construction of a waste water treatment plant.

The development of the sewerage system was started from the dense population around the lake, the area of hotels and restaurants by using a conventional sewerage system. The wastewater from households, hotels and restaurants channeled to a main wastewater pipe. From the pipe it is then processed and put into the aeration ponds. Through the Department of Public Works, construction of the Parapat-Ajibata wastewater treatment plant began in the month of October 1994 when funds from an OECF sector loan was available. Most of the constructed 1.5 km main and secondary sewer pipes located at the Parapat town of Kabupaten Simalungun while the 2,010 m³ capacity of sewage treatment plant with aerated lagoon system located at Ajibata town of Kabupaten Tapanuli Utara. This facility is equipped with pump lifts at three sites each with a capacity of 60-l/second and 5.3-m head, and with a pressure pump in one site with a capacity of 60 l/second and 41.94 m head.

The Parapat-Ajibata treatment plant was constructed with the capacity to serve 17,400 people with an addition of about 4,500 tourists per day in the high season. Until the year of 2001, only fourteen households and two hotels hooked-up, due to the lack of the social marketing of the facility.

Critical land rehabilitation program

The Lake Toba water has been so disturbed particularly during the last few decades due to the disruption in hydrologic cycle from extensive clearing of forest cover around the lake, therefore the priority action for the rehabilitation of the environmental condition is by reforestation of the basin which includes 50,192 ha of highly eroded (critical) lands or 29% of the watershed area. The North Sumatra provincial government has a program to rehabilitate the vegetative cover of over 104,570 ha critical lands in the Lake Toba watershed. The program is divided into two parts, one part being rehabilitation of 50,192 ha into complete forest cover comprising the production and conservation forest. The other part is replanting 54,378 ha of critical lands with perennial crops (estate crops and mountain horticultural gardens). The perennial crops are good in two ways, as ground cover and at the same time increase land productivity to improve the farmers' income. It is hoped that through this program the critical lands could turn green again and thus increase soil water holding capacity, reduced run-off, erosion and sedimentation, and eventually improve water quality and quantity of Lake Toba and at the same time maintain soil fertility in the farm lands.

4.3 Enabling Environment

The critical policy and institutional framework for management of the lake

Before the establishment of the Coordinating Board Lake Toba region has been proposed by UNESCO to be designated as a Biosphere Reserves, focused on three main activities: conservation of bio-diversity; economic and social development; and preservation of associated cultural values. With the biosphere reserves status it was expected that Lake Toba will receive international attention and invite international participation in its development and preservation. According to the Act No.24, 1992 about the Spatial Planning, the Biosphere Reserves is identical with 'Special Region', a region with prioritized spatial planning. Designation of a region as a 'Special Region' needs a Presidential Decree. Up to this time this proposal does not push through for lack of the Presidential Decree.

The general policy which was formulated by the Coordinating Board has put the formulation of a comprehensive and environmentally sensitive Lake Toba drainage basin management master plan a priority. The Coordinating Board must see to it that the master plan sufficiently accommodate aspiration of all the stakeholders. Since the enactment of regional autonomy each kabupaten reserves authority to manage its region and each is trying her best to reach the highest possible genuine regional revenue target. For this purpose all the five kabupatens tend to grant permit to capital investment, and forest logging is the main resource, followed by fishery and estate crops. With the union of the five kabupatens into a coordinating board it is hoped that a common vision and commitment could be reached and for the shake of maintaining the sustainability of Lake Toba basin ecosystem they would refrain themselves from using natural resources in an abusive manner.

Stakeholder involvement

Lake Toba drainage basin in not only home for 590,861 local population of the watershed but also a promising area that attracts outsiders, domestic as well as foreign, to invest in business undertaking. Therefore, all the interested parties related to Lake Toba are the stakeholders: the government, the private/business sector, and the grassroots level communities. The community is the main stakeholder since anything done upon the drainage basin will bear direct consequences to the people living in lake Toba watershed.

At the national level there are at least eight institutions with interest to this area, especially those connected to give approval on foreign investment, namely Departments of Forestry, Agriculture, Tourism and Culture, Finance, Marine and Fishery, State Ministry for Environmental Affairs, Asahan River Authority, and the Agency for Studies and Application of Technologies which played a significant role in the initial decision on PT Indorayon.

At the provincial level there are the Offices and Agencies of Forestry, Estate Crops, Agriculture, Marine and Fishery, Mining and Energy, Tourism and Culture, Planning Agency (BAPPEDA), provincial level Environmental Impact Management Agency (BAPEDALDA), Meteorology and Geophysics, PDAM (Local Government Water Company) and the River and Lake Transportation Agency.

At the kabupaten level the head of administration (Bupati) is directly involved; he is assisted by the related agencies in his subordination such as BAPPEDA, BAPEDALDA, etc.

Although several agencies in each level of the government have been undertaking efforts related to sustaining environmental condition in Lake Toba, the Coordinating Board has to admit the weakness of coordination among agencies within one single kabupaten as it is with

one province, between province and the kabupaten and between the government and the community. It is the sectoral approach that makes a program of one agency alien to one another. This is exactly why the Coordinating Board has to be established.

In the meantime, in comparison with other stakeholders the community participation at the grassroots level for environmental sustainability of the Lake Toba basin is generally better, though they must be accompanied and facilitated by NGOs. As is discussed in chapter two about a variety of grassroots level programs though small as they may seem to be but have proven to produce tangible result in sustaining the Lake Toba basin ecosystem

Thus, there is a big potential for community participation in the efforts to sustain Lake Toba drainage basin. The critical point lies in where and how we could improve the awareness and understanding about the aspects of ecosystem sustainability and to bridge the community attention with a real action toward sustaining the lake ecosystem which at the same time also renders benefit for the improvement of social economic condition of the community. This means an integrated program between social economic improvement and sustainable environmental development. A favorable indication about the potential of community attention is the fact where community members from varying backgrounds, schoolboys and girls, hotel owners, fishermen, traders, farmers, etc. join together in various environmentally related preservation activities such as regreening, garbage collection and water hyacinth clearing, and environmentally sensitive farming practices.

Monitoring and research capacity

Routine monitoring such as rainfall data is performed by the Agency for Meteorology and Geophysics which maintains 11 rainfall measuring stations all over the basin. The water level fluctuation in the lake is monitored by the provincial office of the Department of Mining and Energy. In the meantime, speaking about rehabilitation and maintaining sustainability of Lake Toba ecosystem is speaking about a complicated and multi-dimensional problem. The root causes vary extensively and the problems have been piling up for several decades. A number of researches have been conducted, such as study on water quality, analysis about suitability of plant species, identification of the diversification of plant species, and field trial on the application of environmentally sensitive concept in land use. But all the researches seem to be partial and are focused in some specific aspects only. Beside, the agencies conducting the research tend to be closed one from the other and keep the results for themselves. There is yet no solid and comprehensive research project covering major aspects and concerns in Lake Toba. Some of the researches/studies that have been conducted are as the following:

- Study on water quality, by the BAPEDAL in collaboration with the Bogor Institute for Agriculture, 1993;
- Study on the disturbance to Lake Toba basin ecosystem, by the BAPEDALDA in collaboration with the Faculty of Geography, University of Gadjah Mada, 2000;
- Study on the suitability of several perennial trees to critical lands in the Lake Toba watershed and nutrient depletion in soils under eucalyptus stands, by Forestry Research Center Pematang Siantar;
- Study on land rehabilitation and soil conservation, by North Sumatra Provincial BAPPEDA in collaboration with Community Development Research Division, University of North Sumatra.

The past and on-going financial investment

Up to this time no specific records are available about the size of capital invested for the purpose of Lake Toba preservation efforts since such a program is implemented singularly in isolation one from the other. However, there are a few small investments that could be found in records here and there:

- In 1996, UNESCO in cooperation with the Government of Denmark through DANIDA supported the publication of newsletter 'Pesan Danau Toba' (Message from Lake Toba) as a vehicle of information exchange to accelerate environmentally friendly development of the region. LTHF administered the publication of 1,500 copy monthly bulletin.
- Lake Toba has received financial support from the U.S. government. Starting in 1996, over a period of six years, the investment of U.S. federal funds totals just over \$400,000, and matching funds from other sources in the U.S. totals approximately \$220,000. The fund from various sources is used in a series of projects on Lake Toba under the sister lakes partnership between Lake Toba and Lake Champlain, including the program implementation at the grassroots level.

Although no specific commitment and confirmation about financing, there are at least two funding sources available for use in the Lake Toba ecosystem preservation. First, the North Sumatra government administration and DPRD (Provincial Parliament) have tried to obtain clarification regarding the annual fee for Lake Toba conservation paid by PT Inalum to the government through the Ministry of Finance which up to now is unclear what it is used for. The accumulated fee paid from 1982 through 1999 has reached an amount of USD 59 million. Second, according to North Sumatra BAPEDALDA PT. TPL has paid the local community development foundation, the Toba Samosir Community Development Foundation the amount of money as initially agreed upon.

The Coordinating Board for Lake Toba Basin Conservation is unable to cite the definite amount of fund available for maintaining the sustainability of the lake's drainage basin. It only indicates that the potential funding sources would be: Central Government Budget (APBN), Provincial Government Budget (APBD), Kabupaten Budget (APBD), national and international NGO's, and other non binding sources.

Global network

Lake Toba is grossly benefited from the Sister Lakes Partnership with Lake Champlain of the State of Vermont, USA. In 1996 a delegation from Lake Toba consisting of government representatives, the business and industrial sector and the university visited Lake Champlain to see for themselves and learn the concepts of integrated management implementation of a lake drainage basin systematically and in economically profitable manner. The delegation from Lake Champlain has also visited Lake Toba in 1999 to look closely the potential and the problem faced by Lake Toba. The "people to people" exchange has proven quite effective media for learning.

5. Lesson learned and recommended initiatives

Stakeholders' involvement are key to program design, implementation and effective action

The new management paradigm for Lake Toba drainage basin conservation particularly in the context of coordination among stakeholders covering community group, NGO, private sector and the government must be created and strengthened. It is expected that through an integrated and coordinated approach, a synergetic effort could be made into reality. This will result setting of common priorities, mutual understanding in the approaches to be applied and prevention of duplication and overlapping of activities in which one claims that one is the best above all others. Finally, a sustainable development process in Lake Toba drainage basin will become a reality.

The establishment of Coordinating Board at least indicates the political will of the North Sumatra provincial government in its effort in Lake Toba management. Most of its members are ex-officio, though; several of them represent regional and national level NGO's. Being newly appointed, the effectiveness of the Board is still yet to be seen, and this may need a considerable length of time. However, in the long run the Coordinating Board could become very strategic institution if only it could maintain a continuing community development effort and to iron out the different interests of the various stakeholders in order they could work synergistically including filtering out any exploitative conduct in natural resources based economic activity. The Coordinating Board must be able to maintain continuation in building synergism, coordination and sustainable development of Lake Toba drainage basin, including regular monitoring to allow timely corrective measures should there be any deviation in the development implementation.

The involvement of environmental stakeholders at all levels is indispensable, one of them being the grassroots community. The Lake Toba watershed management is impossible without the involvement of the communities living in it. The adoption of participatory approaches into the development projects in Indonesia has been increasing over the past several years. During the past three decades, the government of Indonesia has used centralized, top-down approach in many development sectors, resulted in lots of abandoned infrastructures and facilities with large investment. The political changes in 1998 have created a bigger autonomy for the provincial and the local governments and so opened a wider chance for community direct involvement in development activities.

Field observations have convinced many, including development practitioners, that the participation of the community in the decision-making process greatly influences the implementation and sustainability of the project. The participatory approach is an effort to solve common problems through building and use of community knowledge upon matters related to the problem. The dynamic, demand-based and change-oriented participatory approach improves care and capability of the community by giving them skills to analyze and solve their own problems. The participatory data and information collection and inventory process by the community stimulates the sense of belongings and involvement in the implementation of the plan they themselves developed.

Community-based activities with profound participatory approach hopefully could bring into the policy development process the voices of usually excluded principal stakeholder group – the community. From the experiences of the community-based project implementation in Lake Toba region, policy makers can draw insight what works and why, and use that

knowledge to create strategies to bridge the gap between national or regional policy and local practice. Through the application of dialogical approach combining bottom up and top down program formulation practices it is expected that community commitment in Lake Toba basin conservation program implementation could be developed and improved.

Capacity building on community participation

Community participation is essential, not optional. Community-based approach offers the most promising strategy for sustainable watershed management of Lake Toba. Whether planning a wastewater treatment facility, rehabilitation of critical land through tree planting, introducing environmentally sound farming, solving water supply problems, implementing measures to improve water quality or trying to change personal hygiene behaviors of people in the community, the most effective programs are those which involve citizens and stakeholders from the very beginning. Perhaps this is one of the more useful lessons that can be learned from the community-based pilot projects, especially when one considers the investments in wastewater infrastructure and other environmental projects on Lake Toba and elsewhere in Indonesia where all too often a facility is built or a plan developed without input or involvement from the community. More often than not, the lacks of a community-based approach results in facilities that do not operate and plans that are not implemented.

Unfortunately, even when provincial and district government staff are committed to a participatory approach as stated in the General Policy for the Lake Toba Basin Ecosystem Conservation document, they may not have the capacity to implement it. Lack of incentives and skills among government staff to encourage them to adopt a participatory approach is the main reason. Clearly, if government staffs are not provided with the necessary knowledge, skills and incentives to work in a participatory way with local communities, their willingness and ability will be severely hampered. Government staffs are often less qualified to work in a flexible, responsive manner in facilitating community action. Thus, they have less capacity to develop participatory forms of working; their decisions therefore tend to be taken in a more top down manner, involving only the village leader or a small group of the elite members of the community. Furthermore, the standard government system for planning, transferring and accounting for funds means those government personnel do not have the time, authority or resources to modify the program to suit the changing needs of the community. Workshop and training on the proper mechanism of community participation is necessary not only for the local community itself but more importantly is for the government officials.

Planning must be supported by a strong research and monitoring program

To enable to develop a workable, comprehensive and widely accepted Lake Toba basin management master plan and to put the common vision into reality, it is necessary to build a thorough research base in a wide range of disciplines and a support from complete and accurate data obtained from continuous and regular monitoring program. The availability of such data would make the implementation of the lake Toba basin conservation be undertaken in a holistic approach covering every angle of the problems, and the success level and its impact to all stakeholders is significant.

In the general policy for Lake Toba basin ecosystem conservation for instance, there is a specific mention about zoning of cage aquaculture as one component of the master plan, and

for this purpose there is a need for an extensive and in-depth study. Up to this time there is no study made in the impact of the vast growing cage aquaculture to Lake Toba waters. The absence of accurate and reliable data is evidently a hindrance to formulating a program. All this time, every attempt to rehabilitation or preservation works in Lake Toba have had to start it from ground zero, i.e. visiting various government agencies in order to collect the basic data needed. It often happens that data users do not know where to find the basic data they need, and if by luck the data were available the users were not sure if the data were reliable and accurate. There is no assurance about the reliability of data and good in terms of statistics (data collection technique) as well as in terms of non-technical aspect, whether there were already manipulated due to some specific interest. The establishment of an information center to collect, arrange, update, verify, process and disseminate them to the parties who are in need for accurate data/information is urgent. The proposal for Lake Toba Science Center which will function as education and environmental research center in Lake Toba area is not only important for the future in assisting educational institution and developing community awareness in environmental aspect, but could also function as a data clearing house for Lake Toba.

Integrate science and policy throughout the lake management institution

Research and monitoring would be essential components if the changes occurring in the lake are to be properly understood. Apart from the fact there is very little has been done in terms of science and social research, the few works that have been done were not sufficiently published let alone directly informed to the policy makers, the more so with the grassroots level communities. The research community, especially the science research tends to be closed. The reports of findings from many costly researches have found their way into the library which should have been used as input to the policy makers. On the other hand, the policy and decision makers seem to ignore the scientific advices to formulating decision. Therefore, it is necessary to build a communication bridge between the scientist and the policy makers especially in the context of relevant scientific advices and provision of feedback in the form of what could be done and not to be done in solving a problem. The communication between the researchers and the grassroots level community should also be established because the community also needs scientific information in order to understand the ecosystem in which they live. For that purpose the scientific terms and language level must be simplified since frequently the scientific information is too technical to be understood by the policy maker let alone the community at the grassroots level.

Environmental awareness and education

Community members are the best influencers and communicators for change. People are more easily convinced by their neighbors' experiences and tend to trust those they live with rather than outsiders. When a new facility such as the community-based wastewater treatment plant is introduced, its pros and cons must be fully understood before it gets accepted. Explanation by outsiders may serve to inform people, but they trust and accept the information to be true only when a relative, neighbor or a local leader checks it out and confirm it. Many of the ten environmental cadres who were selected from the local respective community included in the pilot project have demonstrated their ability to help implement activities begun during this project. However, the sustainability of their willingness to be the community motivator after the project is over could not be guaranteed as it is a very high dedicated work. A more thorough selection process of the environmental cadres as the indigenous potential change

agents is needed. At least three months or more is necessary to devote to the exploration of the dedicated, committed and trust worthy indigenous potential change agents. A scheme of small incentives is important to support the environmental cadres for the time and energy they devote to promoting environmental awareness and initiatives.

Behavior change does not happen until people realize or experience the benefit resulting from the change. Behavior can be said to have changed only when newer behavior patterns replace older one consistently and are sustained thereafter. Measuring the change of behavior as a result of environmental education of schoolchildren would certainly take a very long time, but the results can be far more effective and sustainable. Training for the elementary school teachers on the practical environmental education has been expanded to cover more than a hundred teachers and community leaders in Lake Toba region and it has to be continued.

The implementation of environmental education is a very appropriate means for raising awareness at the elementary school level because the subject is filled with social, cultural and ethical norms. Environmental education is urgently needed to help students develop an attitude of caring for the environment and avoiding behaviors that hurt the environment in their early years. Environmental education can also help students begin to realize that they themselves are an inseparable part of the environment and to feel a sense of stewardship and moral commitment to environmental conservation. Environmental education at the elementary school level is not an independent subject at the current time. It is generally taught as part of other subjects such as social science, natural science and family welfare. As a result, environmental awareness tends to be low among school-age children. At the later stage, mainstreaming the environmental education into the local curriculum of environmental education would be a great advantage for the health of Lake Toba.

Environmental sustainability, economy and poverty alleviation

The economy and environment are two inseparable aspects, especially the natural resources-based economic activities. The economic aspect can be viewed from the local, regional, national and international angles. The business sector in the basin viewed from regional/national context is related to manpower and from international context is the international capital share. From the environmental aspect is how to sustain the Lake Toba drainage basin as an income generating source for local population and pleasantness to the international community. Since the implementation of environmental regulation in Indonesia is still very weak, it is prerequisite that the law enforcement apparatus must be improved. Proper law enforcement would guarantee that everyone could work and invest its capital safely and justice in the community could be established.

The links between environmental sustainability and poverty alleviation in the context of sustainable development are also important, particularly for natural resource management. The poor often contribute to environmental degradation when pushed to the margins in order to survive. More important, environmental degradation from various aspects of industrialization and growth have had very adverse effects on the poor: air and water pollution affect their health, soil erosion weakens their productive capacity, and land encroachment restricts their access to traditional productive assets. Since poverty is seen as both a

consequence and cause of environmental degradation, improvements in environmental quality should help to reduce poverty and vice versa. Poverty alleviation, however, needs a multidimensional approach. The root causes is complex – including for Lake Toba – and must be well understood in order to find the appropriate alternative for integrated and structured solution. And this, of course, is beyond the scope of this report, it requires an extensive study of it's own.

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