JAPAN INTERNATIONAL COOPERATION AGENCY(JICA)

PRIME MINISTER'S OFFICE
THE REPUBLIC OF HUNGARY

THE STUDY
ON
ENVIRONMENTAL IMPROVEMENT
OF
LAKE BALATON
IN
THE REPUBLIC OF HUNGARY

FINAL REPORT

MAIN REPORT

MARCH 1999

PACIFIC CONSULTANTS INTERNATIONAL

SHIN-NIPPON METEOROLOGICAL & OCEANOGRAPHICAL CONSULTANT CO,. LTD.

Foreign Currency Exchange Rates Applied in the Study

Currency	Exchange Rate/US$
Hungarian Forint (HUF)	211.945
Japanese Yen (J.Yen)	132.800
German Mark (DM)	1.81360

(Average rate from January to June 1998)

Note: Following numerical notation is adopted in the Report:

Decimal marker : "." (Period)

Digit separator : "," (Comma)

PREFACE

In response to a request from the Government of the Republic of Hungary, the Government of Japan decided to conduct the Study on the Environmental Improvement of Lake Balaton in the Republic of Hungary and entrusted the study to the Japan International Cooperation Agency.

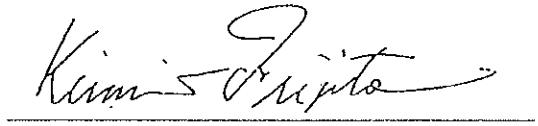
JICA selected and dispatched a study team headed by Mr. Akira Takechi of Pacific Consultants International and composed of Pacific Consultants International and Shin-Nippon Meteorological & Oceanographical Consultant Co., Ltd. to the Republic of Hungary, five times between January 1997 and January 1999. In addition, JICA set up an advisory committee headed by Mr. Senro Imai, Development Specialist of Japan International Cooperation Agency, between January 1997 and January 1999, which examined the Study from specialist and technical points of view.

The team held discussions with the officials concerned of the Government of the Republic of Hungary, and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Hungary for their close cooperation extended to the study.

March 1999



Kimio Fujita
President
Japan International Cooperation Agency

THE STUDY ON ENVIRONMENTAL IMPROVEMENT OF LAKE BALATON IN THE REPUBLIC OF HUNGARY

March, 1999

Mr. Kimio Fujita
President
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

Dear Sir,

We are pleased to submit to you the final report entitled "The Study on Environmental Improvement of Lake Balaton in the Republic of Hungary". This report has been prepared by the Study Team in accordance with the contracts signed on 22 January 1997, 15 May 1997, 10 February 1998 and 8 June 1998 between the Japan International Cooperation Agency and the Joint Study Team of Pacific Consultants International and Shin-Nippon Meteorological & Oceanographical Consultant Co., Ltd.

The report examines the existing conditions of Lake Balaton and its catchment area, develops a pollution load database and a water quality simulation model, and presents a comprehensive plan for the improvement of Lake Balaton environment and results of a feasibility study on the reduction of pollution loads from non-point sources proposed in the comprehensive plan.

The report consists of the Summary, Main Report, Supporting Report and Data Book. The Summary summarizes the results of all studies. The Main Report contains the existing conditions, database, water quality simulation model , comprehensive plan and results of the feasibility study, and conclusions and recommendations. The Supporting Report includes technical details of contents of the Main Report. In addition, Data Book have been prepared and is submitted herewith.

All members of the Study Team wish to express grateful acknowledgement to the personnel of your Agency, Advisory Committee, Ministry of Foreign Affairs, Ministry of Construction, Environment Agency and Embassy of Japan in Hungary, and also to officials and individuals of the Republic of Hungary for their assistance extended to the Study Team. The Study Team sincerely hopes that the results of the study will contribute to the improvement of Lake Balaton and that friendly relations of both countries be promoted further by this occasion.

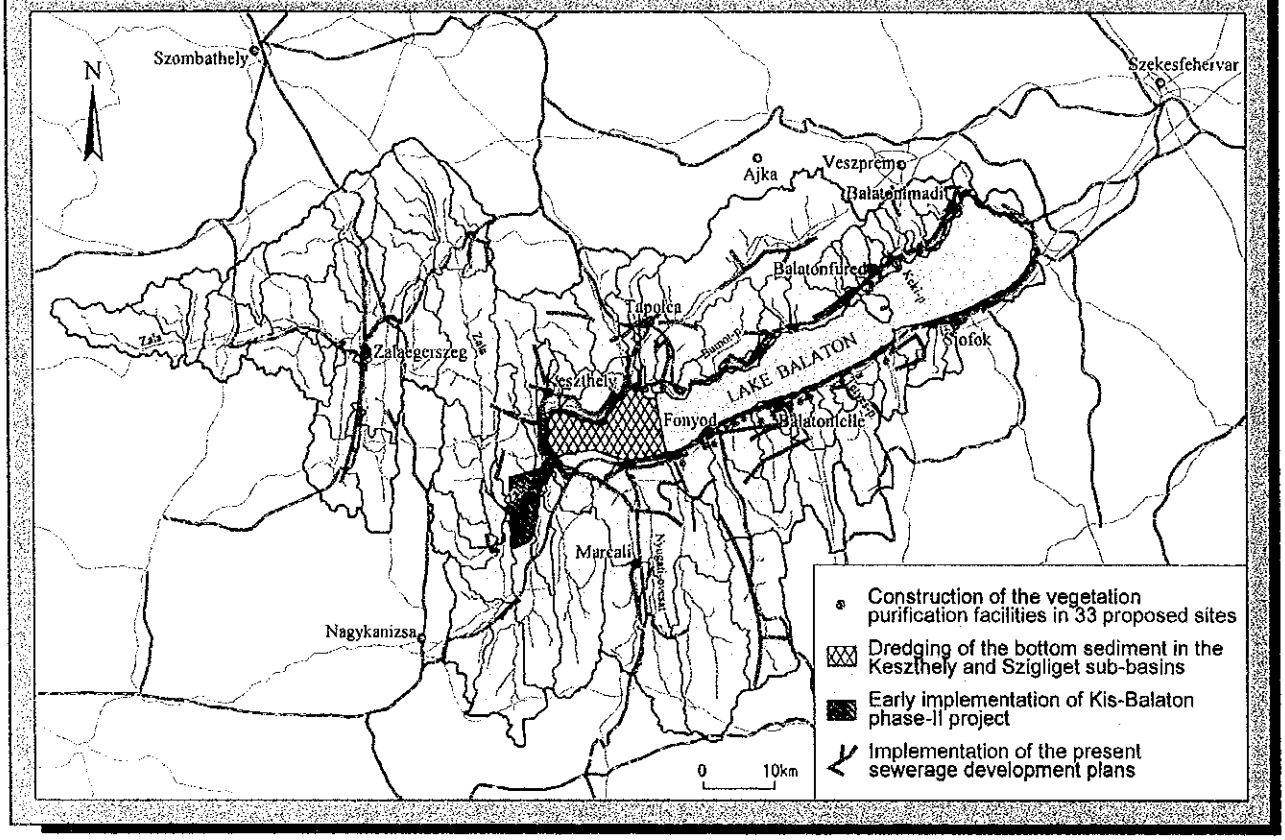
Yours faithfully,

Akira Takechi
Team Leader

Institutional Approach

- Organization of Balaton Policy Making Unit, which is a responsible organization for the management of information, policy making and coordination of every organization related to Lake Balaton issues
- Encouragement of involvement of residents
- Study on the environmental utilization charge

Structural Approach



Non-Structural Approach

- Promotion of the environmental education and campaigns
- Introduction of product charge
- Establishment of the legislative framework for the sewerage house connection and on-site sewage treatment

Proposed Comprehensive Plan

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CHAPTER - 5 FEASIBILITY STUDY

Abbreviations

ÁNTSZ	National Public Health Care and Medical Officer Service
BDC	Balaton Development Council
BLKI	Balaton Limnological Research Institute
BM	Ministry of the Interior
BME	Budapest Technical University
BPMU	Balaton Policy Making Unit
BRT	Lake Balaton Regional Council
COD	Chemical Oxygen Demand
DATE	Debrecen University of Agriculture
DDT KÖFE	Southern Transdanubian Environmental Protection Inspectorate
DDT VIZIG	Southern Transdanubian Water Authority
DRV	Transdanubian Regional Water Woks Incorporation
EIA	Environmental Impact Assessment
EM	Ministry of Health
FVM	Ministry of Agriculture and Regional Development
FÖMI	Institute of Geodesy and Remote Sensing
GIS	Geographical Information System
GM	Ministry of Economic Affairs
JICA	Japan International Cooperation Agency
KDT KÖFE	Central Transdanubian Environmental Protection Inspectorate
KDT VIZIG	Central Transdanubian Water Authority
KHVM	Ministry of Transport, Communication and Water Management
KKA	Central Environmental Protection Fund
KM	Ministry of Environmental Protection
MSZ	Hungarian Standards
MTA TAKI	Agrochemical Research Institute of Hungarian Academy of Sciences
NCD	Nature Conservation Directorate
NyDT KÖFE	West Transdanubian Environmental Protection Inspectorate
NyDT VIZIG	West Transdanubian Water Authority
OMSZ	Hungarian Meteorological Service
PLDB	Pollution Load Database
PLM	Pollution Load Map
PMO	Prime Minister's Office
STP	Sewage Treatment Plant
T-N	Total Nitrogen
T-P	Total Phosphorous
VA	Water Management Fund
VITUKI	Research Institute of Water Resources
WB	The World Bank
WQSM	Lake Balaton Water Quality Simulation Model

CHAPTER - 1

INTRODUCTION

CHAPTER - 1

INTRODUCTION

1. BACKGROUND OF THE STUDY

Lake Balaton is the largest lake in Central Europe located in the central western part of Hungary. In Hungary, which is an inland country, Lake Balaton is one of the most important water resources providing inestimable benefits to the nation. The lake has been utilized for tourism, recreation, fisheries, water supply, etc. In recent years, however, the degradation of the lake water quality has been threatening the sustainable use of this precious water resource.

In 1983, the Hungarian Government launched a Comprehensive Water Management Program (BVFP) as a first government policy for the improvement of water quality of the lake. This included the development of the sewerage systems for the surrounding area, the dredging of Keszthely Bay, and construction of the Kis-Balaton protection system. The sewerage systems have been developed in major settlements along the lakeshore. The Kis-Balaton protection system intends to stop the accumulation of nutrient-rich sediments in Keszthely Bay by rehabilitating the function of the Kis-Balaton area as a nutrient retainer. This system will consist of two parts of inundated areas. The construction of the upper part (Kis-Balaton Phase-I Project) was completed in 1985, but the implementation of the lower part (Phase-II) has been suspended due to financial difficulties.

In June 1994, the government issued Resolution No.1049 concerning the action plan for the environmental protection of Lake Balaton and the improvement of its water quality. This plan covers almost all areas of actions necessary for improvement of the lake environment. The target year is 2010.

Although the action plan covers almost all areas related to the improvement of the lake environment, there is a need of a comprehensive plan in which those activities are properly evaluated and prioritized in order to rationalize required investments. The improvement measures currently implemented or planned and additionally required should be evaluated in terms of their effectiveness and cost, and properly placed in the comprehensive plan.

Under these circumstances, the Government of the Republic of Hungary requested technical cooperation from the Japanese Government in the formulation of a comprehensive plan for the environmental improvement of Lake Balaton and a feasibility study on a high priority project from the comprehensive plan. In response to the request, a preparatory study team was sent to Hungary in July 1996 and both the countries agreed to conduct the Study on Environmental Improvement of Lake Balaton. The Scope of Work for the Study was signed on July 16, 1996.

2. OBJECTIVES OF THE STUDY

The objectives of the Study are;

i) to formulate the comprehensive plan for environmental improvement measures for Lake Balaton,

ii) to conduct a feasibility study on the urgent and/or priority project(s) to be selected from a component(s) of the above-mentioned comprehensive plan, and

iii) to carry out technology transfer to the counterpart personnel of the Government of the Republic of Hungary in the course of the Study.

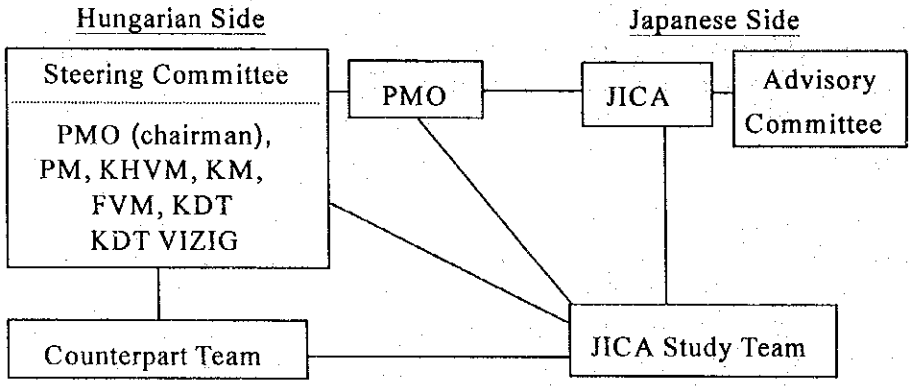
3. STUDY AREA

The Study area, which is shown in *Figure1.1*, covers the water body of Lake Balaton with about 600 km^2 of surface area and its whole catchment area with 5,800 km^2 of area.

4. STUDY ORGANIZATION

4.1 GENERAL ORGANIZATION

The whole organizational scheme of the Study was established as shown below.



Note: PMO= the Prime Minister's Office; PM= the Ministry of Finance; KHVM= the Ministry of Transport, Telecommunication and Water Management; KM= the Ministry of Environment Protection; FVM= the Ministry of Agriculture and Regional Development; KDT KÖFE= the Central Transdanubian Environmental Protection Inspectorate; KDT VIZIG= the Central Transdanubian Water Authority

4.2 JAPANESE ORGANIZATION

The JICA Study Team was composed of the following members.

Team Leader	: Mr. Akira TAKECHI
Water Quality Improvement Planning	: Mr. Tsutomu KURIHARA
Pollution Source Analysis (Non-point Source)	: Mr. Mitsuaki ITOH
Pollution Source Analysis (Point Source)	: Dr. Károly KUTICS
Water Pollution Mechanism Analysis	: Dr. Akio WAKE
Facilities Planning (Inside Lake)	: Mr. Takao NISHIMURA
Facilities Planning (Catchment Area)	: Mr. Masahiro KAWACHI Mr. Hiroyuki SHIRAIWA Mr. Toru Kimura
Socio-economics	: Mr. Eiji MAEDA
Hydrology/Hydraulics	: Mr. Yoichi HARADA
Water Quality Simulation Models	: Mr. Akihiko HIRAYAMA
Institutional Organization	: Mr. Satoshi KOJIMA
Study Administration	: Ms. Kanako IUCHI Ms. Atsuko OTSUKA

A JICA Advisory Committee for the Study was organized by JICA. The Advisory Committee consisted of following members:

Chairman of the Committee	: Mr. Senro IMAI
Committee Member	: Mr. Motokazu IWATA Mr. Satoshi OJIMA Mr. Takashi NAKAMICHI
Committee Member	: Mr. Katsuhisa KOYAMA
Committee Member (Simulation Model Advisor)	: Dr. Motoyuki SUZUKI

4.3 HUNGARIAN ORGANIZATION

A Steering Committee for the Study was established by seven (7) relevant organizations which include PMO; the Ministry of Finance (PM); the Ministry of Transport, Telecommunication and Water Management (KHVM); the Ministry of Environmental Protection (KM); the Ministry of Agriculture and Regional Development (FVM); the Central Transdanubian Environmental Protection Inspectorate (KDT KÖFE); and the Central Transdanubian Water Authority (KDT VIZIG). The Steering Committee was chaired by PMO and consists of following members:

Chairman of the Committee	: Dr. János NEMCSÓK (PMO) Mr. István BALSAY (PMO)
Committee Member	: Mr. Tamás LOYDL (PMO)
Committee Member	: Mr. Gyula SOMLAI (PMO)
Committee Member	: Dr. Ágnes DIÓSZEGI (PMO)
Committee Member	: Mr. Miklós KOLOSZÁR (PM)
Committee Member	: Mr. Tamás KÕSZEGHY (KHVM)
Committee Member	: Mr. László BALÁZS (KTM)
Committee Member	: Dr. Jenõ HORVÁTH (FM)
Committee Member	: Mrs. Mária KALETA (KDT KÖFE)
Committee Member	: Mr. Mátyás SZABÓ (KDT VIZIG)

Counterpart Team consisted of the members of ten (10) organizations which include KDT KÖFE; the Agrochemical Research Institute of Hungarian Academy of Sciences (MTA TAKI); the Keszthely University of Agriculture (PATE); the Debrecen University of Agriculture (DATE); the Research Institute of Water Resources (VITUKI); the West Transdanubian Water Authority (NDT VIZIG); KDT VIZIG; the South Transdanubian Water Authority (DDT VIZIG); the Ministry of Finance; and the Hungarian Meteorological Institute (OMSZ).

Water Quality Improvement Planning	: Mrs. Mária KALETA (KDT KÖFE)
Pollution Source Analysis (Non-point Source)	: Dr. György VÁRALLYAY (MTA TAKI) Dr. Tamás NÉMETH (MTA TAKI) Dr. Ferenc MÁTÉ (PATE) Dr. Ferenc LIGETVÁRY (DATE)
Pollution Source Analysis (Point Source)	: Mr.Endre FARKAS (KDT KÖFE)
Water Pollution Mechanism Analysis	: Dr. Elemér DOBOLYI (KDT KÖFE) Dr. Géza JOLÁNKAI (VITUKI)
Facilities Planning (Inside Lake)	: Mr. István KLING (KDT KÖFE) Dr. Piroska POMOGYI (NDT VIZIG)
Facilities Planning (Catchment Area)	: Mr. Antal GÁBOR (KDT VIZIG) Mr. Vilmos FEJÉR (NDT VIZIG) Mr. István HAMZA (DDT VIZIG)
Hydrology/Hydraulics	: Mr. Mátyás SZABÓ (KDT VIZIG)
Water Quality Simulation Models	: Mr. János MOLDOVÁN (KDT KÖFE)
Institutional Organization	: Mr. István JANÓ (KDT KÖFE)
Study Administration	: Dr. Ágnes DIÓSZEGI (PMO)
Meteorologist	: Mr. Zsolt ZÁRBÓK (OMSZ)

5. REPORTS

The study reports prepared are as follows:

Main Report
Supporting Report
Summary Report
Data Book

The main report presents the results of the whole study. It consists of six chapters. The existing conditions of Lake Balaton and its catchment areas are summarized in *Chapter 2*, as basic information for the Study. *Chapter 3* is devoted to explanation of the database and the water quality simulation model that were developed in this study for the development of decision making tools for Lake Balaton environmental management. *Chapter 4* is a main body of this report, describing the Comprehensive Plan for Lake Balaton environmental improvement. *Chapter 5* presents result of the feasibility study on river water purification as a measure of non-point source pollution load reduction. *Chapter 6* is conclusion and recommendation to encourage the implementation of the Comprehensive Plan.

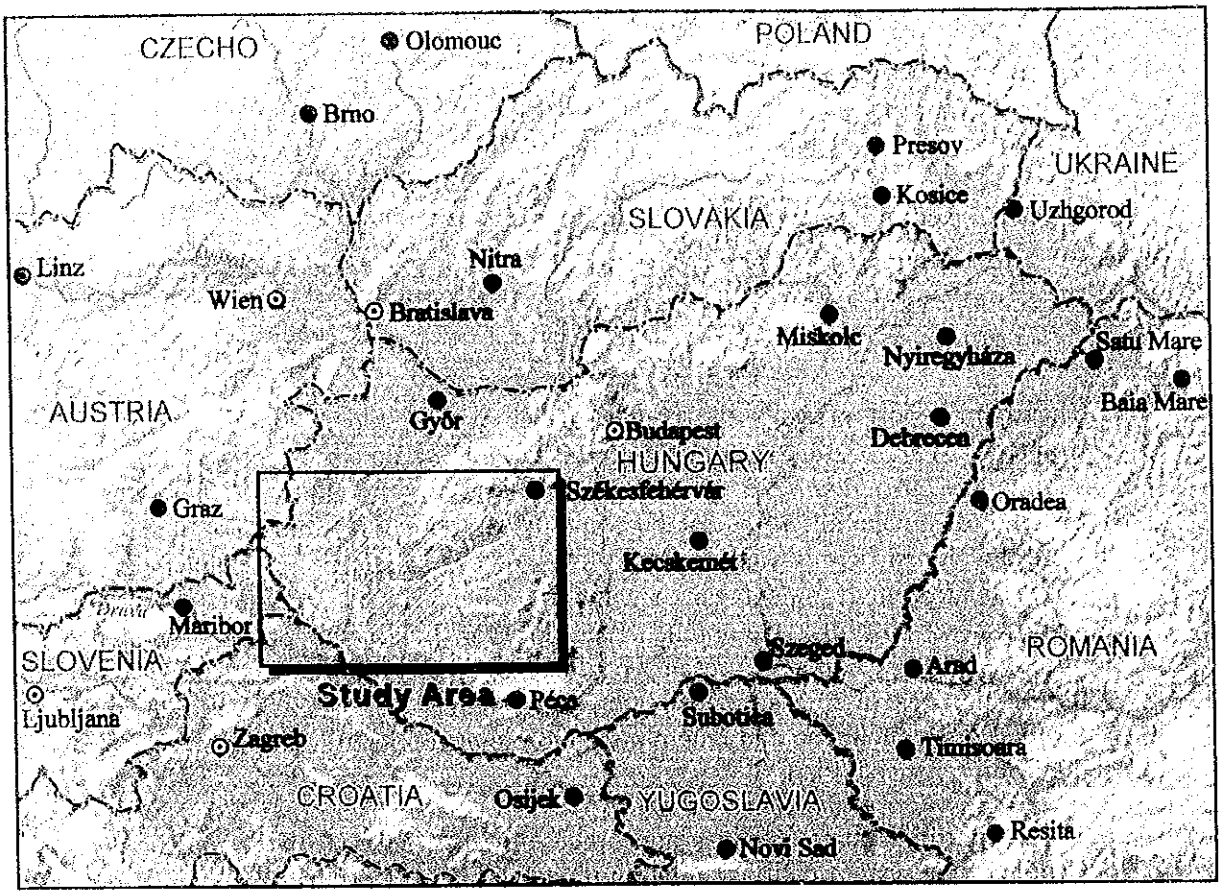
The supporting report provides appendices for the contents of the main report. Details of the water quality simulation model, which is explained in *Chapter 3* of the main report as one of major outputs of the Study, are given in the supporting report.

6. NOTES TO REORGANIZATION OF THE HUNGARIAN GOVERNMENT

A large scale reorganization of ministries were taken place in summer of 1998. As a result of the reorganization, some of ministries concerned to the Study were changed as follows:

Former Ministry	New Ministry
Ministry of Environment and Regional Policy (KTM)	Ministry of Environmental Protection (KM)
Ministry of Agriculture (FM)	Ministry of Agriculture and Regional Development (FVM)
Ministry of Industry and Trade (IKM)	Ministry of Economic Affairs (GM)
Ministry of Health and Welfare (NM)	Ministry of Health (EM)

In this Report, all the ministry names refer to new ministry names, while it has not been confirmed that all the functions of former ministries are transferred to respective new ministries.



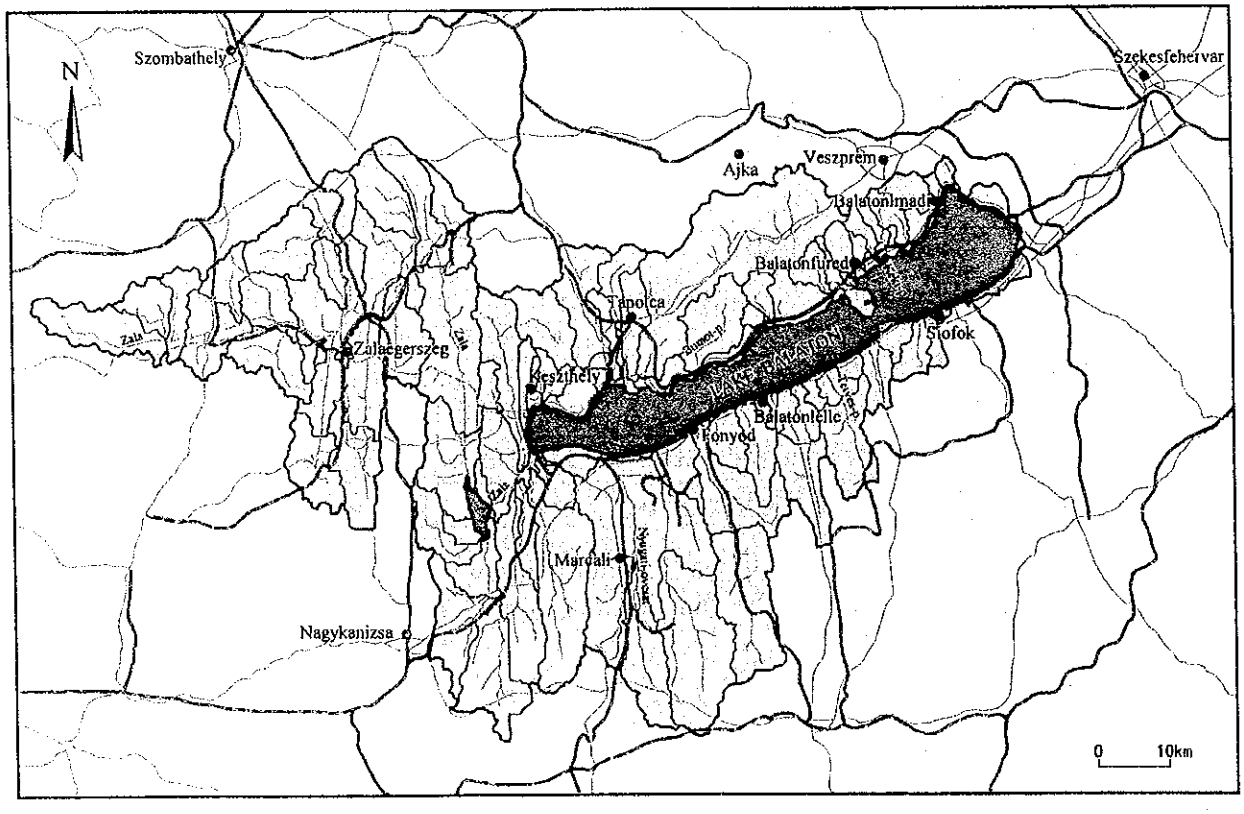


Figure 1.1 Study Area

CHAPTER - 2

EXISTING CONDITIONS

CHAPTER - 2

EXISTING CONDITIONS

1. NATURAL CONDITIONS

1.1 LAKE

(1) Location and Shape

Lake Balaton, situated in the western part of Hungary, is a large shallow lake with a surface area of 593 km^2 and a mean depth of 3.2 m. The shape of the lake is slender with a length of 77.8 km and a width of 7.7 km on average. The narrowest point is the Tihany Strait and here accelerated lake current erodes the bottom sediment up to more than 10 m deep against 3.2 m of mean depth. With the exception of this point, the lake is very shallow with mild slope. The southern shore is generally sandy due to its lotic condition. Contrastively, major part of the northern shore and the shore around the Keszthely Bay are covered by reed belts.

Because of the extreme shallowness of Lake Balaton, the lake water shows quick response to air temperature and solar radiation. During the summer it is not rare that the water temperature exceeds 25°C, on the other hand, normally the lake is covered with ice during January and February.

(2) Characteristics of Sub-basins

For the management purpose the lake is usually subdivided into four sub-basins, namely, the Keszthely basin, the Szigliget basin, the Szemes basin, and the Siófok basin, from the west to the east as shown in *Figure 2.1*. These basins are characterized as follows:

1) Keszthely basin

Surface area of the basin is the smallest but it receives the highest water inflow and nutrient load. Some parts of the shoreline are used for beaches, but lake water is never used for drinking water, irrigation or industrial water. Keszthely Mountains and South-western Balaton Catchment Area are newly designated as environmental protection areas in the "Balaton National Park".

2) Szigliget basin

The basin receives the second highest water inflow and nutrient load (phosphorus; about 30% of the whole) from medium-scale rivers in the north-western and the south-western catchment area. Some parts of northern shoreline and most of southern shoreline are used for beaches. Lake water is used for drinking water for Fonyód water supply systems, but never used for

irrigation or industrial water. Badacsony area in the northern catchment area is designated as environmental protection areas in the "Balaton National Park".

3) Szemes (central) basin

The basin receives water inflow and nutrient load (phosphorus; about 20% of the whole) from small-scale rivers in the northern catchment area and medium-scale rivers in the southern catchment area. Most of northern and southern shorelines are used for beaches. Lake water is used for drinking water for water supply systems in both sides of shoreline, but never used for irrigation.

4) Siófok (eastern) basin

The basin receives water inflow and nutrient load (phosphorus; about 15% of the whole) from small-scale rivers in the catchment area. Most of shorelines are used for beaches. Lake water is used for drinking water, irrigation and industrial water.

(3) Water Quality - Trophic Conditions

Major water quality concerns of Lake Balaton are eutrophication problems. Since exchange of water between adjacent sub-basins is extremely little, eutrophication level aggravates towards the west, and that of the Keszthely basin, which receives about one third of the lake's total nutrient loads, has reached hypertrophic level. Levels of eutrophication of each sub-basin represented by the chlorophyll-a concentration are as shown in *Figure 2.2*.

Trophic state of the lake was earlier uniformly mesotrophic and process of the eutrophication speeded up in the 1960s, resulting in hypertrophic condition in western sub-basins. *Figure 2.3* shows changes of chlorophyll-a concentration of each sub-basin since early 1980's. Seasonal changes generally have two peaks in spring and summer and the summer peak, representing blue-green algae production, is higher than the spring peak. Height of the summer peak changes year to year vastly, at random, and there seems no significant yearly trend. *Figure 2.4* shows the non-exceeding probability of certain chlorophyll-a concentration in each sub-basin from 1982 to 1996.

(4) Water Balance

Water level of the lake is regulated by the Sió Sluice which is located at the mouth of the Sió Canal, the only outlet of the lake, in 1863. The datum level ("0" point) of the lake is 103.41 m above Baltic Sea level (m B.f.), or 104.09 m above Adriatic Sea level. Since 1977 the fluctuation of water level is regulated within 0.3 m by the Sió Sluice. At mean water level, 104.1 m B.f., the total volume is about 1,900 thousand m^3, and theoretical retention time of lake water is about two years with multi-annual averaged water balance. Water balance and water level of the lake are shown in *Figure 2.5*.

1.2 CATCHMENT AREA AND RIVERS

The catchment area of the lake is 5,188 km^2 excluding lake surface itself, and the sub-catchment area of the largest tributary Zala River occupies 2,637 km^2, more than a half of the whole catchment area. The catchment area expands to four administrative counties, i.e. Zala, Somogy, Veszprém, and Vas.

Same as the subdivision of the lake itself, the tributaries of the lake can be grouped by the recipient basin. Zala River flows to the Keszthely basin, second and third largest tributaries, Nyugati-övcsatorna and Eger-víz, flow to the Szigliget basin, on the other hand, the easternmost Siófok basin receives small creeks only. The area of watershed and the inflow volume of each tributary in 1996 are shown in *Table 2.1*. According to this table, areal proportions of the sub-catchment of four sub-basins to the whole catchment are approximately 52 %, 34 %, 12 %, and 2 %, respectively from the west to the east, and the percentages of flow volume are 50%, 38%, 10%, and 2% respectively in the same order. Reflecting a large fluctuation of annual rainfall, annual mean discharges of most tributaries widely vary year by year. *Figure 2.6* shows the change of annual discharge of Zala River.

Along the southwestern part of lakeshore, for discharging water to the lake pumping stations have been installed in Balatonfenyves, Bélatelep, Balatonlelle, and Ordacsehi. In 1996 the total volume of water discharged into the lake by pumping was 34.4 million m^3/year.

1.3 TOPOGRAPHY, GEOLOGY AND SOILS

(1) Topography

The area between the northern border of the catchment area and north shore of the lake is hilly with the Keszthely Mountains, the basaltic mountains around Badacsony, the South Bakony Mountains, and the Balaton Highlands. On the contrary, a considerable portion of southwestern sub-catchment is occupied by marshy lowland, including Nagyberek and Kis-Balaton. Tributaries to northern shore are generally much steeper than those to southern shore. General topography of the catchment is shown in *Figure 2.7*

(2) Geology

In the Pleistocene, a prototype of Lake Balaton, which consisted of several separated basins, was formed by deposition of the Levantine formation on the Pannonian basin which was originally separated from the Mediterranean Sea during the Miocene and was freshened during the Pliocene. Then Pleistocene basaltic volcanic activities, which formed mountains around Badacsony, and subsequent crustal movements reshaped the region and merged the separated basins. The present lake is about 12 to 18 thousand years old.

The Triassic basement that predominantly consists of limestone and dolomite lies below the very thick Miocene and Pliocene formations at the western part of Zala sub-catchment, but it elevates gradually toward the east and reaches the

surface in Keszthely. It forms limestone and dolomite plateaus of the Keszthely Mountains, the Balaton Highlands, and the South Bakony Mountains, in which the karstic aquifer has developed as a consequent of corrosion. The mountains around Badacsony are formed from basalt.

(3) Soils

The most typical soil in the catchment is leached brown forest soil, which is non-calcareous, 70 to 75 % Ca saturation, 50 to 60 % base saturation, and slightly acidic (pH 6.2 to 6.8) and contains 250 to 350 mg-TP/kg. Approximately two third of the whole catchment area is covered by it.

Considerable portion of the northern and southeastern sub-catchments is covered by brown earth, of which characteristics are quite similar to those of the leached brown forest soil.

In the major part of the Keszthely Mountains and the South Bakony Mountains, the predominant soil is rendzina, which is usually calcareous and Ca-saturated with high organic matter content in the shallow humus horizon.

The Kis-Balaton, the Nagyberek, and the Tapolca Basin are peat areas. A main part of the Nagyberek was drained and ameliorated for an agricultural purpose in 1950's, on the contrary, the Tapolca Basin is protected as an ancient peat relict.

From the viewpoint of soil erosion, about 70 % of the northern sub-catchment is strongly eroded ("strongly eroded" means that more than 70 % of the original surface layer is eroded). Above all, almost all areas that are not covered by forest vegetation and are used as orchards and vineyards are strongly eroded. In the flatter southern sub-catchment the ratio of strongly eroded area is about 10 %. In addition to water erosion, the impact of wind erosion has become more and more significant, particularly on drained and ameliorated peat areas and sandy soil areas.

1.4 CLIMATE

(1) Solar Radiation and Air Temperature

Annual solar radiation of the Study Area is 4300 to 4500 MJ/m^2. The maximum monthly total is about 650 MJ/m^2 in July, and 56 % of annual radiation concentrates during May to August.

The annual mean temperature of the Study Area is about 10°C, and annual temperature fluctuation is moderate. Frosty day, of which daily mean temperature is below 0°C, occurs from November to March, and the average number of frosty days is about 40. In July and August, the monthly mean temperature reaches 21 to 23°C. Generally speaking the mean temperature is slightly getting warmer toward the east. *Figure 2.8* shows multi-annual monthly mean temperature in Keszthely and Siófok during 1992 to 1996.

(2) Precipitation

Yearly average precipitation of the Study Area is 750 to 900 mm, and it is relatively higher than the Hungarian average. In summer season the rainfall event often occurs locally, in particular, around the lake. For example, it sometimes happens that Balatonszemes does not have any rain while Balatonakali has heavy rainfall, even their distance is less than 10 km and only Lake Balaton lies between them. *Figure 2.9* shows multi-annual monthly precipitation in Keszthely and Siófok during 1992 to 1996.

(3) Wind

In the Study Area N or NW winds are strongly predominant. Along the northern shore almost all winds stronger than 5 m/s is N or NW, however, along the southern shore considerably a lot of SW or SSW winds are observed besides N or NW. *Figure 2.10* shows multi annual distribution of winds stronger than 5 m/s in Keszthley and Siófok. It should be noted that Keszthely station is surrounded by tall trees and this might be a major reason of that such strong winds are much rarely observed by the Keszthely station.

1.5 Basic Hydrology

(1) Overall Hydrology

Average total runoff rate of the whole Balaton catchment is 0.152, with multi-annual mean annual rainfall of about 700 mm, multi-annual mean inflow of 551,000 thousand m^3, and total catchment area of 5,170 km^2.

(2) Rainfall Characteristics

According to daily rainfall data at Zalaegerszeg, Veszprém, Siófok, and Keszthely Stations in 1995 and 1996 as shown in *Table 2.2,*

- only about 30 days exceed 10 mm, and
- the annual maximum daily rainfall was 78 mm at Keszthely and mostly less than 30 mm.

Judging from precipitation charts of Balatonakali and Balatonszemes from 1994 to 1996;

- hourly intensities of storm rainfalls in an hour are mostly low, say less than 10 mm/hr, and
- high intensity rainfall of 30 to 50 mm/hr were observed a few times a year.

(3) Measured Sediment Runoff

SS data of the Zala River at Zalaapáti in 1996 show the following.

- Average SS concentration is 55.5 mg/l with annual discharge of 253,140 thousand m^3 and annual SS load of 14,041 tons.

- Annual sediment run-off is 0.092 tons/ha/year with catchment area of 1528 km^2, assuming bed load is zero.

- Average SS values at Balatonhídvég and Bukoel were 21.1 and 5.2 mg/l respectively resulted in sedimentation in Kis-Balaton.

According to the suspended solid measurement data of the Zala River (at Zalaapáti) and Tetves patak (at Balatonszemes) in 1994 and 1995, SS values of the rivers are as follows:

- SS values of the Tetves River were small, less than 60 mg/l.

- SS values of the Zala River show sometimes high, the max. of 2,515 mg/l, frequently more than 100 mg/l. High SS values were observed frequently.

(4) Storm Runoff Characteristics

Based on relationship between hourly rainfall intensity and discharge as shown in *Table 2.3* and *Figures 2.11 and 2.12*, peak runoff coefficients of the catchment area are as follows:

- less than 0.01 in rural area

- in urban area, mostly less than 0.1, in the case of large rainfalls 0.1 to 0.3 affected by previous rainfalls

Judging from above peak runoff coefficients and the result of field reconnaissance, the characteristics of storm run-off in the Study Area are as follows.

From rural area

The loam and sandy layers, widely distributed in the catchment area, have high infiltration capacity (more than 100 mm / hr) as shown in *Figure 2.13*, while the rainfall intensity in the catchment area is generally low. Most of the storm water is infiltrated in forests, grass lands, farm lands, vineyards and pastures. Therefore, increase in impermeable surface areas such as road, walkway, roof, waterway, etc. will change this value remarkably. Soil erosion would occur in the less permeable areas with the conditions such as high groundwater level, shallow impermeable layer, and steep slope. Runoff from road surfaces flow generally into the side drains and finally to the grass land, bush, etc.

High SS concentrations in Zala River are frequently observed as mentioned above, and it might be caused by storm run-off. Taking high infiltration capacity of most catchment area into consideration, erosion by storm water must be occurred mostly in the less permeable areas like footpath, bare land, etc.

From urban area

Most of the surface runoff will be produced from the roofs and the roads. Storm waters from the roofs drained to the road surfaces, drainage channels and ground surfaces a part of which would infiltrate into the ground. Urban storm runoff occurs within a short time like a few hours after a storm rainfall, and carries accumulated sediments as well as solid wastes. Therefore storm water from urban areas is highly polluted.

2. SOCIO-ECONOMIC CONDITIONS

Simply due to the data availability, analysis of socio-economic conditions has been done on county basis. Thus here the current situation of the four counties, Zala, Veszprém, Vas and Somogy, were studied.

2.1 DEMOGRAPHY

(1) Past and Present Situation

The most notable demographic trend about the four counties is that the population of those counties at the beginning of 1996 decreased by 1.6% in average against at 1990, which happens to correspond to the decreasing rate of the whole country. Decreasing trend of the period, however, has eased compared to the rate of the period immediately before 1990, the period of 1980 and 1990, which is 2.9% (in whole country, decrease by 3.1%). This easing trend might be explained by the fact that more people are inflowing nowadays to Veszprém and Somogy. In comparison of the population between urban area and rural area, urban area decreased more than rural area in Veszprém and Somogy, which follows the national migration trend, while in Zala rural area decreased more than urban area.

(2) Demographic Projection

Total population of three counties (Zala, Veszprém, and Somogy) of the latest statistical data at the beginning of 1996 quoted above is 1,017 thousand, and the projected population in the same year based on 1987 is 1,023 thousand; the projected population is bigger than that of the statistical data (actual) by only 6 thousand. Assuming and based on the following projection, demographic change between 1996 and 2006 in all three counties is only marginal. Total population of the three counties at the beginning of 2006 is projected to be 1,022 thousand, which is a decrease by two thousand from 1996.

This projection takes the same trend of the most optimistic projection of whole country, in which 10,196 thousand people is projected in 2040 compared to 10,250 thousand in 2000, a decrease of 0.5% or 54 thousand for 40 years.

(3) Population in the Recreation Area

The number of permanent residents within the recreation district was 250 thousand in 1985, which is divided into lakeside communities, 128 thousand, and background communities, 122 thousand. Total population including other categories (recreation guests, enclosed-garden owners and visitors) was 860 thousand. In 2000 they are expected to be 255 - 258 and 875 - 945 respectively, with a small fraction of increase. After replacing the figures in 1985 of lakeside communities with the latest available figures in 1991, population of they was 931 thousand and population of whole recreational district was 1,086 thousand.

The number of people of recreational guests (holidaymakers) on busiest days of the peak season can reach even higher 930 thousand, although the average weekend figure is 596 thousand. So the number of lakeside communities can reach 1,265 thousand; the total number of recreational district can reach roughly 1,500 thousand during the peak season these days.

2.2 LAND USE

(1) Agriculture

In agriculture crop fields and pastures dominate the region. The shares of horticulture and vineyards-orchards are roughly equal. The latter are typical on the northern shore, while vegetables are also important on the southern shore. The northern shore of the lake between Alsóörs and Gyenesdiás comprises one of the most famous historical wine region of Hungary, with centers like Csopak, Balatonfüred and Badacsony. The other products, like fruits, vegetable and animal products are important. The outer areas serve principally agricultural purposes.

(2) Forestry

The proportion of forests in Lake Balaton region is higher than the national average, but additional afforestation is warranted by both tourism and environmental consideration. Forests are called upon primarily to serve the functions of tourism environmental protection.

(3) Industry

Of the industries operating in the tourist area, major factories are situated on the northern shore, especially chemical and paper processing industries at Balatonfüzfô.

Processing industries in the area comprise chemical industry and paper mill at Balatonfüzfô, and wine cellars at Badacsony and Balatonboglár.

Quarrying and basalt used to be active in the region, although several quarries have already been abandoned for reasons of environment protection. Some limestone and sandstone quarries still operate. New mines are given

permission only when thoroughly justified with the fullest regard to environmental consideration.

2.3 ECONOMY

(1) Macro-economy

The present government, which took power through the election of May 1994, has been pushing ahead with macro-economics adjustment policy. An extensive stabilization package program, combining devaluation of HUF with a program of fiscal restraint, reduction in real wages, and introduction of import surcharge, resulted in a sharp slowdown of GDP growth rate, from 2.9% in 1994 to 1.5% in 1995, and estimated 0.8% in 1996. The resultant fall in domestic demand and 8% import surcharge are regarded probably the most important factors which brought about 9.5% fall in import. Also, due to protracted weak domestic demand combined with severe cuts in government spending, unemployment rate has abided over two digits, 10.3% in 1995 and 10.0% in 1996. On the other hand, export expanded in 1995 supported by the devaluation of the currency and crawling peg mechanism. Nearly all indicators of business activity have been rising to date; some indicators like industrial output and export show even further expansion. Inflation in term of GDP price deflator peaked in 1995 with 25.6%, resulted from increases in various regulated prices and import prices caused by the depreciation of HUF. The rate fell to 20.9% in 1996 responding to the disinflationary influence of falling real wages and disposable income.

Turning to short-term outlook, GDP growth rate at constant prices of 1991 is expected to leap from 0.8% in 1996 to 2.4% in 1997 and 3.5% in 1998, with sustained strong export sector and recovery of domestic demand. Elimination of the import surcharge by 1st of July, 1997 combined with recovery of strong domestic demand will result in import growth, which will inevitably raise concerns about deterioration of the balance of trade and current account in the external balance. But continued growth of export sector and invisible trade balance, especially tourism sector, and inflows of foreign direct investment are expected to augment the international payment problem. In a move to counter the inflationary pressure, Hungarian government and the central bank have set and inflation goal of 17 - 18 % in 1997. Major economic indices and short-term projections are summarized in *Tables 2.4 and 2.5*, respectively.

(2) Industrial Structure

Sectoral structure of national economy of Hungary has undergone significant changes after the political and economic transformation as shown in *Table 2.6*. Sectoral shares in 1995 of agriculture/hunting/forestry/fishing (86.4), construction (67.0), and trade sector (75.4) are still far below than in 1980 (assuming the 1980 level to be 100).

3. LAKE UTILIZATION

3.1 WATER USE

(1) Drinking Water

There are 13 in-take facilities for drinking water in Lake Balaton. Their locations and in-take volumes are shown in *Figure 2.14* and *Table 2.7*. Basic in-take volume for permanent dwellers was about 800,000 m^3/month as a whole in 1996, which means that the number of beneficiaries is about 110,000. In-take volume for temporary dwellers such as tourists was about 1,100,000 m^3/month as a whole in the peak period (July and August) of 1996, which means that about 150,000 of tourists benefit from the lake water.

(2) Irrigation

As for irrigation purpose, there are two in-take facilities in Lake Balaton. Their locations and in-take volumes are shown in *Figure 2.14* and *Table 2.8*. One of them, Balatonfüzfô watering facility did not take the water in 1996. Annual in-take volume for irrigation is equivalent to 1.5% of that for drinking water. The lake water is utilized for irrigation during April to October, and the highest demand is in summer season (June to August).

(3) Industrial Water

As for industrial water, three in-take facilities exist in Lake Balaton. Their locations and in-take volumes are shown in *Figure 2.14* and *Table 2.9*. Most of water is supplied for NIKE (nitro-chemical industry) in Balatonfüzfô. Other two are for water treatment plants (different usage from drinking water) in the north-eastern lake-side area and for small industry in Balatonfôldvár and Balatonlelle. Annual in-take volume for industrial water is equivalent to 50% of that for drinking water, however its seasonal variation is not so big as drinking water's.

(4) Fisheries

Commercial fishing is exclusively managed and operated by the Balaton Fishing Incorporation that is under control of Ministry of Agriculture. A private fishing is only done by anglers with license. Total catch by the Balaton Fishing Incorporation in 1996 is about 890 tons/year and that by private fishing in the same year is about 350 tons/year. Main catches by commercial fishing are 514 tons of eel and 264 tons of bream, and that by private fishing is 125 tons of carp.

There exist many fish ponds in the catchment area of Lake Balaton, however there is no fish farm in the lake. Some of the fish ponds are managed by The Balaton Fishing Incorporation and others are by private companies. The young of fish are raised in some of these fish ponds and are released into the lake.

3.2 ONSHORE

Shore protection structures were built over more than a hundred kilometers. It means that almost a half of the lake shoreline have been regulated to protect settlements or beaches. Lake Balaton has about 120 beaches and is known for its summer recreational facilities. These beaches are located all over the lakeshore. Behind these beaches there exist well-equipped recreational facilities such as villas, weekend houses, hotels, restaurants, camping sites, sports facilities and parks. Especially on the southern shores of the lake, there are many holiday resorts that are very closely built to the lake. These resorts along the lakeshore are closely connected by railways and roads.

There exist some small-scale port facilities for ferryboats in Siófok, Balatonfüred, Tihanyi-rev, Balatonföldvár, Balatonkenese, and Keszthely. Balatonalmadi, Balatonfüred, Tihany, Siófok, Balatonföldvár, Keszthely, and Badacsony have yacht harbors. The use of private motor boats is prohibited for the reason of environmental protection.

Kis-Balaton is a shallow, marshy and reedy land which lies along the Zala River to the south-west of Keszthely. Many kinds of waterfowls and fishes are dwelling in this marshy land, which has been protected as a nature conservation area.

3.3 TOURISM ACTIVITIES

(1) General

Number of foreigners visiting Hungary was 37.6 million including 20.5 million tourists in 1990, marking about 50% increase from the previous year. The number stagnated in the following years, 1991-1992, but it resumed upward trend again from 1993 and recorded 39.2 million including 20.7 million tourists.

The number of guest, both foreign and domestic, visiting Lake Balaton region was 650 thousand in 1995, which took 12.6% out of total of whole country. This is the second largest share in Hungary, next to Budapest region. It should be noted that there are many unaccounted tourists, especially in Lake Balaton region. Foreigners' share gradually decreased since 1991 and it was 63% in 1995. It is generally said that Hungary's importance as the meeting point of East and West Germans has now ceased.

(2) Demand Characteristics

Remarkable feature of tourism in Lake Balaton region is its seasonal concentration in the number of tourist. The number of tourist arrival in Lake Balaton region in July, peak month, is as big as 24.1 times as that of January, lowest month, according to the records in 1995.

Seasonal fluctuation is like this: uptrend usually starts from March to reach the peak in July and August. Almost half of annual guests concentrates during these two months. Downtrend starts from September to reach the lowest

during January and February, with surprisingly few guests (around seven thousand).

Domestic tourists used to pay only 10-20% of total expenditure; other cost were subsidized by trade union/governments. Such favorable subsidy systems have collapsed. Higher accommodation cost, security problem, and increasing competition with other domestic and foreign tourism spots are often noted to explain factors underlying stagnating trend, other than recent deteriorating disposable income of Hungarian people. According to the past studies on this subject, major characteristics of domestic Balaton tourism are as follows:

- Decreasing volume and proportion of total number of tourists;
- Their primary activity is a beach holiday;
- 20% travel by train and more than 50% stay in their own holiday homes or with relatives. Almost half of them come with their children;
- They spend 77% on average less than foreign tourists (9,884 HUF/person, 1,853 HUF/day in 1992). Although fewer amounts are spent on accommodation, more is spent on food.

(3) Accommodation Facility

Total present capacity of public accommodation (number of beds) in three counties is about 105 thousand, out of which 27.3 thousand is supplied by hotel and 77.7 thousand is supplied by other types in 1995. As is well known, Somogy takes the dominate share (46%).

Average foreigner's share in 1995 is 70% in total guests nights spent in public accommodation:

- more foreigners are choosing to stay at hotel, rather than other types of accommodation; the number of foreigners staying at hotel has been stable;
- average number of nights of foreigners staying at hotel has also been stable (4.1 nights in 1993, 4.3 nights in 1994 and 1995)

This suggests foreigners' preference to stay at hotel. Further study about this subject should be sought in order to develop future international tourism of Lake Balaton region.

Accommodation capacity supplied privately in terms of private room or second house was estimated as follows:

- 280 thousand (in 1993) by private rooms (not organized by tourist companies);
- 170 thousand by second house.
- 82 thousand (in 1990) by so-called "social-tourism;

In general these accommodation supplied privately in terms of private room or second house are not accounted in statistics. But if they are accounted, accommodation capacity in the region would be around 637 thousand in 1995.

(4) Turnover

When viewed from turnover, hotel takes more than 90% of total turnover of public accommodation, from both international and domestic tourists, as shown in *Table 2.10.* Various information suggest that there is much unaccounted turnover and accommodation capacity in the region. For instance, OECD reported around 69% of turnover of service sector over the country and 16% of both food and beverages and retail sales sector are unreported. The existence of a large underground economy (defined as unreported or under-reported) complicates the assessment of economic activity in Hungary.

As compared to other areas of the country, Lake Balaton region (lakeside and settlements nearby the lake) takes the share of 19% in domestic tourist and 18% in international tourists, as shown in *Table 2.11.* In total the region earned 6,344 million HUF in 1995, which is about 17% of the whole country, out of which coastal area takes 12.5% and settlement areas nearby the lake takes 4.3%. This is the second largest share in Hungary, next to Budapest region. But as far as domestic tourist is concerned, Lake Balaton region takes the largest share of 19%, 1% more than Budapest region.

(5) Problems and Constraints

1) Transportation

The transportation of Lake Balaton in the summer season is frequently unbearably crowded on the Northern and the Southern Shore. Construction of the final section of the M7 highway needs at least a decade. Slovenia and Croatia have already started to construct the section from the borders to their significant ports, and the project is planned to be accomplished by the turn of millennium. If all the truck from the ports in those countries take advantage of the highway, they will extremely overburden and lead to collapse the southern Balaton traffic system.

2) Security

Crimes committed against property are dominant ones, especially break-ins (bungalow break-ins), stealing and forcing open cars. Compared to the first couple of years of 1990s, considerable improvement can be seen in this matter as well, due primarily to organizational arrangements. Significant number of police officer on duty increased. As a result, the numbers of car stealing and violent crimes decreased while the number of theft and prostitution are still unchanged.

3) Information system

The present information system of Lake Balaton is far from satisfaction. Most officers of the Tourinform Office, which can be found in settlements along the shore, can hardly provide the tourist with information on the complete facilities of the region of Lake Balaton.

3.4 PLAN FOR LAKE UTILIZATION

There seems to be no large-scale development plan/project for utilization of Lake Balaton. The area looks as if it is losing its appeal to tourists or investors or it is being bewildered how to develop compatibly with environmental protection. On the other hand, demands for higher quality of life and more attractiveness are rather increasing. The area seems to be expected to renew its appeal as a mature recreational or resort area.

Under these circumstances, sustainable development of water resources has been considered. A demand of utilizing lake water for drinking water is considered to increase due to its flexibility to seasonal variation and deterioration of subsurface water quality. If so, development of sewerage systems will be inevitably needed not only to keep the water quality of the lake in acceptable level but also to deal with the wastewater proportionally increased by the development of water supply.

Balaton National Park is to be established to improve the water quality of Lake Balaton and to protect the values of its catchment area. It would accelerate the development of the measures against water pollution caused by lake water utilization. Lake utilization would be environmentally sound or nature-oriented.

4. INSTITUTIONAL FRAMEWORK

4.1 LAWS AND REGULATIONS CONCERNING LAKE ENVIRONMENTAL PROTECTION

(1) General Laws concerning Environmental Protection

The act LIII/1995, on the general rules concerning environmental protection, establishes basic principles for, duties of the state and local governments for, financial background for, and citizen participation in the environmental protection and the nature conservation. The act covers conservation of land, water, and biosphere; protection of the air; treatment of domestic and hazardous wastes; and protection from noise, vibration, and radiation. As a basis for environmental planning, the National Environmental Program should be renewed every six years and approved by Parliament. First six-year program is expected to be approved by Parliament in September 1997.

The act also establishes the general rules of environmental impact assessment (EIA). For certain activities including implementation of public utilities, the

government resolution 152/1995, on EIA of certain activities and concerning official procedure, regulates how to execute EIA in a more detailed manner.

(2) Water Management Act

The act LVII/1995, on Water Management, provides basic principles of water management, such as the ownership of surface waters, riparian areas, and water management facilities; water resource management; responsibilities of relevant organizations; protection from flood; competence of water authorities; and establishment of water association. The act defines the ownership of natural lake including Lake Balaton together with Kis-Balaton attributes to the state exclusively.

(3) Regulations concerning Environmental Improvement of Lake Balaton

The government resolution 1068/1996, on the action program for the conservation of ecological state and improvement of water quality of Lake Balaton, covers almost all areas related to the improvement of the lake environment. Original version of the action program was enacted as the governmental resolution 1049/1994 under the same title, and has revised every year. The present valid version is the resolution 1068/1996, with slight amendments by the resolution 1054/1997. The target year of the action program was year 2010 in the resolution 1049/1994, however the present valid version does not specify it. Some components of the action program are materialized by the government resolution 2100/1995, on the water management development program for Lake Balaton (1995 - 2000), of which target year is 2010. Contents of the action program, complemented by the resolution 2100/1995, are reviewed in section 5 of this chapter.

(4) International Agreements related to Environment Protection

Among various international agreements which have been ratified by the government, the Ramsar Convention (concerning wetlands of international importance especially as waterfowl habitat, signed at Ramsar, Iran, in 1971) has special significance because whole Lake Balaton and Kis-Balaton are designated as wetlands of international importance. The Ramsar Convention requests to promote the conservation of wetlands of international importance and the wise use of all wetlands, and to inform any changes of ecological character of any wetlands to the organization or government responsible for the duties of the International Union for the Conservation of Nature and Natural Resources.

In connection with nature conservation, the Bonn Convention (concerning the conservation of migratory specie of wild animals, signed at Bonn, Germany, in 1979) and the Bern Convention (concerning the conservation of European wildlife and natural habitats, signed at Bern, Switzerland, in 1979) may concern the Study.

4.2 RELEVANT ORGANIZATIONS

In order to facilitate grasping the roles and responsibilities of various relevant organizations, they are classified into 4 groups, i.e., state level, county level, municipal level, and the other levels. In connection with following descriptions of each group, matrix of relevant organizations and their roles is shown in *Table 2.12.*

(1) State Level

The state level consists of ministries and their local agencies.

In the government resolution 1068/1996, PMO and seven ministries, i.e., the ministries of environmental protection and regional policy (KTM); transportation, telecommunication and water management (KHVM); health and welfare (NM); agriculture (FM); industry and trade (IKM); interior; and finance; are nominated as the execution bodies of the action program. Among them, KTM, KHVM, and NM are directly related to the environmental protection of Lake Balaton through the daily activities of their local agencies.(*In this paragraph, names of ministries refer to former ministry names.*)

Relevant local agencies of ministries include, at least, the Inspectorate for Environmental Protection (KÖFE), and the Nature Conservation Directorate (NCD) of KM; the Water Authority (VIZIG) of KHVM; and the National Public Health Care and Medical Officer Service (ÁNTSZ) of EM. KÖFEs and VIZIGs have the same territories, which divide the whole nation into 12 areas based on catchment area of major water courses. Each ÁNTSZ covers one county and each NCD covers several nature conservation areas. In the Study Area, three KÖFEs and VIZIGs of central Transdanubia (KDT), western Transdanubia (NyDT), and southern Transdanubia (DDT); two NCDs of KDT and DDT; and three ÁNTSZs of Veszprém, Zala, and Somogy counties; are involved in the environmental protection and nature conservation in the Study Area.

Besides KÖFEs, the National Environmental Protection Inspectorate (KFF) takes an important part in the management of hazardous wastes.

(2) County Level

The act LXV/1990, on local government, defines the structure, tasks and competence of self-governments of counties, as well as those of the municipal governments that include governments of villages, towns and the capital cities.

The body of representatives of county government is the county general assembly of which members are elected by the deputies of municipal governments. The county government office, which is directed by the president of the county general assembly, is responsible for execution of tasks.

The act imposes the public services which can not be dealt with by municipal governments, e.g., services of which service area extend over the entire or large

part of the county, on self governments of counties. The management of land use and agriculture in a county is done by the agriculture and land cultivation office of the county.

The act XXI/1996, on regional development and planning, establishes the fundamental objectives and rules as well as institutional structures concerning regional development and planning. The act defines the duties of self-government of counties and establishes the county regional development councils. A county development council, chaired by the chairman of the county general assembly, shall prepare the long-term county development concept as well as financial plan for the implementation of the development program. A county development council is financed by its constituent agencies.

(3) Municipal Level

The act LXV/1990 stipulates the tasks of municipal governments, which include following public services in their territories relating to the environmental protection;

- protection of the built and natural environment,
- water resource planning and drainage, canalization and sewerage,
- maintenance of the local public roads and public areas, and
- public sanitation and ensuring the cleanliness of the settlement.

It results that municipal governments should be involved in all kind of environmental protection activities other than those of which project areas are limited inside Lake Balaton or Kis-Balaton.

(4) The Other Levels

This group includes two important organizations, i.e., the Balaton Development Council (BDC) and the Transdanubian Regional Waterworks Incorporation (DRV), as well as other relevant private companies, associations and NGOs.

The act XXI/1996 requires to establish two regional development councils in the metropolitan area of Budapest and in the recreation area of Lake Balaton. These councils are launched by the government resolution 1059/1997, on the governmental measures related to the establishment of Budapest Agglomeration Development Council and BDC. As a result of the establishment of BDC, its legal processor Balaton Regional Council (BRC) is terminated, however, the secretariat of Balaton Steering Committee (BIB), which performed as secretariat of BRC, remains as that of BDC. The tasks of BDC include preparation of the long-term regional development concept and its financial plan as well as coordination of various subsidies. The operation cost of BDC is covered by the state annual budget.

Water supply and sewerage systems are basically owned by municipal governments, however, some large-scale networks that can not be separated by municipal boundaries are owned by the state. It means that all water supply and sewerage systems installed in the vicinity of Lake Balaton are owned by the state, and DRV operates them. The operators of water works owned by municipal governments are selected through a tender procedure among competent private companies. The government decree 38/1995, on the water supply and sewerage, regulates the tasks and activities of water works operation companies.

4.3 ENVIRONMENTAL REQUIREMENTS AND STANDARDS

(1) Surface Water Quality Standards

The Hungarian standard MSZ-12749 defines the surface water quality requirements as well as location, frequency and parameters of monitoring activities in nation wide. Major surface water bodies are classified into five (5) categories based on their present water quality.

Lake Balaton itself and all principal influent water courses, except for the mouth of Zala river which is applied Category IV, belong to Category III.

Quality requirements for surface water are shown in *Table2.13.*

(2) Drinking and Bathing Water Quality Standards

The Hungarian standards MSZ-450 define the requirements for drinking water quality. The standards stipulate water quality criteria for "acceptable" and "suitable" drinking waters and give different criteria by water sources considering chemical characteristics specific to water sources.

For bathing water, of both natural and artificial bathing place, water quality requirements are defined by the MSZ-13690-3.

ÁNTSZ is responsible for drinking and bathing water quality.

(3) Effluent Standard

The KTM decree 33/1993, on sewerage fine, and the KTM decree 34/1993, on sewer network fine, establish the limit value of discharge from sewage treatment plant (STP) and of wastewater discharged into sewerage network, respectively. Limit values are classified into six (6) categories depending on the recipient of effluent. Reflecting the objective and potential of STPs, very strict limit values on heavy metals are imposed on wastewater discharged into sewerage network.

Effluent into Lake Balaton and its catchment area are applied the category I, which means the most strict limit value.

Limit values of requirements for discharge from STP and wastewater discharged into sewerage system are shown in *Tables 2.14 and 2.15*, respectively.

4.4 ENVIRONMENTAL MONITORING SYSTEM

In addition to the national standard MSZ-12749, the KTM-KHVM-NM decree 1/1995, on the monitoring and evaluating system of the water of Lake Balaton and its catchment area, regulates how to execute regular monitoring activities related to quality and quantity of the surface waters in Balaton region systematically. The decree specifies the duties of relevant KÖFEs, VIZIGs, and ÁNTSZs as follows.

KÖFEs : all sampling activities and analysis of water quality parameters except for micro-biological ones

VIZIGs : observation of water flow, water level, and water bed

ÁNTSZs : analysis of micro-biological parameters

The number of surface water sampling points is 79 including 28 listed in the MSZ-12749, and that of effluent of STP sampling points is 19. The decree regulates sampling dates and frequency of sampling which varies from 6 to 52 times a year, of surface water. Sampling frequency of effluent of sewage treatment plant is 4 times a year.

The organizations that observe or analyze data have to keep them, and also have to provide them for KDT-KÖFE, who is responsible for operation of the database of Lake Balaton. KDT-KÖFE has a responsibility of evaluation of all relevant data and of publication of summary report twice a year.

4.5 FINES AND PRODUCT CHARGES FOR ENVIRONMENTAL PROTECTION

Environmental protection fines and production charges are not only enforcement to reduce the loads imposed on the environment, but also a part of money sources of environmental protection funds which contribute to implement some environmental protection projects.

(1) Environmental Protection Fines

The environmental fines contain, at least, sewerage fine, sewer network fine, and hazardous waste fine.

The KTM decree 33/1993 regulates the detail of sewerage fine. The sewerage fine is imposed on effluent of STPs that exceeds the limit value defined in the decree. The decree obliges operation companies of STP to observe the effluent quality. The competent KÖFE is responsible for inspection of it through their monitoring activity.

The KTM decree 34/1993 regulates the detail of sewer network fine. The sewer network fine is imposed on wastewater discharged into sewer network that exceeds the limit value defined in the decree. The decree imposes the duty of sampling and analysis of wastewater on manufacturers (i.e. polluters). The data should be transferred to the competent KÖFE.

The Government decree 102/1996 provides calculation method of hazardous waste fine. The decree regulates that every activity concerning hazardous waste are subject to a license issued by KKF, and the competence of imposing the fine is attribute to KKF or KÖFE.

The 30 % of collected environmental protection fines is destined to local environmental funds in case that the relevant local governments have established them, and remainder is destined to the Central Environmental Protection Fund.

(2) Environmental Protection Product Charges

The act LVI/1995, on environmental protection production charges of certain products, lists up fuels, tires, cooling apparatus and refrigerants, packing materials, and batteries as the subjects of environmental protection product charges. Schedules of the act describe calculation method of the charges for each subjected product. According to the act, at least 75% of collected product charges should be used as the resource of KKA.

It is note that the act includes a concept of environmental labeling system. In case of the subject product which is entitle to bare a label "environmental friendly", a half of the product charge is exempted.

4.6 Subsidies for Environmental Protection

In order to support the implementation of environmental protection projects, various types of subsidies have been prepared in national legislative framework. Subsidies can be classified by their financial sources as follows;

- directly from the state annual budget,
- from Central Environmental Protection Fund (KKA),
- from Water Management Fund (VA),
- from other funds.

(1) Subsidies Directly from the State Annual Budget

The act LXXXIX/1992, on the addressed and targeted support systems of local governments, provides the scheme of subsidies directly from the state annual budget. The subsidies consist of two types of subsidies, i.e., the addressed and targeted subsidies. Both of them can be applied by local governments only.

The scope of addressed subsidy is restricted in projects related to water management, health and social provision, education, and culture, however, in case of critical situation there is no restriction for applicable fields. Among them the highest priority is given to the implementation of sewer networks and STPs. This subsidy might be able to cover the part of implementation cost which applicants can not finance.

The scope of the targeted subsidy for certain period is defined in the supplement of the act. For example, the supplement No.3 of the act lists the following issues as the subsidy targets from 1997 to 1998; water management, construction of STP, construction of sewer network, education, health care, and waste management.

It is allowed applicants to obtain both subsidies simultaneously for one project.

(2) Subsidy from the Central Environmental Protection Fund

The act LXXXIII/1992, on certain separated state funds, regulates how to operate the Central Environmental Protection Fund (KKA). Presently major sources of KKA are environmental protection charges, environmental protection fines, construction fine, and incomes by selling historical monument of the state interest. KM is responsible for the fund and the KKA secretariat has been established to coordinate and operate it. KKA is open not only for local governments but also for private companies, non governmental organizations (NGOs), and even for authorities such as VIZIG. KKA can provide non-refundable subsidy (grant), refundable subsidy with or without interest (soft loan), and credit guarantee.

The KKA subsidy guidelines on the improvement of water quality of Lake Balaton, which is annually issued by KM in harmony with the revised version of government resolution 1049/1994 (the Action Program), gives the priority to following issues.

- installation of sewerage systems
- reduction of internal and external nutrient loads
- management of solid wastes
- protection of reed belts and natural shores

The guidelines regulates that the maximum contribution is 30% of total implementation cost in case of grant and 60 % in case of soft loan. It is also allowed to utilize grant and soft loan simultaneously for one project up to 60 % of total implementation cost in total.

(3) Subsidy from the Water Fund

The act LXXXIII/1992 also regulates how to operate the Water Management Fund (VA). Responsible authority of VA is KHVM. Major sources of VA

are water supply fee collected from the consumers who are obliged to get water permission or in large scale, and a fine on negligence or delay of payment of water and sewerage fee. VA can provide non-refundable subsidy (grant), refundable subsidy with or without interest (soft loan).

The subsidy from VA can be utilized restrictedly for the issues concerning water management. 60% of total revenue of the fund shall be utilized for the installation of water supply and sewerage systems, the exploration of drinking water sources, the restoration of flood damage, and the protection of water resource pollution.

(4) Subsidy from Other Funds

There are several other central funds which might be related to the Study. Road fund targets to support the construction of national public road networks and the improvement of local public roads. The Settlement Development Fund (TEFA) can be utilized for regional improvement program, especially for the economical improvement and the reduction of unemployment.

4.7 Environmental Education

For more than 10 years KDT-VIZIG has continued youth camp activity around Lake Balaton.

Target group is 16 - 17 year-old students and 200 - 250 students participate in every summer. The curriculum is designed for environmental education as follows. At the beginning of the camp, an introduction paper concerning environmental problems of the lake is provided for each participant. As a daily program, participants are obliged to do some activities such as cleaning lakeshore from morning to 14:00. At the end of the camp, discussion session is held, and video programs about water management of Lake Balaton are shown.

KDT-VIZIG provides for participates' accommodation, food for 5 times per day, conductor for work activity, transportation from campsite to working place, and equipment. Formerly accommodation was tents, however, there were many claims from adjacent inhabitants and nowadays schools or some public buildings are used as accommodation facilities.

For this activity, KDT-VIZIG spends approximately 10 million Forint per year. Main financial sources are KKA, Balaton Association, and MOL.Rt. Some private companies contribute to this activity through provision of certain goods or services. For example, MAHART allows participants to use its disco boat with free of charge, Fishing Rt. provides work boots, and SIÓCOM Rt. renders solid waste collection service in campsite without fee.

NyDT-VIZIG has a plan to start a similar activity around Kis-Balaton from 1998.