JICA

ILEC

FINAL REPORT

6th Group Training Course in Lake Water Quality Management

平成７年度
第６回湖沼水質保全コース報告書

22 January 1996 - 22 March 1996

国際協力事業団大阪国際センター
財団法人国際湖沼環境委員会

Osaka International Centre,
Japan International Cooperation Agency (OSIC/JICA)
and
International Lake Environment Committee Foundation (ILEC)

FINAL REPORT 6th GROUP TRAINING COURSE IN LAKE WATER QUALITY MANAGEMENT 1996

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Preface

The International Lake Environment Committee Foundation (ILEC) is an NGO, established in 1986, with the aim of promoting environmentally sound management of lakes and reservoirs around the world.

As one of its major activities, ILEC held the international training course on lake water quality management in Otsu, Shiga, in 1990 with five participants from China, Ethiopia, Malaysia, Thailand and the Philippines.

Due to the success of the course in 1990, ILEC decided to hold the training course annually in cooperation with the Japan International Cooperation Agency (JICA).

Since the initiation of the Training Course on Lake Water Quality Management in 1991, 68 participants from 27 countries have completed the course so far. They were from Argentina, Bolivia, Brazil, Cambodia, Chile, China, Egypt, Ghana, Guatemala, India, Indonesia, Kenya, Macedonia, Malaysia, Nicaragua, Pakistan, Paraguay, Peru, Philippines, Poland, Singapore, Sri Lanka, Syria, Thailand, Turkey, Venezuela and Zimbabwe.

Aims

The course is intended for technical administrators and researchers engaged in the decision- and policy-making process of lake water quality management in developing countries and countries with economies in transition.

Necessary techniques for lake water quality management, including measurement, prevention, estimation and control techniques at a higher level, will be introduced to the participants through lectures, field study and experiment.

Participants are requested to acquire basic knowledge required to making plans and programs for proper management of lake water quality. The organizers hope that this course will contribute to the improvement and development of environmentally sound management of lakes and reservoirs.

Target Objective

The participants are expected to achieved the following objectives:

1) To have studied Japanese laws and regulations relating to lake water quality management, as well as the relation between conservation and industrial development (Lake Biwa case study will be introduced by Japan experience),

2) To have acquired fundamental knowledge on ecology, hydrology and biology required to conduct water quality management,

3) To have acquired techniques to measure and control the factors which cause deterioration of lake water quality, namely, those related to living environment health and eutrophication,

4) To have acquired knowledge and techniques required for preparation of lake water quality management plans, such as calculation of pollution loading amount, anticipation technique of water quality, etc., and
5) To have improved their environment management ability so that they can promote comprehensive and programmatic measures for the prevention of lake water pollution.

Program

This course is to make the participants to acquire the know-how on comprehensive lake water quality management technologies by integrating, (1) experiences of local governments, (2) pollution control technologies developed by industrial world, (3) basic knowledge obtained by universities and ILEC.

The program provides both opportunities of lectures and observation so that the participants can comprehensively understand. It also includes visits to manufacturing companies and factories For details, please see the concept chart.

It also must be mentioned that this course could have full cooperation with the Shiga Prefectural Government, local universities and other organizations including it in overseas.

Training Organization

The course will be held at:
International Lake Environment Committee foundation (ILEC)
1091 Oroshimo-cho, Kusatsu, Shiga 525
Japan

Tel +81-775-68-4567
Fax +81-775-68-4568

				TRAINING PROGRAMME		
				Monday 22 January to Friday 22 March 1996		
Date				Subject	Lecturer/ Organization	Place
JANUARY						
Sun	21	AM		Move to Kusatsu from JICA/OSIC		
		PM		Introduction to Kusatsu	ILEC	Kusatsu
Mon	22	AM		Opening and Orientation	ILEC	ILEC/TR
		PM	(L)	Introduction to Lake Biwa	Dr. Nakamura	ILEC/TR
				Country report presentation	Prof. Matsui & others	ILEC/TR
Tue	23			Country report presentation	Prof. Matsui & others	ILEC/TR
Wed	24	AM	(L)	Principle of lake/reservoir management	Prof. Kira	ILEC/TR
			(L)	Acid snow	Prof Fushimi	ILEC/TR
Thu	25	AM	(L)	History of water quality control	Prof Matsui	ILEC/TR
		PM	(O)	Lake Biwa Construction Office, etc	Prof Matsui	Otsu
Fri	26	AM	(L)	Water Quality Preservation Law	Mr. Fukada	ILEC/TR
			(L)	Waste Diposal Law	Mr. Yamoto	ILEC/TR
		PM	(L)	Toxic Substances	Prof. Matsui	ILEC/TR
Mon	29	AM	(L)	Overbation to LBRI and	Dr. Nakamura	LBRI
				& environmental issues		
				Visit to Environmental Office		
		PM	(L)	Water resources managment	Dr. Nakamura	LBRI
Tue	30		(L)	Sampling	Dr. Tsuno	ILEC/TR
Wed	31		(L)	Basic knowledge for biological	Dr. Kurata	ILEC/TR
				experiments on aquatic environment		
FEBRUARY						
Thu	1	AM	(L)	Waste water treatment	Dr. Ide	ILEC/TR
		PM	(L)	Public health	Dr. Hongo	ILEC/TR
Fri	2	AM	(L)	Industrial waste water treatment	Mr. Yoshioka	ILEC/TR
		PM	(O)	Waste water treatment plant	ILEC	Kusatsu
Mon	5	AM	(L)	Basic knowledge of water quality data processing	Dr. Ide	ILEC/TR
		PM	(P)	Basic knowledge of water quality data processing	Dr. Ide	ILEC/TR
Tue	6	AM	(L)	Basic knowledge of water quality analysis	Prof. Kawashima	ILEC/TR
		PM	(L)	World lakes	Dr Kurata	ILEC/TR
Wed	7	AM	(L)	Basic knowledge of water quality	Dr Ide	ILEC/TR
				data processing & modeling		
		PM	(P)	Basic knowledge of water quality	Dr. Ide	ILEC/TR
				data processing & modeling		
Thu	8	AM	(L)	Environmental education	Prof. Kawashima	ILEC/TR
		PM	(O)	School visit	Prof. Kawashima	Otsu
				(Karasaki Junior High School)		
Fri	9	AM	(L)	Basic knowledge of water quality	Prof. Kawashima	ILEC/TR
		PM		International Cooperation	Dr. El- Hable	ILEC/TR
Mon	12			*National Holiday*		
Tue	13		(O)	"Lake Watching"	Mr. Kotani	Omi-hachiman
Wed	14		(L)	Lake Biwa Case Study & Discussion	Prof. Matsui & others	LBRI
Thu	15		(L)	Lake Biwa Case Study & Discussion	Dr. Nakamura & others	LBRI
Fri	16		(L)	Lake Biwa Case Study & Discussion	Dr. Nakamura & others	LBRI
Mon	19	AM	(L)	Environmental protection & public participation	Prof. Hobo	ILEC/TR
		PM	(L)	Guidance on final report preparation	Prof. Matsui	
Tue	20	AM	(L)	Mid-term evaluation meeting	ILEC	ILEC/TR
		PM		Move to Tokyo	ILEC	Tokyo
Wed	21	AM	(L)	Japanese environmental administration	Mr. Sugatani	EA,Tokyo
		PM		Move to Tsukuba	ILEC	Ibaraki
Thu	22		(S)	Natonal Institute for Environmental Studies	Dr. Fukushima & Dr. Aizaki	Ibaraki
Fri	23	AM	(S)	Kasumigaura Constration Office	ILEC	Ibaraki
		PM	(S)	Lake Kasumigaura	ILEC	Ibaraki
Sat	24			Back to Shiga	ILEC	Kusatsu
Mon	26		(P)	Basic knowledge of laboratory facilities	Shimadzu Corp.	Kyoto
Tue	27		(P)	Basic knowledge of laboratory facilities	Shimadzu Corp.	Kyoto
Wed	28		(P)	Basic knowledge of laboratory facilities	Shimadzu Corp.	Kyoto
Thu	29		(P)	Basic knowledge of water quality automatic analysis	Horiba Ltd.	Kyoto

MARCH						
Fri	1	AM	(P)	Refuse Burning Plant	ILEC	Otsu
		PM		Move to Hiroshima	ILEC	Hiroshima
Sat	2			Back to Shiga		
Mon	4	AM	(P)	Sampling	IPHES	Otsu
Tue	5		(P)	Basic knowledge of laboratory equipments	IPHES	Otsu
Wed	6		(P)	Water quality Analysis	IPHES & 3 Univ.	Otsu
Thu	7		(P)	Water quality Analysis	IPHES & 3 Univ.	Otsu
Fri	8		(P)	Water quality Analysis	IPHES & 3 Univ.	Otsu
Mon	11			Final report preparation	Prof. Matsui	ILEC/TR
Tue	12			Final report preparation	Prof. Matsui	ILEC/TR
Wed	13	13.00		Submision of final report	ILEC	ILEC/TR
		PM	(O)	RK Excel, Co , Ltd	ILEC	Kusatsu
Thu	14	AM	(O)	Shiga Agricultural Experiment Station	ILEC	Azuchi
		PM	(O)	Reeds factory	ILEC	Omi-hachiman
Fri	15	AM	(O)	Shiga Fisheries Experiment Station	ILEC	Hikone
		PM	(O)	Kirin Brewery Co ltd.	ILEC	Taga
Mon	18	AM	(O)	Water purification plant	ILEC	Kusatsu
		PM	(O)	Zeze water puarification plant	ILEC	
Tue	19			Final presentation & evaluation	Prof Matsui & others	ILEC/TR
Wed	20			*National Holiday*		
Thu	21	AM		Final report presentation & evaluation	Prof Matsui & others	ILEC/TR
		PM	(L)	Technology transfer	UNEP/IETC	ILEC/TR
				Closing ceremony	ILEC	ILEC/TR
Fri	22	AM	(O)	Daihatsu Motor Co., Ltd.	ILEC	Ryuo
		PM		Move to JICA/OSIC	JICA	Osaka

CONCEPTIONAL CHART OF LAKE WATER QUALITY MANAGEMENT COURSE

Lake Water Management

- **Lake/Reservoir Management In General**
  - Presentation of Country Report
  - History of Water Pollution Control in Japan — *(Observation)*
  - Ordinances Relating to the Water Pollution Control Law — Environment Agency
  - Principles of Lake/Reservoir Management
    - Lake Biwa Research Institute
    - Lake Biwa Work Office
    - National Institute for Environmental Studies
    - Kasumigaura Work Office
    - Observation to a local School (Environmental Education)
  - Acid snow in Lake Biwa Catchment Area — *(Observation)*
  - Profile of Lake Biwa (Water Resources Management)
    - Fisheries Experimental Station
    - Agricultural Experimental Station
  - Integrated Water Management & International co-operation
  - State of World Lakes
  - Toxic Pollutants — *(Observation)*
  - Public Health In General (Water born diseases related with lakes)
    - Water Treatment Plant
    - Refuse Treatment Plant
    - Waste Water Treatment
  - Developing Countries & Environmental Issues
  - Environmental Preservation & Citizen Participation
  - Activities of UNEP/IETC
- **Analysis Method of Quality** — *(Practice)*
  - Basic Knowledge of Water Sampling
    - Sampling Practice
    - Water Quality Analysis
  - Water Quality Analysis
  - Sediment Analysis
  - Biological Experiments — *(Practice)*
  - Laboratory Maintenance
    - Analysis of Water Quality,
    - Maintenance of Equipments
  - Chemical, Biological Analyzer
  - Water Quality Analyzer — Maintenance Practice
- **Waste Water Treatment** — *(Observation)*
  - Basic Knowledge For Waste Water Treatment
    - Sewerage Treatment Plants
      - Regional Sewerage Station for Konan district
    - Waste Water Treatment Plants
      - RK Exel Co., Ltd.
      - Kirin Brewery Co., Ltd.
      - Daihatsu Industry Co., Ltd
- **Prediction Mechanism of Water Pollution**
  - Application of Data of Water Quality — Practice of Application of Water Quality
  - Mathematical Model of Water Quality — Practice of Modeling
- **Discussion**
  - Lake Biwa Case Studies Discussion (Lake Biwa Comprehensive Development Project field survey)
    - Lake Watching
    - Reed Manufactory
    - Oki-no Shima Tour
  - Final Report and Presentation

List of Textbook

Subject	Lecturer	Textbook
Lake Biwa Water Resource Management	Nakamura Nakamura	Lake Biwa" 1991, Environment Division, Shiga Prefecture "Water Resource and Indices of Water-Quality" T. Goda "Monitoring and Measurable Indices for Water Resources T. Goda "Management and Status of Japanese Public Waters" T. Goda
History of Japanese Water Pollution Control Toxic Pollutants	Matsui	"Pollution Control in Japan" S. Matsui
Biological Wastewater Treatment	Ide	"Water Pollution Control -Experimented Procedures for Process Design-" (Excerpt chap. 10-14), W.W. Eckenfelder Jr., P.L. Ford, The Pemberton Press, Austin, USA "Chemistry for Environmental Engineering" (Except Chap 7)C.N. Sawyer, P.L. McCarty, McGrow-Hill Book Company
Hazardous Waste Treatment	Yoshioka	"Practice of Hazardous Wastes Treatment" Haruo Okazaki, Environmental Engineering Department, Ebara-Infilo Co., Ltd.
Principles of Lake/reservoir Management	Kira	"Principles of Lake/Reservoir Management" T. Kira
Water Quality Monitoring in Lakes	Tsuno	"Water Quality Monitoring in Lakes" H. Tsuno
Problems of Eutrophication	Kawashima	"Elements in Lake Biwa Sediment (References)" M. Kawashima
State of World Lakes Basic Knowledge for Ecological Factors in Aquatic Environments	Kurata Kurata	"State of World Lakes" A. Kutata "Basic Knowledge for Aquatic Ecosystems" A. Kurata

Subject	Lecturer/ Instructor	Textbook
Developing Countries & Environmental Issues	Nakamura	"Developing Countries and Environmental Issues" M. Nakamura
Outline of Analytical Methods Related to Lake Sediments	Maeda	"Sedimentology of Lake Biwa" H. Maeda "Outline of Analytical Methods Related to Lake Sediments (References)" H. Maeda
Water Born Diseases Related with Lakes	Hongo	"Water Born Diseases Related With Lake" Hongo
The Outline of Laws Concerning Water Quality Conservation	Yamoto	"Outline of the Laws Concerning Water Quality Conservation" M. Moriya
The Outline of Waste Disposal	Sugie	"Waste Disposal Law"
Sampling & Analysis on Water Qualities	IPHES	"Monitoring for Lake Biwa Water Quality Preservation" IPHES
Preservation of Lake Water Quality, Water Quality Monitoring Instrument	HORIBA Ltd.	"WATER QUALITY CHECKER U-10 -Instruction Manual-" HORIBA Ltd.
Basic Knowledge of Laboratory Facilities	SHIMADZU Co.	"Cross Reference of Analytical Instrumental Methods and Their Fields of Application -1st Edition" SHIMADZU Corporation "Atomic Absorption Spectrophotometry for Beginners" SHIMADZU Corporation SHIMADZU APPLICATION -How to Treat Waste Water, Industrial Materials and Biological Materials in Latest Atomic Absorption Analysis"SHIMADZU Corporation

Subject	Lecturer/ Instructor	Textbook
Lake Biwa Case Studies Discussion	Matsui Nakamura Oya Ohashi Fukada Kotani Ishikuro Tsuzuki Jiku	"Appropriate Technology and Measures for Lake Environment Conservation" Chap. 1 Appropriate Technology & Measures for Lake Environment Conservations - Study Aims Chap. 2 Natural, Social and Economic Status of Shiga Prefecture (tentative translation) Chap. 3 Alteration of the Catchment Basin Conditions & Evolution of Lake Management Issues (tentative translation) Chap. 4 Administrative Actions Taken to Preserve Lake Biwa (tentative translation) Chap. 5 Local Community Response to Environmental Protection of Lake Biwa (tentative translation) Chap. 6 Agriculture, Forestry & Fisheries in the Preservation of Lake Biwa (tentative translation) Chap. 7 Industries in the Preservation of Lake Biwa (tentative translation) Chap. 8 Monitoring for Lake Biwa Water Quality Preservation (tentative translation) Chap. 9 Promotion of Environmental Preservation Technologies & Research Activities (tentative translation) Chap. 10 Summary & Further Observations
Lake Biwa Comprehensive Development Project	Nakamura	"Lake Biwa: Have Sustainable Objectives Been Met?"

Background Readings -

Survey of the State of World Lakes -Interim Report (I), 1988-" ILEC
Survey of the State of World Lakes -Interim Report (II), 1989-" ILEC
Survey of the State of World Lakes -Interim Report (III) 1990-" ILEC
Survey of the State of World Lakes -Interim Report (IV), 1991-" ILEC
Survey of the State of World Lakes -Interim Report (V), 1993-" ILEC
Guidelines of Lake Management Vol. 1 - Principles of Lake Management -" S. E. Jorgensen & R. A, Vollenweider, 1989, ILEC
Guidelines of Lake Management Vol. 2 - Socio-Economic Aspects of Lake Reservoir Management -" M. Hashimoto, 1991, ILEC
Guidelines of Lake Management Vol. 3 - Lake Shore Management -" S. E. Jorgensen & H. Loffler, 1990, ILEC
Guidelines of Lake Management Vol. 4 - Toxic Substances Management in Lakes and Reservoirs -" S. Matsui, 1992, ILEC
Guidelines of Lake Management Vol. 5 - Management of Lake Acidification-" S. E. Jorgensen, 1993, ILEC

LIST OF LECTURERS

Supervisors	
Saburo Matsui	ILEC Scientific Committee Member Professor, Kyoto University
Masahisa Nakamura	ILEC Scientific Committee Member Director, Lake Biwa Research Institute
Lecturers	
Tatuo Kira	Vice Director General, ILEC Foundation Ex-Director, Lake Biwa Research Institute
Yoshiya Hongo	Director, IPHES
Hiroshi Tsuno	Professor, Kyoto University
Munetsugu Kawashima	Director, Shiga University, Faculty of Liberal Arts & Education Center for Environmental Education & Lake Science
Habib El-Habr	Acting Deputy Director, UNEP/IETC
Takehiko Hobo	Professor, Shimane University
Takehiko Fukushima	Head of Lake Conservation Research Team, Regional Environment Group, NIES, Environment Agency
Shinya Yamoto	Director, Waste Disposal Management, Shiga Prefectural Government
Kiyoshi Nomura	Senior Researcher, IPHES
Hiroji Fushimi	Professor, University of Shiga Prefecture
Akira Kurata	Senior Researcher, UNEP/IETC
Masahiro Yoshioka	Senior Researcher, UNEP/IETC
Kotani Hiroya	Director, Environment Division, Shiga Prefectural Government
Fumio Fukada	Section Chief, Environment Office, Shiga Prefectural Government
Shinji Ide	Associate Professor, University of Shiga Prefecture
Fumihiko Jiku	Associate Professor, Ryukoku University of Shiga Prefecture
Matsuda	Researcher, Kyoto University
Kenji Oya	Environmental Management Planner, UNCRD
Morihiro Aizaki	Principal Researcher, Water and Soil Environment Division, NIES

Cooperate Organizations

Environment Office, Shiga Prefectural Government
4-1-1 Kyomachi, Otsu, Shiga 520

Lake Biwa Research Institute (LBRI)
1-10 Uchidehama, Otsu, Shiga 520

Institute of Public Health and Environmental Science (IPHES)
13-45 Gotenhama, Otsu, Shiga 520

Shiga Prefectural Fisheries Experimental Station (SPFES)
2138-3 Yasaka-cho, Hikone, Shiga 522

Shiga Prefectural Agricultural Experimental Station (AES)
516 Dainaka, Azuchi, Shiga 521-13

Shiga Prefectural Sewage Works Corporation (SPSWC)
2108 Kihan, Yabase-cho, Kusatsu, Shiga 525

Karasaki Secondary School
2-9-1 Karasaki, Otsu, Shiga 520-01

Waste Control Division, Kusatsu City Government
3-13-6 Kusatsu, Kusatsu, Shiga 525

Rokuha Water Purification Plant
849-1 Oiwake-cho, Kusatsu, Shiga 525

The Lake Biwa Construction Office, Ministry of Construction
Tanakami Kurozu-cho, Otsu, Shiga 520-22

Kasumigaura Works Office, Ministry of Construction
3510 Itako, Itako, Ibaraki 311-24

Environment Agency, Government of Japan
1-2-2 Kasumigaseki, Chiyoda-ku, Tokyo 100

National Institute for Environmental Studies (NIES)
16-2 Onogawa, Tsukuba, Ibaraki 305

Kasumigaura Water Research Station, NIES
Oyama, Miura, Ibaraki 300 -04

Horiba Co., Ltd
2 Kisshouin Miyanohigasi-cho, Minami-ku, Kyoto, Kyoto 601

Shimadzu Corporation
1 Kuwahara-cho, Nishinokyo, Nakagyo-ku, Kyoto, Kyoto 604

Kirin Brewery Co., Ltd
1600 Binmanji, Taga, Shiga 522-03

Lake Biwa Aqua-culture Centre
1393-2 Shina-cho, Kusatsu, Shiga 525

Otsu Refuse Treatment Plant
785-1 Kamibeppo, Zeze, Otsu, Shiga 520

RK Excel Co., Ltd
3-20-1 Yagura, Kusatsu, Shiga 525

Daihatsu Motors Co., Ltd
2910 Yamanoue, Riuo, Shiga

Takeda Reed Manufactory
4220 Shimotoyoura, Azuchi, Shiga 521-13

Oki-shima Fisheries Cooperative Union
Oki-shima-cho, Omihachiman, Shiga

Shiga University
2-5-1 Hiratsu, Otsu, Shiga 520

Ryukoku University
Seta-oe-cho, Otsu, Shiga 520-21

Kyoto University
Research Center for Environmental Quality Control
1-3 Yumihama, Otsu City, Shiga, Japan 520

Abbreviation

UNEP/IETC	The United Nations Environment Programme International Environmental Technology Centre
LBRI	Lake Biwa Research Institute
IPHES	Shiga Prefecture's Institute of Public Health and Environmental Studies
NIES	The National Institute for Environmental Studies

List of Participants

(Group Training Course in Lake Water Quality Management)

No.	国名 Country	氏名・現職及び生年月日 Name, Present Post, Date of Birth	勤務先及び自宅住所 Residence & office Address
1	Bolivia ﾎﾞﾘﾋﾞｱ	Mr. Marcos Gonzalo Espinoza Morales ﾏﾙｺｽ Agronomist Engineer, Mayor San Andres University, Extension & Training Section Chief Bolivian Fisheries Development and Research Center 経済開発省農牧庁 ﾎﾞﾘﾋﾞｱ水産省開発研究ｾﾝﾀｰ 普及課長 May 21, 1965	Residence: 2nd Crucero St./Zona Norte La Paz - Bolivia Tel: 591-2-366281 Office: Bolivian Fisheries Development and Researh Center Av. Camacho No. 1471 La Paz - Bolivia Tel: 591-2-368146 Fax: 591-2-317183
2	Cambodia ｶﾝﾎﾞｼﾞｱ	Mr. Ngoun Kong ｺﾝｸﾞ Chief of Rural and Urban Phnom Penh Environment Office Ministry of Environment Cambodia ｶﾝﾎﾞｼﾞｱ環境省 農村都市環境課 チーフ January 1, 1960	Office: Rural and Urban Environment Office Ministry of Environment 48 Samdech Preah Sihanouk Tonle Basak, Phnom Penh, Cambodia Tel: 27894/ 015 914 055 Fax: 855 23 27844 Residence: 1623 Rd. No. 2 Chak Angre kpom, Srok Mean Chein, Phnon Penh, Cambodia
3	China 中国	Mr. Wang Chun-Man ﾜﾝｸﾞ Environmental Engineer Hunan Hydro & Power Research & Design Institute 湖南省科学技術委員会 環境技師 January 26, 1968	Residence: 284 Laodong Rd, Changsha, Hunan China Tel: 0731-5513424 Office: Hunan Hdro & Power Research & Design Institute (HHPRDI) 284, Laodong Rd, Changsha, Hunan, China Tel: 0831-5525522 Fax: 98121 HPDIC CN/0731- 5554425

No.	国名 Country	氏名・現職及び生年月日 Name, Present Post, Date of Birth	勤務先及び自宅住所 Residence & Office Address
4	Ghana ｶﾞｰﾅ	Ms. Ruby Asmah ﾙﾋﾞ Research Chemist The Limnochemistry Division, Institute of Aquatic Biology of Council for Scientific and Industrial Research 科学産業研究評議会 科学・産業用水生物研究所 陸水科学部 研究員 December 17, 1967	Office: Institute of Aquatic Biology of Council For Scientific & Industrial Research P.O. Box 38, Achimota Ghana Tel: 233-21-775511/775315 Fax: 233-21-775315 Residence: Si Ann's Cottage P.O. Box 7062 Accra-North, Ghana
5	India ｲﾝﾄﾞ	Mr. Narida Rohmedra ﾅﾘﾀﾞ Executive Engineer Water Supply ｼﾞｬﾝﾑ･ｶｼﾐｰﾙ州政府 水道局 上級副技師 October 20, 1954	Residence: 250-1A, Trikuza Nagar Jammu, Jammu & Kashmir State, India Tel: 0191-561722 Office: Govt. of Jammu & Kashmir Executive Engineer Water Supply, Master Plan Division Jammu, J & K State India Tel: 0191-43612
6	Kenya ｹﾆｱ	Mr. Ndetei Robert Musyoki ﾛﾊﾞｰﾄ Research Scientist Kenya Wildlife Service ケニヤ自然保護サービス 研究学者 October 20, 1956	Office: Kenya Wildlife Service P. O. Box 40241, Nairobi, Kenya Tel: 501081-4 Fax: 505866 (or) 501752 Residence: P.O. Box 539, Nakuru, India

No.	国名 Country	氏名・現職及び生年月日 Name, Present Post,Date of Birth	勤務先及び自宅住所 Residence and Office Address
7	Malaysia ﾏﾚｰｼｱ	Mrs. Fatimah Md. Yusoff ﾌｧﾃｨﾏ Associate Professor Faculty of Fisheries & Marine Science, University of Pertanian Malaysia. パータニアン・マレーシア大学 漁業海洋学部 助教授 February 26, 1955	Residence: No.12, Jalan SS14/8F, Subang Jaya Selangor, 47500 Selangor Malaysia. Tel: 03- 7356384 Office: Faculty of Fisheries & Marine Science, University Pertanian Malaysia, Serdang 43400 Selangor Malaysia Tel: 03-9486101 Ext. 2518
8	Peru ﾍﾟﾙｰ	Ms. Damiana Flor Zavala Delgado ﾌﾛﾗ Chemical Engineer Drinking Water Service & Sewer System of Arequipa アルキパ上下水道公社 化学技師 February 22, 1954	Residence: Don Bosco Street 111-4 Arequipa Peru. Tel: 054-212825 Office: Drinking Water Service & Sewer System of Arequipa (Sedapar) Virgen del Pilar Street 1701 Arequipa, Peru Tel: 054-215190 Fax: 054-216521
9	Philippines ﾌｨﾘﾋﾟﾝ	Ms. Angelina Rombawa Tahil ｱﾝｼﾞｪﾘｰﾅ Engineer Bureau of Research & Standards, Department of Public Works and Highways. 公共事業省・高速道路部 研究標準局 技師 April 23, 1960	Residence: Calculus Street, Lot 14, Blk 138, Phase 4D Sto. Nifio, Meycauayan Bulaoan Philippines Tel: 0918-890-27-57 Office: Bureau of Research & Standards-Department of Public Works & Highways EDSA, Diliman, Quezon City Philippines Tel: 96-28-31 Fax: 96-36-22

No.	国名 Country	氏名・現職及び生年月日 Name, Present Post, Date of Birth	勤務先及び自宅住所 Residence & Office Address
10	Sri Lanka ｽﾘ･ﾗﾝｶ	Mr. Loku Pulukkutti R. Wijesinghe ｳｨｼﾞｪｽﾝﾊ Chemist National Water Supply & Drinage Board ｽﾘﾗﾝｶ水道供給・排水委員会 公衆衛生学者 January 4, 1965	Residence: Kindelpitiya Welmilla Junction Bandaragama, Sri Lanka Office: National Water Supply & Drinage Board Regional Laboratory NWS & DB Anuradhapura, Sri Lanka Tel: 025-2556 Fax: 025-5495
11	Thailand ﾀｲ	Mr. Puthai Kamolwarin ﾌﾟﾀｲ Sanatarian Sanitary & Environmental Health Division, Public Health Office of Pathumtani Province, Ministry of Public Health 保健省パツンタニ州保健所 衛生環境部 公衆衛生学者 November 8, 1966	Office: Pathumthani Province Health Office Bangkok Road, Maung District, Pathumthani Province 12000 Thailand Tel: 5816501/5816140/5816454 Fax: 5814126 Residence: 355/749 Moi Pahana Tumbol Kukuto Amphur Lumlukka, Pathumtani Province, 12130 Thailand
12	(Brazil) ﾌﾞﾗｼﾞﾙ	Mr. Eduardo Von Sperling ｳﾞｫﾝ ｽﾊﾟﾘﾝｸﾞ Professor Universidade Federal de Minas Gerais ミナス・ゲラス連邦大学 教授 November 21, 1951 （３月から特別参加者）	Residence: R. Leopoldina 806/205 30.330-230-belo Horizonte-Brazil Tel: 005531-3423237 Office: Universidade Federal de Minas Gerais Av. Contorno 842/7th 30.110-060 Belo Horizonte-Brazil Tel: 005531-238-1882 Fax: 005531-222-3433

Planning Committee for Assistance Project

Shin Sugatani	Assistant Director, Water Quality Management Division, Environment Agency
Takehiko Fukushima	Senior Research Scientist, Water and Soil Environment Division, NIES
Yoshiya Hongo	Director, IPHES
Kiichi Ariga	Ex-Director, Japan Environment Technology Association
Saburo Matsui	ILEC Scientific Committee Member Professor, Faculty of Engineering, Kyoto University
Masahisa Nakamura	Director, Lake Biwa Research Institute

はじめに

財団法人国際湖沼環境委員会（ILEC)は世界の湖沼の環境保全を目的に、1986に設立されたNGOである。

ILECはその主な活動の一つとして、1990年に中国、エチオピア、マレーシア、タイ、フイリピンの5ヶ国の参加者を対象に滋賀県大津市で湖沼水質保全の国際研修コースを開催した。

1990年の研修コースを契機に、ILECは国際協力事業団（JICA)の委託を受けてこの研修コースを毎年、開催することにした。

1991年の研修コース以来、アルゼンチン、ボリヴィア、ブラジル、カンボジア、チリ、中国、エジプト、ガーナ、グアテマラ、インド、インドネシア、ケンニヤ、マケドニア、マレシア、ニカラグア、パキスタン、パラグアイ、ペール、ポーランド、フィリピン、シンカポール、スリランカ、シリア、タイ、トルコ、ヴェネズエラとジバブエの27ヶ国から68名の参加のもとに研修事業を実施した。

コースの目的

湖沼水質保全コースでは、開発途上国における湖沼（含人工湖）の水質管理の実施について、保全施策の立案、管理計画の策定などを担当する技術系行政官や指導的立場にある研究者を対象とする。湖沼の水質管理に関する測定技術、防止技術、予測技術、管理技術などについてより高度な学習と演習を行うことにより、研修員に、湖沼の水質の適正な管理のための政策立案に必要な基礎知識を修得させ、これにより各国の指導的技術者の質的向上にも寄与するとともに、湖沼とその環境の適正な管理と均衡ある発展に貢献することを目的とする。

到達目標

（1）湖沼の水質管理のための法令、開発とのかかわりなどを、日本や琵琶湖の事例から検証すること。

（2）湖沼の水質管理に必要な生態学、水文学、生物学などの基礎知識を習得し検証すること。

（3）湖沼の水質汚濁に関係する生活環境項目、健康項目および富栄養化項目の測定技術ならびに制御技術を習得し検証すること。

（4）湖沼の水質管理計画の基礎となる汚濁負荷量の算定、水質予測技術などを習得し、検証すること。

（5）湖沼水質汚濁防止技術を総合的・計画的に推進するなどの環境管理能力の向上を図ること。

研修内容

このコースの特色は、地方自治体における湖沼の水質管理技術の経験、産業界の水質汚濁防止技術の実績、大学および（財）国際湖沼環境委員会の技術的蓄積などを総合化し湖沼水質管理技術のノウハウを習得することにある。

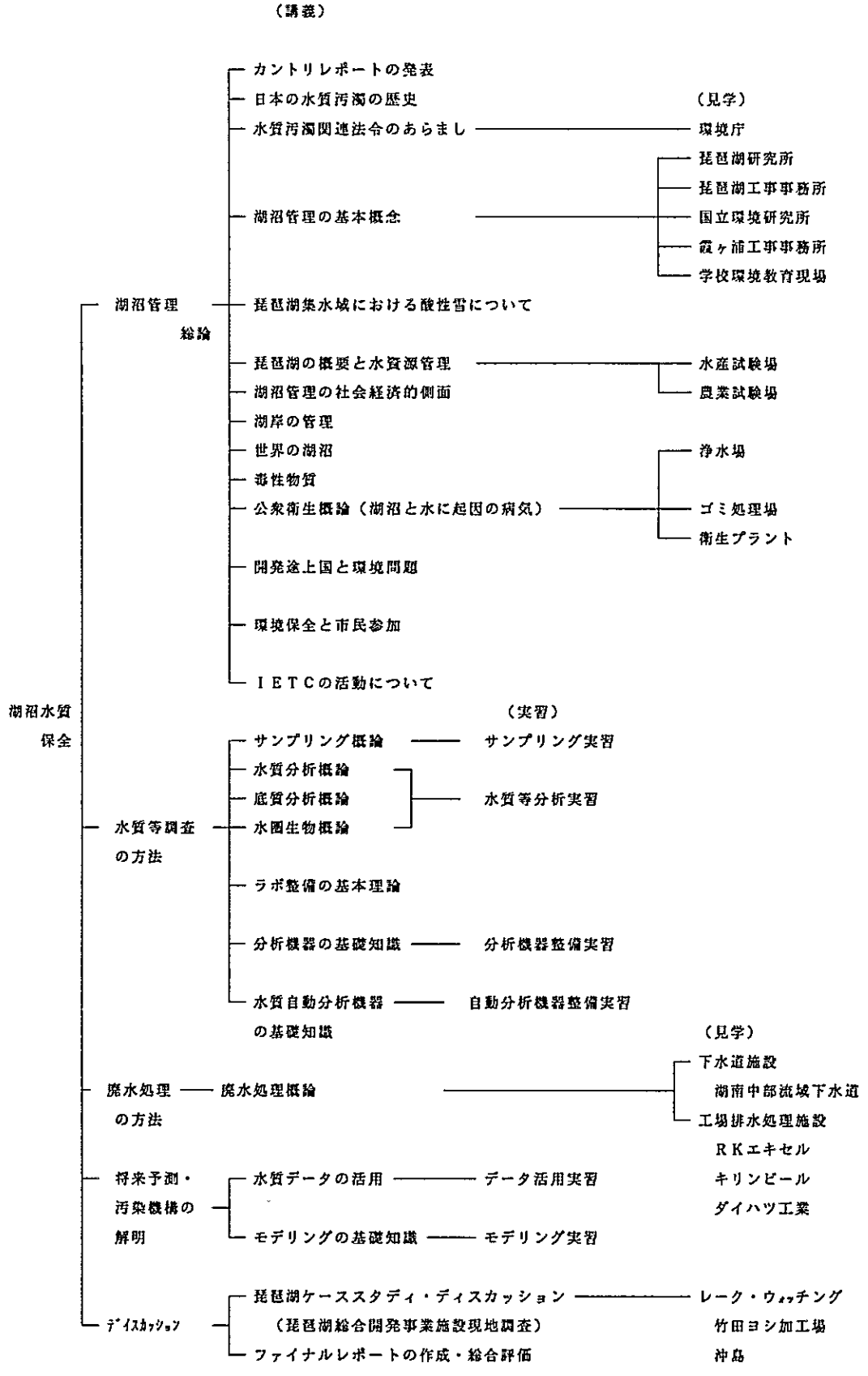
そのため、カリキュラムでは、講義と、水質監視測定技術、工場見学など現場での研修を交互に行い、研修員が総合的に把握できるようになっている。処理装置や分析機器の維持管理についても、メーカーや工場を実際に訪れることも組み込まれている。講義内容、実習、見学内容については「湖沼水質保全コース研修の概念図」を参照されたい。

また、講師には、滋賀県庁や地元の大学などの全面的な協力を得たほか、特別に海外からも参加してもらった。

研修実施機関

財団法人国際湖沼環境委員会
International Lake Environment Committee Foundation (ILEC)
代表者　理事長　山崎　圭
所在地　〒５２５　滋賀県草津市下物町１０９１番地
Phone 0775-68-4567 Fax 0775-68-4568

湖沼水質保全コース研修の概念図　(1995)



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講師・協力機関

指導および講義

松井三郎	国際湖沼環境委員会科学委員 京都大学教授
中村正久	国際湖沼環境委員会科学委員 滋賀県琵琶湖研究所所長

講義

吉良龍夫	国際湖沼環境委員会副理事長 滋賀県琵琶湖研究所前所長
本郷美弥	滋賀県衛生環境センター所長
津野　洋	京都大学教授
川嶋宗継	滋賀大学教育学部環境教育湖沼実習センター長
保母武彦	島根大学教授
福島武彦	国立環境研究所地域環境研究グループ総合研究官
野村　潔	滋賀県衛生環境センター主任専門員
伏見碩二	滋賀県立大学教授
倉田　亮	財団法人国際湖沼環境委員会総括研究員
吉岡正弘	財団法人国際湖沼環境委員会参事
井手慎司	滋賀県立大学助教授
竺　文彦	竜谷大学助教授
松田和成	京都大学助手
大矢鋭治	国連地域開発センター環境管理計画主幹
相崎守弘	国立環境研究所上席研究官

協力機関

滋賀県環境室
滋賀県琵琶湖研究所
滋賀県衛生環境センター
滋賀県水産試験場
滋賀県農業試験場
滋賀県下水道公社
滋賀県大津市立唐崎中学校
滋賀県草津市クリーン事業課
滋賀県草津市水道部ロクハ浄水場
建設省近畿地方建設局琵琶湖工事事務所
建設省関東地方建設局霞ケ浦工事事務所
環境庁水質保全局水質管理課
国立環境研究所
京都大学工学部付属環境微量汚染制御実験施設
株式会社堀場製作所
株式会社島津製作所
キリンビール株式会社滋賀工場
水環境科学館
滋賀県大津市環境美化センター
アールケーエキセル株式会社
ダイハツ工業株式会社
竹田勝博（よし加工）
滋賀県近江八幡市沖島漁業協同組合
滋賀大学教育学部
竜谷大学理工学部

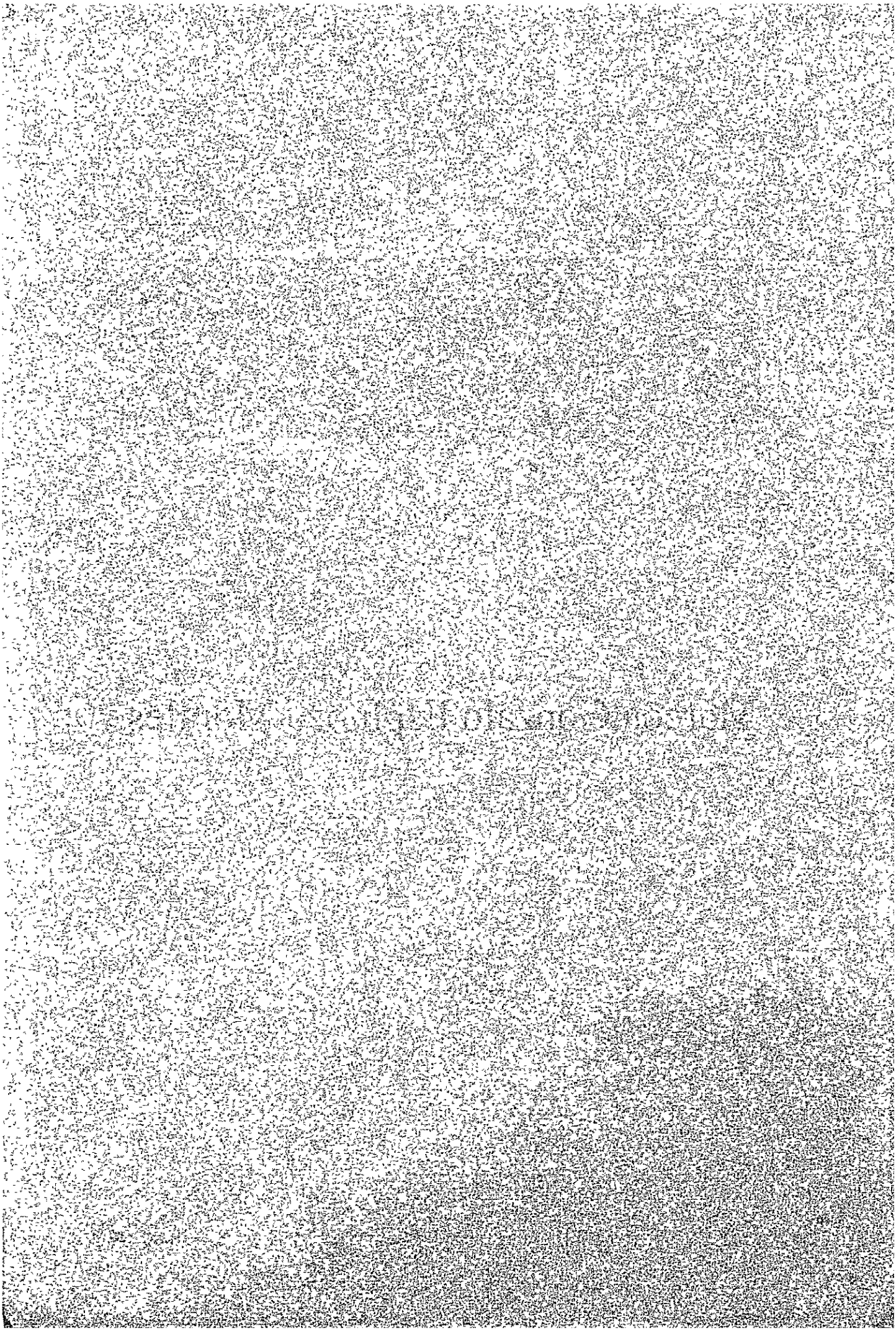
財団法人国際湖沼環境委員会海外技術援助企画委員会

管谷　晋	環境庁水質保全局水質管理課課長補佐
本郷美弥	滋賀県衛生環境センター所長
有賀喜一	社団法人環境技術協会常務理事 株式会社堀場製作所
福島武彦	環境庁国立環境研究所水土壌圏環境部 地域環境研究グループ 総合研究官
中村正久	滋賀県琵琶湖研究所長 国際湖沼環境委員会科学委員
松井三郎	京都大学工学部教授 国際湖沼環境委員会科学委員

Final Report

Bolivia

Marcos Gonzalo Espinoza Morales



THE KEYS TO IMPROVE THE LAKE WATER QUALITY MANAGEMENT IN BOLIVIA

Environmental Legislation And Sustainable Development
Environmental Impact Assessment And
Lake Environment Education Plan

Marcos Gonzalo Espinoza Morales
Bolivia

1. INTRODUCTION

Lakes around the world confront serious problems such as eutrophication, falling water levels, accumulation of earth, acidification, and pollution by harmful substances. There is also concern about changes to the ecosystem and extinction of indigenous species. Lakes throughout the world are plagued by many problems. In 1992, at the Earth Summit on the environment and development in Rio de Janeiro, the UN adopted an action plan called Agenda 21. This plan included the protection and management of the quality of fresh water as a precious resource, (Hashimoto, 1995). Deterioration in lake environments has been advancing mainly due to the increase and change in human activities. In order to preserve lake environments, it is essential to consider and improve all activities, including agriculture, industry and human life throughout the whole watershed. Legal, administrative and technological measures are essential in solving these environmental problems. However, these alone are insufficient and people also needs to understand the relationship between themselves and the lake environment and then live a more environmentally sensitive life. That is to say, it is important to initiate an aquatic ecosystem conservation and environmental education plan for all people. Developing Countries like Bolivia can not be separated of the international policy framework in the field of aquatic ecosystem conservation and management.

A rapid social transformation, population growth and economic development are observable in Bolivia. The transition of the Country from a traditional economy structure into a modern one constitutes the most significant aspects of Bolivia in the last years. It is natural that every transformation process brings about certain problems, and that surface water resources, lakes and reservoirs are also affected during this structural transformation. Safe water supply now and in the future from a surface water resources

as lakes and dams requires protection of water in their catchment areas against any kind of pollution.

2. SOME CONSIDERATIONS ABOUT WATER MANAGEMENT IN BOLIVIA

Bolivia is located just in the centre of South America and occupies a surface area of 1,098,581 square kilometres. Has got approximately seven million in habitants which are divided into 40% in high plateau and valleys, in a surface area less of 20% of national territory, the tropical plains have 22% of the population in a surface area of 65% and the high concentration of the population are in the main cities as La Paz, El Alto, Cochabamba and Santa Cruz de la Sierra.

Ecologically, Bolivian lands are divided into three zones, the High plateau (Altiplano), Valleys and Tropical plains. The high plateau are of the regions habitated highest of the world with more than 3,800 meters above sea level, a temperature annual rate about 10 C and a rainfall between 200 to 900 mm/year. The north high plateau, catchment area of Lake Titikaka, is the zone more wet and fertile. The influence of the Lake Titikaka is notorious in to surrounding environment.

2.1 Population

The annual growth rate of the population in Bolivia is 2.8% however, this growth to amount to 4.4% in the urban areas due to rural migration. In the last five years the urban population to represented 51% of total. For the year 2000, 57% of Bolivians citizens will be live in urban areas. The four most important cities (La Paz, El Alto, Cochabamba and Santa Cruz) to include 29.6% of Bolivian population. The Santa Cruz City, the population increase with a annual rate of 6.3% only to exceed by El Alto City with 10%.

This quick urbanization process means that will be need of urban planning and provision of basic services to the news urban areas that need water, waste water and garbage treatment facilities, health attention, soon.

2.2 Health and Nutrition

The best indicator about the health conditions in Bolivia is the infantile mortality, 167/1000 in the first year of life and 285/1000 between zero to five years. The Bolivian hope of life is 50.7 years. The almost part of the child diseases can be warned or to heal.

. The environmental degradation had direct repercussions in the health of the urban and rural population. The deficiency in domestic and industrial waste water treatment, especially from mining activities, is a primary factor of pollution and to reflect

in the high levels of hydric origin diseases in Bolivia. Diarrea, Cholera, and enthericas infections are the diseases most common between Bolivian children.

2.3 Education

The 32.9% of population major to 10 years don't had access to formal education. The average to years of study is 4.5, only 1% of the students that started the elemental school will finish the university studies. Same educational problems are: poverty relationship between scholar programs and basic necessity of the population, methods and educational procedures inadequate, poverty organization and administrative following.

2.4 Environmental Education

International organizations, specially UNICEF and FAO another as non governmental organizations or dependants of the state universities, achieve some actions in environmental education field, but are spares the educative programs with permanent character and of half or long time. However, the incorporation of environmental themes in the organization and enforcement of the populational conscience is still limited and don't exist until now a clear governmental policy for environmental education.

3. FRESH WATER RESOURCES AND SUSTAINABLE DEVELOPMENT

The function of lakes and reservoirs is multifarious. Some functions are well defined, their benefits can be expressed in numbers and measures and their control is generally entrusted to engineers and scientists. Institutionally these functions are entrusted to Water Authorities, Public Works Departments, etc. They include water supply, for which lakes frequently are major resources; power generation; irrigation; fisheries; flood control, etc. The benefits are expressed in production of drinking water, megawatts, crop yields, fish catch, etc. Many nations as Bolivia presently reorganize their planning and management in the water sector in order to account for environmental interests, aspects of nature conservation and land use planning. The term "Integral Water Management" expresses this approach. Technically it means that the scope of the system considered includes surface waters and ground water, the shores, adjoining wetlands and sediments.

In terms of pollution, in Bolivia the traditional attention for point sources is extended to diffuse sources originating from urban areas, livestock, agriculture, etc. Quality criteria on emissions are formulated with a view on the quality of water, air and soil, effects on human health and ecological effects. This all forms a necessary ingredient for the decision making. The broadening of the institutional and legal framework tends to

lag behind, but progress can be noted in several cities and regions.

Bolivia is not a develop Country and doesn't have high industrial activities and that's why there are no historical background in these topic. The main activities that the institutions in charged of the water quality management are: to prevent the water pollution and preserve the actual conditions of some water bodies that are without pollution caused by human activities. The present status of water pollution in Bolivia is not quantify; and these problem doesn't have any general information neither technical. Although, there are some information about levels of water pollution by biological and chemical causes in same rivers that go through big urban zones as the main Bolivian cities.

Socio-economic development is fundamental for enhancing the material quality of human life. Prior to about two decades ago, it was generally believed that socio-economic development could only be achieved at the sacrifice of environmental quality. Stated another way, some degree of environmental damage or misuse was believed to be a mandatory cost of socio-economic development. Since about the mid-70's, however, it has become more and more appreciated that the opposite actually is true. Sustained socio-economic development can not be achieved without also considering the environmentally-sound management of the natural resources that support it, including freshwater. Broadly speaking, the concept of sustainable development encompasses:

* Economic development within the limitations of available natural resources;
* The notion that economic development should not result in a degraded natural environment, nor in reduced productivity over long term;
* The recognition of poverty is a root cause of environmental degradation, primarily because the very poor have no options other than to degrade their own environment;
* The goals of health control, appropriate technologies, and self-reliance in food, clean water and shelter for all.

Based is this concept, a more defined consensus for achieving sustainable development would include the following goals:

* Improving indigenous capabilities to manage environmental and natural resources;
* Using the lessons of past experiences, successes and failures, as a means of attempting to avoid repetitious mistakes; don't' sacrifice the environment an name of the economic develop;
* Incorporating environmental considerations as an integral part of socio-economic development and planning;
* Acquisition of accurate data as the quantitative basis for environmentally-sound development and planning; and

* An informed public, including the needs and risks of not working to achieve environmentally-sustainable development.

4. RECENT IMPROVEMENTS IN THE BOLIVIAN ENVIRONMENTAL POLICY

The increasing complexity of water management and the increasing involvement of interest groups ask for new approaches of the water management authorities. Some major changes in the Bolivian policy making process in the last ten years are:

4.1 Integration of sustainable development, water quality and ecological policy

In the first Bolivian Policy Document in 1906 concerning fresh water uses was inspired on Spanish laws of 1866, only water property objectives were formulated. The law projects of 1983 and 1987/88 water management and distinct uses (e.g. ownership, drinking water, mining and agricultural demands) were made more coherent with help of a national model. In the Water Law Substitutive Project in 1991 on water management was formulated as: to have and to maintain a safe and habitable country and to develop and maintain healthy water systems which guarantee sustained use. An important recent development is to improve the lakes water quality and carrying capacity of the rivers by means of ecological development: environment management and sustainable development.

Until 1990 no one national institutions had programs of diagnosis and control of water pollution, although there are institutions related with the management and use, these one don't work together. The regulations were insufficient and no one respect. There are Health Code Laws that regulate the throwing toxic residues in rivers and lakes. The Mining Code Laws that regulated and control the environmental impact by the use of toxic materials, but none of these regulations are respect. In the last years the central government has worried about the problem of water pollution and his environmental impact, that's why they begin to plan and write regulations and mainly laws to protect and the management of hydrobiologic resources.

4.2 Increasing co-operation between Ministries

The Bolivian government has five ministries and one parliament. Three ministries are involved in the policy-making on water management: Sustainable Development and Environment; Economic Development; Urban Affairs. The Under Secretary of Forestry and Fisheries are in charged of the lakes water use and management. Although each

ministry prepares policy documents in the field of their own responsibility, harmonization of the different documents is intended. This is achieved by getting agreement from other ministries by means of co-operation and discussion.

Also, the research and development institutes (as the Bolivian Fisheries Research and Development Centre) of the different ministries co-operate. There is a general feeling that the co-operation has to be improved further. Recent approach in the governmental organization are the integration of the technical and scientific advise groups and a shift in scientific background of the employees from biologist, economist engineering to a broad scale of disciplines (chemists, ecologists, lawyers, agronomists, etc.)

4.3 Co-operation in implementation, monitoring and evaluation

The writing and accepting of a policy plan can not be successful without implementation. Furthermore, evaluation of the plans is an important stem in the development of new plans. For this evaluation data must be gathered by monitoring. Several Bolivian institutions play a role in the cyclic process of policy-making, implementation, monitoring and evaluation. The water managers carry the primary responsibility for the implementation, this implementation and the realization of consensus on it is sometimes more complicated than the policy-making itself. The data are used for the evaluation and the analysis of the lake water management plans and aquatic ecosystems conservation.

5. APPROACHES TO WATER RESOURCES MANAGEMENT

Water resources development has been viewed as one of the priority areas in regional development, particularly in the developing countries. This is because water is the most important factor determining the performance of productive activities as well as the quality life. The range of water-based requirements is quite wide, including agricultural, industrial, and domestic needs, energy production, fisheries, transportation, flood control, and outdoor recreation, etc.

Taking as example the study under the UNCRD Research Project on River/Lakes Basin Approaches to Water Resources Management, is possible to recommend do it following: 1) institutional and organizational mechanisms for integrating land use decisions and water resources management and 2) policy responses to environmental and social effects of water resources development. Water pollution becomes increasingly serious as the density of human activities intensifies with continued expansion of water use. In semi-closed water systems such as lakes and reservoirs, the problem of water pollution is much more serious due to the fact that inflow pollutants

accumulate in the water bodies. The water-use practices along lake shore areas where water users are polluters and at the same time victims of pollution. Is a great need to develop an organizational structure where sectorial agencies charged with water quality management can work together towards common goals within an integrated basinwide policy framework.

One of the issues that often bothers water resources managers is how to judge what water is of good quality. Water quality requirements vary from one use to another. It is therefore theoretically not possible to determine the water quality requirements applicable to all water-use activities. It would, however, be fair to assume that water which meets the following criteria is generally of good quality:

1. water that can be used for drinking purposes after simple treatment;
2. water that can be used for irrigation purposes without any treatment;
3. water that assures the healthy growth of aquatic fauna and flora; and
4. water that causes no harmful effect on human beings when aquatic life is used for food.

Water bodies which meet the above criteria ensure the normal functioning of aquatic ecosystems, and also tally with the common sense of good quality water. The basic goal of water quality management is therefore to maintain such quality standards in the water bodies, and in cases where water bodies do not possess such standards, efforts must be made towards improving water quality.

The conventional approach to water quality management, which largely relies on such measures as the installation of waste water treatment plants coupled with the enforcement of effluent standards, has been successful in controlling the incidences of serious water pollution, such as those caused by mining. However, as past experiences reveal, this approach has been not effective in achieving an overall improvement in water quality. This is because non-point sources such as domestic waste water and affluent from farmlands contribute greatly to the deterioration of water quality in lakes and rivers. Many, if don't all these measures are very necessaries be considered in the Bolivian environmental policy.

The use of Simulation Models

The simulation models for water bodies is designed to carry out simulation experiments using mathematical models of aquatic ecosystems. The simulation experiment allows a number of water management problems in a given region to be solved. The mathematical model allows also: the dynamic of water ecosystem components to be calculated; estimate the influence anthropogenic and hydrometeorological environmental conditions

on space-temporal dynamics of ecosystem and water quality and its sensitivity; and check adequacy for some real water ecosystem.

In 1993 the Bolivian Ministry of Sustainable Development and Environment started to support the decision making process using integrated models. The models are still under further development. The most important benefits of the use of simulation models are·

* a systematically quantitative description of characteristics of all water systems and the linking between the systems due to transport;
* the co-ordinated, target-oriented discussion between experts of different institutes on getting consensus on the modelling of the impacts of management measures;
* the easy way of assessing the multiple consequences of the national water management policy;
* the interpretation and presentation of results in maps with help of GIS-techniques.

There are, however, some boundary conditions and limitations as well: mobilization of experts, investment in gathering data, co-operation between various institutes, the results of models depend on initial assumptions and have margins of uncertainly. Generating new policy and measures is primarily based on thinking, working, together and open communication.

6. IMPLEMENTATION OF ENVIRONMENTAL IMPACT ASSESSMENT

The conventional methods used for environmental impact assessment are found to be ineffective in dealing with such cumulative impacts. In this connection, two policy issues deserve special attention: implementation issues of environmental impact assessment (EIA); and planning and implementation of involuntary resettlement schemes as integral parts of regional planning and development.

The first policy issue is concerned with the question of how to ensure proper implementation of environmental impact assessment. It is generally noted that the effectiveness of EIA implementation in developing countries (as Bolivia) is low because: a) EIA is implemented only to meet the requirements of funding agencies; b) impact mitigation measures are not properly implemented; c) EIA is undertaken at a stage where the results of EIA cannot be reflected in project decisions; d) institutions for environmental management are weak, together with the limited availability of trained personnel for EIA; and e) data available for EIA is poor and insufficient.

There appears to be many aspects of an effective Environment Impact Assessment implementation. They may be grouped into three areas:

* Procedural compliance is seen as a major way for an effective EIA implementation. This refers to the procedures used by an agency to follow what is prescribed in the legislation, rules, or requirements of a formal EIA programme. Project planners and EIA personnel are expected to act commensurate with the step-by-step requirements for a complete EIA.
* Technical completeness is another important aspect for an effective EIA implementation. EIA itself is a relatively recent and technically oriented method, specially for developing countries. It requires considerable professional involvement of technical staff in the project planning process. The judgements of the planners, which stem from their professional knowledge and ethical standards, may constitute the major factor which leads to improved EIA implementation. The competence and conscience of the technical personnel, methods of assessment adopted, as well as the scientific techniques employed in the EIA process, are all vital to an effective EIA implementation.
* Influence on decision making: the third major aspect of effective EIA implementation can be refereed to as influence on decision making. It is widely recognized that EIA is a procedure which opens up the decision-making process for review by the public and any concerned parties. Since it involves the weighing of various predicted impacts to evaluate alternative actions, the EIA process will be complete and effective only if outside inputs can be incorporated into the planning process. Consideration of alternative plans, adoption of outside inputs, and adjustment of the original proposal in relation to reasonable comments are all necessary conditions of an effective EIA implementation.

7. LAKE ENVIRONMENTAL EDUCATION

The environment is of global concern today. The major environmental concerns of today are affecting not only the advanced industrial societies, but also developing countries like Bolivia. Man has long been modifying the environment through his actions Some these actions influence the environment in a positive and constructive manner, but large number of interventions by man have been proved to be largely harmful to environment. Environmental Awareness and Education, in this regard aims to create a more harmonious relationship between man and environment.

Science should be defined as a study which has a purpose of repairing the natural and social environments and create better ones. It is an interdisciplinary science, including natural and social sciences, which should study the best method of solving environmental

problems with an understanding of environmental phenomena. Thus, the development of environmental science is expected to solve environmental problems. However, the main people who judges the state of the environment should no just of scientists or administrators but citizens. That is, citizens should be central to overcoming environmental crisis. Therefore, it should be essential that citizens have ability to: 1) understand environmental problems with scientific eyes; 2) make decisions about technology and society; and 3) act on the basis of their own decisions. A reformation in lifestyle will be able to change the present socio-economic system towards and environmentally sound society. Consequently the preservation of nature and solutions to environmental problems are important objectives for all human beings as a social subject in lifelong learning. The importance of environmental and science education for the citizens is recognized and emphasized.

7.1 ILEC's School Project

The International Lake Environment Committee was established in Japan (Shiga Prefecture) at 1986 to contribute to the development and dissemination of scientific and technological knowledge for the better conservation and management of lakes all over the world. After having organized its main scientific programs, ILEC considered the convenience to start with Environmental Education (EE Projects) focused on the study of lake ecosystem with aim to involve young pupils (and their families) in the comprehension of environmental and limnological processes and consequently, to generate rational attitudes for the protection of lakes.

After an initial and successful experience of this kind (1989-1990), ILEC obtained in 1991 the support of the Japan Environmental Agency to sponsored an EE Pilot Project which was launched in six countries. Denmark, Brazil, Japan, Argentina, Ghana and Thailand are participating in the project. The main theme of the project has been water resource watershed management (water quality, ecosystem, forest and wildlife).

7.2 Experiences in Japan

In Japan, "The Shiga Project for Environmental Education" has played an important role in making new teaching materials and a curricula for environmental education on eutrophication, acid rain and forest ecosystems. The fundamental belief of the Shiga Project is that the students should have as many opportunities as possible to:
experience and feel the natural and social environments, understand scientifically the phenomena through experiments and enjoy the environment with "scientific eyes".

Consequently, it is essential that teachers understand the environmental problems and make environmental education programs so as to satisfy their students desires to learn more about the environment in depth. The children who had lots of natural experiences and scientific exercises should be able to judge the good or bad environment and act responsibly, when they become adults. Specially in environmental/science education, education of giving only knowledge should be changed to one of fostering in the students an ability and attitude to self-learning.

7.3 Experiences in South America - Argentina

The circumstances that the experimental activities into the schools should finish at the end of 1994 and the extension of the annual period of classes (from March to December in the South Hemisphere) generated the idea to organize the Argentina experience starting at the beginning of 1992. The Project was named ILEC-PEAEL (*Programa de Educacion Ambiental y Ecologia Lacustre* in Spanish) or Lake Ecology Environmental Education Program an its objectives were identified with those established by ILEC Scientific Committee: to promote the EE and the knowledge on natural resources, focusing the process of teaching and learning on lake ecosystem and the quality of lakes water.

Changes in attitudes and the acquisition of knowledge and skills were evaluated in the student. The teachers judged that the students had progressed significantly in the understanding of ecological problems and in the significance of lake conservation and sustainable development, as well as in the need for participating actively in the identification of problems and in the search for solutions to promote the sustainable use of natural and social resources.

7.4 Evaluation

The EE Pilot Project supported by ILEC and developed since 1989 in six countries under the name of Water Resources and Watershed Management (water quality, forests and wildlife) should have completed by 1994 the experimental activities in the schools in order to dedicate year 1995 to its review and methodological discussions and 1996 to the preparation of the Final Report. This report will be edited by Prof. S. Jorgensen, from Denmark, chairperson of ILEC Scientific Committee, and will constitute a new volume of the Guidelines for Lake Conservation and Management that ILEC published in several languages and distributes internationally.

To conclude, it can be stated that the Project has to comply with the Agenda 21 (UNCED, 1992) and the recommendations of international organizations concerned with education for sustainable development (UNESCO/UNEP, 1993; UNEP IEO, 1993). The

experience with the " Shiga Project for Environmental Education" and the "Programa de Educacion Ambiental y Ecologia Lacustre" has demonstrated its practical feasibility and has produced very encouraging results. The antecedents so collected, together with those provided by the other countries participating in the Programme, will make possible the preparation of recommendations whose international dissemination will constitute, no doubt, a relevant contribution of ILEC towards the improvement of the Environmental Education and the development of more adequate knowledge and attitudes for the better conservation and utilization of lakes all over the world.

8. CONCLUSIONS

Lake water quality is protect successfully in Japan, Lake Biwa is exactly typical case, a lot the experiences can be use as a reference for implementation of the comprehensive water quality management in Lake Titikaka, and another water bodies in Bolivia. Is very important to take into account the need for development the third World countries as well as the importance to establish control measures for the pollution problems.

In order the avoid past mistakes, it is necessary to generate solutions to solve the damage occurred and also establishment of preventive regulations and ordinances with the help of environment impact assessment, using prediction models and with education plans. It is also important to have the purpose of preservation and sustainable use of the important aquatic resources, obtain the co-operation of the community and the coordination among the several sector, public, privates, government, Bolivian society, etc.

The environmental legislation and education are very relevant to sustain the adequate relationship between environment conservation and sustainable development. I think that in very important, (is my appointment for further works), to carry out a comparative analysis of the Bolivian Legislation about water quality and the Japanese legislation and past experiences. Through this analysis, will possible to find the best solution for the country's needs.

ACKNOWLEDGEMENTS

I would like to express my sincerest gratitude to the government and people Japanese's that through JICA and the International Lake Environment Committee for give me the opportunity to be participant in the Training Course: "Lake Water Quality Management", the opportunity of to learn and enjoy japan's unique culture, the warm hospitality of our

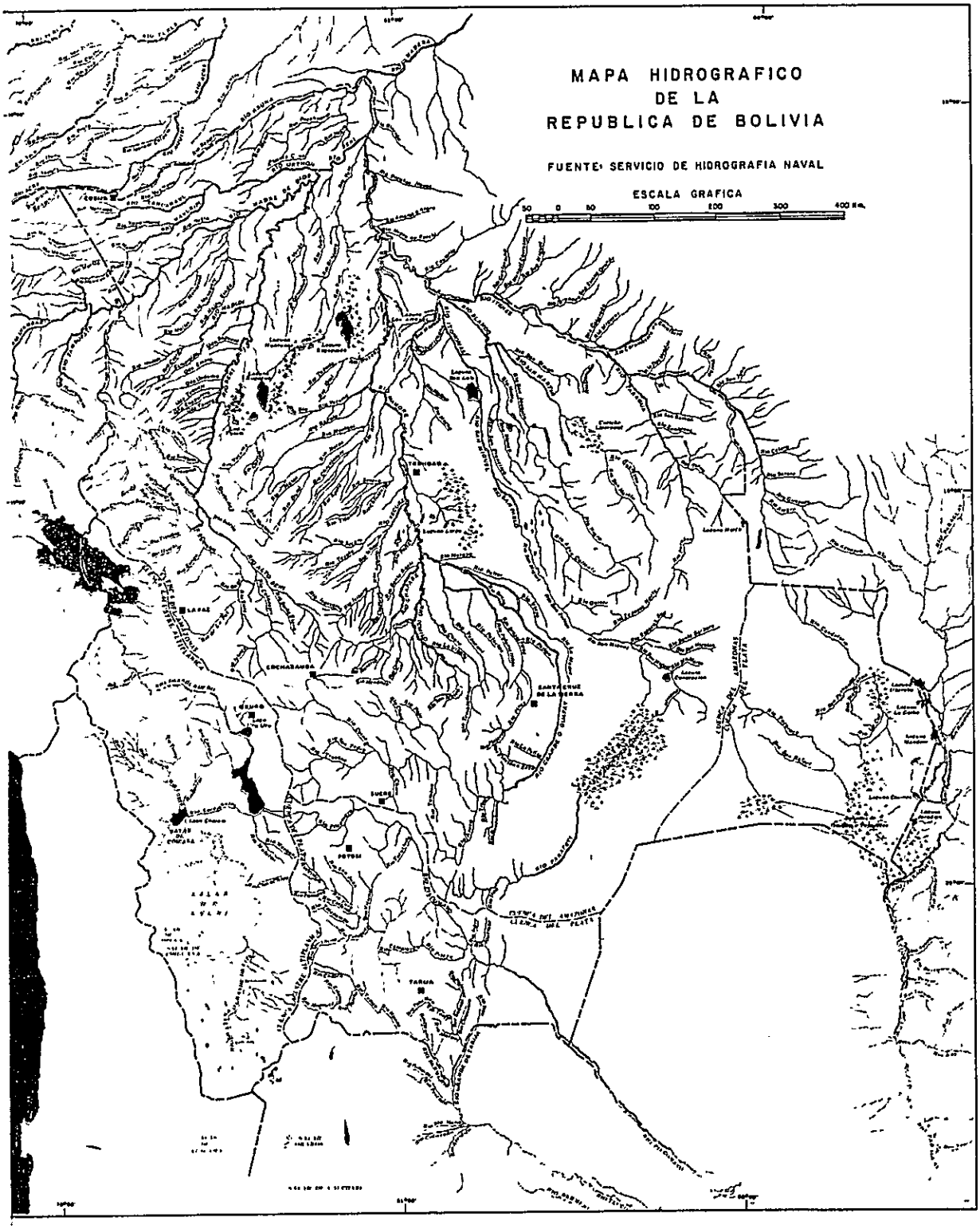
people, and overall. the opportunity of to receive the knowledge and necessary tools for to work in the conservation and improvement of the aquatic ecosystems around the world.

I would also like to express my gratefulness to ILEC Director, Scientific Committee, Officers and administrative staff, Shiga Prefecture government, Universities, Research Institutes, organizations and private companies, to the professors, lecturers for a very commendable training program and, for the unlimited and unconditional support and assistance.

My admiration and reverence to:
Professor Saburo Matsui, Dr. Masahisa Nakamura, Dr. Munetsugu Kawashima, Dr. Fumihiko Jiku to learn me the way for solve many environmental problems in my Country, Bolivia.

Thanks to Mr. Toda for your forbearance, to Mr. Kanematsu for your friendship and assistance on every one moment of this training. People of Japan, Domo arigato gozaimasu.

Kusatsu, Shiga Prefecture, Japan, 19 March 1996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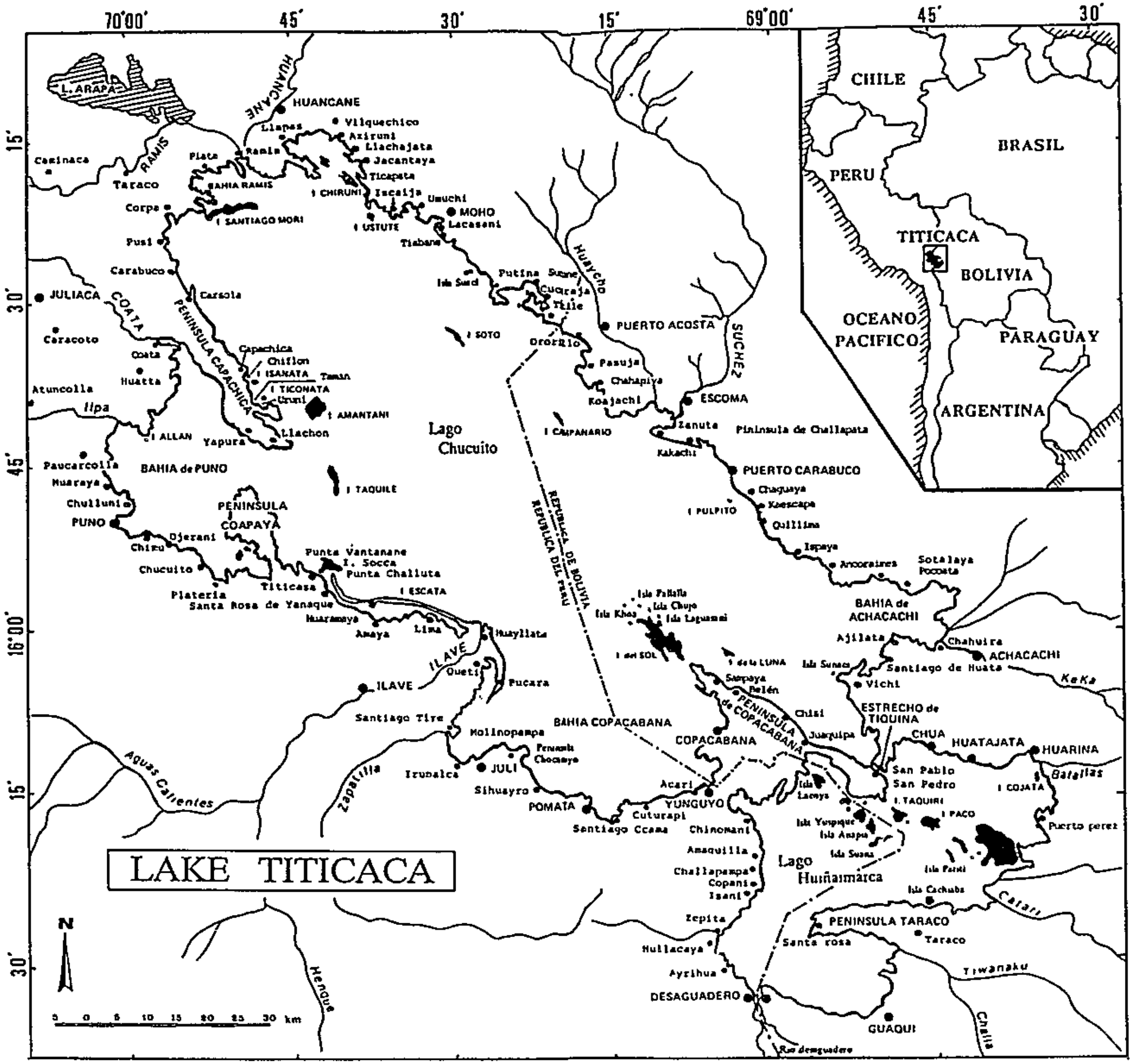
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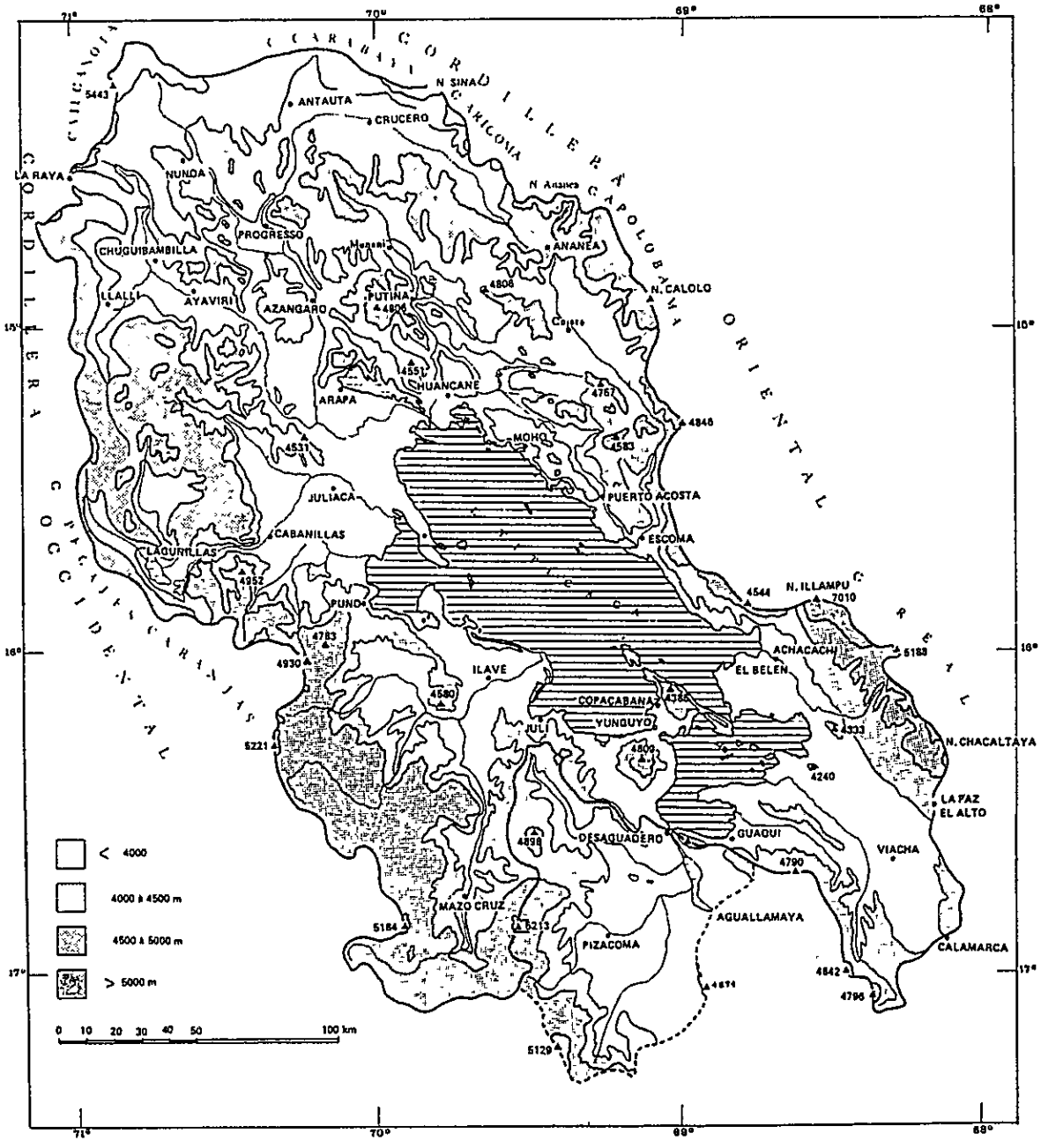
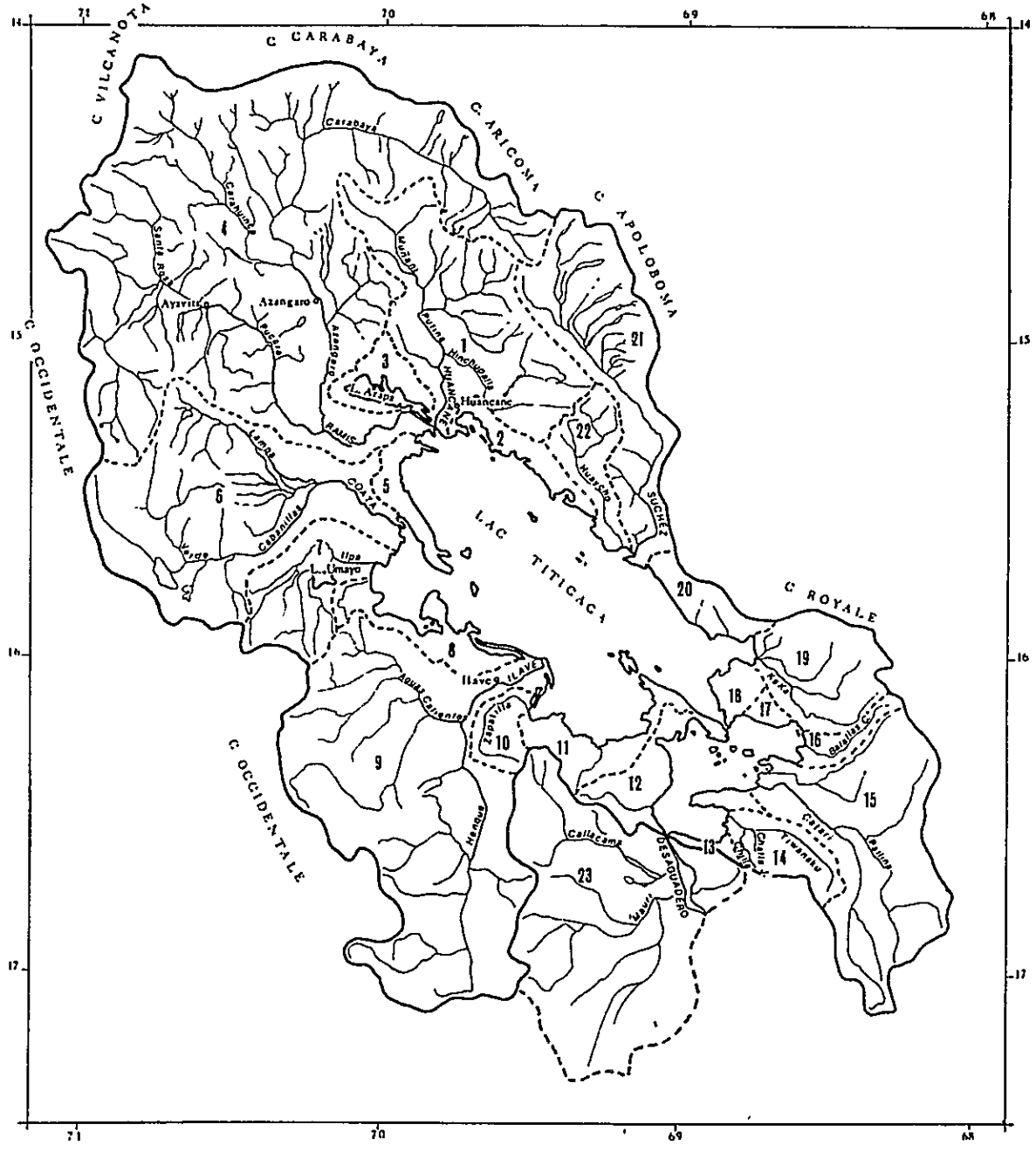


Carta Geográfica de la Cuenca del Lago Titicaca



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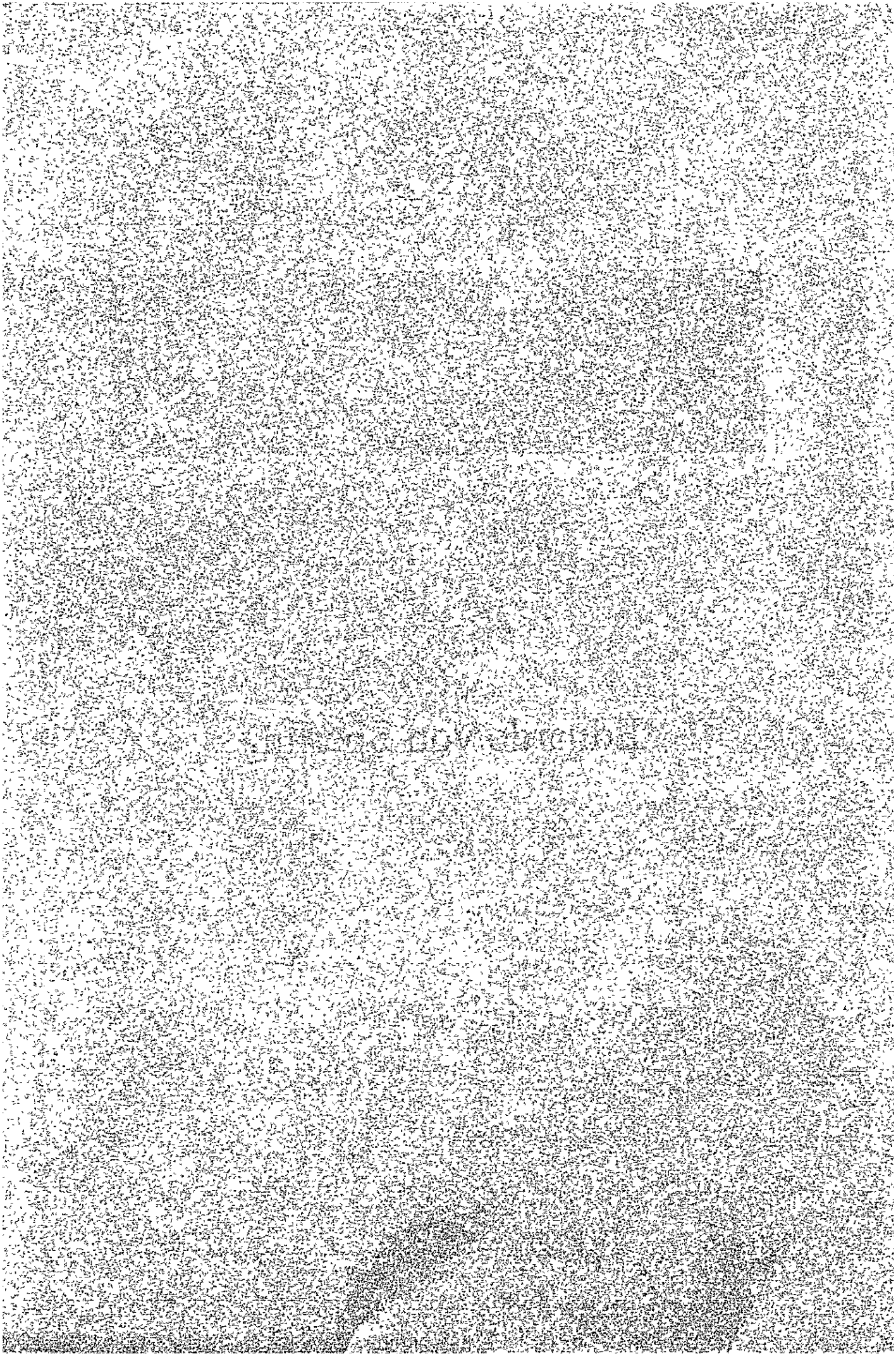
Brazil

Eduardo von Sperling



RESTORATION OF DEGRADED LAKES

Eduardo von Sperling
Brazil

BACKGROUND

The intense population growth and the accelerated increase in industrial activities are the major primary causes of the degradation of aquatic systems. Lakes and reservoirs, due to the generally long water residence periods, are particularly subjected to these negative influences. In the case of tropical countries, among which Brazil is included, the main concerns are related to the following lake pollution problems:

- Contamination, i.e. discharge of pathogenics and toxic material (heavy metals, synthetic organic compounds);
- Eutrophication, i.e. discharge of nutrients (nitrogen and phosphorus) leading to massive growths of algae and macrophytes;
- Siltation, i.e. receivement of particulate mineral material originated from erosion problems in the lake drainage basin.

These pollution phenomena can impair in a very severe degree the distinct uses of lake water such as human and industrial supply, energy generation, irrigation, recreation, aquaculture, navigation.

RESTORATION OF DEGRADED LAKES

In order to guarantee the adequate use of the water resource it is necessary the establishment of sound management activities. One of the most conspicuous issues in the lake management refers to the selection and implementation of restoration measures which are adopted with the aim of recovering the quality of the lake environment. A careful monitoring should be previously carried out in order to achieve a reasonable knowledge about structure and function of the system to be rehabilitated.

The broad array of possible restoration measures can be summarized in the following way:

- PREVENTIVE TECHNIQUES (taken in the lake drainage basin)

* Legal and institutional regulations about use of the soil;
* Environmental education concerning the population living in the drainage basin;
* Use of environmental friendly soaps and detergents;
* Control of natural and artificial erosion processes;

* Tertiary wastewater treatment;
* Sewage diversion;
* Construction of pre-dams;
* Construction of sedimentation basins

- CORRECTIVE TECHNIQUES (in-lake techniques)

A) Mechanical processes

* Destratification: forced circulation of the water body with the objective of bringing oxygen into the deep layers; the limitation (or minimization) of the reducing conditions in the hypolimnion can contribute to the phosphorus fixation in the sediments, diminishing hence the internal load in the lake;
* Hypolimnetic aeration: aeration of the deep layers without destroying the thermal stability of the lake;
* Hypolimnetic withdrawal: forced discharge of the deep layers by using pumps or by utilizing the hydrostatic pressure;
* Dilution: conduction of water of good quality (e.g. from nearby rivers) into the lake;
* Dredging: sediment removal through suction pumps or by using special equipment (dredgers);
* Algae and macrophyte removal: biomass removal in a manual or mechanical way;
* Sediment covering: isolation of this lake compartment by covering it with mineral material or plastic sheets;
* Shading: technique to avoid the penetration of solar radiation by covering the water surface with small balls of plastic material or by using non toxic dyes;
* Water level fluctuation: man operated variations of the water level with the aim of reducing macrophytes population.

B) Chemical processes

* Nutrient precipitation: precipitation of nutrients, mainly phosphorus, through the addition of chemical compounds (iron and manganese salts);
* Sediment oxidation: oxidation of the top layers of the sediment by adding an oxidizing agent (e.g. nitrate salts);
* Application of herbicides: world wide used method to combat the excessive growth of aquatic plants (algae and macrophytes);

C) Biological processes

* Biomanipulation: control of the development of aquatic organisms through

manipulation of the trophic chain bottom-up techniques: control of the micro-organisms; top-down techniques: control of the fish population);
* Use of herbivorous fishes: technique used for reduction of the phytoplankton population

CHARACTERISTICS OF TROPICAL LAKES

The restoration of tropical lakes should be carried out under the consideration of the typical features of warm water lakes, such as:
- The intense solar radiation and the high water temperature values accelerate the nutrient uptake by the algae;
- The phytoplanktonic population peaks are less frequent in comparison with temperate aquatic environments;
- The high nutrient assimilation, associated with high recycling rates, lead to the prevalence of an intense degree of productivity;
- The nutrients concentrations are generally low; as a consequence many water bodies are erroneously classified as oligotrophic in spite of their high productivity;
- There is the frequent occurrence of low phytoplanktonic densities, which are however associated with high growth rates;
- The high mineralization rates lead to an accelerated oxygen depletion and to the formation of sediments poor in organic matter; consequently there is no direct connection between the hypolimnetic oxygen depletion or the content of organic matter in the sediment and the productivity of the water body;
- Due to the high temperature the water viscosity is low, leading to a higher settling velocity of organisms and nutrients.

SOME RESEARCH ISSUES

The success of the implementation of restoration techniques depends in a first degree on a broad knowledge of structure and function of the lake system. Other factors, such as existence of financial resources and the involvement of citizens in the process, play also an important role but under a technical point of view the key issue refers to the scientific information.

With this respect three research topics, which are not sufficiently understood, should be here highlighted:
a) Definition of monitoring programs

The main characteristic of a monitoring program should be the achievement of a realistic compromise between the existence of human and financial resources and the demands that are required in the local situation. In a broad sense a monitoring program can be implemented in order to know the lake system, identify problems, evaluate its conformity to the uses, compare its quality with standards and regulations and check the effectiveness of restoration measures. Under a conceptual point of view the main feature of a monitoring program is its representativity. In the case of third world countries there is often a lack in financial resources and specialized personnel, what makes absolutely necessary a clear comprehension of the goals of the proposed monitoring. The monitoring program should contain a clear and sound definition of its basic aspects, namely the frequency, the location of the sampling points and the choice of the parameters to be monitored. The fact that the less developed countries are mostly located in the tropical belt of our planet, with a striking climatic seasonality (rainy and dry periods) leads to the convenience of defining the sampling frequency according to this characteristic.

b) Hydrodynamics

It consists in one of the most important, and at the same time less considered, aspects of lake management. The measuring and evaluation of vertical and horizontal currents provides very valuable information about the behaviour of the aquatic system. This point has a special significance with respect to the pattern of stratification and circulation in the lake, which has a striking influence in the distribution of chemical compounds and biological components.

c) Relationship nutrient X biomass

There is a very complex relationship between nutrient concentration in the water body and the biomass formation. This interaction depends on the influence of several forcing factors (climate, hydrology, morphomology),which should be hence deep analysed. It is important to point out that, in the case of lake restoration due to eutrophication, the main concern is related to the way biomass is formed. Therefore the appropriated measures should be directed to the use of effective techniques for reducing the amount of biomass, which in its turn can be independent of the nutrient load arriving in the lake.

CONCLUSION

The valuable contact with lecturers, professors and colleagues during my short participation (4-23 March, as individual trainee) in the course on "Lake Water Quality

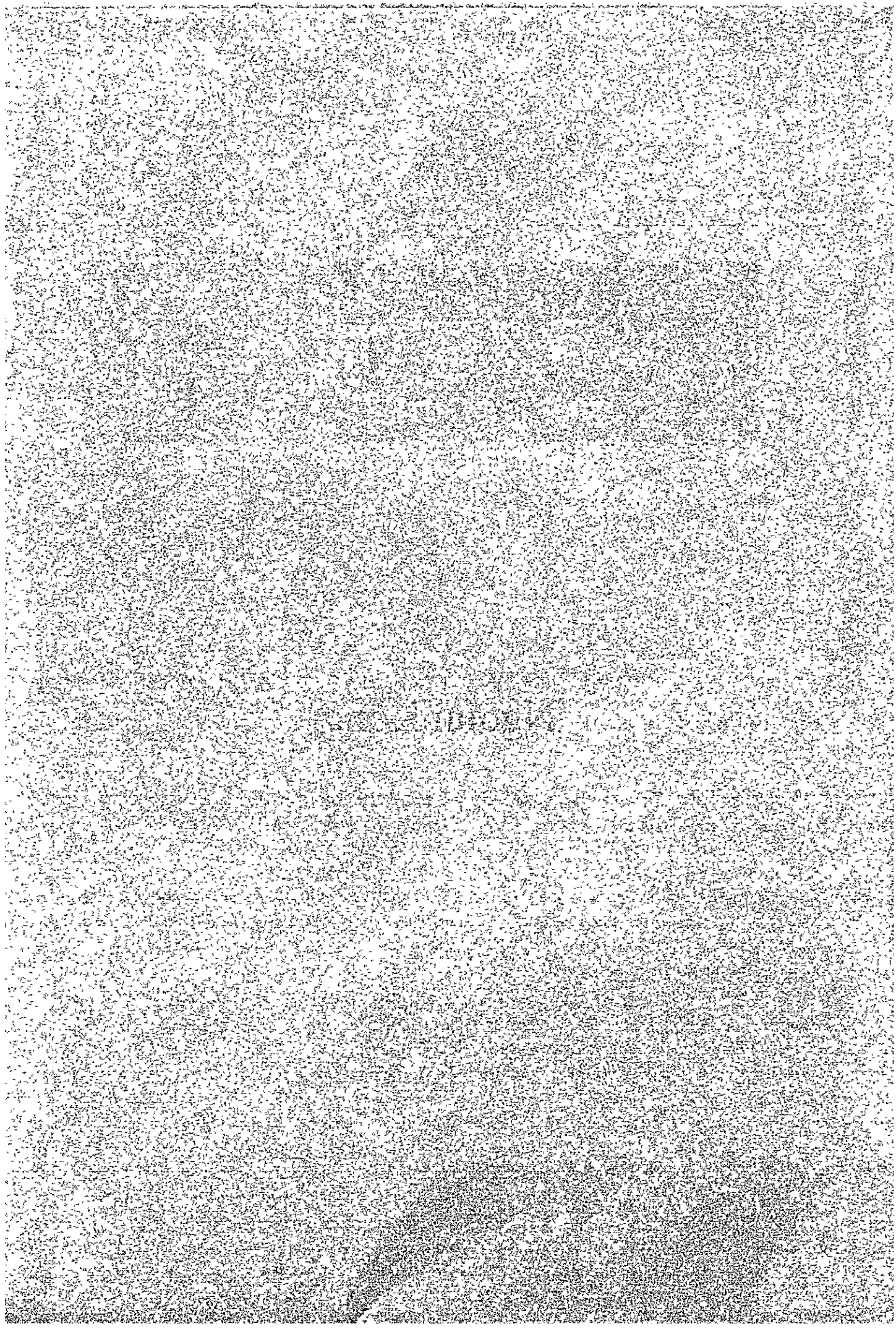
Management" has arisen reflections about the here related needs for future research. These ideas will be surely implemented as part of my activity as professor in the Department of Sanitary and Environmental Engineering at the Federal University of Minas Gerais, Brazil.

ACKNOWLEDGEMENTS

I gratefully acknowledge in this opportunity JICA, for the granting of a most valuable individual training, its staff for the perfect organization and helpful assistance and of course my dear colleagues for contributing to my personal development regarding not only lake but also life management.

Cambodia

Ngoun Kong



LAKE WATER QUALITY MANAGEMENT
LAKE TONLESAP

Ngoun Kong
Cambodia

I. INTRODUCTION

Lakes and Reservoirs are precious environment where fresh water resources exist on the earth. There are rich biological resources and living creatures in and around lake. They support the various functions of people's life and activity of production, such as water supply, electric power, transportation, irrigation, aquatic breeding, tourism and climate regulation.

River, ground water or lake are our water sources. Recently, many of them suffered from pollution which is caused by human activities such as: domestic waste, industrial, agriculture, etc. Many of developing countries used river and ground water for their own purpose instead of lakes.

It is necessary for us to take appropriate technologies and measures for lake conservation, such as making an efficient and practicable comprehensive pollution control plan, using appropriate methods for controlling point sources, having a reasonable social economic composition in the lake basin and so on.

II. THE TONLE SAP LAKE

The great lake is the largest permanent body of fresh water in South East Asia. The lake covers an area varying between 2500km during the dry season with an average depth of less than 2 metres, and more than 1300km at the end of the rainy season with a maximum depth of 8 to 10 metres. The Great Lake is connected to the Mekong River via the Tonle Sap Lake, 120km South West at Chaktomuk, Phnom Penh.

The lake and river are unique in the wet season the lake accepts the flood waters of the Mekong river, but in the dry season the direction of flow of the river reverses and the lake drains into the Mekong river.

The lake, partly as a result of the reverse flow, and due to the shallow water, large size and extensive flooded and vegetated areas, is on of the most productive freshwater fisheries in the world.

The flooded forest is important for flood protection and provides a sheltered habitat for the wildlife and fish stocks that live in close association with the shoreline. The

Tonle Sap lake gets pollution from many sources. Deforestation of watersheds and flooded forest change the Hydrological regime and effect erosion of catchment areas and sedimentation of the lake. To assess environmental impacts in the Tonle Sap, data has to be collected during base-line surveys and consecutive interpretation studies have to be carried out, especially in the fields of hydrology , water quality, fisheries, land-use and socio-economy.

III. WATER USES AND SOURCES OF POLLUTION

The freshwater resources are needed and used for many purposes such as : agriculture (irrigation, recession, cropping etc.), domestic (drinking, cooking and washing), transportation, hydropower, industry (factories and small businesses), recreation and tourism, wildlife, fisheries, and aquatic vegetation (flooded forest etc.).

1. Water supply and irrigation

Improper use and management of water resources, and environmental degradation , are leading to shortages, floods and sedimentation problems. Poorly planned irrigation systems are removing irreplaceable topsoil, as well as increasing salinisation.

Overuse of water in the dry season can result in water shortages, effecting agriculture, domestic water supplies, and reduces navigable routes and fisheries habitats. Lack of protection against flood events, which are aggravated by deforestation, has lead to damage to crops and properties and an increase in sedimentation.

2. Fisheries

Fish consumption has traditionally been high in the Tonle Sap basin due to the almost legendary productivity of its waters. An estimated average of 40 - 80% of the animal protein consumed by humans is provide by fish. The inland capture fishery is still the most important source of fish for consumption by the local population.

In recent times, many problem have appeared in riparian countries relating to inland fisheries resources and management. A decline is being experienced in the Tonle Sap fish production, which may be explained by the degradation of habitats for feeding and spawning, overfishing, deforestation and increased population pressure. Unfortunately the institutions working in this sector are weak, in terms of technical knowledge, equipment and lack of financial support.

3. Domestic use and industrial waste water disposal

Disposal of untreated domestic waste water from urban centres and to health risks, increase of biological oxygen demand and increase of suspended solids. Especially the disposal of raw sewage at Phnom Penh from a threat to the Mekong and Tonle Sap River. It is no doubt that most of the fishermen live on the water body all year round. There are three main fishing villages in the lake where they live in floating houses. As the water depth drastically changes between season, the villages move accordingly nearer to the shore. In these areas, all activities including transportation make the water more polluted. The untreated waste water including night soil is directly discharged therefor causing eutrophication.

4. Navigation

Water transport plays an important role in the transportation of goods in Cambodia. During most of the wet season, when large areas of the country are flooded, waterways are almost the only means of communication. The Tonle Sap lake is one of the most important waterways in Cambodia. Area of the lake are shallow in the dry season, and so navigation impracticable. However, the lake still accounts for about 15 % of the waterborne traffic of the country. Tourism is one way that the Government wishes to boots the water transport on the lake. Increased sedimentation will reduce the amount of navigable lake.

5. Flooded forest

The shoreline and flooded areas of the lake once had considerable flooded forest. As noted in many reports (MoE, Cambodian, 1994), this is considered as an important factor responsible for the huge fisheries production of the Great Lake, and keeping down the rate of siltation. The current rate of flooded forest depletion is high, a major concern to the equilibrium of the lake. The flooded forest, not only being important for flood protection and fisheries, is a unique and ecologically important habitat that contains many species of animals, birds and wildlife. Very little is known about the ecological processes and regeneration of the flooded forest. The major sources of forest depletion are :

- Agricultural encroachment.
- Use of forest products: fuelwood, charcoal, construction materials, fish traps and smoking fish. The communities are dependent on the resources of the forest for survival.
- Fire used in hunting.

IV. ENVIRONMENTAL ASPECTS

The Tonle Sap Lake functions as an important water reservoir and buffer to the Mekong and Bassac Rivers. It therefore plays a role in diminishing the effects of flooding and salt water infiltration in the Mekong Delta.

The flood plain of the Tonle Sap Lake consists mainly of secondary forest dominated by thickets (the so called inundated forest) and grassland brushwood. Paddy fields, where receding rice culture is practised, are located at the fringes of the flood plain. Fisheries yields and aquaculture production at the Tonle Sap Lake contribute to the Cambodian economy as hard currency earners and form an important animal protein source to the Cambodian population.

V. LAKE TONLE SAP WATER QUALITY MANAGEMENT PLAN

1. Lake water quality management

The setting-up of a water quality monitoring network is recommended to ensure that relevant and up-to-date data are collected, processed and compiled for management and planning decisions. The water quality monitoring may indicate immediate need for waste water treatment. To achieve the framework, following steps are probably applicable:

- information and data collection and dataset formulation.
- assessment of existing data and information.
- control socio-economic activities through alternative methods and uses.
- coordination amongst institutes and laboratories and determining parameters for detection.
- water quality monitoring plan and study project formulation.
- formulation of management plan.

2. Aquaculture

Fish culture in the Tonle Sap depends on capture fisheries for stocking and feeding. The development of a price competitive fish feed and the construction of fish hatcheries and nurseries are previous conditions for an increase in the aquaculture production. Aquaculture would not be restricted to a seasonal activity and dependant only on capture fisheries.

3. Erosion and sedimentation

Deforestation and consequent erosion of catchment areas endanger future productive land use and the viability of reservoirs which rapidly silt up. Several catchment areas of

the Tonle Sap basin are known to be effected.

The rate of sedimentation of the lake is increasing, putting more and more pressure on the natural resource use. The lake depth decreases, which results in decreased transportation ability in the dry season, and larger flood events into areas already prone to flooding as a result of the loss of flooded forest.

4. Potential pesticides problem

The unregulated use of pesticides in Cambodia has caused the use of highly toxic chemicals that are banned in many countries in the world. These flush off farm lands into the waterways, killing fish and invertebrates that the fish feed on The result will be a further decline in the lake, unless regulation reduces or remove the threat.

5. Environmental conservation

Lake and reservoirs are precious environments where fresh -water existence is concerned. Most of the living creatures, biological resources within and around the lakes as well as the human being in the surrounding areas are dependent on the water resources in their basins.

To assess environmental impacts in the Tonle Sap Lake, data has to be collected during base-line surveys and consecutive interpretation studies have to be carried out, especially in the fields of hydrology, water quality, fisheries, land-use and socio-economy.

The major environmental impacts are expected to be:

- Sedimentation and pollution in the Battambang River and the Tonle Sap Lake due to gem mining in the upper parts of the watershed.
- Possible impact-especially on aquatic life and fisheries-of domestic waste water released from the urban areas (Phnom Penh, Siem Reap, Battambang, etc.)
- Possible impact of deforestation of the inundated forest on wild life and fish

6. Environmental education

Awareness is everyone's business. Thus, promotion of environmental awareness to the public community plays a vital role. To achieve the goal, information, should be given to all municipalities concerned as well as in the schools, in connection with the environmental conservation and management program.

If possible, inclusion of environmental subject in the school curriculum would be more effective.

7. Non-governmental organization

NGOs have so far been involved with community development and improvement of agricultural yield and training. For the purpose of lake environment, these organization could cooperate with the relevant agencies to develop appropriate measure to mitigate agriculture pollution from chemicals and pesticides. Likewise, in the context of community development the foresaid organizations could advice local community about cause and effect of pollution and how to preserve lake water. Moreover, the support for training on environmental science could focused more than on production or economic issues.

VI. CONCLUSION

The training course on lake water quality management broadens my knowledge on advanced technology and concept on water management. The lake Biwa management is a good example, since a lake play the role of an integrator for many processes. With the hope that the knowledge and techniques acquired through these training course will be a step forward the conservation of the lake Cambodia.

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ACKNOWLEDGEMENT

I would like to express my thanks and appreciate Government of Japan through JICA for giving me opportunity to follow this training course.

I would also like to express my thanks to ILEC members, course's professors, doctors, lectures, institutes who making this course program become successful.

Finally, I would like to express my thanks to all of my co-participants for the good and enjoyable time we have had during three months in Japan.

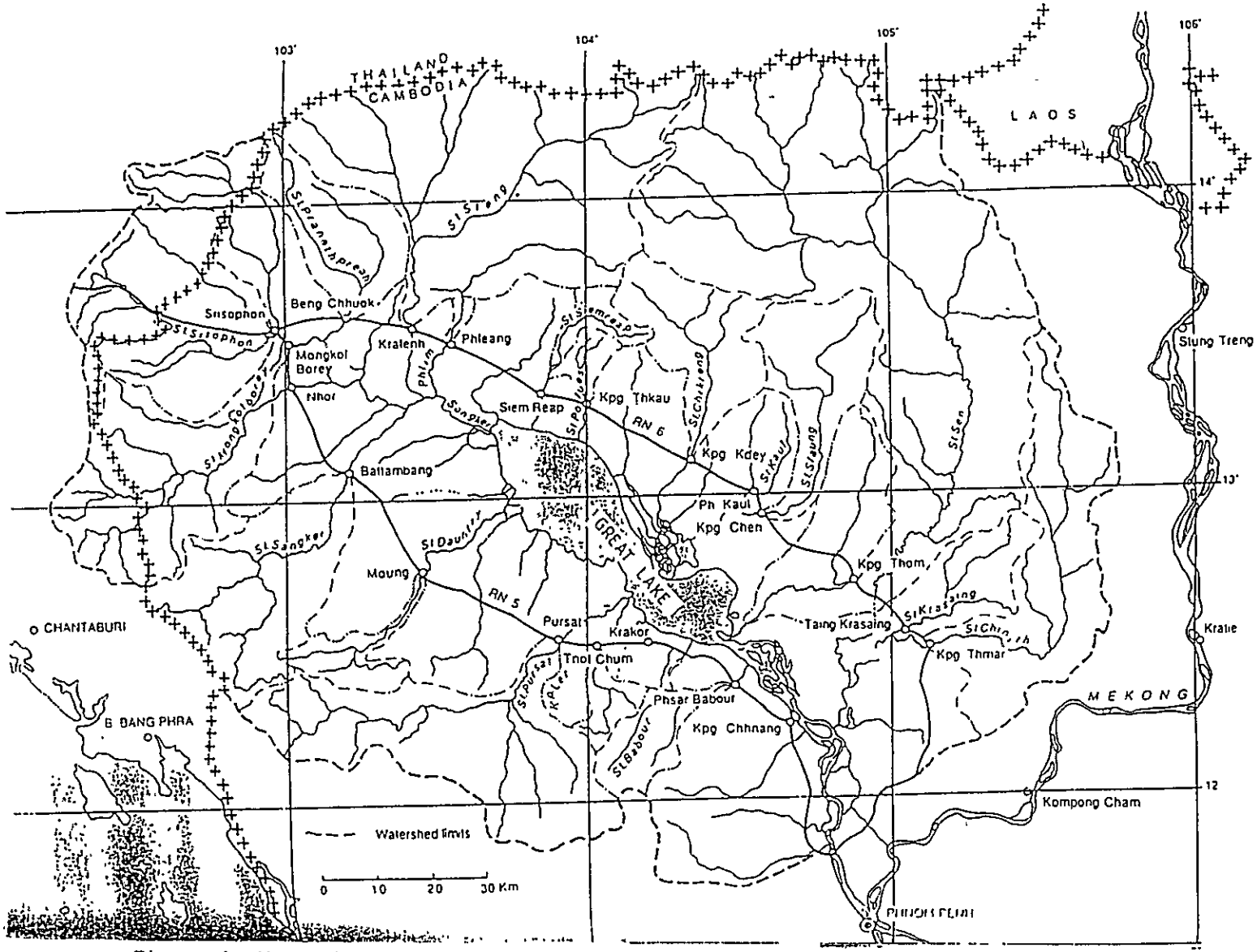
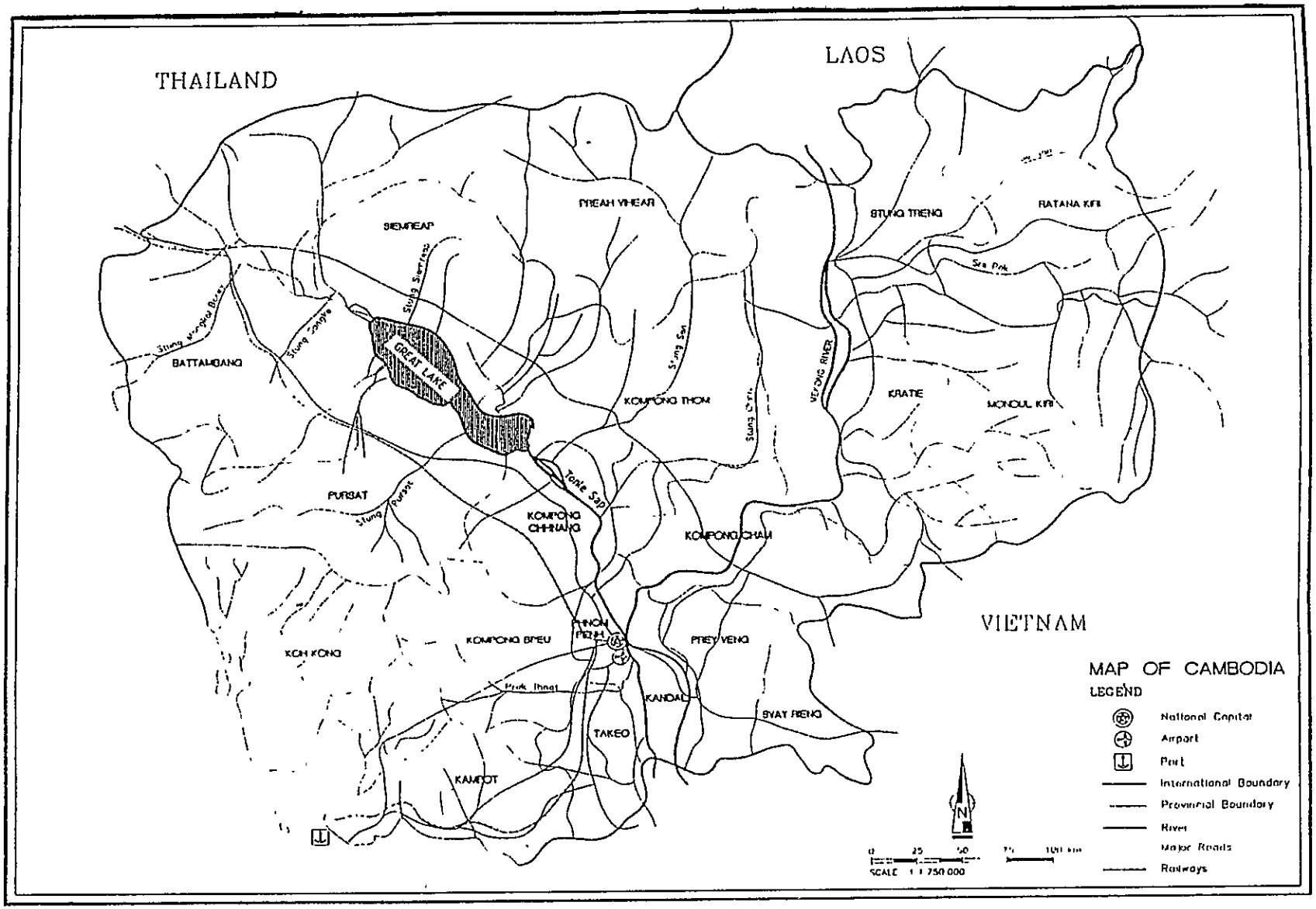


Figure 1: Watershed of the Tonlesap Lake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