

JAPAN INTERNATIONAL COOPERATION AGENCY [JICA]

SECRETARIAT OF COORDINATION AND PLANNING

THE STATE OF RIO GRANDE DO SUL

THE FEDERATIVE REPUBLIC OF BRAZIL

**THE STUDY
ON
THE ENVIRONMENTAL MANAGEMENT
OF
THE HYDROGRAPHIC BASIN OF PATOS AND MIRIM LAKES
IN
THE FEDERATIVE REPUBLIC OF BRAZIL**

FINAL REPORT : VOLUME 2

MAIN REPORT

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The final reports are composed of the following 6 volumes.

- 1. Vol.1 Summary**
- 2. Vol.2 Main Report**
- 3. Vol.3 Supporting Report**
- 4. Vol.4 Data Book**
- 5. Summary (Japanese)**
- 6. Summary (Portuguese)**

PREFACE

In response to a request from the Government of the Federative Republic of Brazil, the Government of Japan decided to conduct a Development study on the Environmental Management of the Hydrographic Basin of Patos and Mirim Lakes in the Federative Republic of Brazil and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Dr. Akira Sugiyama of Kokusai Kogyo Co., Ltd. and consists of Kokusai Kogyo Co., Ltd and Pacific Consultants International to Brazil, four times between November 1998 and August 2000.

In addition, JICA set up an advisory committee headed by Jiro Eiho of Environmental Bureau, Hyogo Prefectural Government between November 1998 and October 2000, which examined the study from specialist and technical points of view.

The team held discussion with the officials concerned of the State Government of Rio Grande do Sul 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 State Government of Rio Grande do Sul for their close cooperation extended to the Team.

October, 2000



Kunihiko Saito

President

Japan International Cooperation Agency

October 2000

Mr. Kunihiko Saito
President
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

Dear Sir,

We are pleased to submit the final report of "The Study on the Environmental Management of the Hydrographic Basin of Patos and Mirim Lakes in the Federative Republic of Brazil".

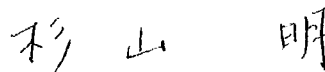
This report has been prepared based on the field survey in Brazil and the further studies in Japan conducted from November 1998 to October 2000.

This report proposes a master plan for environmental management, regarding 2010 and 2020, to rehabilitate and preserve the water quality of Patos Lake and the wetland ecosystem around Patos and Mirim Lakes to a sustainable level.

We sincerely hope that the implementation of this master plan would greatly contribute to the improvement of the environmental conditions around Patos and Mirim Lakes.

The Study Team wishes to express his sincere thanks to the personnel of your Agency and the Sao Paulo office, the Japanese Consulate General in Porto Alegre and the persons concerned in the State Government of Rio Grande do Sul.

Very truly yours,



Akira Sugiyama

Team Leader

The Study on the Environmental Management
of the Hydrographic Basin of Patos and Mirim
Lakes in the Federative Republic of Brazil

LIST OF ABBREVIATIONS

Organizations

- ABC** (Agencia Brasileira de Cooperacao) : Brazilian Cooperation Agency
- ALM** (Agencia da Lagoa Mirim) : Agency of Lake Mirim
- APEDEMA/RS** (Assembleia Permanente de Defesa do Meio Ambiente do RS)
: Assembly for Environmental Deficiency of RS State
- CEA** (Centro de Estudos Ambientais) : Center for Environmental Studies
- CEFET** (Centro Federal de Educacao Tecnologica) : Federal Center of Technical Education
- CEPSRM** (Centro Estadual de Pesquisa em Sensoriamento Remoto e Meteorologia) : Remote Sensing and Meteorological Reserch Center attached to the State University of Rio Grande do Sul
- CIENTEC** (Fundacao de Ciencia e Tecnologia) : Foundation of Science and Technology
- CMA/RBPM**(Conselhos Municipais Ambientais da Regiao da Bacia Patos-Mirim)
: Municipal Council for Environment of the Region of Patos-Mirim Basin
- CONRHIRGS** (Conselho Estadual de Recursos Hidricos) : State Council for Water Resource Development
- CONSEMA** (Conselho Estadual de Meio Ambiente) : State Council for Environment
- COREDE** (Conselho de Regional de Desenvolvimento) : Council for Regional Development
- COREDE-SUL** (Conselho Regional da Regiao Sul) : Promotion Committee for the Southern Region of RS State
- CORSAN**(Companhia Rio Grandense de Saneamento) : State Public Corporation for Water Supply and Sewage Treatment
- CPRM** (Companhia de Pesquisas de Recursos Minerais) : Research Corporation for Mineral Resources
- C/RBPM** (Comites de Regiao da Bacia Patos-Mirim) : Committee for the Region of Patos-Mirim Basin
- DEPRC** (Superintendencia de Portos e Hidrovias) : Superintendence of Port and Waterway
- DHN** (Diretoria de Hidrografia e Navegacao, Marinha do Brasil) : Hydrographic and Navigation Division of the Navy of Brazil
- DMAE** (Departamento Municipal de Agua e Esgoto) : Municipal Department of Water Supply and Sewage Treatment

DNAEE (Departamento Nacional de Aguas e Energia Electrica) : Federative
Department of Water, Energy and Electricity

DSG (Divisao de Servico Geografico do Exercicio) : Geographic Division of
Military of Brazil

EMATER (Associacao Riograndense de Empreendimentos de Assisitencia
Tecnica e Extensao Rural) : Enterprise for Technical Assistance

EMBRAPA (Empresa Brasoleira de Pesquisa Agro-pecuaria) : Federal Research
Institute for Agriculture and Farming

FAMURS (Fedetacao das Associacoes de Municipios do Rio Grande do Sul) :
Association of Municipals of RS State

FEE (Fundacao de Economia e Estatistica) : Foundation of Economics and
Statistics

FEPAGRO (Fundacao Eestadual de Pesquisa Agropecuaria) : Research
Foundation of Agriculture and Farming

FEPAM(Fundacao Estadual de Protecao Ambiental Henrique Luiz Rossler/RS) :
State Foundation for Environmental Protection

FURG (Fundacao Universidade do Rio Grande) : Federal University of Rio
Grande

FZB (Fundacao Zoobotanica) : State Foundation for Zoology and Botany

GEEPAA (Grupo Especial de Estudo e Protecao do Ambiente Aquatico) : Group
for the Study and Protection of the Aquatic Environment

GTZ : (Deutsche Gesellschaft fur Technische Zusammenarbeit) : Organization for
Technical Cooperation of German

IBAMA (Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais
Renobabeis) : Federal Institute of Environment and Natural Resources

IDG-UFRGS (Instituto de Geociencias) : Institute of Geoscience attached to the
Federal University of Rio Grande do Sul

INMET(Instituto Nacional de Meteorologia) : Federal Institute of Meteorology
attached to the Ministry of Agriculture

IPH (Instituto de Pesquisa Hidraulicas da Universidade Federal do Rio Grande do
Sul) : Hydraulic Research Institute attached to the Federal University of Rio
Grande

IRGA (Instituto Riograndense do Arroz) : Institute of Rice Crop in Rio Grande

JICA : Japan International Cooperation Agency

KK : Kokusai Kogyo Co. Ltd.

MCT (Ministerio de Ciencia e Tecnologia) : Ministry of Science and Technology

METROPLAN (Fundacao de Planejamento Metropolitano e Regional) :
Foundation of Planning for Metropolitan

NEMA (Nucleo de Educacao e Monitoramento Ambiental) : Center for Environmental Monitoring and Study

NGO : Non-Governmental Organization

PCI : Pacific Consultants International

PMD (Secretario Executivo do Programa Mar de Dentro) : Mar de Dentro Program

PMP (Prefeitura Municipal de Pelotas) : Pelotas City

PMRG (Prefeitura Municipal de Rio Grande) : Rio Grande City

RS : The Sate of Rio Grande do Sul

SAA (Secretario da Agricultura e Abastecimento) : Secretariat of Agricultural Production of RS State

SANEP (Servico Autonomo de Saneamento de Pelotas) : Service Agency of Pelotas for Water Supply and Sewage Treatment

SCP(Secretario da Coordenacao e do Planejamento) : Secretariat of Coordination and Planning of RS State

SE (Secretario da Educacao) : Secretariat of Education of RS State

SEMA (Secretario do Meio Ambiente) : Secretariat of Environment of RS State

SF (Secretario da Fazenda) : Secretariat of Finance of RS State

SOPSH (Secretario das Obras Publicas, Saniamento e Habitacao) : Secretariat of Public Works, Sanitation and Residences

SUPRG (Superintendencia do Porto de Rio Grande) : Superintendent of Rio Grande Port

UCPEL (Universidade Catolico de Pelotas) : Catholic University of Pelotas

UFPEL (Universidade Federal de Pelotas) : Federal University of Pelotas

UFRGS (Universidade Federal de Rio Gande do Sul) : Federal University of Rio Grande do Sul

ULBRA (Universidade Luterana do Brasil) : Luther University of Brazil

UNISINOS (Universidade do Vale do Rio dos Sinos) : Sinos University

WHO : World Health Organization

Chemical Terms

AA : Atomic Absorption Spectrometer

APHA : American Public Health
Association

As : Arsenic

BOD : Biochemical Oxygen Demand

Cd : Cadmium

Chl-a : Chlorophyl-a

Cl : Chlorine

CN : Cyanide

COD : Chemical Oxygen Demand

COD(Cr):COD(Potassium Bichloride
Method)

COD(Mn):COD(Potassium Perman-
ganate Method)

Cr : Chrome

Cu : Copper

DO : Dissolved Oxygen

Fe : Iron

Hg : Mercury

Ig-Loss : Ignition Loss

IN : Inorganic Nitrogen

IP : Inorganic Phosphate

NH₄-N : Ammonia Nitrogen

Ni : Nickel

NO₂-N : Nitrite Nitrogen

NO₃-N : Nitrate Nitrogen

ON : Organic Nitrogen

OP : Organic Phosphorus

ORP : Oxidation Reduction Potential

Pb : Lead

pH : Potential of Hydrogen

POC : Particular Organic Carbon

PON : Particular Organic Nitrogen

PO₄-P : Phosphoric Phosphate

SPM : (correspond to **SS**)

SS : Suspended Solid

TOC : Total Organic Carbon

TN : Total Nitrogen

TP : Total Phosphorus

TS : Total Solid

TV : Total Volatile

Zn : Zinc

Economic Terms

B/C : Benefit Cost Ratio

EIRR : Economic Internal Rate of
Return

FIRR : Financial Internal Rate of
Return

GDP : Gross Domestic Products

IRR : Internal Rate of Return

PPP : Polluter Pays Principle

WSP : Willingness to Pay

Unit of Measurement

km : kilometer

m : meter

cm : centimeter

mm : millimeter

km² : square kilometer

ha : hectare

m³ : cubic meter

L : liter

kg : kilogram

g : gram

mg : milligram
µg : microgram
sec : second

MPN : Most Probable Number
NTU : Nephelometric Turbidity Units

Reports

S/W : Scope of Work
IC/R : Inception Report
P/R : Progress Report

IT/R : Interim Report
DF/R : Draft Final Report
F/R : Final Report

Others

ADCP : Acoustic Doppler Current
 Profiler
APA : Areas for Environmental
 Protection
C/P : Counterpart Personnel
EIA : Environmental Impact
 Assessment
EAA : Everglades Agricultural Area

GC-MS : Gas Chromatography Mass
 Spectrometer
GIS : Geographic Information System
IPTU : Urban Territory and
 Construction Tax
OM : Operation and Maintenance
RPPN : Private Reserves of Natural
 Patrimony

LIST OF COLLABORATORS

Many people from several sectors of RS State Government, universities, municipal government, NGOs, etc., collaborated with the implementation of this study by offering information or data and in assisting in field surveys or laboratory experiments. The names of these people are listed below.

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