Brazil
Santa Catarina State

PREPARATORY SURVEY
FOR
THE PROJECT ON DISASTER PREVENTION
AND
MITIGATION MEASURES FOR THE ITAJAI RIVER BASIN

FINAL REPORT

VOLUME II :MAIN REPORT

NOVEMBER 2011

JAPAN INTERNATIONAL COOPERATION AGENCY

NIPPON KOEI CO., LTD

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FINAL REPORT

Composition of Reports

VOLUME I	EXECUTIVE SUMMARY
VOLUME II	MAIN REPORT Part I : Master Plan Study Part II : Feasibility Study
VOLUME III	SUPPORTING REPORT (A) Hydrology (B) Flood Mitigation Plan (C) Natural Condition and Landslide Management Plan (D) Flood Forecasting and Warning System (E) Water Storage in Paddy Fields (F) Environmental and Social Considerations (G) Structural Design and Cost Estimate (H) Economic Evaluation
VOLUME IV	DATA BOOK CD

EXCHANGE RATE

The exchange rate used in this Study is:	
Master Plan (2010/10)	Brazilian Real (R$1.0)=US Dollar (US$0.58) = Japanese Yen(Y47.87)
Feasibility Study(2011/06)	Brazilian Real (R$1.0)=US Dollar (US$0.63) = Japanese Yen(Y50.71)


Legend
City
Road
River
Dam
Basin
966m
986m
Itajai do Norte River
Benedito River
Norte Dam
Pomerade
Timbo
Tijucp River
Luiz Alves River
Picarras
Itajai River
Ilhota
Itajai
Ascurro
Indaial
Blumenau
Gaspar
Warnow
Itajai Mirim River
Ibirama
Apiuna
Neisse River
Subida River
Oeste Dam
Itajai do Oeste River
Lontras
Rio do Sul
Aurora
1,244m
Trombudo
Central
Itajai do Sul River
Ituporanga
Sul Dam
Geral Mountains
1,508m
1,742m
SANTA CATARINA STATE
FLORIANOPOLIS
ATLANTIC OCEAN
Brazil
Rio de
Janeiro
SANTA CATARINA
STATE
0 500 1000 km
0 5 10 15 20 25 km
SCALE
Location Map of Itajai River Basin

Master Plan of Flood Management for Itajai River Basin

■ Characteristics of the flood disasters in the Itajai River basin

Urban areas are developed over flood plain and houses are close to the river. This might cause frequent inundation and restriction of flow capacity of the river.

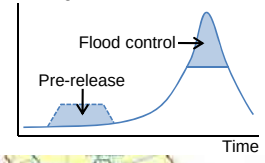
Urban areas extending to mountainous area, where are used as mainly pastures. This might increase peak discharge such as flash floods and sediment-related disasters.

■ Flood Prevension and Mitigation Measures for Safety Level of 50-year Flood

Project Components	Location	Amount	Project Cost (R$ 10^3)	Priority for F/S
Water storage in rice field	All the basin	22,000ha	33,000	○
Heightening existing flood control dams	Taio, Ituporanga	2 dams	33,000	○
Basin storage (small dams)	Upstream area of Rio do Sul	7 locations	211,000	
Flood Gates	Itajai (Itajai Mirim River)	2 gates	94,000	○
Floodway	Itajai, Navegantes (Itajai River)	10.9 km	593,000	
New flood control dam	Brusque	1 dam	95,000	
River improvement (widening, dyke)	Taio	3.7 km	114,000	
River improvement (dyke)	Rio do Sul	8.2 km	268,000	
River improvement (dyke)	Timbo	1.0 km	22,000	
Composite section with APP	Blumenau (Itajai River)	15.8 km	267,000	
River improvement (widening)	Blumenau (Garcia, Velha River)	7.0 km	196,000	
Ring dyke	Ilhota	8.0 km	70,000	
Modification of operation of existing hydropower dams	Rio dos Cedros	2 dams	-	○
Strengthening existing FFWS	All the basin	-	4,000	○

■ Structural Measures

Heightening of Oeste Dam
(Heightening by 2.0 m)



Modification of operation of existing hydropower dams

Composite section with APP
Blumenau L=15.8 km

Floodway, Itajai/Navegantes
L=10.9 km

Widening, Dyke
Taio L=3.7 km

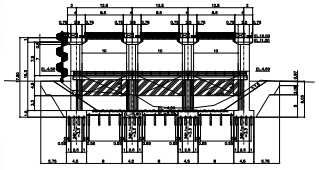
Dyke
Timbo L=1.0 km

Widening
Garcia, Velha L=7.0 km

Dyke
Rio do Sul
L=8.2 km

Basin storage (small dams)
7 locations

Heightening of Spillway of Sul Dam
(Heightening by 2.0 m)



Flood gates, Itajai N=2

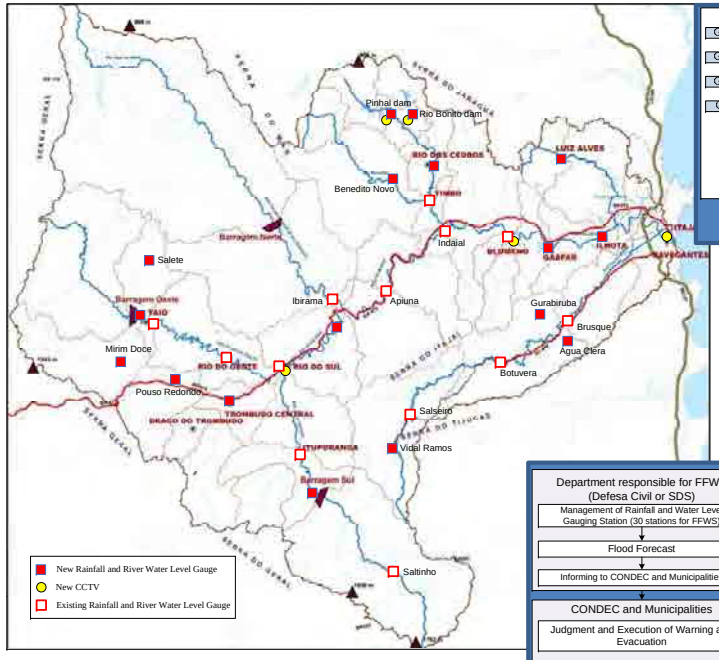
New flood control dam, Brusque

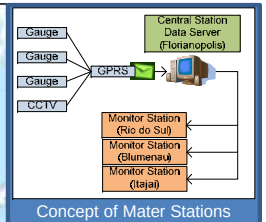
Ring dyke, Ilhota L=8.0km

Floodway, Itajai/Navegantes L=10.9 km

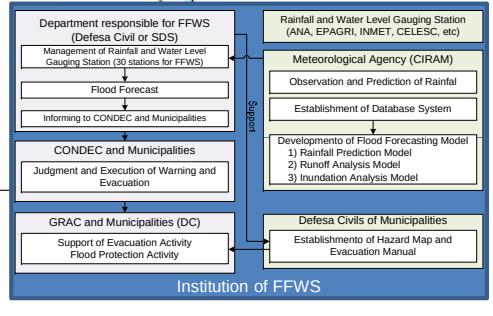
■ Non-Structural Measures :

Strengthening of Existing FFWS





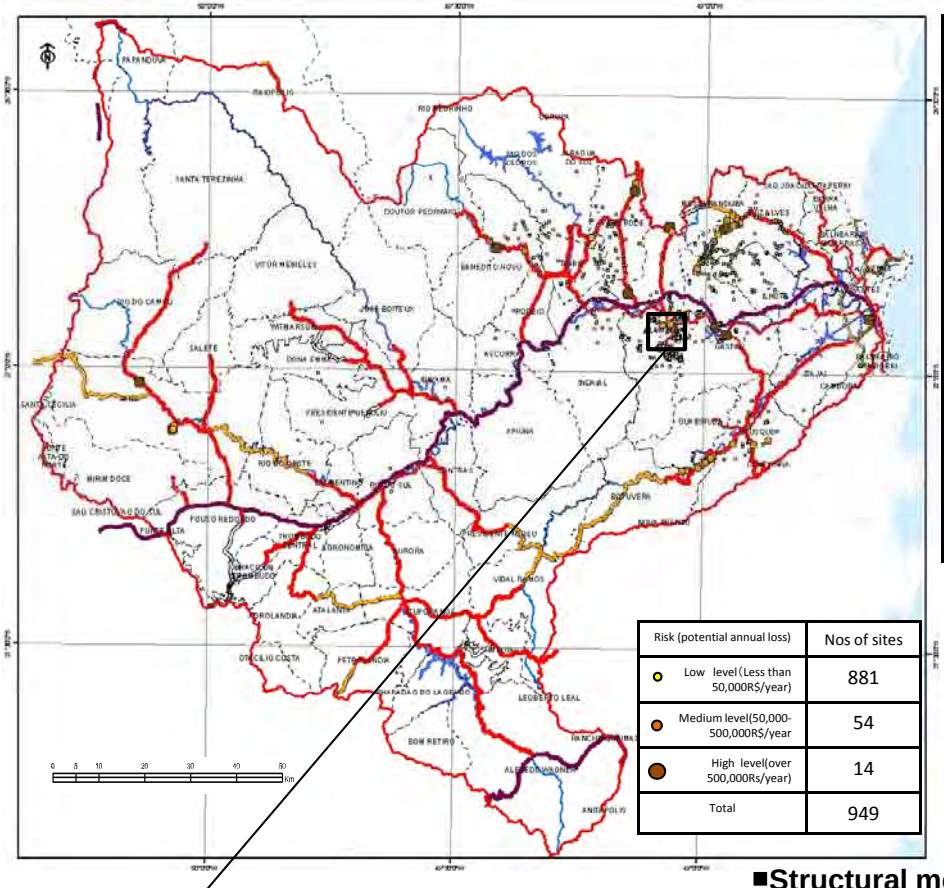
Concept of Mater Stations and Central Station



Institution of FFWS

Master Plan of Landslide Management for Itajai River Basin

■ Result of the Risk Assessment



Legend

Road
- Federal paved roads, two lanes each way
- Federal paved roads
- State paved roads, two lanes each way
- State paved road
- State unpaved roads gravel base
- State unpaved roads natural
- Municipality paved roads
- Municipality unpaved roads

Boundary
- Itajai Basin
- Municipality
- Drainage
- Basin

Example of landslide risk map

■ Components of Landslide Management Master Plan

Purpose	Measures	Project Cost Unit : R$×10³
Avoidance of human lives loss	(1) Non-structural measures a) Formulation of Early warning system for Landslide/Flash flood. b) Disaster education	4,000
Reducing economic losses	(2) Structural measures for landslide Structural measures from the priority sites which have high potential annual loss.	13 High Risk landslide 19,000 54 Medium Risk landslide 35,000 Total 54,000
	(3) Sediment yield mitigation by forestation. Forestation of bare collapsed land, prevention of river-bank erosion by river bank forest will be promoted. Prevention of sediment yield will be secured by vegetation at structural measures sites for landslide.	–
	(4) Flash flood/Flood mitigation by discharge regulation facilities Installation of discharge regulation facilities for rainfall runoff .	–
	(5) Capacity building for structural measure and support for private self –reliant effort a) Capacity building for structural measure project b) Support for private self –reliant effort of structural measures by subsidy.	–

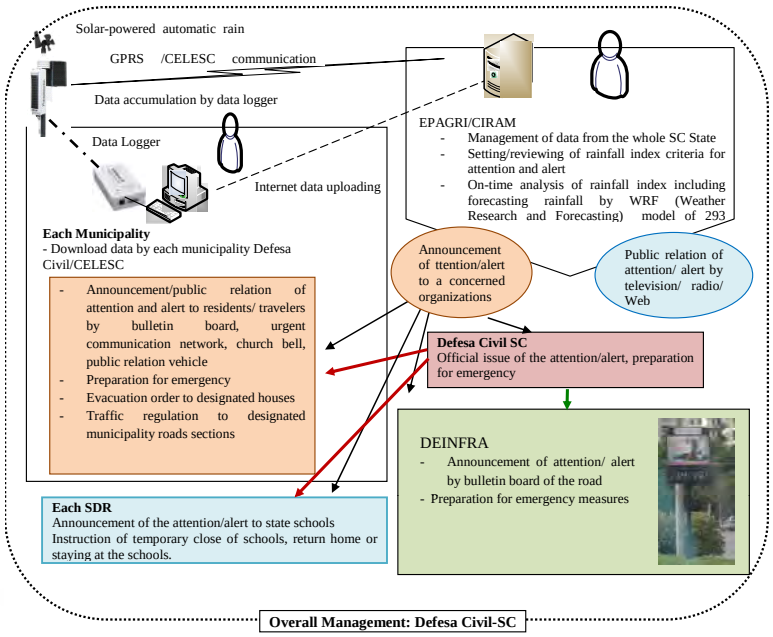
■Structural measures for landslide

Safety level: to ensure half functionality of infrastructures and/or building/lands against heavy rain of 60 years return period, (heavy rain level in Nov 2008 at Blumeau City

Areas of high possibility disaster occurrence on main infrastructure. (67 sites)
32 SC road slops, and 35 Municipality road slopes

■Non-structural measures

Early warning system for Landslide/ flash flood



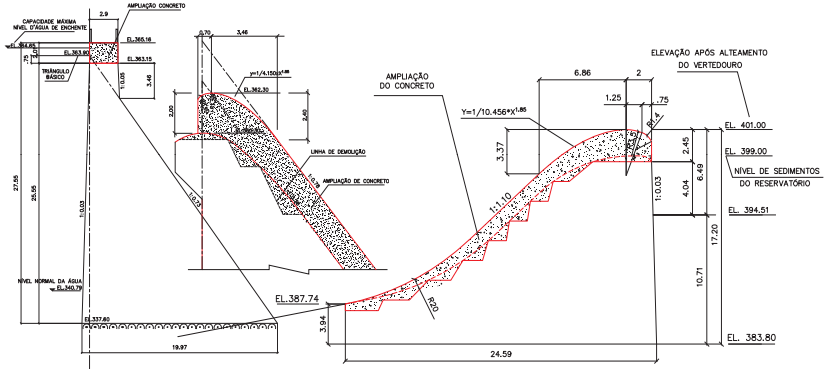
Feasibility Study of Priority Projects for Flood Prevention and Mitigation

■ SELECTION PRIORITY PROJECT

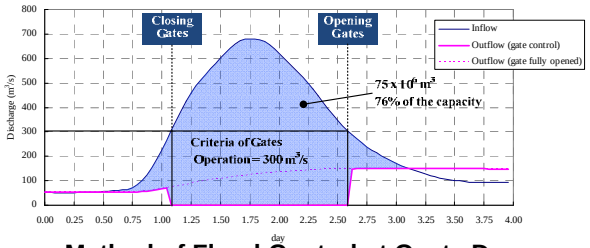
To achieve the 50-year flood safety level, a lot of cost and long period of implementation will be necessary. It is important to implement step-wise gradually increasing safety level with priority projects including the non-structural measures. The 10-year flood level might be recommended for the target safety level of the first phase, considering the budget of the State Government. The priority flood prevention and mitigation measures for feasibility study were selected as follows:

- Water storage in paddy fields
- Heightening of existing flood control dam and modification of operation (2 dams)
- Utilization of existing hydropower dams for flood control (2 dams)
- Strengthening existing flood forecasting and warning system (FFWS)
- Installation of floodgates and improving Itajai Mirim River in Itajai city

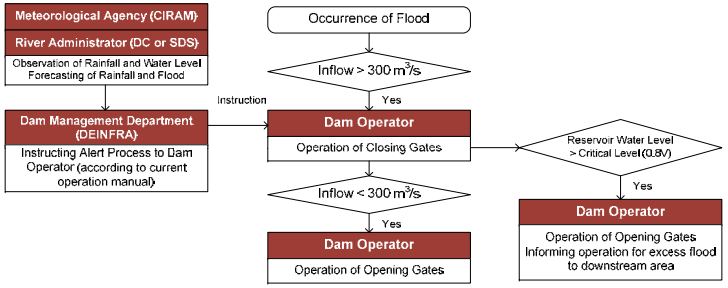
Heightening of Existing Flood Control Dams and Modification of Operation



Oeste Dam Sul Dam

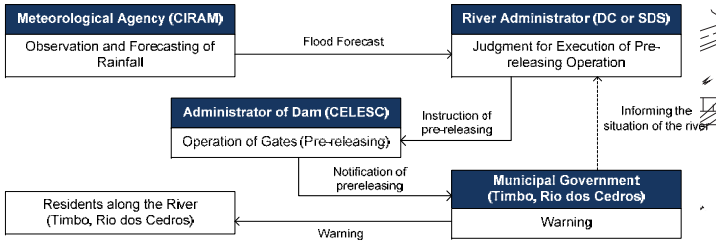


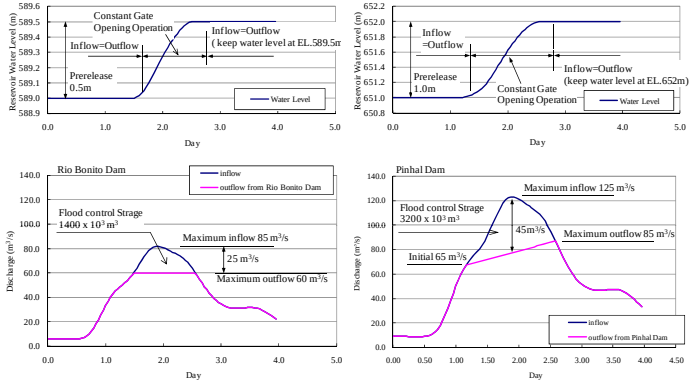
Method of Flood Control at Oeste Dam



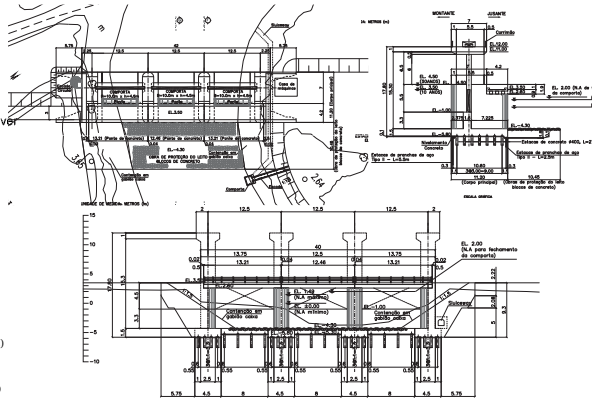
Flowchart of Gates Operation (in case of Oeste Dam)

Utilization of Existing Hydropower Dams for Flood Control

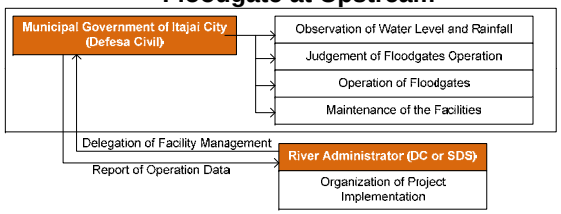




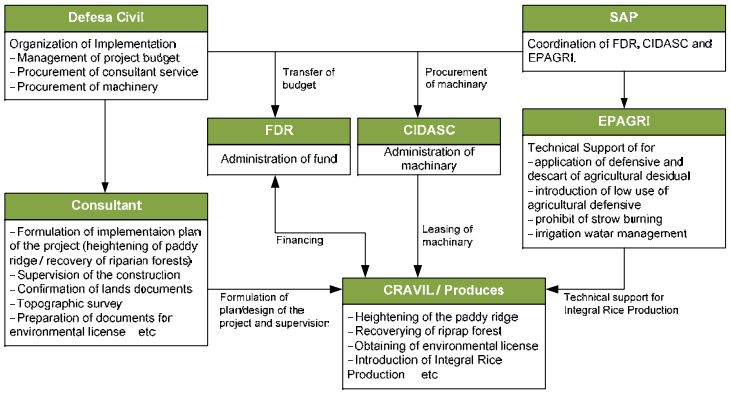
Installation of Floodgates and Improving Itajai Mirim River



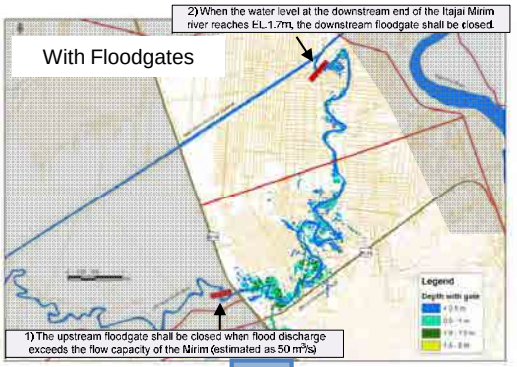
Floodgate at Upstream



Water Storage in Paddy Field



Organization Chart for Water Storage in Paddy Field

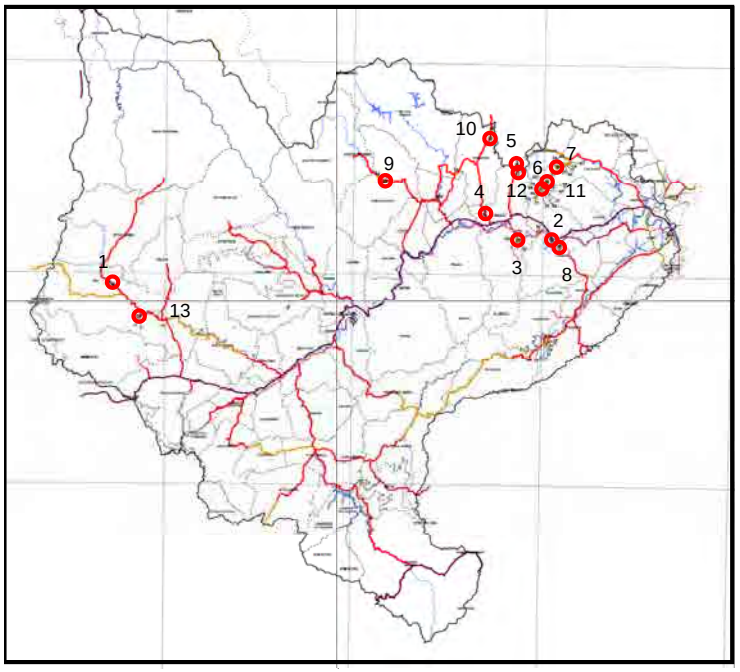


Feasibility Study of Landslide Management for Itajai River Basin

■Structural Measures

Selected Priority Sites and Selected Measures

No. of priority order	Site name	Selected countermeasure
1	SC 302 Taio-Passo Manso-5	Horizontal Drainage drilling
		Gabion retaining wall
2	SC470 Gaspar River Bank	Cutting,excavation
		Embankment
		Pavement
3	Blumenau –Av Pres Casrelo Branco	Sheet pile
		Connecting concrete block
		Geotextile
4	SC418 Blumenau – Pomerode	Closed conduit with open ditch
		Reinforced earth of polypropylene fiber/cement/sand mixture with vegetation
5	SC474 Blumenau-Massaranduba 2	Reinforced earth of polypropylene fiber/cement/sand mixture with vegetation
6	Gaspar - Luiz Alves, Gaspar 9	Reinforced earth of polypropylene fiber/cement/sand mixture with vegetation
		Horizontal Drainage drilling
		Gabion retaining wall
7	Gaspar - Luiz Alves, Luiz Alves 6	Reinforced earth of polypropylene fiber/cement/sand mixture with vegetation
8	SC470 Gaspar Bypass	Reinforced earth of polypropylene fiber/cement/sand mixture with vegetation
9	SC477 Benedito Novo - Dutor Pedrinho 1	Lightweight embankment by EPS(Expanded polystyrene)
		Pavement
10	SC418 Pomerode - Jaraguá do Sul 1	Gabion retaining wall
		Embankment
		Pavement
11	Gaspar - Luiz Alves, Luiz Alves 4	Reinforced earth of polypropylene fiber/cement/sand mixture with vegetation
12	SC474 Blumenau-Massaranduba 1	Reinforced earth of polypropylene fiber/cement/sand mixture with vegetation
13	SC 302 Taio-Passo Manso 4	Reinforced earth of polypropylene fiber/cement/sand mixture with vegetation



Location Map of Priority Sites for Structual Measuers

■ Setting of High Safety Level for the Priority 13 Sites to Avoid Human Loss

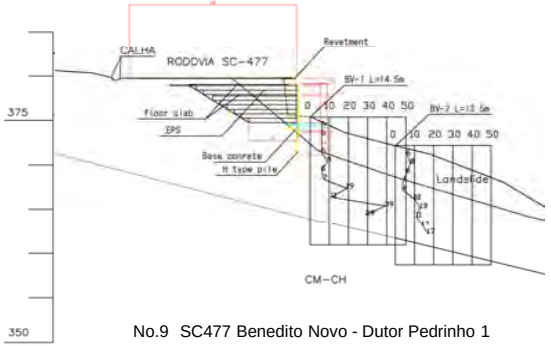
The safety target of the structural measures for the 13 priority sites (potential annual loss is more than R$500 thousands) is to ensure full functionality of the infrastructure against heavy rainfall of 60 years return period.

The 13 priority sites are road slopes of relatively high traffic volume and possibility of high spread failure which directly attack road users. Therefore target safety level shall be high to avoid human loss.

■ Adaptation of Economically Advantageous Countermeasures

-Reinforced earth of polypropylene (PP) fiber/cement/sand mixture with vegetation For erosible red-yellow soils

-Lightweight embankment by EPS for deep slide surface landslide



No.9 SC477 Benedito Novo - Dutor Pedrinho 1

Example: Soil Splaying with PP fiber/cement/sand mixture under construction

Example: Lightweight embankment by EPS for mountaineous road in Japan

Example: 2 years after construction in Japan

Example: 2 years after construction in Japan

■Non-structural measures:

Early Warning System for Landslide

No.	Measures	Unit and Quantities
1	Pluviometer 53 sites, Modem, Antenna, Computers	1 Unit
2	Radio Base and VHF Data Repeater	1 Unit
3	The Early Warning System Development for Communication, Repository, and Calculation of the Data	1 Unit

Abbreviations	Portuguese	English
ABRH	Associação Brasileira de Recursos Hídricos	Water Resources Brazilian Association
ALESC	Assembléia Legislativa do Estado de Santa Catarina	Legislative Assembly of The State of Santa Catarina
AMAVI	Associação dos Municípios do Alto Vale do Itajai	Upper Itajaí Valley Municipalities Association
AMFRI	Associação dos Municípios da Região da Foz do Rio Itajaí	Itajaí River Mouth Municipalities Associations
AMMVI	Associação dos Municípios do Médio Vale do Itajaí	Mid-Valley Municipalities Association
ANA	Agência Nacional de Águas	National Water Agency
ANEEL	Agência Nacional de Energia Elétrica	Eletric Power National Agency
APA	Área de Proteção Ambiental	Environmental Protection Area
ARCOVALI	Associação de Rádios Comunitárias de Santa Catarina	Communities Radio Association of Santa Catarina
CASAN	Companhia Catarinense de Águas e Saneamento	Water And Sanitation Company of Santa Catarina
CDRURAL	Conselho Estadual de Desenvolvimento Rural	State Council of Rural Development
CDU	Conselho de Desenvolvimento Urbano	Urban Development Council
CEDEC	Conselho Estadual de Defesa Civil	Civil Defense State Council
CELESC	Centrais Elétricas de Santa Catarina S.A.	Eletrical Power Station of Santa Catarina
CEMEAR	Centro de Motivação Ecológica e Alternativas Rurais	Centre For Ecological Motivation And Rural Alternatives
CEOPS	Centro de Operações do Sistema de Alerta da Bacia Hidrográfica do Rio Itajaí-Açu	Centre of Warning System operation of The Itajaí-Açu River Basin
CEPED	Centro Universitário de Estudos e Pesquisas sobre Desastres	University Centre of Disasters Studies And Surveys
CERH	Conselho Estadual de Recursos Hídricos	Water Resources State Council
CIDASC	Companhia Integrada de Desenvolvimento Agrícola de Santa Catarina	Integrated Agricultural Development Company of Santa Catarina
CIRAM	Centro de Informações de Recursos Ambientais e de Hidrometeorologia de Santa Catarina	Information Center of Hydrometeorology And Environmental Resources of Santa Catarina
CNRH	Conselho Nacional de Recursos Hídricos	Water Resoucers National Council
COHAB	Companhia de Habitação	Housing Company
COMDEC	Comissões Municipais de Defesa Civil	Municipal Civil Defense Committees
CONAMA	Conselho Nacional do Meio Ambiente	Environment National Council
CONSEMA	Conselho Estadual do Meio Ambiente	Environmental State Council
COREDEC	Coordenadorias Regionais de Defesa Civil	Civil Defense Regional Coordenation
CRAVIL	Cooperativa Regional Agropecuária Vale do Itajaí	Itajaí Valley Regional Agricultural Cooperative
CTTMAR	Centro de Ciências e Tecnológicas da Terra e do Mar	Science And Technology Center of The Earth And Sea
Defesa Civil	Defesa Civil	Civil Defense
DEINFRA	Departamento Estadual de Infraestrutura	State Department of Infrastructure
DEOH	Departamento de Edificações e Obras Hidráulicas de Santa Catarina	Department of Hydraulic Works And Buildings of Santa Catarina
DNAEE	Departamento Nacional de Águas e Energia Elétrica	National Department of Water And Electrical Energy
DNIT	Departamento Nacional de Infraestrutura de transportes	National Department of Transport Infrastructure
EAS	Estudo Ambiental Simplificado	Simplified Environmental Study
EIA	Estudo de Impacto Ambiental	Environmental Impact Study
EPAGRI	Empresa de Pesquisa Agropecuária e Extensão Rural de Santa Catarina	Company of Agricultural Research And Rural Extension of Santa Catarina
FAPESC	Fundo de Apoio à Pesquisa Científica e Tecnológica do Estado de Santa Catarina	Support Fund For Scientific And Technological Research of Santa Catarina State
FATMA	Fundação do Meio Ambiente	Environment Foundation
FECAM	Federação Catarinense de Municípios	Federation of Santa Catarina Municipalities
FUNAI	Fundação Nacional do Índio	Indians National Foundations
FURB	Fundação Universidade Regional de	Blumenau Regional University Foundation

Abbreviations	Portuguese	English
	Blumenau	
GTC	Grupo Técnico-Científico	Scientific Technical Froup
IBGE	Instituto Brasileiro de Geografia e Estatística	Brazilian Institute of Geography And Statistics
INEP	Instituto Nacional de Estudos e Pesquisas Educacionais	National Institute of Educational Studies And Surveys
INPE	Instituto Nacional de Pesquisas Espaciais	National Institute For Space Research
JICA	Agência de Cooperação Internacional do Japão	Japan International Cooperation Angency
MMA	Ministério do Meio Ambiente	Environmental Ministry
MPE	Ministério Público Estadual	State Public Ministry
PCHs	Pequenas centrais hidrelétricas	Small Hydroelectrical Stations
PEEA	Política Estadual de Educação Ambiental	Environmnetal Education State Policy
PNMA	Política Nacional de Meio Ambiente	Environment National Policy
PNRH	Política Nacional de Recursos Hídricos	Water Resources National Policy
RAP	Relatorio Ambiental Previo	Preliminary Environmental Report
REABRI	Rede de Educação Ambiental da Bacia do Rio Itajaí	Environmental Education Network of The Itajaí River Basin
RIMA	Relatório de Impacto Ambiental	Environmental Impact Report
SDR	Secretaria de Desenvolvimento Regional	Regional Development Secretary
SDS	Secretaria de Estado do Desenvolvimento Econômico Sustentável	Secretary of State For Sustainable Economic Development
SDU	Secretaria de Desenvolvimento Urbano	Urban Development Secretary
SEAIN-COFIEX	Secretaria de Assuntos Internacionais/ Comissão de Financiamentos Externos	Seain-Cofiex
SEMASA	Serviço Municipal de Água, Saneamento Básico e Infra-estrutura de Itajaí	Municipal Service of Water, Sanitation And Infrastructure Itajaí
SIEDC	Sistema Estadual de Defesa Civil	Civil Defence State System
SIRHESC	Sistema de Informações de Recursos Hídricos do Estado de Santa Catarina	Information System of Water Resources of The Santa Catarina State
SISNAMA	Sistema Nacional de Meio Ambiente	Environment National System
SMA	Secretaria de Meio Ambiente	Environment Secretary
SPG	Secretaria de Estado do Planejamento	Secretary of State For Planning
STN/MF	Secretária do Tesouro Nacional/ Ministério da Fazenda	Secretary of The Treasury / Ministry of Finance
UCs	Unidades de Conservação	Conservation Units
UDESC	Universidade do Estado de Santa Catarina	Santa Catarina State University
UFSC	Universidade Federal de Santa Catarina	Federal University of Santa Catarina
UNIFEBE	Centro Universitário de Brusque	University Centre of Brusque
UNIVALI	Universidade do Vale do Itajaí	Itajaí Valley University

Part I
Master Plan Study

PREPARATORY SURVEY
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MITIGATION MEASURES FOR THE ITAJAI RIVER BASIN

FINAL REPORT

VOLUME II : MAIN REPORT
PART I : MASTER PLAN

Table of Contents

Tables

Figures

Page

CHAPTER 1 INTRODUCTION

1.1 Background of the Preparatory Survey

The Itajai River basin with a catchment area of 15,221 km^2 locates in the center of the State of Santa Catarina in the southern part of Brazil. Riparian areas along the Itajai River and its tributaries have been suffering from flood damage due to repeated inundation. To cope with frequent flood damage along the Itajai River, flood control schemes such as flood control dam construction and river improvement works have been implemented since 1970s.


Source: FAPESC

Flood Inundation in Blumenau City in 1983 and 1984

After the consecutive attacks by large flood in both years 1983 and 1984, a master plan on flood control in the Itajai River basin was formulated in 1988 and several feasibility studies were conducted on the selected urgent flood control projects through the following studies under the technical cooperation between the Government of Federative Republic of Brazil and the Government of Japan (hereinafter referred as "the GOJ"). Both studies were carried out by Japan International Cooperation Agency (hereinafter referred as "JICA").

- The Itajai River Basin Flood Control Project (1986-88) (Master plan study and feasibility study)
- The Lower Itajai River Basin Flood Control Project (1988-90) (Feasibility study)

The Exchange of Note (E/N) on the Japanese ODA Loan for implementation of the Itajai River Flood Control Project was concluded in 1996 between the Government of the Sate of Santa Catarina (hereinafter referred as "the GSC")and the GOJ. However, the Loan Agreement (L/A) was not concluded due to lack of guarantee of the Government of the Federative Republic. Several flood control projects have been implemented on small scale by use of the budget of State Government and municipal governments to achieve small effects on flood damage reduction, which could not substantially mitigate flood disaster risk.

A catastrophically heavy rainfall hit the Sate of Santa Catarina from November to December in 2008, resulting in serious impacts due to flood and sediment-related disasters in the Itajai River basin. Victims were 135 people dead, 2 people missing, and more than 6,000 people homeless.

This catastrophic storm triggered further strengthening of disaster prevention and mitigation management activities by the GSC. The Governor of the State established the Technical Scientific Group (GTC) to implement urgent recovery measures and actions, gathering various experts of related field. The GTC formulated the Integrated Plan for Prevention and Mitigation of Natural Disaster Risks in the Itajai River Basin (hereinafter referred as "the Integrated Plan") in September 2009. The GSC showed the willingness to implement the Integrated Plan with technical and financial assistance by the GOJ.


Source: EPAGRI, FAPESC

Disaster Damage by the 2008 Rain Storm

The GOJ decided to dispatch the JICA Mission of the Preparatory Survey for the Project on Disaster Prevention and Mitigation Measures for the Itajai River Basin (hereinafter referred as "the Preparatory Survey"). The Preparatory Survey was undertaken in November 2009. The purpose of the Preparatory Survey was to prepare an implementation plan for the Project.

The main result of the Preparatory Survey is as follows:

- The flood control master plan in the Itajai River basin in 1988 shall be comprehensively reviewed and updated taking account of the latest river basin management policies in Brazil and the State of Santa Catarina as well as economic and social considerations in the Itajai River basin that had been prominently changing.
- Sediment disaster and flash floods occurred in 2008 were significant among the water-related disasters in the Itajai River basin The master plan therefore shall cover the countermeasures against sediment disaster and flash flood.

Referring to the above points, the GOJ decided to undertake the Preparatory Survey to formulate a master plan for disaster mitigation and to conduct a feasibility study for priority schemes. The Minutes of Meeting (M/M) on the implementation of the Preparatory Survey was concluded between the GSC and JICA Mission.

1.2 Objective of the Preparatory Survey

The objectives of the Preparatory Survey are to:

(1) Formulate a master plan for flood and sediment disaster prevention and mitigation measures for the Itajai River basin, and

(2) Conduct a feasibility study of the selected priority project(s) in the master plan with future provision of the Japanese ODA Loan.

1.3 Area for the Preparatory Survey

The area of the Preparatory Survey covers the whole Itajai River basin with the catchment area of 15,521 km^2. The location of the Preparatory Survey is shown in the Location Map attached at the beginning of this report.

1.4 Scope and Schedule of the Preparatory Survey

1.4.1 Scope of the Preparatory Survey

The Preparatory Survey was carried out in accordance with the Scope of Works which was agreed between the GSC and the JICA Mission on November 5, 2009. According to the Minutes of Meeting, target natural disasters in the Preparatory Survey are flood including flash flood, sediment discharge as well as sediment disasters of debris flow, land slide and slope failure. The Preparatory Survey mainly targets mitigation and preparedness in the disaster management cycle that consists of the four elements; response, rehabilitation, mitigation and preparedness.

The scope the Preparatory Survey is summarized as follows:

(1) Basic Survey

In order to study technical solutions to water-related disasters and formulate the master plan, the following data and information will be collected and analyzed:

a. Data collection and analysis of past disasters in the Itajai River basin
b. Review of existing development plans in the Itajai River basin
c. Collection of geology maps, soil maps, vegetation maps, and land use maps that cover principal sediment disaster risk areas
d. Survey of changes in vegetation and land use
e. Survey of the longitudinal and cross-section profiles of the rivers
f. Collection and analysis of meteorological and hydrological data, sediment yield and discharge data, and river-bed fluctuation data
g. Inventory survey of existing river works and urban drainage facilities, including survey of their operational rules
h. Field survey to identify candidate sites for construction of disaster mitigation facilities, as well as existing facilities that can be used for disaster mitigation
1. Analysis of maps, satellite images, and aerial photos, as well as field survey to identify major sediment production sites and sediment disaster risk sites
j. Analysis of factors that cause water-related disasters
k. Rainfall analysis, flood runoff analysis, and flood and flush flood analysis
l. Sediment balance analysis
m. Review of the existing flood early warning system
n. Risk assessment and risk mapping of floods, flash floods, and sediment disasters

(2) Formulation of the Master Plan

a. Flood mitigation plan
   a-1. List up of possible flood mitigation measures
   a-2. Preliminary planning and evaluation of the possible flood mitigation measures
   a-3. Preparation of alternatives of flood mitigation plans corresponding to 5-year, 10-year and 25-year return period floods
   a-4. Technical support to stakeholder consultation meetings for consideration of the alternatives of flood mitigation plans
   a-5. Plan and design of flood mitigation measures
b. Sediment-disaster mitigation and rehabilitation plan
   b-1. List up of possible sediment-disaster mitigation and rehabilitation measures
   b-2. Preliminary planning and evaluation of the possible sediment-disaster mitigation and rehabilitation measures
   b-3. Plan and design of sediment-disaster mitigation and rehabilitation measures
c. Cost estimates
d. Implementation schedule
e. Economic analysis

f. Environmental evaluation

(3) Feasibility Study

a. Selection of priority projects from the Master Plan for a request of finance to the GOJ
b. Additional survey for feasibility study of the priority projects (e.g. geotechnical survey)
c. Feasibility study of the selected projects
f. Technical support to environmental and social considerations studies and procedures by the GSC

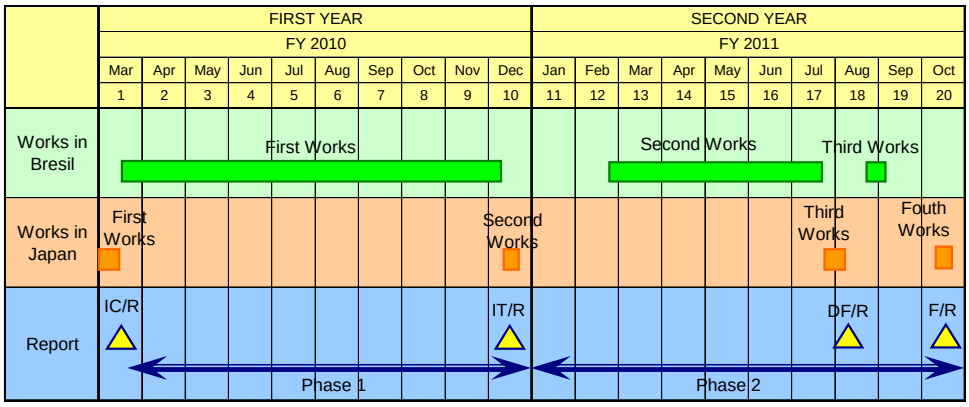
(4) Technical assistance

The Preparatory Survey team will provide technical assistance to Brazilian counterpart personnel through collaborative study activities and technical seminars.

1.4.2 Schedule of the Preparatory Survey

The Scope of Works describes that the Preparatory Survey was carried out in two phases, Phase 1 and Phase 2. The overall work schedule of the Preparatory Study is shown below.

The phase 1 was carried out from March to December in 2010 and the phase 2 was from February to October in 2011. The phase 1 consisted of the basic survey of the Preparatory Survey area and formulation of a master plan. The phase 2 aimed at feasibility study of the selected priority projects in the master plan.



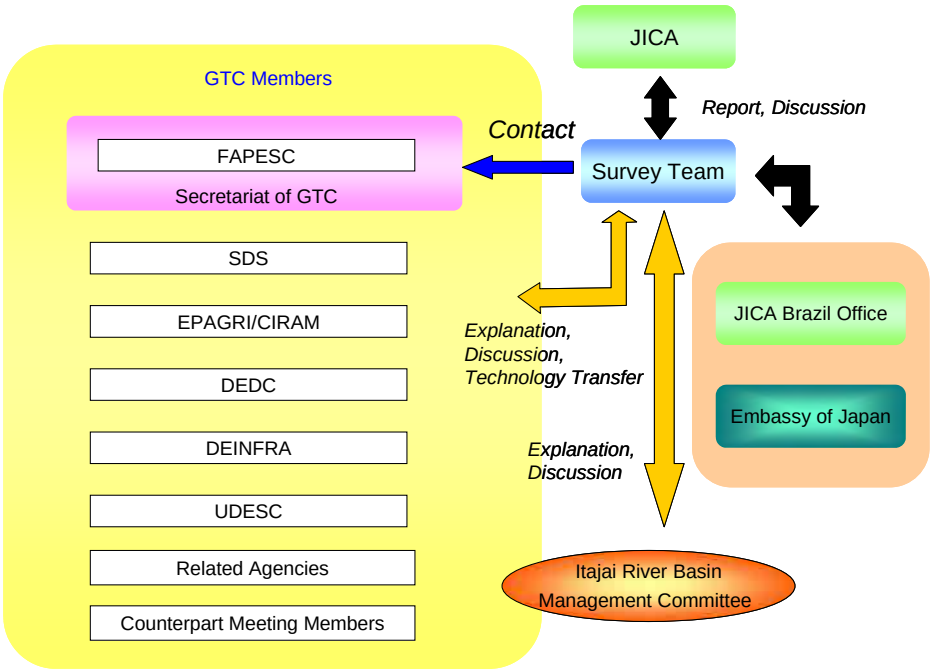
Remarks; IC/R: Inception Report, IT/R: Interim Report, DF/R: Draft Final Report, F/R: Final Report

Figure 1.4.1 Overall Work Schedule of the Preparatory Survey

1.5 Implementation Framework of the Preparatory Survey

1.5.1 Executing Agency of the Preparatory Survey

According to the Minutes of Meeting (M/M) for the Preparatory Survey, the executing agency of the Preparatory Survey is the Secretary of State for Sustainable Development (SDS: Secretaria de Estado do Desenvolvimento Economico Sustentavel) of the Government of the Santa Catarina State. Representing the GSC, FAPESC (Fundacao de Apoio a Pesquisa Cientifica e Tecnologica do Estado de Santa Catarina) under SDS worked together with the Preparatory Survey Team and participate in the planning process of a master plan and feasibility study. Figure 1.5.1 below shows the implementation framework of the Preparatory Survey.



Source: JICA Survey Team

Figure 1.5.1 Implementation Framework of the Preparatory Survey

1.5.2 Counterpart Meeting for the Preparatory Survey

The Preparatory Survey involves various organizations of the State Government as well as municipal governments and universities. For proceeding with the Preparatory Survey effectively and smoothly, a counter part meeting that was expected to have the function of a steering committee was established on May 19, 2010. The Preparatory Survey Team discussed and developed consensus about technical matters as well as exchange various opinions at the counterpart meeting. The counterpart meeting has been held regularly twice a month. The FAPESC selected the member of the counterpart meeting mainly from the member organizations of GTC as listed in Table 1.5.1. In view of various organizations to be involved in this Survey, three chief counterpart personnel were appointed from SDS, Defesa Civil and DEINFRA.

Counterpart meetings

Table 1.5.1 Member of Counterpart Meeting

Organization	Name
FAPESC	Hugo José Braga
SDS	Carlos Alberto Rockenbach Frederico de Moraes Ruddorff
EPAGRI/CIRAM	Edison Silva Sérgio Luiz Zampieri
DEDC	Rafael Schadeck
DEINFRA	Guilherme Rodolfo Bresciani Osni Berreta Filho Adolar Ferreira Filho (DIOP)
UDESC	Aderbal Vicente Lapolli Jaime Antônio de Almeida
SPG	Tânia R. Santiago Costa Jorge Rebolo
FATMA	Cícero Augusto Souza Almeida
SC – Parcerias	Wenceslau Diotallevy Marcelo Burigo Guilherme Custódio de Medeiros
Environmental Military Police	Alexsandro Cravo Kalfeltz
Itajaí River Basin Committee	Fabiana de Carvalho Rosa
Member of GTC	Rodrigo Del Olmo Sato (CREA/SC) Luiz Henrique Pellegrini (CREA/SC) Harry Dorow (CRAVIL) João Luiz B. Carvalho (UNIVALI) André Gustavo Wormsbacher (AMAVI) Regina Davison Dias (UNISUL)
Other institutions	Hélio dos Santos Silva (FUB) Laura (EPAGRI/CIRAM) Álvaro Back (EPAGRI/Urussanga) Hebert Xavier Ferreira (RIO do SUL) Washington de Oliveira Cunha (RIO do SUL) James Rides da Silva (Defesa Civil – Rio do Sul) Juarez Almond (FURB) Mário Tachini (FURB) Marlon Hoelzer (CPRM) Paulo Branco (CPRM) Lauz (EPAGRI/CIRAM) Kadu (EPAGRI/CIRAM) Everton (EPAGRI/CIRAM) Eduardo (EPAGRI/CIRAM)

Source: JICA Survey Team

A participatory approach for formulating a master plan was very actively promoted by the GSC. Along this line, various meetings and face-to-face interviews were undertaken with various State organizations, municipal governments, universities as well as the Itajai River Basin Committee to identify many needs to be addressed for master plan formulation for disaster mitigation. Table 1.5.2 presents the records of meetings during the first phase.

Table1.5.2 Record of Meetings with Related Organizations during Phase 1

No.	Date	Location	Organization/Interviewee	Agenda
1	5/4/2010	CIRAM, Florianópolis	Iara (CIRAM)	Collection of existing geological maps, topographical maps, etc.
2	5/4/2010	UNISUL, Florianópolis	Regina (UNISUL)	Collection of sediment disaster damages in 2008
3	6/4/2010	CIRAM, Florianópolis	Adilson (CIRAM) Juliana (CIRAM)	Disater at the area of Mt. Bau (land slide)
4	7/4/2010	UFSC, Florianópolis	Maria Lúcia (UFSC)	Atlas of natural disasters in the State of Santa Catarina
5	7/4/2010	UFSC - CEPED	Rafael Schadec (CEPED/UFSC)	Atlas of natural disasters in the State of Santa Catarina
6	8/4/2010	SPG, Florianópolis	Tulio Tavares Santo (SPG) Norton Flores Boppré (SPG/Planejamento) Jorge Rebolo Squera (SPG/Cidades) Murilo Colaço (SPG/Estatística/Geo)	Introduction of this preparatory Survey, exchange of views on natural disaster damage mitigation in the State of Santa Catarina, and collection of various socio-economical statistic data and topographical maps
7	13/42010	DEINFRA, Florianópolis	Guilherme R.Bresciani (DEINFRA)	Collection of flood operation manuals of dams and related operation data
8	14/4/2010	City hall, Itajaí City	Itajaí River Basin Committee	Attendance at the public hearing by the Itajai Committee on the established Water Resources Management Master Plan in the Itajai River Basin
9	15/4/2010	SDS, Florianópolis	Flávio Victoria (SDS/Rec.Hídricos) Carlos Rockenbach (SDS/Rec.Hídricos)	Water resources management policy and organizations in the State of Santa Catarina and collection of data and information
10	19/4/2010	IBGE, Florianópolis	Moser (IBGE) Sueni Juraci de Mello (IBGE)	Collection of economic statistical data, topographical maps, geological maps
11	20/4/2010	SDS, Florianópolis	Flávio Victoria (SDS/Rec.Hídricos) Carlos Rockenbach (SDS/Rec.Hídricos)	Attendance at the ceremony for commencement of aerial photograph shooting and mapping by SDS
12	22/4/2010	Norte Dam Oeste Dam	Guilherme R.Bresciani (DEINFRA)	Visit to the existing flood control dams
13	23/4/2010	Fortaleza, Velha, and Garcia Rivers	Sheila Mafra Ghoddosi (FURB)	Visit to uraban rivers in Blumenau city and collection of information on flood inundation
14	23/4/2010	Mt. Bau area, Ilhota	Almir Cezar Paul (Ilhota/Sec.Agriculture)	Site inspection on the slided and collapsed areas at Mt. Bau
15	23/4/2010	UFSC Florianópolis	Antonio Cendrero (Cantabria University, Spain)	Attendance at the address of Professor Antonio Cendrero on Evaluation and Prevention of Risks of Sediment Diasters
16	24/4/2010	Mt. Bau area, Ilhota	Maria Lúcia (UFSC) Masato Kobiyama (UFSC)	Site inspection on the slided and collapsed areas at Mt. Baú
17	26/4/2010	EPAGRI, Florianópolis	Antonio Cendrero (Cantabria University) Professora Maria Lúcia (UFSC)	Meeting for exchanging views with Professor Antonio Cendrero on natural disaster damage mitigation in the Itajai River basin
18	27/4/2010	City hall, Brusque	Diego Furtado (FUNDEMA) Alexandre Gevaerd (IBEPLAN)	Collection of data and information on past floods in Brusque city
19	28/4/2010	CRAVIL, Rio do Sul	Harry Dorow (CRAVIL) Moacir Warmling (CRAVIL) Paulo Roberto Arruda (EPAGRI)	Flood problems in Rio do Sul city and collection of information on the plan of rainwater storage in paddy fields by CRAVIL
20	28/4/2010	Technical Group of Disaster Prevention	Fabiana da Rosa (AMMVI), Chairman of Group, Itajaí Riber Basin Committee	Attendance at the regular meeting for introducing this Preparatory Survey and exchanging views on disaster prevention
21	3/5/2010	SDR-Blumenau	All of the SDRs and Civil Defense in Itajaí River basin	Presentation on Introduction of this Preparatory Survey
22	5/5/2010	DNIT, Rio do Sul	Elifas Levi Nolasco Marques (DNIT)	Collection of data and information on the federal road BR 470
23	5/5/2010	Deinfra, Blumenau	Magno Vinicius de Andrade (DEINFRA) Guilherme Bresciani (DEINFRA)	Collection of data and information on the federal and municipal roads; SC423, SC416, SC418, SC474, SC470, BR486
24	7/5/2010	Civil Defense, Blumenau	Carlos Olimpio Menestrina (Civil Defense) Henrique Mario Carreirão	Collection of data and information on measures for flood and sediment disasters in Blumenau city

No.	Date	Location	Organization/Interviewee	Agenda
			(Civil Defense)	
25	7/5/2010	Department of Construction, Blumenau	Alexandre Brollo (General Manager of Department of Construction)	Collection of data and information on restoration works afeter the 2008 disaster in Blumenau city
26	7/5/2010	Itajaí River Basin Committee	Beate Frank (Itajaí River Basin Committee) Cleverton (SDR-Blumenau)	Exchange of views on flood control needs in the Itajai River and organizational structure of the Itajai River Basin Committee
27	11/5/2010	SDR-Blumenau	Beate Frank (Itajaí River Basin Committee) Cleverton (SDR-Blumenau)	Exchange of technical views on the river improvement plan on the left bank of Itajai River in Blumenau city
28	11/5/2010	Department of Planning, Blumenau	Walfredo Balistieri Fernando de Fontoura Xavier Mauricio Pozzobon Henrique Mario Carreirão (Planning Department)	Collection of data and information on future urban plans, zonings,relocation of illegal houses along urban rivers, etc.
29	11/5/2010	UNIVALI, Itajaí	João Luiz Carvalho (UNIVALI)	Exchange of views on flood problems in the lower reach of Itajai River
30	12/5/2010	Department of Planning, Itajaí	Marcelo Marquetti (General Manager)	Collection of data and information on urgent restoration works afeter the 2008 disaster in Itajai city
31	12/5/2010	Department of Planning, Itajaí	Paulo Praum Cunha Neto (Planning Department) Amarildo (Planning Dep.)	Collection of data and information on future urban plans and zonings in Itajai city
32	12/5/2010	Itajai Port, Itajaí	Antonio Ayres dos Santos (Itajai Port) Robert Granthan (Itajai Port)	Exchange of views on sedimentation isuues and urgent restoration works after the 2008 disaster in the Itajai port
33	13/5/2010	Civil Defense, Gaspar	Mari Inês Testoni Theiss (Civil Defense)	Collection of data and information on the disaster damage in 2008 in Gaspar city
34	13/5/2010	EPAGRI, Florianópolis	Fernando Takasugui Elídio Sinzato Luiz Nakayama (Nipo-Catarinense)	Introduction of this Preparatory Survey
35	14/5/2010	Iguatemi Consultant Company, Florianópolis	Prudêncio Wust Marnei Saccas Ribeiro Felipe Zacchi Gomez Alexandre Mosimann Silveira	Collection of data and information, exchange views on improvement plan of urban rivers in Blumenau city
36	14/5/2010	Civil Defense, Brusque	Eliseu Muller Junior (Civil Defense)	Collection of data and information on the disaster damage in 2008 in Brusque city
37	18/5/2010	EPAGRI, Florianópolis	Antônio Diomário de Queiroz (FAPESC), and various related organaizations, universities, etc.	First Technical Seminar for introducing technology and measures for disaster management in Japan
38	19/5/2010	EPAGRI, Florianópolis	First Counterpart Meeting	Progress of the Preparatory Survey
39	20/5/2010	DEINFRA, Florianópolis	João Flávio Gomes Costa (DEINFRA)	Collection of data and information on restoration projects and cost of damaged roads, traffic jams of road, etc.
40	20/5/2010	DENIT, Florianópolis	Gervásio Martinichi (DENIT)	Collection of data and information on restoration projects and cost of damaged roads, traffic jams of road, etc.
41	21/5/2010	FAPESC, Florianópolis	Antonio Diomário de Queiroz (FAPESC) Zenório Piana (FAPESC) Hugo Graga (EPAGRI/CIRAM)	Report the progress of Preparatory Survey collected needs for disaster management and draft strategy of master planning
42	21/5/2010	EPAGRI, Florianópolis	Guilherme R.Bresciani (DEINFRA)	Exchange technical views on heightening of Oeste and Sul dams
43	24/5/2010	DEINFRA, Blumenau	Magno Vinicius de Andrade (DEINFRA)	Collection of information on flood inundation in Blumenau city, road management, function of DEINFRA, etc.
44	24/5/2010	Department of Construction, Luiz Alves	Reinvald José Tiedt (Department of Construction)	Collection of information on the sediment damage due to the 2008 disaster in Luiz Alves city
45	25/5/2010	Civil Defense, Brusque	Eliseu Muller Junior (Civil Defense)	Collection of information on the sediment damage due to the 2008 disaster in Brusque city
46	25/5/2010	Department of Planning, Rio do Sul	Garibaldi Antônio Ayroso André Gustavo Wormsbecher (Department of Planning) James Rides da Silva (Civil Defense)	Collection of information and exchange of views on flood inundation, evacuation manual prepared by Civil Defense, etc.

No.	Date	Location	Organization/Interviewee	Agenda
47	25/5/2010	CRAVIL, Rio do Sul	Moacir Warmling (CRAVIL) Paulo Roberto Arruda (EPAGRI)	Collection of information on the plan of rain water storage in paddy fields
48	26/5/2010	FURB/CEOPS, Blumenau	Helio dos Santos Silva (FURB) Mario Tachini (FURB)	Collection and exchange views on the exsiting FFWS and flood data
49	27/5/2010	Civil Defense, Ilhota	Paulo Brun (Civil Defense)	Collection of information on the sediment and flood disaster in 2008 in Ilhota city and aerial inspection over the Mt. Bau
50	27/5/2010	Portonave, Navegantes	Osmari de Castilho Ribas Lélio Esteves Rossa Paulo Roberto Deschamps (Navegantes Port)	Collection of data and information on the operation and management of Navegantes Port
51	27/5/2010	City Government, Navegantes	Cassiano Ricardo Weiss (Financial Department) Fabiano Zucco (Administ. Dep.) Antônio Carmona (Economic Department)	Collection of information on the flood disaster in 2008 and future development plan in Navegantes city
52	27/5/2010	Autopista Company Litoral Sul, Joinville	Fernando Araújo (Autopista Company)	Collection of data on traffic volume of the federal road BR-101
53	28/5/2010	Civil Defense, Rio do Sul	James Rides da Silva (Civil Defense)	Collection of information on the sediment disaster in 2008 and site inspection
54	31/5/2010	Itajaí Port, Itajaí	André Pimentel (Engeneer, Itajaí Port)	Collection of tidal data at the Itajai port and confirmation of the BM
55	31/5/2010	Civil Defense, Itajaí City	Major Sérgio Murilo de Melo (Civil Defense)	Collection of information on the flood inundeation and disaster evacuation manuals in Itajai city
56	1/6/2010	Civil Defense, Florianópolis	Major Emerson Emerim Paulo Cesar Knihs (Civil Defense, Gov. of SC)	Collection of information on the flood inundeations, disaster evacuation manuals, reports on natural disasters (AVADAN) in the SC State, etc.
57	2/6/2010	Civil Defense, Blumenau	Carlos Olimpio Menestrina Major Baptista Neto (Civil Defense)	Collection of information on the existing FFWS and disaster evacuation manuals in Blumenau city
58	2/6/2010	FURB/CEOPS, Blumenau	Mario Tachini (FURB)	Collection of information on the existing FFWS and telemetry stations by ADA and SDS
59	7/6/2010	Civil Defense, Itajaí	Major Sérgio Murilo de Melo (Civil Defense)	Collection of information on the sediment damage due to the 2008 disaster in Itajai city
60	8/6/2010	EPAGRI, Florianópolis	Second Counterpart Meeting	Progress of the Preparatory Survey and excahge views on master planning
61	9/6/2010	SDS, Florianópolis	Carlos Rockenbach Robson Marcos (SDS)	Collection of information on the future expansion plan of rainfall and WL stations by SDS/FURB and the Microbasin 3 Project under World Bank
62	10/6/2010	UNIVALI, Itajaí	João Luiz Carvalho (UNIVALI)	Excahge technical views on the flood problems in Itajai city and the hydraulic study on the confluence of Itajai River4 with Mirim River under UNIVALI
63	10/6/2010	Civil Defense, Gaspar	Mari Inês Testoni Theiss (Civil Defense)	Collection of information on the flood inundation and disaster evacuation manuals in Gaspar city
64	11/6/2010	Norte Dam, José Boiteux	Guilherme R.Bresciani (DEINFRA)	Inspection of the Norte dam and excahge views on flood control operation
65	11/6/2010	Oeste Dam, Taió	Guilherme R.Bresciani (DEINFRA)	Inspection of the Oeste dam and excahge views on flood control operation
66	11/6/2010	Sul Dam, Ituporanga	Guilherme R.Bresciani (DEINFRA)	Inspection of the Sul dam and excahge views on flood control operation
67	14/6/2010	Civil Defense, Rio do Sul	James Rides da Silva (Civil Defense) André Gustavo Wormsbecher (Planning Department)	Collection of information on the operation of FFWS and evacuation manual in Rio do Sul city
68	14/6/2010	COHAB, Florianópolis	Maria Darci Mota Beck (COHAB)	Collection of information on the guideline for new residential estate development in the Santa Catarina State
69	14/6/2010	Microbacias, Florianópolis	Valdemar Salgado Vicente Sandrini Pereira (Microbacias)	Collection of information on the completed/ongoing projects of the Microbacias 1, 2 and 3 by World Bank

No.	Date	Location	Organization/Interviewee	Agenda
70	15/6/2010	CIRAM, Florianópolis	Everton Blank Carlos Eduardo Salles de Araujo (CIRAM)	Collection of information on the weather analysis/forecast models under development by CIRAM: SWAT and FINEP 14
71	16/6/2010	SDS, Florianópolis	Carlos Rockenbach Robson Marcos (SDS/Water Resources)	Collection of information on the FFWS under development by the World Bank project (Microbacia 3)
72	16/6/2010	FATMA, Florianópolis	Graciela Canton (FATIMA) Martim (Lawyer, FATIMA)	Collection of information on APP and application procedure for environmental licenses (CONAMA, CONSEMA)
73	19/6/2010	SDR-Blumenau	Beate Frank (Itajai River Committee)	Exchange views on introduction of debris and flush flood forecasting and warning system in the Itajai River basin and some structural method for stabilization of road slopes
74	21/6/2010	Civil Defense, Florianópolis	Major Emerson Emerim (Civil Defense, SC State)	Collection of reports and data on natural disasters (AVADAN) in the SC State, etc.
75	27/7/2010	FAPESC, Florianópolis	Antônio Diomário de Queiroz (FAPESC) Hugo Braga (EPAGRI/CIRAM) Zenório Piana (FAPESC)	Explanation and discussion on the basic principle for formulating maste plan for flood and sediment disater mitigation in the Itajai River basin
76	28/7/2010	SDR-Blumenau	Raimundo Mette Cleverton (SDR-Blumenau) Beate Frank (Itajai River Committee) Noemia Bohn (FURB) Sheila Mafra Ghoddosi (FURB) Fabiana de Carvalho Rosa (AMMVI)	Explanation and discussion on the basic principle for formulating maste plan for flood and sediment disater mitigation in the Itajai River basin
77	2/8/2010	Defesa Civil, Florianópolis	Major Emerson Emerim (Civil Defense, SC State)	Explanation and discussion on the basic principle for formulating maste plan for flood and sediment disater mitigation
78	3/8/2010	EPAGRI, Florianópolis	Third Counterpart Meeting	Explanation and discussion on the basic principle for formulating maste plan for flood and sediment disater mitigation
79	5/8/2010	SDS, Florianópolis	Flávio Victoria Carlos Rockenbach (SDS/Water Resources)	Explanation and discussion on the basic principle for formulating maste plan for flood and sediment disater mitigation
80	9/8/2010	CRAVIL, Florianópolis	Harry Dorow (CRAVIL) Moacir Warmling (CRAVIL) Paulo Roberto Arruda (EPAGRI)	Explanation and discussion on the basic principle for formulating maste plan for flood and sediment disater mitigation and the plan of rainwater storage in paddy fields by CRAVIL
81	11/8/2010	SDR-Blumenau	Ari Roedez (FURB) Hélio dos Santos Silva (FURB)	Collection of information on flood inundation problems in Rio dos Cedros and Timbo cities
82	11/8/2010	FURB, Blumenau	Technical Group of Disaster Prevention, Itajai River B asin Committee	Explanation and discussion on the basic principle for formulating maste plan for flood and sediment disater mitigation
83	12/8/2010	Agronômica, Pouso Redondo, Taió Cities	Moacir Warmling (CRAVIL) Iloi (EPAGRI) Olimpio (EPAGRI)	Site inspection on the planned small scale irrigation dams and the existing irrigation ponds, and the Oeste dam
84	13/8/2010	UFSC-CEPED, Florianopolis	Rafael Schadec (CEPED/UFSC)	Explanation and discussion on the basic principle for formulating maste plan for flood and sediment disater mitigation
85	24/8/2010	UFSC - CEPED, Florianópolis	Rafael Schadec (CEPED/UFSC)	Information on the update data of the Atlas of Natural Disaster in the State of Santa Catarina
86	24/8/2010	DEINFRA, Florianópolis	Adolar Ferreira Osni Beretta (DEINFRA)	Exchage views on the site inspection for road solope protections and drainage works
87	26/8/2010	FUNDAGRO, Florianópolis	Eugênia Maria Michele de Aguiar Backes (FUNDAGRO)	Collection of data and information on the exsiting two power generation dams on the Itajai River by CELESC
88	27/8/2010	City Hall, Rio dos Cedros	Fernando Tomaselli (Mayor Rio dos Cedros City) Guilherme Voigt Junior (Congress, Timbo City)	Discussions on the condition and cause of flood inundation in Rio dos Cedros and Timbo cities and an idea of introduction of FFWS to the existing two

No.	Date	Location	Organization/Interviewee	Agenda
			Hélio dos Santos Silva Ari Roedez (FURB) José Belmont Verzola (CELESC) Carlos Rockenbach (SDS) Sergio Boezel (SDR-Timbo)	hyropower generation dams by CELESC to mitigate flood inundation in the downstream cities
89	1/9/2010	FURB, Blumenau	Sheila Mafra Ghoddosi (FURB)	Exchange views on the necessity of environmental consideration for master planning and restoration of river forest proposed in the Water Resources Management Master Plan in 2010
90	1/9/2010	FURB, Blumenau	Hélio dos Santos Silva (FURB)	Excahge technical views on the study of relatioship between sediment disaster and rainfall and disater risk evaluation
91	1/9/2010	CELESC, Florianópolis	José Belmont Verzola Daniel Pedro Medeiros (CELESC)	Collection of operation data of the existing two hyropower generation dams by CELESC
92	8/9/2010	SDS, Florianópolis	Carlos Rockenbach Tobias (SDS/Water Resources)	Confirmation of the drainage area of Cedros River by GIS analysis
93	8/9/2010	SPG, Florianópolis	Vinícus Lummertz (SPG) Jorge Rebollo Squera (SPG/Uran)	Explanation and discussion on the basic principle for formulating maste plan for flood and sediment disater mitigation and the guideline for new residential estate development in the Santa Catarina State
94	13/9/2010	SDR-Blumenau	Municipal Governments All of the SDRs in Itajaí River basin, AMFRI, AMMVI, AMAVI	Explanation and discussion on the basic principle for formulating maste plan for flood and sediment disater mitigation
95	14/9/2010	Benedito Novo, Luis Alves, Gaspar, Doutor Pedrinho Cities	Adolar Ferreira (DEINFRA) Osni Beretta (DEINFRA)	Site inspection for road solope protections and drainage works
96	15/9/2010	Benedito Novo, Luis Alves, Gaspar, Doutor Pedrinho Cities	Adolar Ferreira (DEINFRA) Osni Beretta (DEINFRA)	Site inspection for road solope protections and drainage works
97	23/9/2010	FAPESC, Florianópolis	Member of GTC	Explanation and discussion on the basic principle for formulating maste plan for flood and sediment disater mitigation
98	29/9/2010	DEINFRA, Florianópolis	Adolar Ferreira Osni Beretta (DEINFRA)	Collection of data on the cost for restoration of damaged roads, road traffic density, etc.
99	30/9/2010	EPAGRI, Florianópolis	Fourth Counterpart Meeting Fabiana de Carvalho Rosa (AMMVI)	Explanation and discussion on the basic principle for formulating maste plan for flood and sediment disater mitigation
100	08/10/2010	EPAGRI, Florianópolis	Beate Frank (Itajai River Committee) João Luiz Carvalho (UNIVALI)	Discussion on arrangement of public hearings in the Itajai River
101	14/10/2010	AMMVI, Blumenau	Fabiana de Carvalho Rosa (AMMVI)	Discussion on the existing FFWS and flood alarms in the Itajai middle reaches
102	14/10/2010	FURB/CEOPS, Blumenau	Hélio dos Santos Silva (FURB)	Discussion on the existing FFWS and flood alarms in the Itajai middle reaches
103	14/10/2010	EPAGRI, Florianópolis	Fifth Counterpart Meeting	Explanation and discussion on emergency actions against sediment disasters
104	15/10/2010	City Hall, Rio do Sul	James Rides da Silva (Civil Defense) André Wormsbecher (Planning Department)	Discussion on the existing FFWS and flood alarms in the Itajai upper reaches
105	15/10/2010	Hydropower Dams Rio dos Cedros	Miguel (Palmeiras Power Station)	Inspection of the Rio Bonito and Pinhal dams and power stations by CELESC
106	19/10/2010	SDS, Florianópolis	Flávio Victoria Carlos Rockenbach (SDS/Water Resources)	Discussion on the existing and future FFWS and flood alarms in the Itajai River basin
107	20/10/2010	City Hall, Blumenau	Walfredo Balistieri Vera Krummenauer (Planning Department)	Collection of information and discussion on the aspects of flood protection and environment of urban plan in Blumenau City
108	20/10/2010	SDR, Blumenau	Fabiana de Carvalho Rosa (AMMVI)	Discussion on the environmental issues of urban plan in Blumenau City

No.	Date	Location	Organization/Interviewee	Agenda
109	21/10/2010	CELESC, Florianópolis	José Belmont Verzola (CELESC)	Discussion on the desirable FFWS for Rio dos Cedros City
110	25/10/2010	City Hall, Rio do Sul	James Rides da Silva (Civil Defense) André Wormsbecher (Planning Department)	Discussion on the desirable FFWS and flood alarms in the Itajai upper reaches
111	26/10/2010	City Hall, Brusque	Eliseu Muller Junior (Civil Defense)	Discussion on the desirable FFWS and flood alarms in the Mirim River (Brusque City)
112	26/10/2010	FURB/CEOPS, Blumenau	Hélio dos Santos Silva Mário Tachini (FURB)	Discussion on the desirable FFWS and flood alarms in the Itajai River
113	27/10/2010	EPAGRI, Florianópolis	Marcelo Jorge Medeiros (ANA)	Discussion on the alert/alarm system of ANA and future expansion plans
114	28/10/2010	EPAGRI, Florianópolis	Sixth Counterpart Meeting	Explanation and discussion on the reinforced FFWS and sediment disaster and flush flood warning system
115	04/11/2010	UNIVALI, Itajaí	João Luiz B. Carvalho (UNIVALI)	Discussion on the conceivable countermeasures for the flood inundation issues in the lower Itajai River
116	04/11/2010	SDS, Florianópolis	Robson Marcos (SDS/Water Resources)	Explanation and discussion on the reinforced FFWS and sediment disaster and flush flood warning system
117	04/11/2010	DEINFRA, Florianópolis	Willian Ernest Wojcikiewicz (DEINFRA)	Collection of data on the unit prices for construction of civil structures
118	08/11/2010	DEINFRA, Florianópolis	Roberto Alexandre Zattar (DEINFRA)	Collection of data on the unit prices for construction of civil structures
119	09/11/2010	EPAGRI, Florianópolis	Beate Frank (Itajaí River Committee) João Luiz Carvalho (UNIVALI)	Discussion on arrangement of public hearings in the Itajai River
120	11/11/2010	EPAGRI, Florianópolis	Seventh Counterpart Meeting	Discussion on the agenda and presentation materials for public hearings
121	16/11/2010	AMFRI, Itajaí	Residents in Itajaí, Brusque and neighbors (Members of AMFRI)	First Public Hearing
122	17/11/2010	SDR, Blumenau	Residents in Blumenau and neighbors (Members of AMMVI)	Second Public Hearing
123	18/11/2010	Office of Education Rio do Sul	Residents in Rio do Sul and neighbors (Members of AMAVI)	Third Public Hearing
124	25/11/2010	FURB, Blumenau	Zenorio Piana (FAPESC), and various related organaizations, universities, etc.	Second Technical Seminar for introducing technology and measures for disaster management in Japan
125	29/11/2010	EPAGRI, Florianópolis	Eighth Counterpart Meeting Members of Itajai River Committee	Discussion on selection of safety level for the flood control master plan
126	29/11/2010	EPAGRI, Florianópolis	Antônio Diomário de Queiroz (FAPESC)	Explanation the selected safety level for the flood control master plan to the Santa Catarina State
127	10/12/2010	EPAGRI, Florianópolis	Antônio Diomário de Queiroz Clovis Renato Squio (FAPESC), Paulo Eli (SEA) Ichiro Sato Patricai Shizuka Takeda (JICA Brazil Office)	Explanation of flood controle measures to the Santa Catarina State
128	13/12/2010	EPAGRI, Florianópolis	Antônio Diomário de Queiroz (FAPESC) Paulo Cesar da Costa (SDS) Ichiro Sato Patricai Shizuka Takeda (JICA Brazil Office)	Explanation of flood controle measures to the Santa Catarina State

Source: JICA Survey Team


Technical Seminars (18 May and 25 November, 2010)


Public Hearings (16, 17 and 18 November, 2010)

1.6 Draft Final Report

This Draft Final Report is hereby submitted as the final product of Phase 1 and Phase 2 studies conducted to date since the beginning of the Preparatory Survey in March 2010.

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

Volume I	Executive Summary
Volume II	Main Report (this volume)
Volume III	Supporting Report
Volume IV	Data Book (CD)

CHAPTER 2 PRESENT CONDITION OF THE SURVEY AREA

2.1 Socio-economic Conditions

2.1.1 Administrative Division

The Santa Catarina State is administratively divided into 293 cities and 36 SDRs (Regional Development Office of the State Government) (see further details in Section 2.5). The SDR was established as a part of the administrative decentralization process for providing efficient local services in the State. The SDR has authority for performing the following services:

i) Administrative representation of the State Government
ii) Elaboration of the regional development plan and coordination among municipal governments
iii) Implementation of projects and coordination among municipal governments
iv) Support to municipal projects
v) Elaboration of budget for project implementation
vi) Maintenance of roads

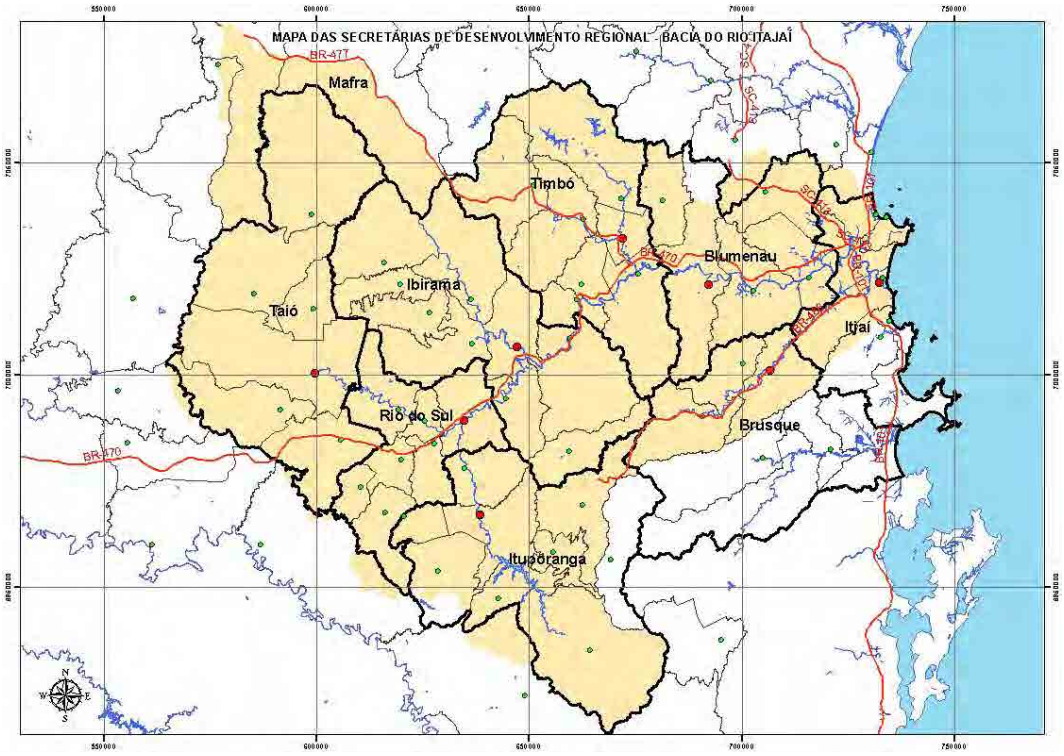
There are 50 cities and 9 SDRs in the Itajaí River basin as listed in the Table 2.1.1 below. As shown, the total population and area are 1.23 million and 15,100 km^2, respectively. Figure 2.1.1 shows the administrative area of each SDR in the Itajaí River basin.

Table 2.1.1 Population and Area by SDR as of 2009

SDR	City	Population	Area (km^2)
SDR-Rio do Sul	Braço do Trombudo	3,419	89.64
	Agronômica	4,925	130.24
	Laurentino	5,757	79.62
	Trombudo Central	6,520	108.82
	Rio do Oeste	7,033	246.43
	Agrolândia	9,661	207.32
	Rio do Sul	59,962	260.47
SDR-Ituporanga	Chapadão do Lageado	2,882	125.45
	Atalanta	3,402	94.24
	Aurora	5,560	206.72
	Imbuia	5,738	122.78
	Vidal Ramos	6,112	338.30
	Petrolândia	6,188	306.13
	Alfredo Wagner	10,274	731.74
	Ituporanga	21,496	337.20
SDR-Ibirama	Presidente Nereu	2,324	224.80
	Dona Emma	3,583	181.07
	Witmarsum	3,584	151.39
	José Boiteux	5,054	405.62
	Vítor Meireles	5,756	371.41
	Lontras	9,660	197.73
	Apiúna	10,996	493.82
	Presidente Getúlio	14,392	295.26
	Ibirama	17,469	246.44
SDR-Blumenau	Luiz Alves	9,506	261.09
	Ilhota	12,149	253.68
	Pomerode	26,788	215.40
	Gaspar	55,489	386.99
	Blumenau	299,416	520.38
SDR-Brusque	Botuverá	4,345	301.94
	Guabiruba	17,316	173.85
	Brusque	102,280	283.23
SDR-Itajaí	Balneário Piçarras	14,845	99.26
	Penha	22,263	58.68
	Navegantes	57,324	111.70
	Itajaí	172,081	288.91
SDR-Mafra	Itaiópolis	20,551	1,294.50

SDR	City	Population	Area (km^2)
SDR-Taió	Mirim Doce	2,583	339.34
	Rio do Campo	6,135	503.25
	Salete	7,737	180.56
	Santa Terezinha	9,363	718.92
	Pouso Redondo	14,510	362.13
	Taió	17,522	692.58
SDR-Timbó	Doutor Pedrinho	3,432	376.19
	Ascurra	6,945	111.23
	Rio dos Cedros	10,170	554.91
	Benedito Novo	10,335	388.88
	Rodeio	11,215	128.11
	Timbó	35,303	127.47
	Indaial	50,917	432.86
Total		**1,232,267**	**15,119**

Source：Compiled by JICA Survey Team (http://www.spg.sc.gov.br/dados_munic.php#comercio)



Source: JICA Survey Team

Figure 2.1.1 Administrative Area of SDR in the Itajaí River Basin

Planning of economic developments in the Santa Catarina Sate is responsible for SUDESUL (South Region Development Superintendence). The SUDESUL proposed to establish the associations of municipalities gathering neighboring cities, and thus 21 associations were established. In the Itajaí River basin, three associations were established as follows:

i) Associação dos Municípios da Foz do Rio Itajaí (AMFRI : Association of Municipalities in the Itajaí Rivermouth)

ii) Associação dos Municípios do Médio Vale do Itajaí (AMMVI : Association of Municipalities in the Itajaí Middle Valley)

iii) Associação dos Municípios do Alto Vale do Rio Itajaí（AMAVI : Association of Municipalities in the Itajaí Upper Valley）

2.1.2 Social Conditions

(1) Population

The total population in the Itajaí River basin in 2009 was recorded at 1.23 million, which is about 20% of the total population in the Santa Catarina State. The average annual population growth in the period of 1970-2009 was 2.0 % as shown in the table below. Cities of Itajaí, Blumenau and Brusque show higher population growth. On the other hand, population growth in the upper Itajaí River basin shows a stagnation or decreasing trend, indicating a significant migration towards the middle-scale cities.

Table 2.1.2 Population and Average Annual Growth Rate in 1970-2009 by SDR

SDR	1970	1991	2000	2005	2009	Annual Growth Rate
SDR-Blumenau	146,948	282,298	348,897	390,622	403,348	2.6%
SDR-Brusque	45,241	72,163	92,790	105,713	123,941	2.6%
SDR-Ibirama	49,077	60,741	64,014	66,119	72,818	1.0%
SDR-Itajaí	85,107	164,336	215,400	247,391	266,513	3.0%
SDR-Ituporanga	52,898	59,983	57,744	56,262	61,652	0.4%
SDR-Mafra	24,102	26,240	19,086	20,014	20,551	-0.4%
SDR-Rio do Sul	57,831	76,313	84,491	89,615	97,277	1.3%
SDR-Taió	40,334	44,850	53,738	53,842	57,850	0.9%
SDR-Timbó	67,457	89,521	107,958	119,509	128,317	1.7%
Itajaí River Basin	**568,995**	**876,445**	**1,044,118**	**1,149,087**	**1,232,267**	**2.0%**
Santa Catarina State	2,901,660	4,541,994	5,356,360	5,866,568	6,118,743	1.9%

Source：http://www.spg.sc.gov.br/dados_munic.php#comercio

The following table presents average annual growth rate of major cities in 1970-2009 in the Itajaí River basin.

Table 2.1.3 Average Annual Growth Rate of Major Cities in 1970-2009

City in an increasing trend		City in a decreasing trend	
City	**Growth Rate**	**City**	**Growth Rate**
Navegantes	4.6%	Presidente Nereu	-1.4%
Balneário Piçarras	3.2%	Vidal Ramos	-1.1%
Gaspar	2.9%	Mirim Doce	-0.7%
Blumenau	2.8%	Ibirama	-0.5%
Timbó	2.8%	Rio do Oeste	-0.5%
Penha	2.8%	Itaiópolis	-0.4%
Brusque	2.8%	Benedito Novo	-0.3%
Guabiruba	2.6%	Trombudo Central	-0.3%
Itajaí	2.6%	Petrolândia	-0.3%
Indaial	2.1%	Dona Emma	-0.2%
Pomerode	2.1%	Presidente Nereu	-1.4%
Rio do Sul	2.0%	Vidal Ramos	-1.1%

Source：http://www.spg.sc.gov.br/dados_munic.php#comercio

The table below shows the number of houses by SDR region in 2008, dividing into urban and rural areas. As seen, approximately 80% of the houses is located in the urban area in the Itajaí River basin. This concentration trend in the urban area is more visible in municipalities such as Itajaí and Brusque cities. In the downstream basin where urbanization is progressing, most of the population lives in the urban area, while in the upstream basin, most of the population lives in the rural area.

Table 2.1.4 Number of Houses by SDR in 2008

SDR	No. of Houses			Rate	
	Total residences	Urban Area	Rural Area	Urban	Rural
SDR-Blumenau	113,092	97,634	15,458	86.3%	13.7%
SDR-Brusque	29,799	27,499	2,300	92.3%	7.7%
SDR-Ibirama	19,586	10,948	8,638	55.9%	44.1%
SDR-Itajaí	80,690	76,801	3,889	95.2%	4.8%
SDR-Ituporanga	17,417	6,838	10,579	39.3%	60.7%
SDR-Mafra	5,589	2,603	2,986	46.6%	53.4%
SDR-Rio do Sul	26,714	20,562	6,152	77.0%	23.0%
SDR-Taió	15,818	7,088	8,730	44.8%	55.2%
SDR-Timbó	34,205	28,253	5,952	82.6%	17.4%
Itajaí Basin	342,910	278,226	64,684	81.1%	18.9%
Santa Catarina State	1,821,483	1,473,162	348,321	80.9%	19.1%

Source: http://www.spg.sc.gov.br/

(2) Employment Opportunities

Regarding employment opportunities, the industrial sector is the biggest employer, followed by the commercial sector. Per region, Blumenau city, followed by Itajaí city, is creating more job opportunities. As for the agricultural sector, although it has created job opportunities in Itajaí city, it has created less opportunity in other regions. The agriculture in the basin is mainly family-based agriculture.

Table 2.1.5 Persons Employed per Sector in 2008

SDR Region	Mining	Industry	Public Corporation	Construction	Commerce	Services	Public Institutions	Agriculture and Forestry	Total
SDR-Blumenau	246	70,902	1,308	5,242	26,838	37,607	8,007	625	150,775
SDR-Brusque	178	28,427	249	1,304	7,884	7,204	1,412	155	46,813
SDR-Ibirama	5	10,775	36	1,385	2,436	1,497	1,797	197	18,128
SDR-Itajaí	231	15,699	717	2,010	19,648	31,344	8,581	2,161	80,391
SDR-Ituporanga	33	2,237	23	284	2,444	1,331	1,603	169	8,124
SDR-Mafra	4	1,058	11	9	498	302	530	113	2,525
SDR-Rio do Sul	145	13,635	294	637	6,318	10,622	2,389	381	34,421
SDR-Taió	53	5,615	39	42	1,794	1,161	1,557	311	10,572
SDR-Timbó	29	29,075	114	1,422	6,595	5,464	3,046	289	46,034
Itajai Basin	**924**	**177,423**	**2,791**	**12,335**	**74,455**	**96,532**	**28,922**	**4,401**	**397,783**
Santa Catarina State	7,711	581,610	17,453	75,901	344,885	481,475	225,767	42,802	1,777,604

Source：http://www.spg.sc.gov.br/

2.1.3 Economic Conditions

The services sector prevails in terms of GRDP in the Itajaí River basin, which accounts for around 50.2% of the GRDP. In Itajaí city, the port services sector is the most important economic activity. The industrial sector is has been the major engine of economic growth in the regions of Brusque, Timbó, Blumenau and Ibirama, and the agricultural sector has contributed the biggest share in the regions of Ituporanga and Mafra. The following table shows the share by sector to the GRDP in the SDR region.

Table 2.1.6 Share by Sector to GRDP in SDR Region in 2007

SDR	Agriculture	Industry	Services	Public	Tax	Total
SDR-Blumenau	0.9%	36.1%	50.6%	6.3%	12.4%	100.0%
SDR-Brusque	0.5%	44.7%	44.1%	5.9%	10.7%	100.0%
SDR-Ibirama	18.1%	34.6%	40.4%	10.2%	6.9%	100.0%
SDR-Itajaí	1.0%	13.5%	56.5%	4.3%	28.9%	100.0%
SDR-Ituporanga	43.8%	12.9%	39.6%	9.3%	3.7%	100.0%
SDR-Mafra	37.7%	19.5%	38.5%	11.3%	4.2%	100.0%

SDR	Agriculture	Industry	Services	Public	Tax	Total
SDR-Rio do Sul	7.1%	34.7%	48.5%	7.0%	9.6%	100.0%
SDR-Taió	26.2%	25.6%	42.0%	10.0%	6.2%	100.0%
SDR-Timbó	2.4%	44.5%	41.6%	8.0%	11.5%	100.0%
Itajaí River Basin	**4.2%**	**28.6%**	**50.2%**	**6.1%**	**17.0%**	**100.0%**
Santa Catarina State	6.3%	31.2%	49.8%	7.6%	12.7%	100.0%

Source：Compiled by JICA Survey Team (http://www.spg.sc.gov.br)

The exports of Santa Catarina State significantly depend on the exportation of chicken and pork meats by the Sadia and Perdigão companies. The Itajaí port, located has been the exportation door for these products, becoming an important economic center for the State.

The following table shows the economic growth per sector and SDR region in the period of 1997-2007. All sectors showed high economic growth in this period, and the services sector prevails. Tax income shows remarkable growth in Itajaí city.

Table 2.1.7 Economic Growth Rate by Sector and SDR Region in 1999-2007

SDR	Agriculture	Industry	Services	Taxes	Revenue
SDR-Blumenau	8.2%	9.9%	18.0%	10.4%	14.4%
SDR-Brusque	6.1%	14.9%	19.2%	9.2%	16.7%
SDR-Ibirama	9.7%	12.9%	20.3%	12.0%	16.2%
SDR-Itajaí	10.2%	16.9%	19.9%	30.9%	21.3%
SDR-Ituporanga	10.7%	18.4%	22.5%	12.6%	17.3%
SDR-Mafra	14.2%	13.9%	23.8%	14.1%	19.1%
SDR-Rio do Sul	10.3%	16.7%	19.0%	12.1%	17.2%
SDR-Taió	10.2%	17.6%	21.7%	14.3%	17.8%
SDR-Timbó	3.9%	11.8%	20.5%	12.2%	16.0%
Itajaí River Basin	10.0%	12.6%	19.3%	18.5%	17.0%
Santa Catarina State	9.9%	12.8%	18.8%	14.6%	16.2%

Source: Compiled by JICA Survey Team (site http://www.spg.sc.gov.br/)

(1) Agriculture

The agricultural production of Itajaí River basin is conducted in the cultivated area of 1,560,000 ha mainly in the cities of Ituporanga, Taió and Rio do Sul, in the upper Itajaí river valley, with soybean, maize and tobacco plantations. In the downstream region, irrigated rice, sugar cane and banana are cultivated. The following table shows the cultivated area of major crops by SDR.

Table 2.1.8 Cultivation Area of Main Crops by SDR Region in 2008 (Unit: ha)

	SDR-Blumenau	SDR-Brusque	SDR-Ibirama	SDR-Itajaí	SDR-Ituporanga	SDR-Mafra	SDR-Rio do Sul	SDR-Taió	SDR-Timbó	Total
Area	11,143	1,366	21,796	4,026	51,427	32,694	18,914	35,902	8,913	1,553,343
Maize	2,000	680	10,180	50	18,530	12,500	8,710	14,265	2,658	715,774
Soybean	0	0	150	0	400	12,500	23	260	200	373,358
Tobacco	2	210	8,798	0	15,067	4,401	4,486	10,162	27	43,153
Rice	7,300	230	440	3,770	190	20	2,584	9,180	4,610	28,324
Onion	0	0	133	0	13,600	15	196	46	0	13,990
Feijão bean	44	72	462	30	2,120	3,100	680	823	104	7,435
Cassava	740	134	1,065	65	505	0	1,410	685	970	5,574
Water melon	2	0	75	30	219	90	262	150	2	2,518
Wheat	9	0	12	0	58	3	10	3	21	2,219
Sugarcane	1,036	40	123	31	55	0	73	40	275	1,673
Sweet potato	7	0	215	50	210	0	373	143	37	1,035
Others	3	0	143	3	473	65	107	145	9	960
Total area	4,943	156	498	715	247	252	233	290	536	7,870

	SDR-Blumenau	SDR-Brusque	SDR-Ibirama	SDR-Itajaí	SDR-Ituporanga	SDR-Mafra	SDR-Rio do Sul	SDR-Taió	SDR-Timbó	Total
Banana	4,702	114	15	690	0	0	0	30	446	5,997
Orange	65	20	169	0	119	70	130	117	23	713
Orange	7	0	136	0	81	0	41	68	25	358
Mate Tea	0	0	100	0	10	70	0	0	30	210
Grapes	0	16	51	0	17	13	37	39	32	205
Palm heart	164	0	0	14	0	0	0	0	24	202
Others	5	6	27	11	20	99	25	36	3	232

Source: Organized by JICA Survey Team (site http://www.spg.sc.gov.br/)

Regarding the agricultural production, rice cultivation is the main crop in the downstream region, mainly in Taió city, while in the upstreamj region the main crops are maize and soybean. Agriculture with chicken and pork production became the mainstay. Rice cultivation has been increasing in recent years with an increase of 5,700 ha in the period of 1990-2008, mainly concentrated in the downstream region. The following table shows historical change of the rice cultivation area by SDR regions.

Table 2.1.9 Rice Cultivation Area by SDR Region (Unit; ha)

SDR	City	1990	1995	2000	2005	2008	Increase in 1990-2008
SDR-Blumenau	Gaspar	2,410	3,080	3,200	3,200	3,400	990
SDR-Blumenau	Ilhota	1,600	1,700	2,000	3,000	3,200	1,600
SDR-Taió	Pouso Redondo	2,280	2,535	3,200	3,020	2,600	320
SDR-Taió	Taió	2,150	1,430	1,900	2,500	2,450	300
SDR-Itajaí	Itajaí	1,250	1,300	2,000	2,300	2,300	1,050
SDR-Taió	Mirim Doce	-	1,664	1,605	2,000	2,100	2,100
SDR-Taió	Rio do Campo	670	750	1,040	1,510	1,800	1,130
SDR-Rio do Sul	Rio do Oeste	1,260	1,350	1,460	1,600	1,600	340
SDR-Timbó	Rio dos Cedros	830	865	960	1,100	1,100	270
SDR-Itajaí	Navegantes	250	320	600	900	1,050	800
Cultivation area: 10 main cities		12.700	14,994	17,965	21,130	21,600	8,900
Other municipalities		9.923	8,524	7,010	6,576	6,724	-3,199
Total of Itajaí River Basin		22.623	23,518	24,975	27,706	28,324	5,701

Source: Compiled by JICA Survey Team (site http://www.spg.sc.gov.br/)

The Ituporanga region is the higher share of the agricultural GDP. On the other hand, share of the downstream region in the agriculture is gradually being reduced as shown below.

Table 2.1.10 Agricultural GDP and Annual Growth Rate by SDR Region

SDR	Value of the agricultural GDP (R$ thousand)			Share per region	
	1999	2007	Growth Rate	1999	2007
SDR-Blumenau	37,359	76,245	9.3%	7.9%	6.9%
SDR-Brusque	7,351	12,479	6.8%	1.6%	1.1%
SDR-Ibirama	66,621	153,311	11.0%	14.1%	13.8%
SDR-Itajaí	38,571	92,368	11.5%	8.2%	8.3%
SDR-Ituporanga	136,565	339,807	12.1%	28.9%	30.6%
SDR-Mafra	26,629	88,191	16.1%	5.6%	7.9%
SDR-Rio do Sul	49,736	120,249	11.7%	10.5%	10.8%
SDR-Taió	74,451	178,369	11.5%	15.8%	16.1%
SDR-Timbó	35,023	49,384	4.4%	7.4%	4.4%
Itajaí River Basin	472,306	1,110,403	11.3%	100.0%	100.0%
Santa Catarina State	2,828,833	6,591,359	11.2%		

Source: Compiled by JICA Survey Team (site http://www.spg.sc.gov.br/)

(2) Industry

The industrial centers of the Santa Catarina State are mainly Joinvile and Blumenau cities with textile, food processing and steel industries. In Blumenau, Gaspar and Brusque cities, textile and software industries are very dominant. Although of smaller size, there is also wood processing industry. The industrial sector has been rapidly growing in recent years resulting in an increase of the number of employees. The following table shows the number of companies, employees and total revenue by SDR in 1996 and 2003.

Table 2.1.11 Number of Companies, Employees and Total Revenue by SDR Region

SDR	No. of Companies			No. of Employees			Total Revenue (R$)		
	1996	2003	Growth Rate	1996	2003	Growth Rate	1996	2003	Growth Rate
SDR-Blumenau	3,404	3,963	2.2%	10,695	15,956	5.9%	1,255,474,176	2,104,409,936	7.7%
SDR-Brusque	1,058	1,167	1.4%	2,524	3,826	6.1%	280,488,465	538,926,488	9.8%
SDR-Ibirama	490	588	2.6%	849	19,411	56.4%	88,099,767	166,789,878	9.5%
SDR-Itajaí	1,897	2,408	3.5%	5,949	7,609	3.6%	535,531,607	1,661,302,038	17.6%
SDR-Ituporanga	465	559	2.7%	574	954	7.5%	41,915,631	139,305,500	18.7%
SDR-Mafra	157	157	0.0%	237	339	5.2%	12,642,617	34,033,762	15.2%
SDR-Rio do Sul	1,084	1,181	1.2%	2,391	11,347	24.9%	182,423,243	432,637,251	13.1%
SDR-Taió	410	493	2.7%	745	1,135	6.2%	47,399,131	122,454,834	14.5%
SDR-Timbó	1,074	1,319	3.0%	2,684	7,444	15.7%	162,215,639	403,147,412	13.9%
Itajaí River Basin	**10,039**	**11,835**	**2.4%**	**26,648**	**68,021**	**14.3%**	**2,606,190,276**	**5,603,007,099**	**11.6%**
Santa Catarina State	47,393	58,407	3.0%	121,861	208,779	8.0%	10,348,465,839	25,055,756,954	13.5%

Source: Compiled by JICA Survey Team（http://www.spg.sc.gov.br/）

The following industrial estates have been constructed:

i) Textile and clothing industries (Blumenau city)
ii) Machines and electric industries (Blumenau, Brusque, Timbó, and Rio do Sul cities)
iii) Wood and furniture (Ibirama city)
iv) Computer industry (Blumenau city)
v) Ceramic industry (Rio do Sul, Pouso Redondo cities)

In the 1990s, the industry sector prevailed in Blumenau city. However, the industrial sector has recently been contributing bigger share of GRDP in Itajaí and Brusque cities as shown below.

Table 2.1.12 Industrial GDP and Annual Growth Rate by SDR Region

SDR	Industrial GDP (R$ thousand)			Participation per region	
	1999	2007	Annual Growth	1999	2007
SDR-Blumenau	1,315,463	3,085,956	11.2%	51.0%	41.2%
SDR-Brusque	307,338	1,070,322	16.9%	11.9%	14.3%
SDR-Ibirama	98,242	292,883	14.6%	3.8%	3.9%
SDR-Itajaí	297,870	1,216,554	19.2%	11.5%	16.2%
SDR-Ituporanga	21,926	100,076	20.9%	0.8%	1.3%
SDR-Mafra	14,127	45,665	15.8%	0.5%	0.6%
SDR-Rio do Sul	146,393	587,578	19.0%	5.7%	7.8%
SDR-Taió	40,697	174,430	20.0%	1.6%	2.3%
SDR-Timbó	337,908	918,769	13.3%	13.1%	12.3%
Itajaí River Basin	**2,579,964**	**7,492,233**	**14.3%**	**100.0%**	**100.0%**
Santa Catarina State	11,049,770	32,619,432	14.5%		

Source: Compiled by JICA Survey Team (site http://www.spg.sc.gov.br/)

(3) Services

The services sector has been recently growing at an average growth rate over 20% in all the regions. The following table shows the services GDP, annual growth rate and share by SDR region.

Table 2.1.13 Services GDP and Annual Growth Rate by SDR Region

SDR	Services GDP (R$ thousand)			Participation per region	
	1999	2007	Annual Growth	1999	2007
SDR-Blumenau	1,693,360	7,486,492	20.4%	38.1%	34.4%
SDR-Brusque	438,334	2,137,618	21.9%	9.9%	9.8%
SDR-Ibirama	149,441	787,864	23.1%	3.4%	3.6%
SDR-Itajaí	1,246,678	6,385,224	22.7%	28.0%	29.3%
SDR-Ituporanga	120,721	747,400	25.6%	2.7%	3.4%
SDR-Mafra	32,756	223,935	27.2%	0.7%	1.0%
SDR-Rio do Sul	318,282	1,528,462	21.7%	7.2%	7.0%
SDR-Taió	108,998	638,345	24.7%	2.4%	2.9%
SDR-Timbó	341,395	1,825,976	23.3%	7.7%	8.4%
Itajaí River Basin	**4,449,966**	**21,761,315**	**21.9%**	**100.0%**	**100.0%**
Santa Catarina State	1,693,360	7,486,492	20.4%		

Source: Compiled by JICA Survey Team (site http://www.spg.sc.gov.br/)

(4) Distribution of Goods

The BR-101, one of the federal trunk highways of Brazil, runs Itajaí city. The BR-101 is an important highway connecting both Porto Alegre and Curitiba cities, the state capitals in the southern region in Brazil.

As another federal highway, BR-470 is an important highway to connect main cities along the Itajaí River. This highway connects the west region in the State, where production of chicken and pork meats for export is the mainstays of the state, to the Itajaí port. The Itajaí port is the center of distribution of goods, where various products are exported to various countries in the world. The following table shows the exports and imports by SDR region in 2008.

Table 2.1.14 Exports and Imports by SDR Region in 2008

SDR	2008 (US$ FOB)			
	Exports	Imports	Balance	Total Volume of Distribution
SDR-Blumenau	733,158,359	500,246,661	-52,963,979	1,233,405,020
SDR-Brusque	116,059,335	148,512,582	-2,022,228	264,571,917
SDR-Ibirama	65,494,521	2,037,161	992,908,385	67,531,682
SDR-Itajaí	3,007,133,068	3,501,340,577	31,012,990	6,508,473,645
SDR-Ituporanga	2,585,735	115,970	-377,501,059	2,701,705
SDR-Mafra	10,243,142	117	25,569,266	10,243,259
SDR-Rio do Sul	201,559,040	18,118,103	196,941,085	219,677,143
SDR-Taió	32,222,718	9,205,767	-6,658,157	41,428,485
SDR-Timbó	120,274,993	60,948,705	37,519,903	181,223,698
Itajaí River Basin	**4,288,730,911**	**4,240,525,643**	**844,806,206**	**8,529,256,554**
Santa Catarina State	9,999,360,608	7,902,703,422	2,096,657,186	17,902,064,030

Source: Compiled by JICA Survey Team (site http://www.spg.sc.gov.br/)

2.1.4 Infrastructure

(1) Ports and Airports

In the Santa Catarina State, there are five ports in operation:

i) São Francisco do Sul Port（export for soybean and soybean bran）
ii) Itajaí Port (Frozen products and containers)
iii) Navegantes Port (Frozen products and containers)
iv) Imbituba Port (Scientific products, fertilizers, cokes, frozen products and sugar)
v) Laguna Port (Fishing port and ice)
vi) Ferry

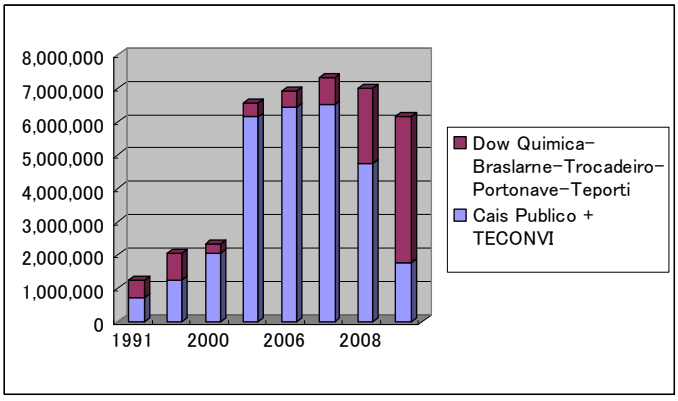
Besides the above ports, the Itapoá Port is now under construction. In the Preparatory Survey area, there are the Itajaí Port at the right bank and the Navegantes Port at the left bank at the mouth of Itajaí River. Salient features of these ports are as follows:

a. Itajaí Port

The Itajaí Port was opened for fishing port in 1938. In 1997 it was administrated by the Itajaí city and in 2000 it became officially municipal port. Although the Itajaí Port handled approximately 730 thousand ton in 1990, it has expanded to manage 6250 thousand ton in 2006. Most of the transaction goods is for import and export of products coming from the States of Paraná, Mato Grosso do Sul, Mato Grosso, Rondônia, Goiás, São Paulo and Rio Grande do Sul. The Itajaí Port exports wood, frozen products (chicken, fish and meat), ceramics, machinery and their parts, paper, sugar and tobacco. Wheat, engines, scientific products, textile products and paper, among others, come to the port as imported products. The Itajaí Port is currently administered by the following companies that operate in the field of warehouses and transports.

i) Public berth (2 berths, 470 m)
ii) Teconvi (2 berths, 555 m)
iii) Portonave (3 berths, 900m)
iv) Braskarne/Cargil (1 berth, 150m)
v) Trocadeiro (1 berth, 150m)
vi) Poly S.A (1 berth; 80m)
vii) Teporti Itazem (1 berth, 150m)
viii) Barra do Rio/under construction (1 berth, 372m)
ix) Logistic services (Brasmar, Conexão Marítimo, Coopercarga Logistica, DKN, Embrafrio, Embrareef, Exologistica, Localfrio, Mares, Refribras,Rogerio Philippi, Saam, Safrio, Standard, Tecadi, TransOrsi)

Figure 2.1.2 shows the transaction volume at the Itajaí Port. Most of products has been handled by the public company berth and the Teconvi company berth until 2008. However after the flood disaster in 2008, other private companies have been managing majority of products.



Source: Compiled by JICA Survey Team
(http://www.portoitajai.com.br/estatisticas/index.php)

Figure 2.1.2 Transaction Volume at the Itajaí Port

The table below shows the transaction volume by the public berth and Teconvi company in 2007 and 2008.

Table 2.1.15 Transaction Volume at the Itajaí Port in 2007 and 2008

Unit: ton

Export		
General Cargo	**2007**	**2008**
Frozen chickens	383,331	308,331
Wood and processed products	289,887	147,534
Others	115,199	81,913
Ceramic products	112,526	40,187
Sugar	70,215	200
Machines / accessories for engines	66,349	56,089
Frozen meat	55,745	22,505
Cigarette	27,887	29,123
Paper	17,158	11,991
Apples	15,907	11,053
Other frozen products	10,428	2,348
Glass	5,570	139
Textile products	4,102	2,743
Others	2,703	5,810
Liquid cargo		
Water	8,400	4,205
Teconvi		
Various products	4,953,476	3,597,312
Liquid Bulk		
General load - BRASKARNE		
Frozen products	198,845	132,490
Others	1,390	5,059
General cargo – TROCADEIRO TERMINAL		
PORTONAVE		
Containers	87,883	1,420,936
TEPORTI		
Containers		14,033
Subtotal exportation	**6,427,001**	**5,894,001**

Import		
General Cargo	**2007**	**2008**
Textile products	19,823	37,675
Machines, accessories for engines	14,309	23,635
Beverages	4,059	15,251
Chemical products	11,105	11,562
Paper		5,194
Electric appliances	1,967	4,915
Others	337,750	302,241
	10,146	9,684
Liquid cargo		
Teconvi		
Various products		
Liquid Bulk		
Soda	66,736	66,951
General load - BRASKARNE		
Frozen products	11,240	1,460
Others	24,825	224
	335,436	
PORTONAVE		
Containers	45,576	631,957
TEPORT		
Containers	904	
Subtotal importation	**883,876**	**1,110,749**

Total operations	**7,310,877**	**7,004,750**

Source: Compiled by JICA Survey Team (http://www.portoitajai.com.br/estatisticas/index.php)

As seen in the above, exports have significantly exceeded imports in volume at the Itajaí Port, and frozen chicken is the main export product. The transaction volume in 2008 weresmaller than in 2007 due to the damages caused by the November 2008 flood. In 2009, also due to the influence of the flood damages, operations were reduced in approximately 1 million ton. The Itajaí Port stretches from the river mouth to near the federal highway BR-101. The port depth in the river mouth is 11 m of water, and the port is utilized for large scale ships navigation. The upstream depth is 9 meters for middle scale ship navigation.

b. Navegantes Port

The Navegantes Port has been administrated by the Portonave S.A.-Navegantes Port Terminals company, and is under temporary operation since October 2007. The Navegantes Port has 4 berths with a 900 m long and port area of 27 ha.

c. Navegantes Airport

The Navegantes airport is located at the left bank of Itajaí River in Navegantes city. The number

of passengers in the airport is recorded at around 600 thousand in 2009.

(2) Hydropower Generation Plants

There are 28 hydroelectric power plants installed in the Itajaí River basin and a total installed capacity is around 210 MW.

2.2 Topography, Geology, Soil and Vegetation

2.2.1 Topography

Figure 2.1.1 shows the location map of rivers, mountains and roads in the Itajai River basin, while Figure 2.1.2 shows the classification map of elevations.

The Itajai River Basin is surrounded by mountains with elevations varying from 200 to 1,750 m, except on the Atlantic Ocean side. The northeast boundary of the Itajai River basin is formed by the Jaragua Mountain Range, which is the watershed divide of the Luis Alves and the Benedito River sub-basins, with the highest point at an elevation of 986 m, located at the riverhead of the Benedito River, at the north end of Rio dos Cedros city. The east-southeast boundary of the Itajai River basin is formed by the Geral Mountain Range, which is the watershed divide of Itajai do Norte, Itajai do Oeste and Itajai do Sul River sub-basins, with the highest point at an elevation of 1,752 m, at the southern end of Alfredo Wagner city, at the riverheads of Itajai do Sul river. The southwest boundary of Itajai River basin is Tijucas Mountain Range, and the right bank of Itajai Mirim River.

Between the Itajai-Acu River and Itajai Mirim River, there is the Itajai Mountain Range, with elevations of more than 800 m, diverging perpendicularly from Mar Mountain Range in Lontras city, stretching out at the south areas of Apiuna, Indaial, Blumenau and Gaspar cities, in a northeast -southwest direction.

In Ibirama city, the Itajai-Acu River flows down, and its elevation is from 100 to 200 m and it meets with the Itajai do Norte River. In Indaial city it flows down to below 100 m elevation. Downstream from Blumenau city, it meanders with an extremely gentle gradient flow across a flat alluvial plain, and flows into the Atlantic Ocean. From the Itajai-Acu River mouth in Itajai and Navegantes cities until Ilhota and Gaspar cities, the alluvial lowland spreads out from both banks. Along the Itajai Mirim River, alluvial lowland also spreads out from Itajai city until Brusque and Guabiruba cities. The width of this lowland is approximately 5 km in Gaspar city, and approximately 3 km on the border between Itajai and Brusque cities.

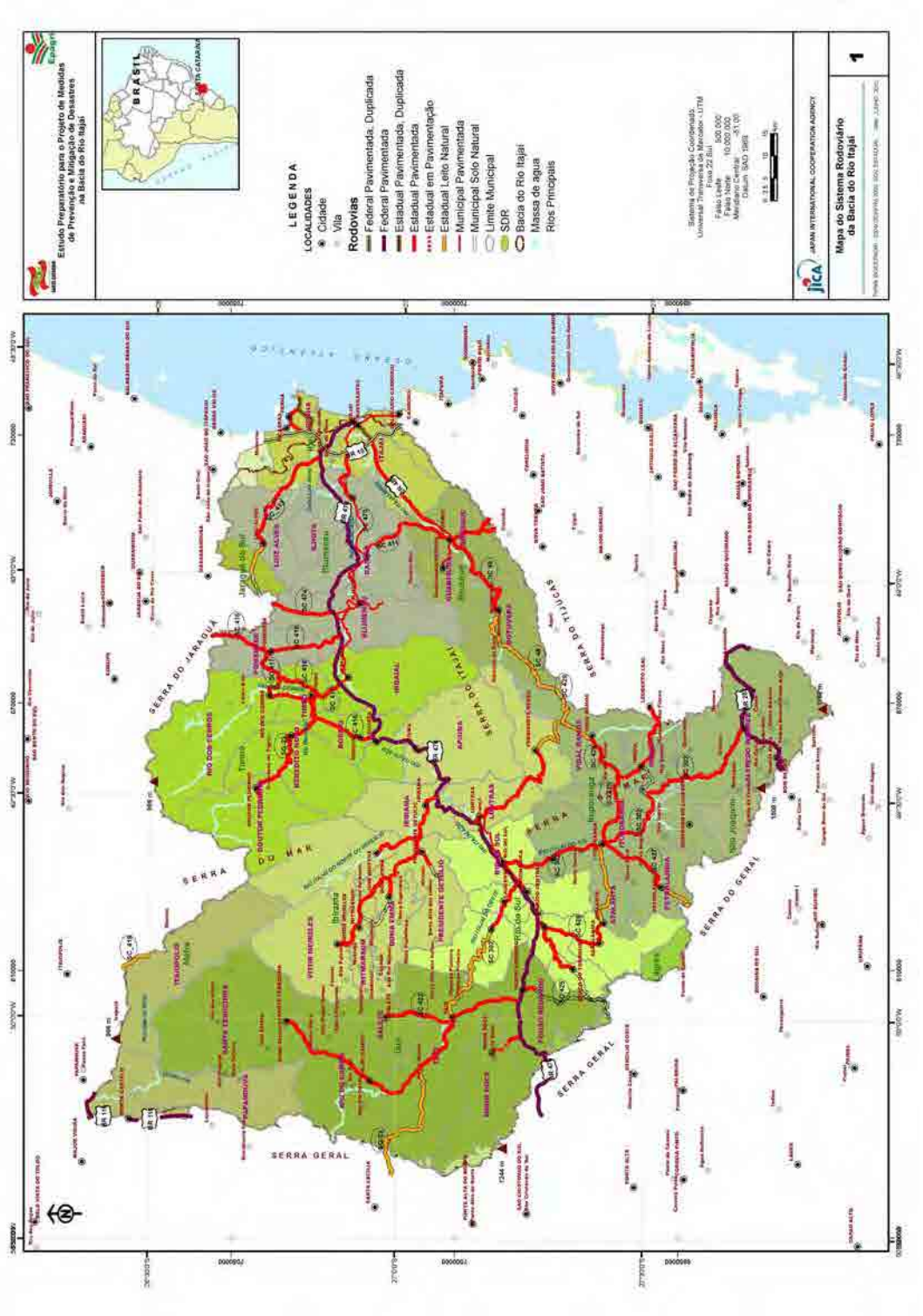
Table 2.1.1 shows the area rate of altitude ranges in the whole Itajai River basin and in sub river basins.

Table 2.2.1 Area Rate of Altitude Ranges

Altitude Range	Area rate of a elevation range (Area of a altitude range/basin area)							
	Whole Itajai River basin	Sub-Basin						
		Itajai do Norte	Itajai do Oeste	Itajaí do Sul	Benedito	Itajai-Acu	Itajai Mirim	Luis Alves
	15,111km^2	3,354km^2	3,015km^2	2,027km^2	1,496km^2	2,777km^2	1,679km^2	580km^2
Below 100m	11%	0%	0%	0%	8%	26%	26%	35%
100 to 500m	36%	23%	36%	19%	17%	50%	39%	63%
500 to 1000m	53%	77%	61%	75%	74%	24%	35%	2%
Above 1000m	1%	0%	4%	6%	1%	0%	0%	0%
Total	100%	100%	100%	100%	100%	100%	100%	100%

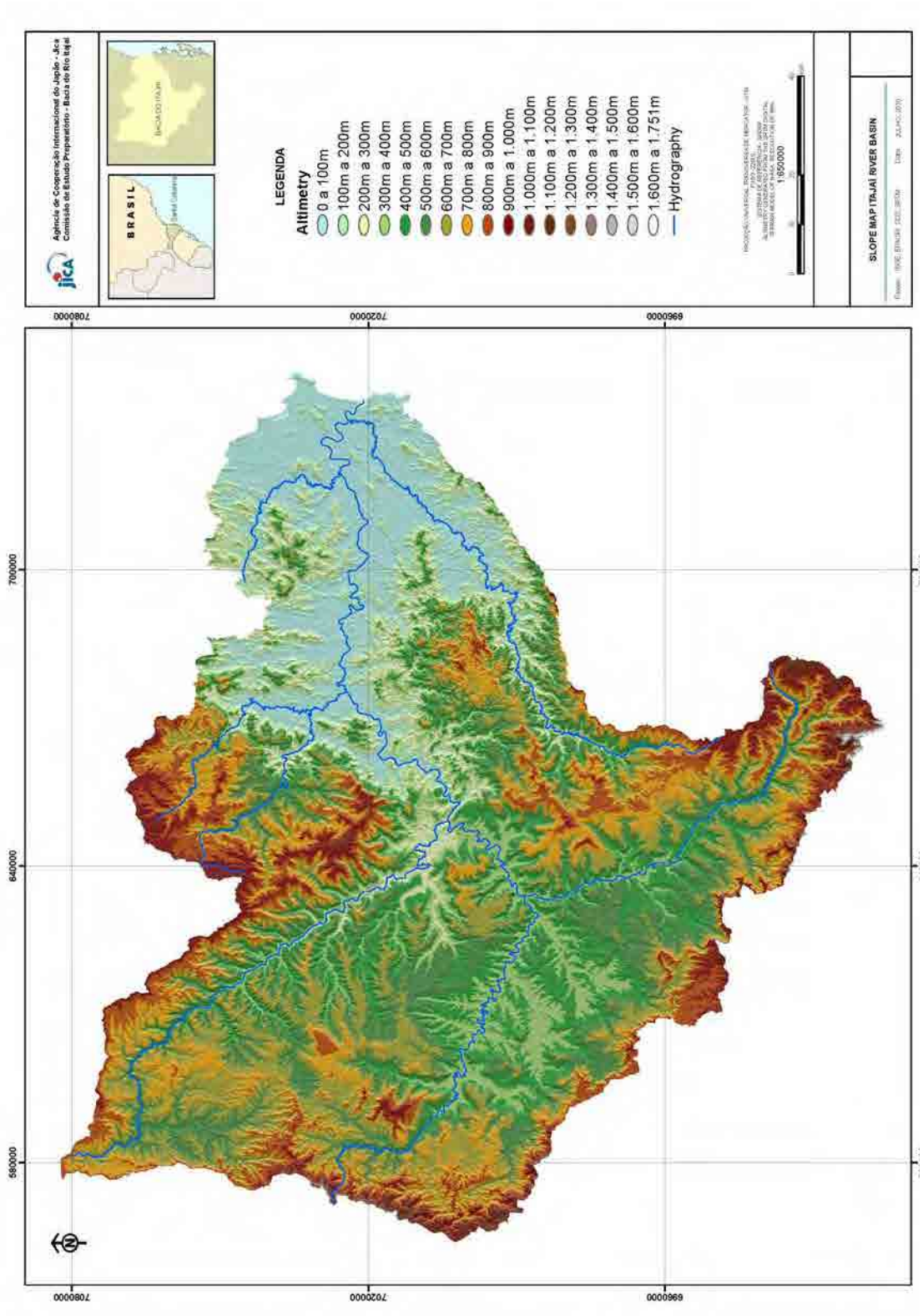
Source: JICA Survey Team

In the whole Itajai River basin, area rate of altitude range below 100 m is approximately 11%; the range 500 m to 1000 m is predominately 53%; and the range above 1000 m does not reach 1%.



Source: Material edited by JICA Survey Team based on 2009 DEINFRA, MAPA RODOVIÀRIO DO ESTADO DE SANTA CATARINA

Figure 2.2.1 Location Map of Rivers, Mountain Ranges and Roads in Itajaí River Basin



Source: IBGE,EPAGRI,SDS,SRTM

Figure 2.2.2 Map of Elevation Ranges of Itajaí River Basin

2.2.2 Geology

(1) Generation Information

The geological map of Itajai River Basin and surrounding areas are presented in Figure 2.2.3, and the geological structure legend is presented in Figure 2.2.4.

Itajai River basin is located at the east end of the so-called Parana sedimentary basin, which stretches out from Brazilian Mid-South to the northeast of Argentine, passing through the east region of Paraguay (the central portion is young geology , and as they stretch out to the periphery, geology become older) .

The geology of Itajai River Basin has the base from Archean to Proterozoic eons, which compose the stable continent of South America, and above it, there are sedimentary rocks from the Paleozoic and Mesozoic eras, and in the upper layer, there are basaltic rocks run off in the Mesozoic era. Except for the alluvial portion that stretches out in the lowland of the Atlantic coast and the lowland of the banks of rivers, in general, the geology are old in the northeast region and young in the southwest region. In the upstream areas of the basin, there are rocks from the Paleozoic to Mesozoic eras. In the middle and lower portions, there are sedimentary rocks in the Paleozoic era, and metamorphic rocks from the Archean to Proterozoic eons.

The fault system that stands out at the east side of Serra do Mar (downstream Itajai River) is the Northeast – Southwest system, at the maximum length of 60 km, which as good continuity. We also observe the North-Northeast – South – Southwest fault systems, with lengths of up to 20 km. At the west side of Mar Mountain Range (upstream Itajai River), the fault systems are relatively sparsely distributed. In addition to the Northeast – Southwest system, we also observe the North – Northwest South – Southeast system that continuously stretches out for 80 km along Itajai do Norte River, and for 40 km along Itajai do Sul River.

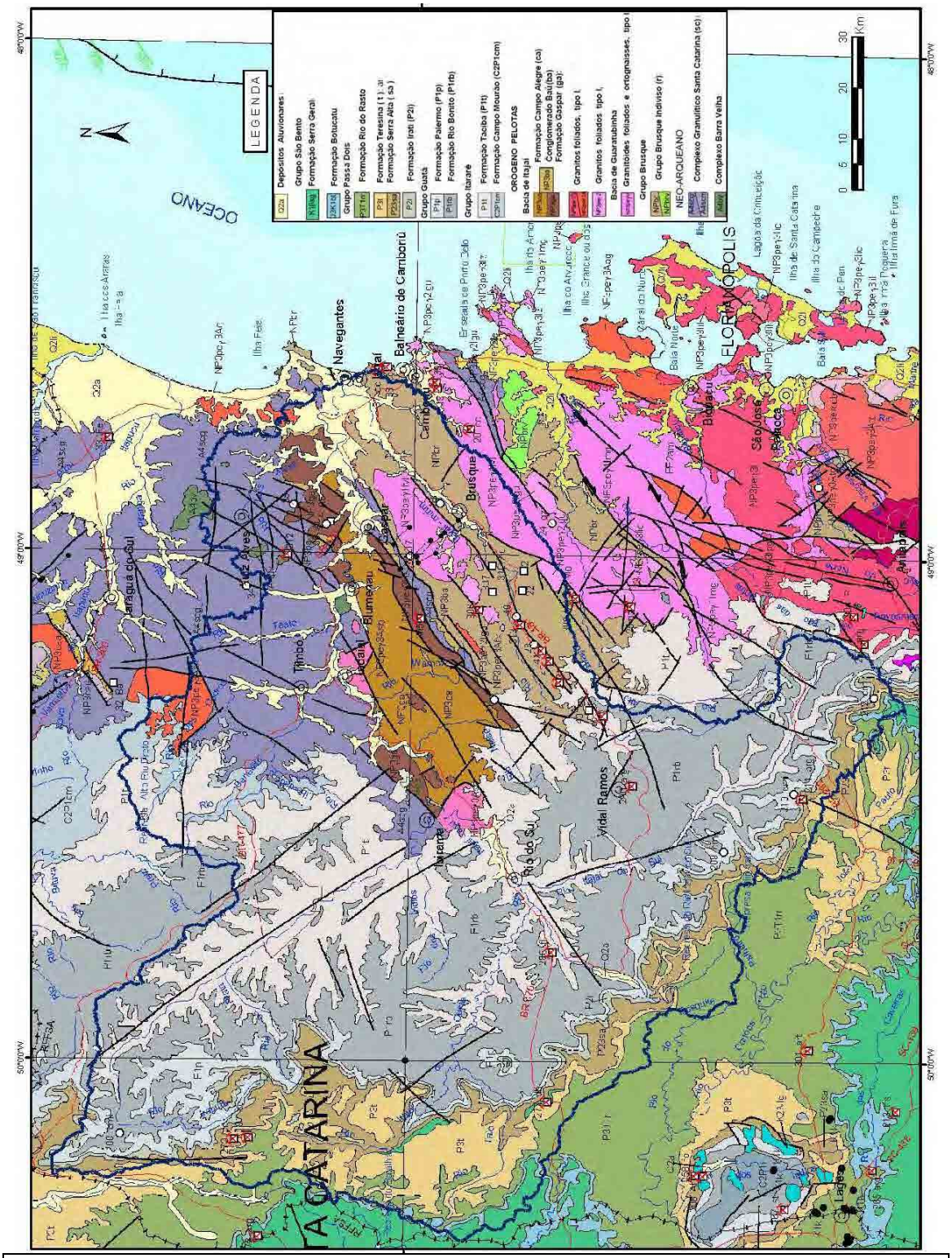
The geology of Itajai River basin is divided into four chronological orders from the most recent one:

i) Alluvial deposit in the Cenozoic era. It is largely distributed in the downstream portion of the Itajai-Acu, Itajai Mirim and Luis Alves River basins, with depth lower than 30 m, and in the narrower areas along the upstream of Itajai-Acu river and other tributaries, with depth of up to 10 m.
ii) Sedimentary and volcanic rocks in the Mesozoic era. These are distributed throughout the General Mountain Range, the eastern margin of Itajai River basin.
iii) Sedimentary and volcanic rocks of the Paleozoic era. These are distributed at from the Mar Mountain Range which transverse the center of the Itajai River basin until eastern foot area of Geral Mountain Range.
iv) Granulite, migmatite, metamorphic volcanic rocks, sedimentary rocks, intrusive rocks, and plutonic rocks of from Archean to Proterozoic eons. These are distributed in the eastern foot area of Mar Mountain Range (downstream area of the Itajai River basin).

(2) Sub-river basins of the three upstream tributaries of Itajai-Acu River (Itajai do Norte, Itajai do Oeste, Itajai do Sul)

The geology of the three upstream tributaries of Itajai-Acu River in the west than Mar Mountain Range, sedimentary rocks from the Paleozoic to Mesozoic eras stand out (Itarare formation, Guata formation and Passa Dois formation).

In the lower elevation portions, there are sedimentary rocks from the Paleozoic and Mesozoic eras, mainly shale. These rocks are mainly constituted of marine sediment rocks, and are interstratified with fine sandstone.



Source: IBGE, EPAGRI, SDS, SRTM

Figure 2.2.3 Map of Gradient Ranges of the Itajaí River Basin

———	Contact
# # ———	Dikes
▬▬▬	Fracture, failure or shearing zone
▬▬▬	Failure or extensional shearing zone (shading in the low block)
▬▬▬	Failure or contractional shearing zone (triangles in the high block)
▬▬▬	Failure or sinistral transcurrent shearing zone
▬▬▬	Failure or dextral transcurrent shearing zone

Source: Edited by JICA Survey Team from CPRM Serviço Geológico do Brasil

Figure 2.2.4 Legend for the Geological Structure

In the portions with high elevations of General Mountain Range, which is the watershed of Itajai River basin, there are sedimentary rocks in the Mesozoic era. These are mudstone, sandstone, and are interstratified with siltstone and fine sandstone. They are characterized by the reducing environment of purple, pink and white color.

In the Itajai do Oeste River basin, there are basalts in the Mesozoic era.

The alluvial deposit is punctually distributed in the micro-basin along the Itajai-Acu River, between Rio do Sul and Lontras, and in Itajai do Oeste River and its tributaries. These alluvial deposits are generally composed of silty sand or sandy silt, and are interstratified by gravel layers. The alluvial deposits thicknesses are thought of be generally smaller than 10 m.

(3) Geology of the basins of Itajai-Acu River and Benedito, Itajai Mirim and Luis Alves tributaries

The geology distributed in this region, which is to the east of Mar Mountain Range, are described below in order from the old one as follows:

The Santa Catarina granulite complex of the Archean era (metamorphic rocks mainly composed of granulite) at the East side of Mar Mountain Range, at the North side of the Itajai-Acu river, which includes Benedito River basin and Luis Alves River basin.

The complex of Metamorphic rocks of the Brusque Group of the Proterozoic eon, and granite/orthogneiss with schistosity developed are distributed in the south of the Itajai-Acu River and the downstream from the Gaspar Municipality, in other words in the Itajai Mountain Range and the Itajai Mirim basin.

Non-metamorphic sedimentary rocks (Gaspar formation, Bau formation, Campo Alegre formation) in the Proterozoic eon are distributed from the north region of Itajai Mountain Range, and from Blumenau Municipality until the Luis Alves River basin.

Sedimentary rocks of Itarare strata group, and strata from the Paleozoic era and from Carboniferous to Permian period are found at the eastern side of Serra do Mar in Benedito river basin.

Alluvial sediments, to the east of Serra do Mar, are found along the main river and tributaries. The width of the alluvial layer distribution increases near Gaspar, in the main river, and near the meeting point of Luis Alves and Itajaí Mirim rivers, on the downstream side. Alluvial sediments are mainly composed of sandy silt or silty sand, intermingled with gravel layers. The thickness of sediments is generally close to 10 m. According to the location, basal rock outcrop is found in the river beds. River bed sediments are middle sized particle sand, containing rough particles. According to the results of foundation survey carried out by highway contractors, there is thick clay sedimentation containing organic matter in some portions.

(4) Geological characteristics of sub-river basins

In the Itajai do Norte River basin, the sedimentary rocks of Mesozoic and Paleozoic eras represent 97% of the total. Guata Formation, of the relatively median sedimentation period, and the Itarare Formation, of an older period, are dominant.

In the Itajai do Oeste River basin, the sedimentary rocks of Mesozoic and Paleozoic eras represent 97% of the total. Compared with the river basins of Itajai do Norte and Itajai do Sul, this is the biggest ratio of relatively new sedimentary rocks, of the Mesozoic era, subject to erosion by weathering, and thus the sediment yield is also relatively big, also with a relatively big distribution of alluvial layer formed by the sedimentation. In some cases, crack rich volcanic

rocks such as Basalt on the aquiclude soft sedimentary rocks, sometimes to be geological conditions of primary cause of landslide.

In the Itajai do Sul River basin, the sedimentary rocks of Mesozoic and Paleozoic eras represent approximate 100% of the total. It is predominantly distributed that the Guata Formation in the middle age from Mesozoic to Paleozoic eras.

In the Benedito River basin, the sedimentary rocks from Mesozoic to Paleozoic eras represent 61% of the total; older sedimentary rocks of Proterozoic eon represent 6%, and the oldest metamorphic rocks of the Archean era represent 30%.

In the Itajai-Acu River basin, the ratio of alluvial deposit is 13%, the biggest among the seven basins. The sedimentary rocks from Mesozoic and Paleozoic eras represent 18% of the total; the sedimentary rocks from Proterozoic era represent 31%, and the metamorphic rocks of the Achaean eon, the oldest one, 24%.

In the Itajai Mirim River basin, the sedimentary rocks from Mesozoic and Paleozoic eras represent 29% of the total; the metamorphic sedimentary rocks (Brusque Group) of the Proterozoic eon represent 47%.

In the Luis Alves river basin, the sedimentary rocks from the Mesozoic and Paleozoic eras represent 0%, and the metamorphic rock of the Archean eon is dominant with 73%.

2.2.3 Pedology

Figure 2.2.5 shows the map of soil classification of Itajai River basin. Table 2.2.2 presents a comparison between the soil classification of this map and the soil classification of institutions from the UN, USA and Japan.

Table 2.2.2 Comparison between the Classification of Soil Map of Itajai River Basin and the Soil Classification of Various Institutions

Portuguese			**English**		
Soil classification		**SiBCS: Brazilian System of Soil Classification 2006**	**Soil Type**	**FAO Soil Type**	**EUA1991 Soil Taxonomy**
Type of soil	**Code**				
Água	A		Water		
Urbano	U		Urban Area		
Argissolo Vermelho-Amarelo	PVA	Argissolo	Red-Yellow Acrisols	Acrisols Lixisols Alisols	Ultisols Oxisols
Cambissolos Haplico	CX	Cambissolos	Ordinary Cambisols	Cambisols	Inceptisols
Cambissolos Humico	CH		Humic Cambisols		
Espodossolo Humiluvico	EK	Espodossolo	Podzols Humic-elubial horizon	Podzols	Spodosols
Gleissolo Haplico	GX	Gleisso	Ordinary Greysols	Greysols	Entisols
Latossolos Bruno	LB	Latossolos	Ferralsols	Ferralsols	Oxisols
Neossolos Fluvicos	RY	Neossolos Fluvicos	Fluvisols	Fluvisols	Fluvents
Neossolos Litólicos	RL	Neossolos Litólicos	Leptosols	Leptosols	
Neossolos Quartarênicos	RQ	Neossolos Quartarênicos	Quartz Sand Marine	Arenosols	Quartziosamments
Nitossolos Haplico	NX	Nitossolos	Hapic Nitisols	Nitisols Lixisols Alisols	Utisols Oxisols Altisols
Nitossolos Vermelho	NV		Red Nitisols		

Source: Edited by JICA Survey Team based on Embrapa 2006 Brazilian System of Soil Classification

The characteristics of soil distribution in Itajaí River basin and in the basins of its tributaries are as follows:

i) The dominant soil type in Itajai River Basin is the Ordinary cambisols, occupying 43% of the whole area and mainly distributed in the middle altitude of the hillside. The second dominant soil type is the Leptosols occupying 26% of the total area, mainly found in the peak and in the watershed of the Itajai-acu River and tributaries. The third dominant is the Red-Yelow Acrisols, occupying 20% of the whole area, distributed from the hillside with elevation below 500 m until the banks of the Itajai-Acu River and tributaries.
ii) Itajai do Norte River basin has the same trend in the whole basin.
iii) In Itajai do Oeste River basin, the distribution ratio of Ordinary cambisols is quite big, occupying 56 % of the whole area, and the distribution ratio of Red-Yellow Acrisols is small, occupying 6 % of the whole area.
iv) In Itajai do Sul River Basin, the distribution ratio of Ordinary cambisols is the biggest one among the tributaries basins, occupying 61% of the whole area.
v) In Benedito River Basin, the distribution ratio of Ordinary cambisols is quite big, occupying 56 % of the whole area, and the distribution ratio of Leptosols is small in comparison with the other tributaries basins, only 2 % of the whole area.
vi) In Itajai-Acu River basin, the distribution ratio of Leptosols is big, occupying 40 % of the whole area, and this is the most dominant type of soil in the basin. The second place is occupied by the Red-Yellow Acrisols, occupying 24 % of the whole area, and the third place is of the Ordinary cambisols, occupying 18% of the whole area.
vii) In Itajai Mirim River basin, the distribution of Leptosols is big, occupying 39 % of the whole area, the most outstanding type of soil in the basin, showing the same trend of Itajai-Acu River basin.
viii) In the Luis Alves River basin, the Red-yellow acrisols is predominant, occupying 63 % of the whole area.

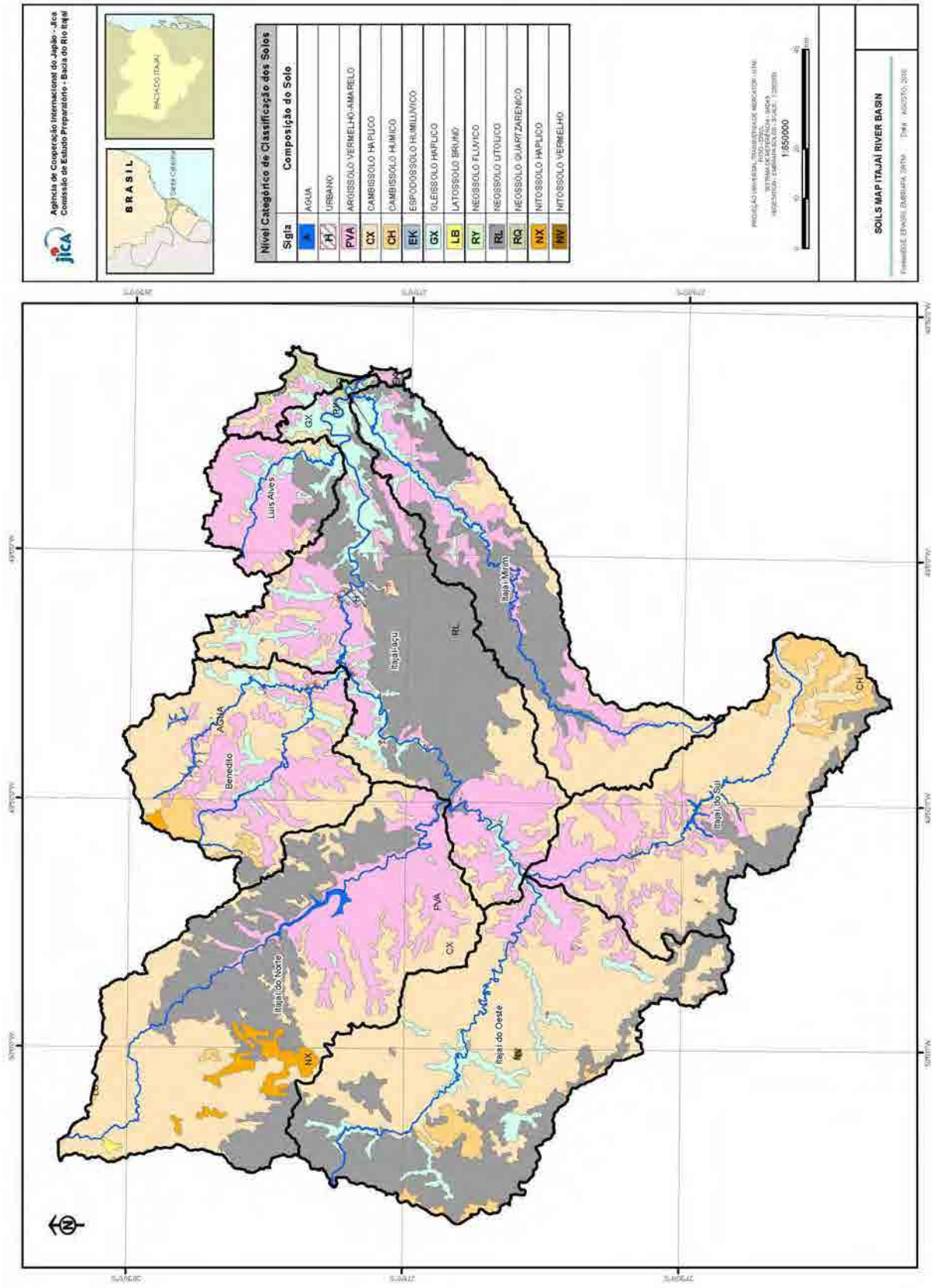


Figure 2.2.5 Soil Classification Map of Itajaí River Basin. Source: Embrapa Solos, 2004

2.2.4 Vegetation

Figure 2.2.6 below presents the vegetation classification in Itajai River basin. The definition for each vegetation type is presented according to the below Table 2.2.4.

Table 2.2.4 Nomenclature of Vegetation Type

Nomenclature	
Portuguese	**English**
Área urbana	Urban area
Corpos dágua	Water body
Campo e floresta subtropical perenifólia	Field and forest, subtropical evergreen
Campo subtropical	Subtropical Field
Fase campo subtropical	Phase field subtropical
Fase floresta subtropical perenifolia	Phase subtropical evergreen forests
Fase floresta tropical perenifolia de varzea	Phase lowland evergreen tropical rain forest
Floresta e campo subtropical	Subtropical forest and field
Floresta subtropical altimontana	Subtropical forest highland
Floresta subtropical perenifolia	Subtropical evergreen forest
Floresta tropical de restinga	Tropical sandbar
Floresta tropical de varzea	Lowland tropical forest
Floresta tropical perenifolia	Tropical forest evergreen
Floresta tropical perenifolia de várzea	Lowland evergreen tropical forest
Floresta tropical/subtropical perenifolia	Tropical subtropical evergreen forest
Floresta tropical/subtropical perenifolia de Varzea	Lowland tropical/subtropical forest

Source: Elaborated by JICA Survey Team, based on information from IBGE, EPAGRI, SDS, SRTM

The subtropical evergreen forest is the largest vegetation type in the whole basin, occupying 38 % of the total area. The tropical subtropical evergreen forest is the second largest one, occupying 29 %. The tropical evergreen forest is the third largest one, occupying 15% of the total area. These 3 types of vegetation represent more than 82 % of the total basin.

In the sub-basins of Itajai do Norte, Itajai do Oeste and Itajai do Sul Rivers, which are located at West of Mar Mountain Range, the subtropical evergreen forests are predominate, corresponding to 52% to 63% of each river basin, the tropical evergreen forest occupied relatively small area, representing 1% to 9%.

At the East side of Mar mountain range and North side of Itajai-Acu River, the tropical evergreen forest occupies 33% of the whole Benedito River basin, and 72 % of Luis Alves River basin.

At the East side of Mar Mountain Range and south of Itajai-Acu River basin, the tropical subtropical evergreen forest occupies very expressively, corresponding to 51 % of the whole Itajai-Acu River basin, and 58 % of the whole Itajai Mirim River basin.

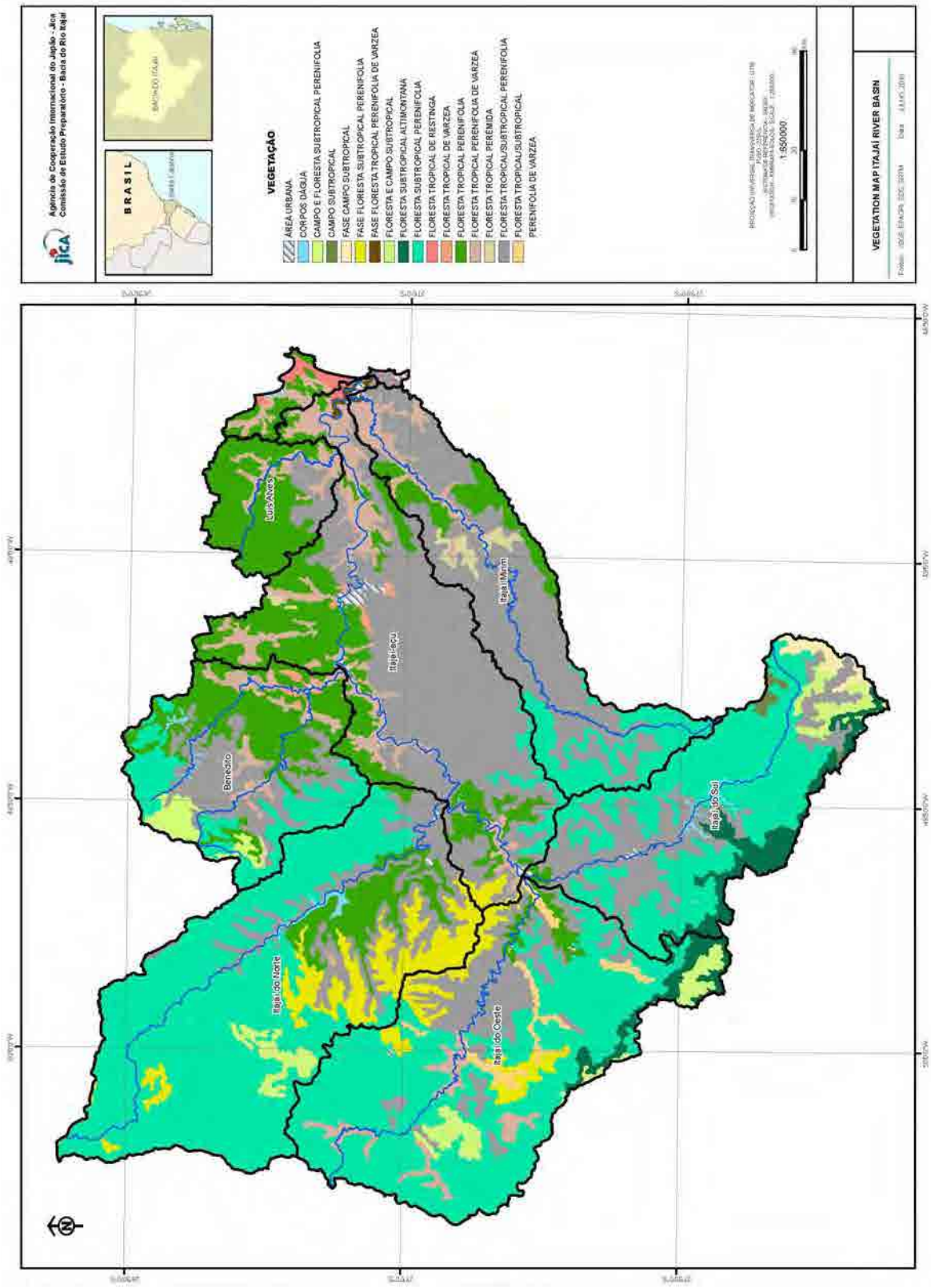
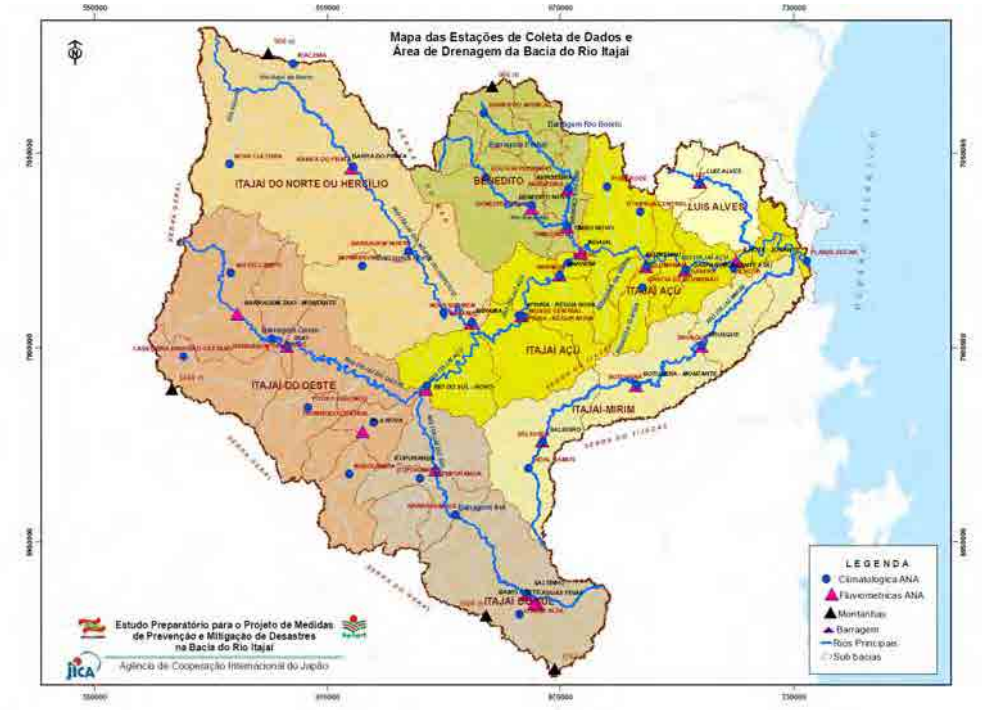


Figure 2.2.6 Classification Map of Itajaí River Basin Vegetation Source: IBGE, , EPAGRI, SDS, SRTM

2.3 Meteorology and Hydrology

2.3.1 Hydro-meteorological Observation Network

At the federal level, ANA is a responsible agency for meteorological observation as well as measurement of water level and discharge for major rivers in Brazil, and in the Santa Catarina State, hydro-meteorological observation are being conducted by EPAGRI/CIRAM under the fund provided by ANA. Currently there are 42 meteorological stations and 23 water level and discharge measurement stations in the Itajaí River basin as shown in the location map below. Usually observation is carried out manually twice per day (at 7 am and 5 pm) by neighboring residents. The observation data is accessible to the database at the website of ANA. Telemetry equipment is provided for many stations and thus hourly data is available. However, only daily based data is available at the ANA database.



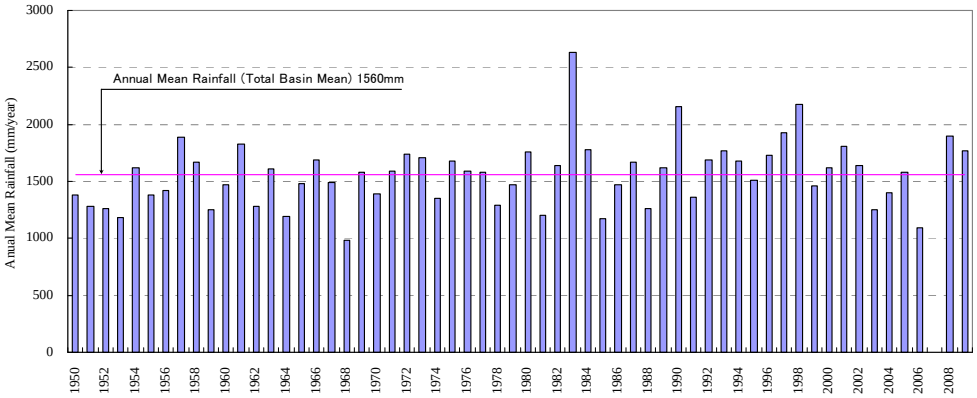
Source: Elaborated by JICA Survey Team based on the ANA database

Figure 2.3.1 Location Map of Hydro-meteorological Stations of ANA

In addition to the observation by ANA, hydro-meteorological observations are being conducted by SDS, INMET, CELESC, etc. Similar to ANA, FURB conducts the observation sublet by SDS with manual measurement by the neighboring residents (at 7 am and 5 pm, twice a day). Further, the automatic observation is also carried out in parallel with the manual observation and the data are sent to the master station every 15 minutes through cellular phone communication (or through satellite communication). However, due to low reliability of the automatic measurement equipment, the observed data has not yet arranged for use.

2.3.2 Rainfall

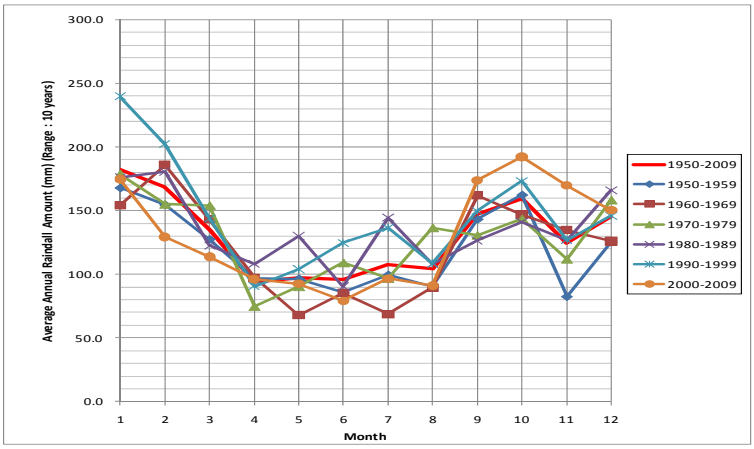
Figure 2.3.2 below shows the annual basin mean rainfalls in the Itajaí River basin for the period of 1950-2008 (excluded in 2007 due to many data gaps). As seen, the average annual basin mean rainfall is 1,560 mm. The maximum annual rainfall is 2,632 mm in 1983 and the minimum is 2,632 mm in 1983. However, in 2008 when the most serious flood disaster recently occurred, the annual basin mean rainfall is 1,899 mm. This is due to the concentration of the rainfalls in the lower part of Itajaí River basin from Indaial city during the 2008 flood.



Source: Compilation from the data of ANA

Figure 2.3.2 Annual Basin Rainfalls in the Itajaí River Basin

Figure 2.3.3 presents the comparison of monthly mean rainfalls by the decade in the Itajaí River basin. The monthly rainfall shows relatively low from April to August, gradually increasing from September onward, and the highest occurs in January and February. However, historical large floods occurred both in July 1983 and August 1984 even during the period of relatively low rainfalls.



Source: JICA Survey Team

Figure 2.3.3 Comparison of Monthly Mean Rainfalls in the Itajaí River Basin

2.3.3 River Discharge

Table 2.3.1 summarizes the monthly mean and annual discharges at major gauging stations. The annual mean discharges in 1980-2004 are 40 m^3/s at the Ituporanga station, 131 m^3/s at the Rio do Sul station, and 269 m^3/s at theIndaial station. The annual mean discharge at the Blumenau station is 340 m^3/s. Although wet and dry seasons are not clearly divided, the monthly mean discharges from September to February are generally higher than the annual mean discharge.

Table 2.3.1 Mean Monthly and Annual Mean Discharges

Unit: m^3/s

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Taio	24 years average (1980-2004): 54 m^3/s											
	50	76	76	36	46	45	48	44	55	74	56	48
Ituporanga	24 years average (1980-2004): 40 m^3/s											
	42	45	28	23	32	36	56	49	46	51	37	34
Rio do Sul	24 years average(1980-2004) : 131 m^3/s											
	123	158	108	91	113	122	134	137	145	181	139	117
Ibirama	24 years average (1980-2004) : 71 m^3/s											

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	64	77	54	37	64	65	100	79	79	102	68	63
Apiuna	7 years average (1997-2004) : 206 m^3/s											
	150	250	131	148	125	115	196	196	263	453	236	205
Timbo Novo	14 years average (1990-2004) : 46 m^3/s											
	60	63	50	34	36	37	46	38	48	58	44	36
Indaial	24 years average (1980-2004) : 269 m^3/s											
	288	333	241	177	232	240	320	240	298	375	266	222
Blumenau	22 years average(1982-2004) : 340 m^3/s											
	344	434	345	246	323	313	324	332	375	444	332	274
Brusque	24 years average (1980-2004) : 26 m^3/s											
	30	31	25	20	22	21	29	24	26	32	25	25

Source: JICA Survey Team

2.4 Land Use

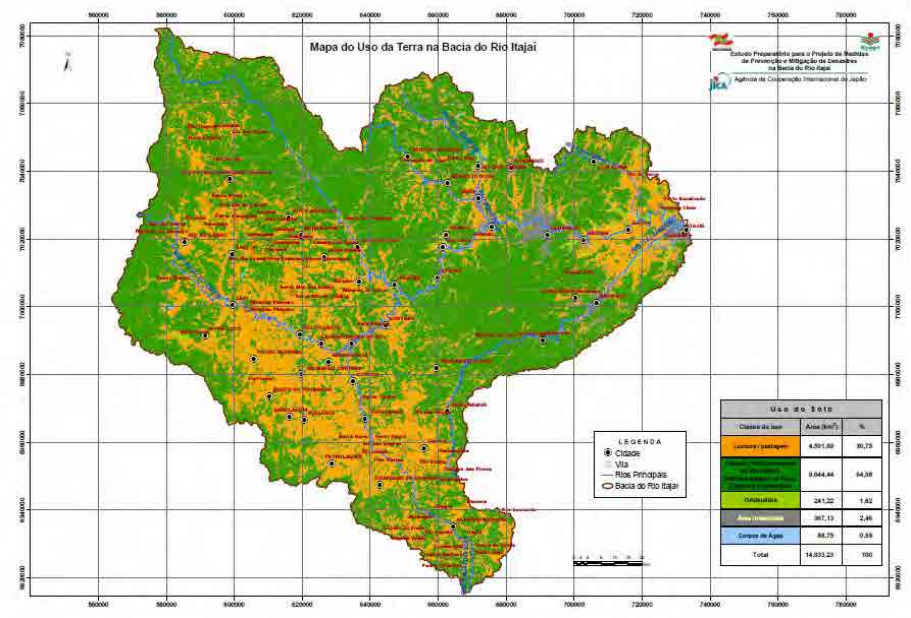
2.4.1 Land Use within the Basin

Figure 2.4.1 shows the present land use in the Itajaí River basin in 2000 and the area and ratio by land use category are summarized in Table 2.4.1. The forest area accounts for 64.6% of the whole basin, followed by the agricultural land use of crops and pastures with 36.7%. The distribution of agricultural area is bigger both in the upstream and downstream portions of the River basin.

Table 2.4.1 Present Land Use within the Itajai River Basin in 2000

Land Use Category	Area (km^2)	Ratio (%)
Crops/pastures	4,591.69	36.7
Forests	9,644.44	64.6
Rice paddies	241.22	1.6
Urban region	367.13	2.5
Water bodies	88.75	0.6
Total	**14,933.23**	**100.0**

Source: JICA Survey Team (based on IBGE data)

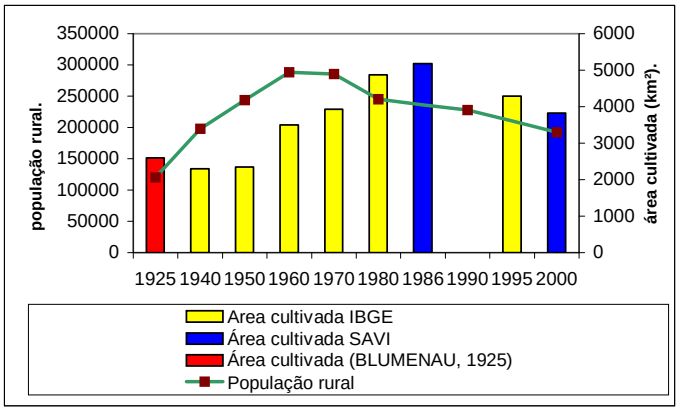


Source: JICA Survey Team (based on IBGE data)

Figure 2.4.1 Present Land Use within the Itajai River Basin in 2000

The land use in the Itajaí River basin is closely related to colonization. The cultivated area has increased due to the colonization both in the beginning of 1900s and 1950s. In 1990 when the migration to the Cerrado region started, the cultivated areas in the whole basin have been

decreasing because of various factors, such as migration to other regions and abandonment of the agricultural activities. Figure 2.4.2 shows the historical changes of cultivated areas in the Itajaí River basin. As shown, the areas of agricultural and livestock farming in the whole basin has been decreasing. On the other hand, the forest area has been increasing. And the modality of agricultural and livestock farming has been changed from extensive to intensive farming (for pig and chicken). This is a main reason for the reduction of land used in agricultural and livestock farming.



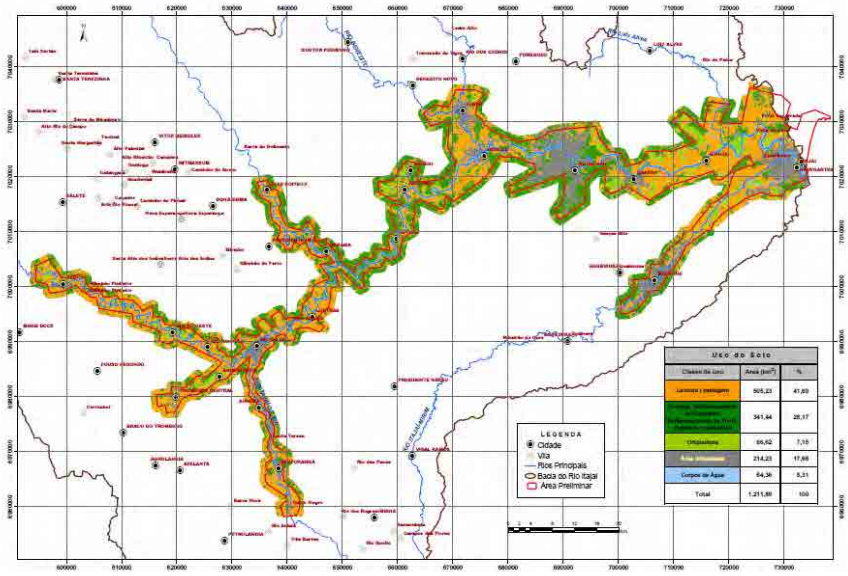
Source: Report of Itajaí River Committe – State Decree no. 2109/97, 2009-2011 Administration, Vibrans (2006)

Figure 2.4.2 Changes of Cultivated Area in the Itajaí River Basin

As for the land use in the middle and lower area of the Itajaí River, paddy and residential areas have been increasing. Especially in the downstream area, an increase of urban land is remarkable due to economic development. The expansion of urban land in this area is predicted to continue.

2.4.2 Land Use in Flood Vulnerable Area

Relatively flat low-lying area and hills are formed along the middle and lower reaches of the Itajaí River. The low-lying areas are used for agricultural and livestock farming, paddy and urban areas, although these areas are vulnerable for habitual flooding due to inadequate flow capacity of river channel. Figure 2.4.3 and Table 2.4.2 present the current land use in the flood vulnerable area along the Itajaí River.



Source: JICA Survey Team (based on IBGE data)

Figure 2.4.3 Land Use of Flood Vulnerable Area along the Itajaí River in 2000

Table 2.4.2 Use of Flood Vulnerable Area along the Itajaí River in 2000

Land Use	Area (km^2)	Ratio (%)
Agriculture/pastures	505.2	58.0
Rice paddies	86.6	9.9
Urban area	214.2	24.6
River area	64.4	7.4
Total	**870.4**	**100.0**

Source: JICA Survey Team (based on IBGE data)

Major urban areas in the basin are located in the flood vulnerable areas, and thus most of the basin population lives in these flood prone areas. The table below shows the number of residences of main cities subject to inundation.

Table 2.4.3 Number of Residences in Flood Vulnerable Area in 2000

Municipality	Total number of residences	Number of residences in the urban area	Number of residences in the rural area
Blumenau	85,873	80,029	5,844
Brusque	24,324	23,342	982
Gaspar	14,709	9,160	5,549
Ilhota	3,231	1,926	1,305
Itajaí	45,795	44,013	1,782
Navegantes	17,683	16,857	826
Total	**191,615**	**175,327**	**16,288**

Source: Summary done by JICA Survey Team (based on IBGE data: Residences surveyed per type and situation of domicile, according to municipalities of Santa Catarina – 2000)

2.5 Related Government Institutions

2.5.1 Government Institutions Related to the Preparatory Survey

As government institutions related to prevention of disaster, there are federal, state, municipal institutions and others as listed in Table 2.5.1 below. Federal Government is predominantly legislative body and responsible for fund transfer through concession, while State Government is the implementing agency for this Preparatory Study. Disaster prevention policies are undertaken by respective government institutions with jurisdiction in target measures. In Brazil, administration system of the existing facilities located in the Itajaí River basin is very complex, thus various institutions shall be involved for implementation of projects.

Table 2.5.1 Government Institutions Related to the Preparatory Survey

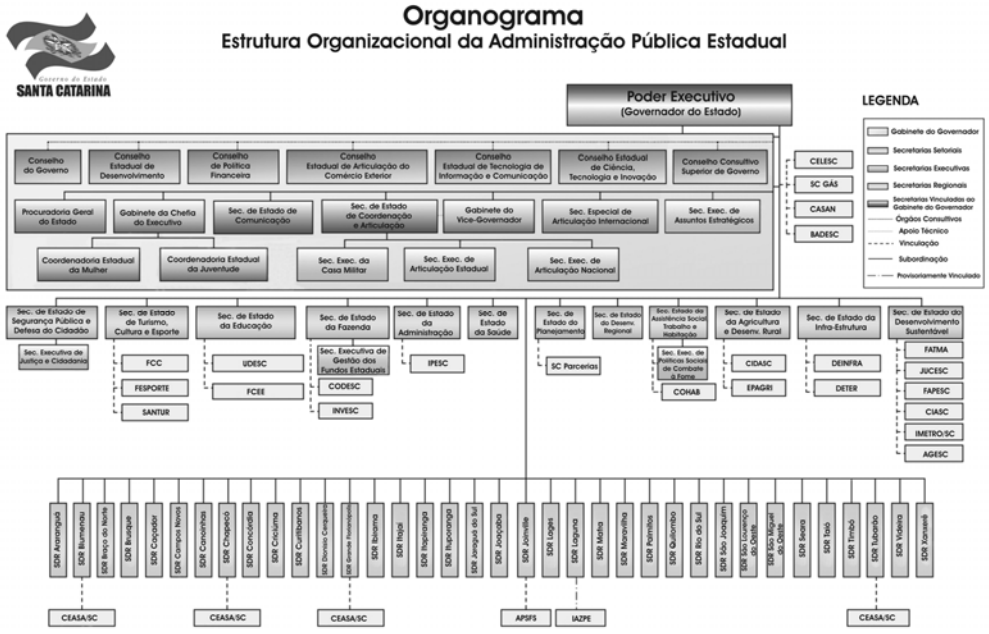
Government	Function	Institution
Federal government	Fund raising overseas for the project implementation	Request of funds: SEAIN Foreign debts: General Attorney Office of the National Finances (PGFN), National Treasure, Central Bank/DEDIP, Federal Senate, BACEN
	Preparation of laws related to the rive basin	River basin management: ANA Environmental laws: IBAMA
	Divulgation of information within the river basin	Meteorological information: ANA, IMNET, AERONAUTICA Geographic information: IBGE
	Administration bodies of establishments located within the river basin	Federal roads: DNIT, ANTT Port establishments: MT/ANTAQ
	Financial support	Support to prefectures: Ministry of Cities Equipment of federal government establishments: Establishments inspecting bodies
State government	Fund raising for the project implementation	Request of funds: SEA, SEF
	Execution of this Preparatory Survey	Coordination of the Survey: FAPESC Support to the Survey: SPG

Government	Function	Institution
	Divulgation of information	Alert: Civil Defense of the State Meteorological information: SAR/EPAGRI/ CIRAM
	Administration body of establishments located within the Basin	Roads: DEINFRA Electric energy generation: CELSC Water and sewage: CASAN
	Regional Development Department	Nine offices
	Preparation of laws related to the water resources located within the river basin and inspection	River basin management: CERH Environment: FATMA, PMA (Environment Police)
Municipal government	Municipalities involved	50 municipalities
	Planning and fund raising	Planning Secretariat of the municipality
	Execution of works and administration of facilities	Works Secretariats of the municipalities
	Evacuation of residents	Municipal Civil Defense
	Municipal facilities	Itajaí Port
Others	Administration of the Basin	Itajaí River Basin Committee
	Universities	FURB, UDESC, UFSC, CEPED, UNIVALE, UNISUL
	NGO	

Source: JICA Survey Team

2.5.2 State Government Institutions

Figure 2.5.1 shows the structure of government organizations in the Santa Catarina State. The administrative organization of the State Government is composed 21 departments, 36 regional development offices and 29 affiliated entities.



Source: Government of Santa Catarina State

Figure 2.5.1 Organization Chart of Government of Santa Catarina State

SDS (Department of Sustainable Economic Development) is responsible for water resources management within the State. The SDS consists of the following three divisions:

- DIRH – Directorate of Water Resources
- GEPHI – Water Resources Planning
- GEORH – Use and Management of Water Resources

The institution in charge of meteorological data and public information is EPAGRI/CIRAM, which exhibits to the public meteorological and oceanographic information as well as geographic information. Infrastructure such as roads and dams are under the jurisdiction of DEINFRA.

2.5.3 Municipal Government Institutions

There are 50 municipalities in the Itajaí River basin. Each municipality has its own funds and undertakes projects according to implementing programs. The municipal government institutions relating to the Preparatory Survey are planning department, construction department, civil defense, etc. The planning department elaborates municipal budget and the work programs and the construction department is in charge of execution of construction works and post-disaster restoration works. The civil defense carries out activities to secure inhabitants from disasters through provision of preventive measures and evacuation.

2.6 Itajaí River Basin Committee

2.6.1 National Water Resources Policy and National Water Resources Management System

(1) Overview

In Brazil, river basin management through the river basin organization (RBO) is well developed. The Federal Government stipulates the National Water Resources Policy and the National Water Resources Management System in the Law No. 9433 on January 08, 1997. This Law aims at reservation and conservation of water resources, promotion of rational utilization of water resources, sustainable water resources development, and mitigation of damages due to occurrence of extraordinary hydrological events such as flood and drought. This Law also stipulates that water resources management shall be executed independently for each river basin establishing management standards with provision of legal norms, and shall be decentralized by establishment of an agency of participatory approach.

The National Water Resources Policy stipulates to establish the followings (Chapter IV, Article 5):

i) Formulation of water resources plan
ii) Establishment and enforcement of water utilization standards for water source and river basin
iii) Establishment of system for water right
iv) Establishment of collection system for water utilization fee
v) Establishment of information system on water resources

In the formulation of the water resources plan, the Law requires to formulate a long term water resources development plan for the river basin, which shall be based on diagnosis of the current situation of water resources, future population, water balance between availability of water resources and future water demand, identification of potential water conflicts reflected by the economic growth, rational use of water resources, improvement of water quality, execution of programs based on the future water demand, securing water right for priority water use, collection of water fee, and determination of the conservation area in view of water resources management.

(2) Stipulated Agencies and Respective Competences

In order to implement the National Water Resources Policy, the following competences (responsibilities) are assigned to the Federal and State Governments (Article 30 in the Law):

i) Grant of water rights and inspect fulfillment of responsibilities
ii) Management of construction of water utilization facilities
iii) Establishment of water resources information system
iv) Promotion of water resources management in harmony with environments

The National Water Resources Management System is divided into two bodies; policy making

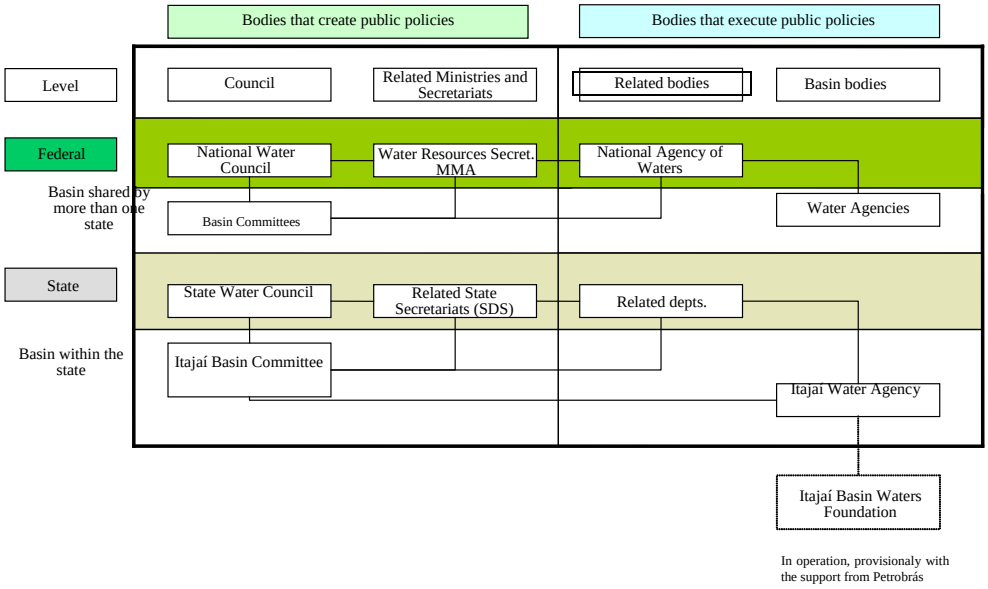
executing bodies, which comprises of the following agencies (Title 2, Chapter 1 and Article 33):

i) National Water Resources Council
ii) National Water Agency
iii) State Water Resources Council
iv) River Basin Committee
v) Water Agency

In regard to the policy on water, regulations are established by the water resources councils. At the federal level, ANA (National Agency of Waters) is an executing agency for the National Water Resources Policy. At the State level, water agencies are established in every basin and execute the water resources policy.

As the Itajaí River is an inter-state river, its jurisdiction falls on the state. At this moment, the Water Foundation of Itajaí River Basin is provisionally executing the policies as the Water Agency and also formulated the water resources development plan. Currently the Foundation has the support of Petrobrás for implementation of activities.

The following figure shows the composition of the National Water Resources Management System under the Law.



Source: JICA Survey Team

Figure 2.6.1 Institutions under the National Water Resources Management System

Competences of the state water resources council, river basin committee and water agency are listed below:

State Water Resources Council (Title 2, Chapter 2 and Article 34): 20 members in total comprising 10 representatives from related state departments and 10 representatives of the state population.

i) Analysis on various projects and researches related to recuperation, preservation and utilization of water resources
ii) Proposal of state guidelines related to utilization of water resources
iii) Proposal of state programs for flood control
iv) Proposal of guidelines related to recuperation, preservation and utilization of water resources

v) Proposal of actions to execute undertakings and plans related to the utilization of water resources in harmony with planning coordination agencies
vi) Coordination of water resources utilization policy between federal and state governments
vii) Coordination of plans and programs between state and municipal governments
viii) Proposal of guidelines for execution of various projects related to utilization of water resources
ix) Preparation of the regulation of river basin committee
x) Promotion of formulating comprehensive development plans related to water supply, flood control, irrigation and drainage, aquiculture and fishing, river transportation, hydropower generation, land use, environment, hydrology, climate, sedimentation, leisure, etc. to the river basin committee

River basin committee (Title 2, Chapter 3 and Article 38):

i) Consultation with institutions related to water resources
ii) Arbitration of water conflicts
iii) Approval of river basin development plans
iv) Implementation of river basin development plans and necessary measures
v) Proposal of certification of water rights to the Water Resources Council
vi) Establishment of system for collection of water utilization fees
vii) Regulation of the expense sharing system for construction works

Water agency (Title 2, Chapter 4 and Article 44):

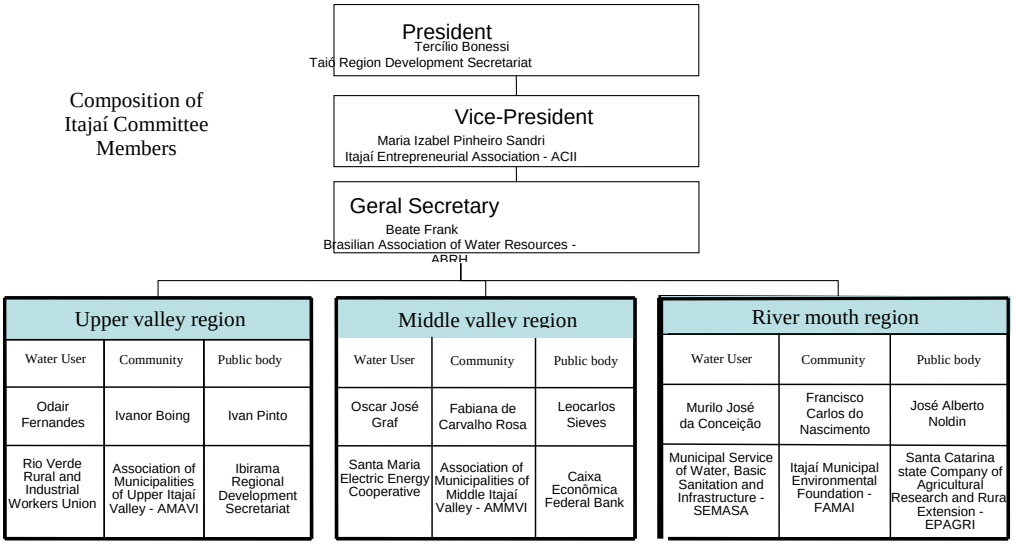
i) Registration of water users
ii) Collection of water utilization fees
iii) Administration of facilities constructed from the revenue of water use fees
iv) Budget raising
v) Formulation of water resources plan

Establishment of the Water Agency shall be approved by the Water Resources Councils at both the federal state levels based on an application from the river basin committee. This approval basically requisites an existence of river basin committee and operation of the water agency based on the collected fees from water users (Article 43).

2.6.2 Itajaí River Basin Committee

(1) Composition of the Committee

The Itajaí River Basin Committee is an institution established by the State Decree 2109/97 and is composed of various members of public and private institutions. The Committee is composed of representatives from the upper, middle and lower reaches of the Itajaí River. They are water users, representatives of community organizations, and representatives of public institutions, and are elected every two years. The following figure shows the composition of the Committee.



Source: JICA Survey Team

Figure 2.6.2 Composition of the Itajaí River Basin Committee

The Committee comprises 50 organizations, that is, 20 organizations of water users, 20 organizations of community representation and 10 institutions representative of public institutions. The water user organizations are composed of entities such as water supply and sewage, electric energy, agricultural cooperatives, industrial workers associations, entrepreneurial associations, etc. The community organizations are composed by associations of municipalities, municipal environmental funds, municipal governments, municipal councils, NGOs, engineers associations, indigenous representation, etc. The public institutions are composed by the state house of representatives, banks, state government, institutions related to the state government, regional development secretariats, federal government institutions, etc. The following table shows the member of the Committee.

Table 2.6.1 Member of Itajaí River Basin Committee

Water users organizations 20 organizations	
State Company of Water and Sewage :	(CASAN)
Municipal Companies of Water and Sewage:	(SAMAE, SEMASA, SAMAE, Serra São Miguel Intermunicipal Consortium)
State Company of Electric Energy:	(CELESC)
Private electric energy companies:	(Salto Pilão Entrepreneurial Consortium, Estação Indaial Energética S.A., Santa Maria Gerador a S.A., Cooperative of Electric Energy)
Agricultural cooperatives:	(CRAVIL, Industrial e Agrícola Rio Verde Ltda, Voltapinho Cereals Drying and Storage Unit, Mirim Doce Cereals Storage Company, Agronômica Rural Workers Union, Braço do Trombudo Aquiculture Association)
Industrial workers associations:	(SIMMMERS, Ibirama Construction and Furniture Industries Union, SINTEX – Spinning Mills, Textile and Clothing Industries Union of Blumenau)
Entrepreneurial associations:	(Entrepreneurial Association of Itajaí – ACII, Entrepreneurial Association of Rio do Sul – ACIRS)
Community organizations: 20 organizations	
Associations of municipalities:	(AMAVI – Upper Itajaí valley; AMMVI – Middle Itajaí valley; AMFRI –Itajaí river mouth region; CIMVI – Municipal fund of middle Itajaí valley)
Environment fund:	(FAMAI – Municipal environment fund of middle Itajaí valley)
Prefectures:	(Taió, Ibirama)
Municipal house of representatives:	(Benedito Novo, Trombudo Central, UCAVI – Union of municipal houses of representatives of upper Itajaí valley)
NGOs:	(ACAPRENA – Santa Catarina Association of Nature Preservation, CEMEAR – Center of Ecological Motivation and Rural Alternatives, Pastoral Land Commission, Praia Vermelha Foundation of Nature Conservation, Santa Catarina Journalists Union)
Association of engineers:	(ABES – Brazilian Association of Sanitary and Environmental Engineering,

	ABRH – Brazilian Association of Water Resources, FURB – Blumenau Regional University Foundation, UNIFEBE – University Center of Brusque)
Indigenous community:	(Nuclei of indigenous housing)
Representations of public institutions: 10 organizations	
State House of Representatives	(ALESC – House of Representatives of Santa Catarina State)
Banks:	(CEF - Caixa Econômica Federal)
State government:	(SDS State Secretariat of Sustainable Economic Development)
Institutions related to the state government:	(DEINFRA – Department of Infrastructure, EPAGRI – Itajaí Experimental station, EPAGRI – Ituporanga Regional Management)
Regional development secretariats:	(Ibirama, Itajaí, Taió)
Institution of the federal government:	FUNAI – National Indigenous Foundation

Source: JICA Survey Team

Since its establishment in 1997, the Committee has been executing various activities. The objectives of the Committee as well as the competences stipulated by the State Decree are presented as follows:

(2) Objectives of Establishment of the Committee

i) Promotion of regional decentralization and river basin management with participation of communities
ii) Promotion of execution of comprehensive actions against extraordinary hydrological phenomena such as floods, droughts, etc.
iii) Establishment and management of water resources development plan in the basin
iv) Review of the values of water sources
v) Proposal of expense sharing of construction works to secure the water sources of the basin
vi) Promotion of a basin management toward well harmonized development between regional development and environmental preservation
vii) Maximization of natural resources by efficient utilization of water sources
viii) Promotion of preservation of water resources taking future water use in consideration
ix) Promotion of setting up of conservation areas in the basin

(3) Competences of the Committee

i) Arrangement of consultation meetings on water resources preservation and related actions
ii) Formulation and approval of the water resources plan in the Itajaí River basin, follow-up of implementation of projects and provision of necessary suggestions
iii) Suggestions to the State Water Resources Council for formulating the state water resources development plan in the Itajaí River basin
iv) Recommendation of the exemption of obtaining water right to small volume consumers
v) Suggestions to institutions related to respective water uses and preservations
vi) Establishment of mechanism for collection of water utilization fee and suggestion of fees to be charged
vii) Suggestion of sharing of expenses for construction of water utilization facilities
viii) Coordination among institutions related to water use
ix) Investigation and consultation on the priority projects
x) Provision of documents for compilation of annual report
xi) Presentation of water resources problems and decision items for policy making
xii) Suggestion of countermeasure for disasters
xiii) Follow-up and advice on formulation of flood control plan, and maintenance and management of alarm system, etc. in the basin
xiv) Follow-up and advice on the federal and state projects in the basin

xv) Harmonization of the municipal environmental law and water resources plan
xvi) Application for establishment of the Water Agency to the State Water Resources Council
xvii) Implementation of public hearings
xviii) Request of information on the institutions that implement projects in the basin in terms of data, license documents, etc.

(4) Current Situation of the Committee

Current situation of the Itajaí River Basin Committee is summarized below based on the information so far obtained:

i) From the legal point of view, planning and execution of projects related to water resources development in the Itajaí River basin including disaster prevention projects shall be responsibility of the Water Agency to be established in this basin.

ii) The Itajaí River Basin Committee approves water resources plans and execution of the implementation works. However, this shall require the final approval from the State Water Resources Council.

iii) The executing agency of water resources policies is the Water Agency. However, an establishment of this Agency has not yet been legally approved by the State Government. This might be due to the fact that collection system of water utilization fee has not yet established.

iv) The Foundation of Water Agency was established in 2002 based on the financial support of Petrobrás, which is a private organization established within FURB (Blumenau Regional University). Three executives of the Itajaí River Basin Committee concurrently hold the post of Board of Directors of this Foundation.

v) Planning of water resources is carried out by the planning group established within the Committee. And planning of disasters prevention including flood control is in charge of the disasters prevention group within the Committee.

2.7 Management and Development Plans

2.7.1 Plans of the Federal Government

The Federal Government is currently promoting the national socio-economic development programs based on the PAC2 (Program of Growth Acceleration 2). The goal of this Program is to reduce the social difference by improving the distribution of income, promoting social inclusion and fostering the normalization of job contracts.

As shown in Table 2.7.1 below, the PAC2 aims at an increase development funds, improvement of investment system, development of environment for investments, reduction of tax load in the strategic sectors, formulation of middle and long term budgetary plans, ensuring the balance between tax revenue and budget and efficient operation of development programs.

Table 2.7.1 Development Strategy of PAC2 by Federal Government

Target	Actions
Increase of development funds and improvement of investment system	• Promotion of basic sanitation, water supply and construction of residences by the Federal Economic Bank (Caixa Econômica Federal) • Increase of range of investments related to water supply and sewage, basic sanitation, supply and construction of residences that are executed by the public authorities • Creation of funds of investments for infrastructure by using the FGTS • Expansion of the investment funds in residences • Reduction of long term interests • Urban development financed by BNDES, improvement of investment conditions for transports infrastructure

Target	Actions
Improvement of the environment for investments	• Intensification of the investment toward the environment • Institutional reformation to intensify investments to the population • Creation of the natural gas distribution system • Modernization of the bidding process • Preparation of the environment for investments in basic sanitation and supply • Release of the insurances sector • Revitalization of regional bodies´ activities: SUDAM, SUDENE, etc.
Reduction of the tax load on strategic sectors	• Intensification of investments in residences using PIS and COFINS • Exemption of PIS and COFINS taxes for civil construction activities • Creation of funds for investments in infrastructure • Tax exemption for the equipment applied to digital TV • Tax exemption for the supply and sanitation sector • Tax exemption for the production of semiconductors and microcomputers, steel profiles, and for small and middle scale companies. • Revision of the income tax
Middle and long term budgetary plan	• Taxes • Creation of the revenue department • Improvement of the tax collection system
Balance between tax revenue and budget	• Control of the expansion of expenses with the Federal government personnel • Valuation of the minimum wage • Improvement of the social welfare model • Acceleration of the bidding process • Improvement of the corporate governance in state owned companies
Efficient program management	• Creation of the PAC Steering Committee

Source: : http://www.brasil.gov.br/pac/ and compiled by JICA Survey Team

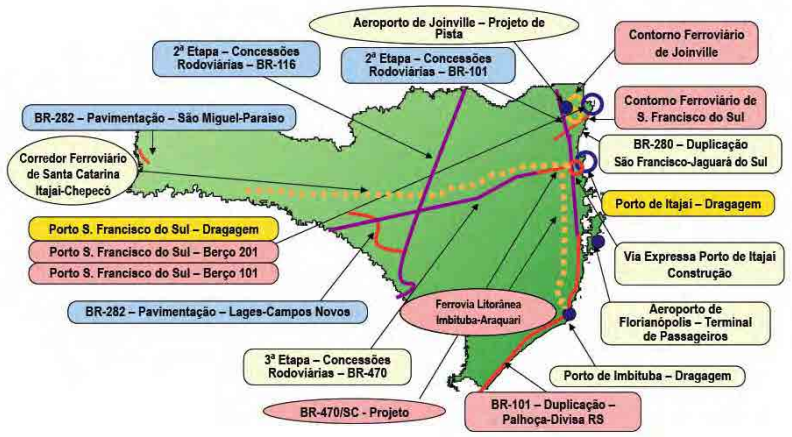
The PAC2 plan aims at development of socio-economic infrastructure, especially the investments in the field of transports, energy and urban infrastructure. Table 2.7.2 below shows the sectoral strategic projects of PAC2.

Table 2.7.2 Strategic Projects of PAC2 by Federal Government

Sector	Projects
Transports infrastructure	• Improvement of the highway network • Improvement of the railway network • Development of port facilities • Development of airport facilities
Energy	• Development of energetic infrastructure • Development of energy distribution • Development of Oil and natural gas • Development of oil refineries • Intensification of the shipbuilding industry
Urban infrastructure	• Light for Everyone (supply infrastructure) • Development of subways • Development of water resources infrastructure • Residences and water/sewage

Source: : http://www.brasil.gov.br/pac/ and organized by JICA Survey Team

Among the PAC projects, strategic projects of the transports sector in the Santa Catarina State are shown in the figure below.



Source: 10th Balance from January to April 2010, Santa Catarina

Figure 2.7.1 PAC2 Projects of Transports Sector in the Santa Catarina State

In relation to development of the transports infrastructure network, the State of Santa Catarina intends to develop the Itajaí Port based transports network. The main investment plans are listed as follows:

i) Chicken meat railway transportation between the cities of Itajaí and Chapecó
ii) Coastal railway
iii) Dredging in the Itajaí Port
iv) Concession of the federal highway BR470
v) Construction of highway with separator connecting the cities of Navegantes and Blumenau
vi) Access roads to the Itajaí Port

The following projects are planned under the PAC2 in the Itajaí River basin:

i) Improvement of the drainage system in the Garcia River
ii) Improvement of the drainage system in the Itoupava River
iii) Improvement of the drainage system in Ilhota city
iv) Improvement of the flow capacity of Itajaí River
v) Improvement of the drainage system in Navegantes city
vi) Improvement of the drainage system in Pomerode city
vii) Dredging in the Oeste River
viii) Improvement of the drainage system Timbó city
ix) Levee construction in the left bank of Itajaí-açu River, Blumenau city
x) River improvement in the left bank of Fortaleza River
xi) Improvement of the drainage system in Brusque city
xii) Improvement of the drainage system of Santa Terezinha district in Brusque city
xiii) Installation of the meteorological observation station in Itajaí city
xiv) Dredging in the urban are of Itajaí city
xv) Improvement of the drainage system in Itajaí city

2.7.2 Development Plans in the Santa Catarina State

Development plans in the Santa Catarina State was formulated based on the PAC2 plan and aim at construction of basic structures for fostering industries, improvement of the transports sector infrastructure, improvement of the energy sector and improvement of the urban infrastructure. The following development plans are formulated by the State Givernment:

i) Improvement of the highway network in the Santa Catarina State (double tracking of the major state roads, expansion of the paved roads and maintenance of paved roads)

ii) Development in Itajaí and Navegantes cities (improvement of access roads and double tracking of highway BR-470)

2.7.3 Water Resources Management Master Plan of Itajaí River Basin

The Itajaí Committee formulated the Water Resources Management Master Plan of Itajaí River Basin in March 2010. In the Plan, 28 strategic goals in total have been set up as follows:

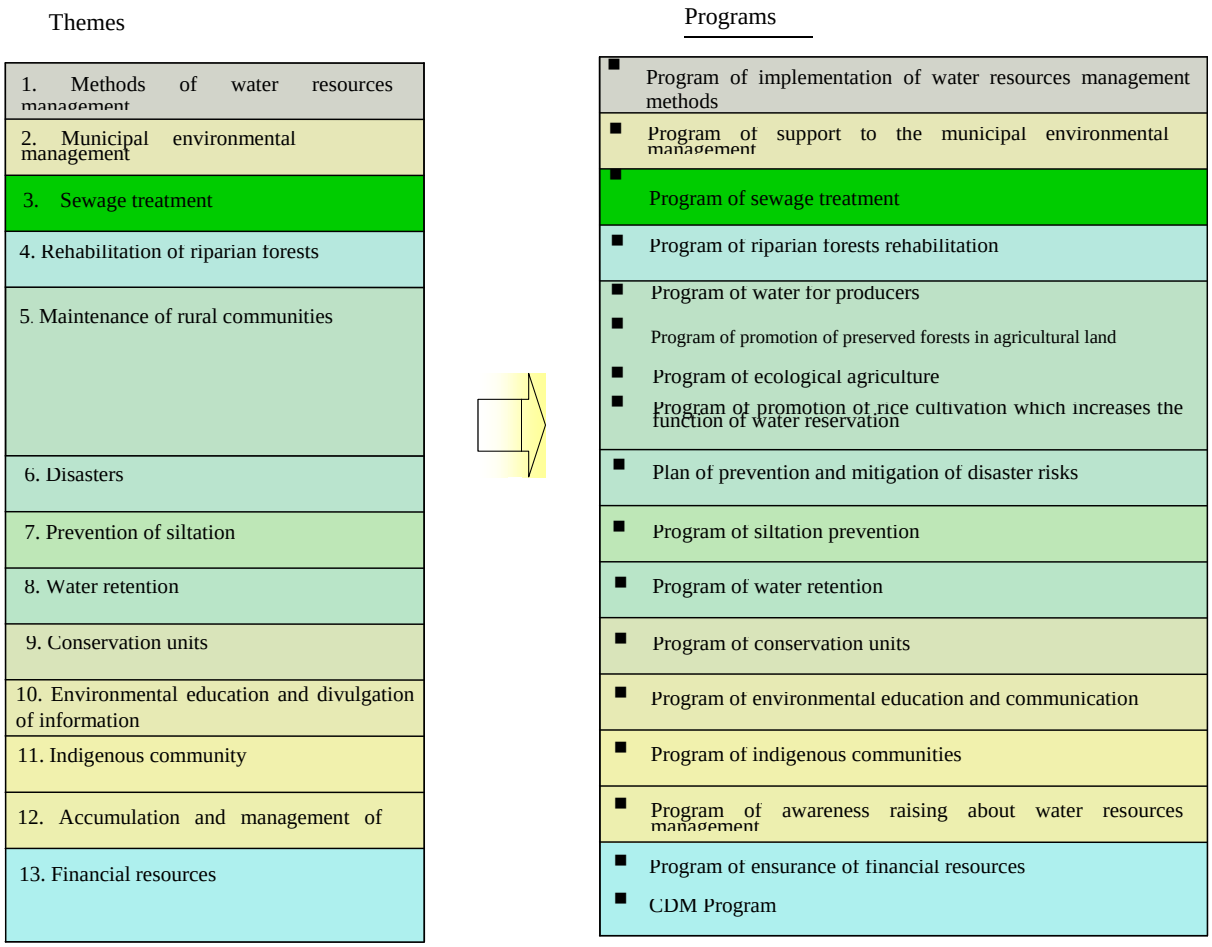
Table 2.7.3 Strategic Goals of Water Resources Management Master Plan

Strategic Goals	Measures to attain the goals	Themes
01 Water Resources Management and establishment of system for collection of water utilization fees from water users	• Prioritization of existing water users • Grant the right of water use for hydroelectric generation taking into consideration the basin environment • Review of criteria in 2015 • Analysis of the water supply and sewage facilities considering the collection of water utilization fees • Establishment of regulations for the use of water resources • Establishment of collection model for water utilization fees • Formulation of collection policy of water utilization fees	1. Definition of the methodology of water resources management
02 Establishment of information system of Itajaí River basin	• Publication of information • Collection and publication of information on water quality data by related agencies • Obtainment and publication of various information	
03 Strengthening of environmental management of municipalities	• Upskilling of municipal technical experts in comprehensive water resources management • Promotion for formulation of municipal environmental policies	2. 03 Strengthening of environmental management in municipalities
04 Establishment of integration mechanism of conservation areas	• Execution of researches for establishment of conservation areas • Promotion for integration of conservation areas	
05 Setting of standards for inspection of river works.	• Establishment of mechanism to avoid execution of inappropriate river works	
06 Reduction of un treated discharge of sewage system	• Support to expansion of sewage treatment systems • Promotion for strengthening of sewage control • Promotion of formulation of plans for implementation of sewage, domestic water, solid waste facilities, etc. • Study of alternatives for sewage treatment system • Increase of efficiency of each sewage treatment system • Establishment of goals for treatment targets in the sewage plan • Establishment of criteria for obtainment of environmental license	3. Improvement of sewage treatment system
07. Promotion of recovery of river forests 08. Promotion of municipal program for recovery of river forests	• Promotion of activities towards the recovery of river forests	4. Rehabilitation of river forests
09 Promotion of production of nursery trees	• Support to construction of nursery trees	
10. Improvement of production sector	• Improvement of the use of pesticides • Recovery of degraded land areas • Improvement of production techniques ➢ Promotion of intensive rice cultivation ➢ Diffusion of techniques of sustainable water use in rural areas ➢ Addition of value to agricultural land products in conformity with the codes ➢ Compensation to farmers who make a proper use of water • Promotion of water resources preservation activities	5. Preservation of rural communities
11. Strengthening of Civil Defense 12. Promotion of municipal master plan for disaster prevention	• Suggestion of integrated solutions for flash floods	6. Strengthening of measures against disasters

Strategic Goals	Measures to attain the goals	Themes
13. Promotion of construction of small scale reservoirs in micro-basins	• Construction of small scale reservoirs in micro-basins	
14. Promotion of infrastructure development for multiple use including flood control	• Promotion of infrastructure development for multiple use including flood control	
15. Promotion of watershed management	• Strengthening of the cooperation between public policies and institutions of Itajaí and Navegantes ports • Elaboration of the environmental impact reports for sand mining • Suggestion of action plans for the use and recuperation of ores	7. Prevention of sedimentation
16. Establishment of information system on water retention in upstream catchment area	• Investigations on development of water retention facilities in the upstream catchment area	8. Promotion of water retention in the upstream catchment area
17. Execution of pilot projects on water retention in upstream catchment area	• Construction of facilities for reutilization of water in agricultural production areas • Water retention the upstream catchment area	
18. Establishment of information system on conservation areas	• Propagation of information on conservation areas • Promotion of establishment of organizations for maintenance of conservation areas by local communities	9. Promotion of conservation areas
19. Strengthening of existing conservation areas 20. Promotion of preservation of water retention areas	• Definition of water retention areas • Strengthening of the existing conservation areas • Establishment of necessary conservation areas • Promotion of municipal reforestation activities to increase the forests area to the minimum level of 35%	
21. Promotion of environmental education in municipalities	• Promotion of environmental education	10 Environmental Education / propagation of information
22. Promotion of citizen participation	• Strengthening of the institutional qualification • Promotion of the participation of the population	
23. Promotion of technical supports	• Strengthening of reforestation techniques • Strengthening of municipal environmental management • Implementation of environmental education (river environment and sewage)	
24. Promotion of participation of the indigenous community	• Clarification of locations necessary for preservation	11. Promotion of indigenous participation
25. Promotion of follow-up of plan implementation	• Promotion of follow-up of plan implementation	
26. Strengthening of knowledge on water resources management	• Accumulation of information on river environment • Support to strengthening of researches • Accumulation of information on environmental conservation areas • Strengthening of information on water retention areas • Accumulation of information on groundwater quality and recharge • Execution of researches for rational use of water	12. Accumulation of knowledge and strengthening of management
27. Collection of funds for strengthening of water agency	• Collection of funds for strengthening of water agency	13. Strengthening of financial resources
28. Support to activities of preservation of river forests	• Promotion of the use of CDM in river forestation projects	

Source: Compiled by JICA Survey Team (Water Resources Management Plan of Itajaí River Basin)

For the implementation of themes in the above, 17 execution programs are proposed as shown in Figure 2.7.1. Target-years are also established dividing three terms; short term (5 years), middle term (10 years) and long term (20 years).



Source: JICA Survey Team

Figure 2.7.2 Themes and Programs of Water Resources Management Master Plan

The implementation frameworks for respective themes are presented as follows:

(1) Theme 1: Definition of Water Resources Management Methodology and Theme 4: Rehabilitation of River Forests

Involved institutions are SDS, GTC/FAPESC, FATMA and EPAGRI from the State Government, the Itajaí River Basin Committee, municipal associations (AMAVI, AMMVI, AMFRI) and producers of nursery trees. These institutions shall establish the water resources management methodology as well as promote rehabilitation of river forests along the river banks.

The Water Resources Division of SDS is responsible for legislation regarding water resources management and issuance of water right. FATMA is responsible for setting up water quality standards, while GTC/FAPESC is delegated to organize the information that shall be the basis for the water resources management and to prepare hydraulic facilities development plans. The Itajaí River Basin Committee is responsible for conducting basic researches so that SDS and FATMA might set criteria. In regard to the rehabilitation of river forests, the plan proposes the rehabilitation of approximately 400 ha per year. As for the water right, the plan proposes to grant the right according to the following priority order; piped water, animal use industrial use and hydroelectric power generation. The collection of water utilization fees is also proposed in the Master Plan, which provides the fund for water resources management.

(2) Theme 2: Strengthening of Municipal Environmental Management.

The Municipal Environmental Council (CMMA) plays a central role in strengthening of municipal environmental management by means of establishments of environmental sector and

environmental policy and plans. The strengthening would be carried out in 5 years and guidelines for water quality standards and management of environmental conservation areas in municipalities would be prepared.

(3) Theme 3: Improvement of Sewage Treatment

For the improvement of sewage treatment, approximately one billion Reals would be invested to expand the existing sewage treatment system in 20 years.

(4) Theme 6: Strengthening of Measures against Disasters

Six programs are planned to mitigate disaster risk as shown in Table 2.7.4. Among the programs, land use management and river management are proposed as the projects for disaster mitigation. The land use management consists of support to formulation of urban plan, monitoring of land use per urban district, restriction to housing in areas subject to disasters, recovery of forests, efficient land use in rural areas, promotion of solid waste treatment and compensation in the areas with land use restriction. As for the river management, maintenance of old rivers, renovation of improved segments of rivers, multiple utilization of existing infrastructure and management of urban drainage are proposed.

Table 2.7.4 Programs for Disaster Risk Mitigation

Program	Activity	Indicator
Institutional strengthening for the preparation of emergency measures against disasters	・ Staff training ・ Creation of Civil Defense	・ Training of 30 persons ・ Creation of 5 Civil Defense coordination per year
Monitoring, alert and alarm	・ Monitoring, alert and alarm, or institutional strengthening ・ Creation of the alarm system	・ Formulation of alarm plan
Incentive to the population to reduce the vulnerability and to increase resilience	・ Education towards the recuperation of damages caused by disasters ・ Creation of mechanisms to stimulate the resident participation ・ Creation of mechanisms to stimulate the civil cooperation ・ Divulgation of measures against epidemics	
Risk evaluation	・ Elaboration of theme maps and figures ・ Creation of the integrated disaster information system ・ Evaluation of disaster risks ・ Evaluation of drainage networks	• New topographic map in 2012. • Creation of GIS information. • Elaboration of risk maps.
Mitigation of disaster risks	Land use ・ Support to the elaboration of the urbanization plan ・ Monitoring of land use per urbanized area ・ Regulation of housing in disaster areas ・ Forest recuperation ・ Efficient use of land in rural zones ・ Promotion of the implementation of solid waste treatment undertakings ・ Compensation in areas with land use restriction	Land use management ・ Review of the urbanization plan. ・ Establishment of the Earthworks Code.
	River management ・ Maintenance of old rivers and renovation of rectified segments of rivers ・ Effective and multifunctional use of existing infrastructure ・ Management of urban drainage	River management ・ Execution of hydraulic ・ structures works ・ JICA Project
Restoration of areas affected by disasters	・ Identification of areas affected by disasters ・ Restoration of environmental protection areas	

Source: Compiled by JICA Survey Team (Water Resources Plan of Itajaí River Basin)

The FAPESC and Itajaí Committee Disaster Fighting Technical Commission are proposed as execution coordinating bodies for disaster management.

(5) Theme 10: Environmental Education / Transmission of Information

Considering that community participation is of an efficient strategy for environmental preservation, strengthening of environmental education and transmission of information is proposed to promote community participation. Concrete initiatives are establishment of actions for environmental education, implementation of actions to promote community participation and fostering of technical experts related to environmental education.

(6) Theme 12: Accumulation of Knowledge and Management Enhancement

As for the accumulation of knowledge and enhancement of management, the plan proposes rational water management through accumulation of knowledge about the basin. The accumulated knowledge would assist to grant the water right and creation of its mechanism to realize rational water use. Therefore, it plans to strengthen researches about the basin by research laboratories and to clarify the following aspects:

i) Clarification of the role of conservation areas in environmental corridors and conservation of water resources
ii) Clarification of the methodology for the rational use of water
iii) Accumulation of information on the function of environmental conservation areas in the Itajaí River basin
iv) Clarification of the negative impact of contamination sources on the water quality
v) Accumulation of information on the sources of urban sewage
vi) Accumulation of information on conservation and improvement of the environment