JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

STATE SECRETARIAT OF PLANNING AND GENERAL COORDINATION,
PARANÁ STATE, THE FEDERATIVE REPUBLIC OF BRAZIL

THE MASTER PLAN STUDY ON THE UTILIZATION OF WATER RESOURCES IN PARANÁ STATE IN THE FEDERATIVE REPUBLIC OF BRAZIL

FINAL REPORT

MAIN REPORT II

MASTER PLAN FOR IGUAÇU RIVER BASIN

December, 1995

Yachiyo Engineering Co., Ltd.
Tokyo, Japan

and

Nippon Koei Co., Ltd.
Tokyo, Japan

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

STATE SECRETARIAT OF PLANNING AND GENERAL COORDINATION,
PARANÁ STATE, THE FEDERATIVE REPUBLIC OF BRAZIL

THE MASTER PLAN STUDY ON
THE UTILIZATION OF WATER RESOURCES IN PARANÁ STATE
IN
THE FEDERATIVE REPUBLIC OF BRAZIL

FINAL REPORT

MAIN REPORT II

MASTER PLAN FOR IGUAÇU RIVER BASIN

December, 1995

Yachiyo Engineering Co., Ltd.
Tokyo, Japan

and

Nippon Koei Co., Ltd.
Tokyo, Japan

Cost Estimate is Based
on The Price Level of August, 1994,
According to The Following Exchange Rate.

US$ 1.00 = ¥ 98.87
(as of August, 1994)

PREFACE

In response to a request from the Government of the Federative Republic of Brazil, the Government of Japan decided to conduct a study on the Master Plan for the Utilization of Water Resources in Paraná State and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Brazil a study team headed by Mr. Yoshio Nakagawa, Yachiyo Engineering Co., Ltd., and composed of staff members of Yachiyo Engineering Co., Ltd. and Nippon Koei Co., Ltd. (5 times between March 1994 and October 1995).

The team held discussions with the officials concerned of the Government of Brazil, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

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

I wish to express my sincere appreciation to the officials concerned of the Government of the Federative Republic of Brazil for their close cooperation extended to the team.

December, 1995

Kimio Fujita
President
Japan International Cooperation Agency

December, 1995

Mr. Kimio Fujita
President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

Dear Mr. Fujita,

We are pleased to submit to you the Master Plan report on the Utilization of Water Resources in Paraná State in the Federative Republic of Brazil. This report presents a strategy over the state on water environment, which includes not only comprehensive surface and underground resources development for various types of water use but also environmental facets of water, such as flood, quality of river water, soil erosion, eco-system, forest, etc., as well as a Master Plan for improvement of water environment in selected two pilot river basins.

In the Master Plan for the pilot river basins, projects and recommendations are embodied towards the year of 2015 for sectors of water supply, hydro-electric generation, flood control, water quality control and sewerage development, soil erosion control, eco-system conservation, forest preservation, water environment management, and institutional improvement. Urgent implementation of studies to follow this Master Plan Study is also proposed in the report.

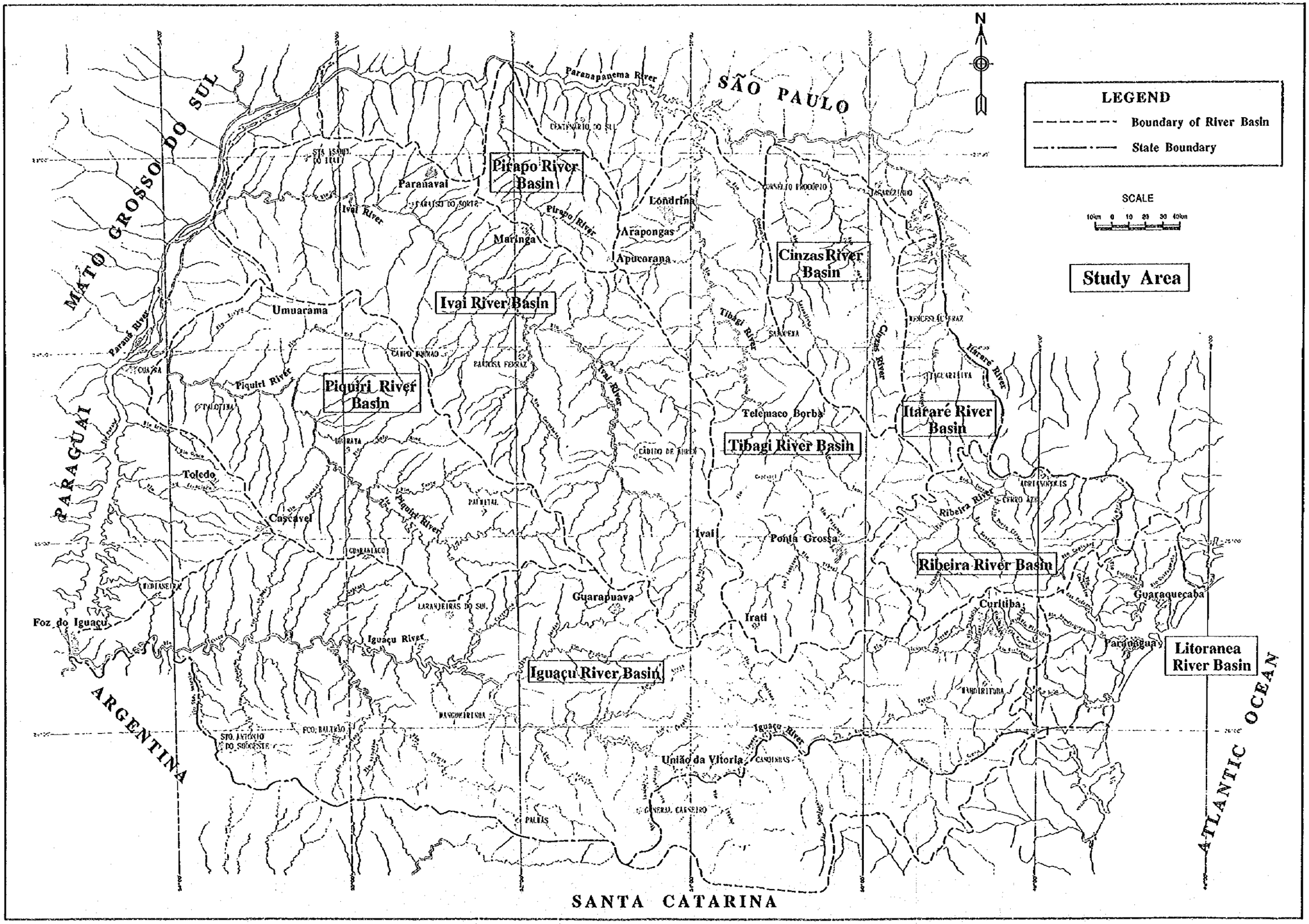
It would be a great honor for us that the result of the study would contribute to socio-economic development of Paraná State and to closer friendship between Japan and the Federative Republic of Brazil.

We wish to take this opportunity to express our sincerest gratitude to your Agency, the Ministry of Foreign Affairs, the Ministry of Construction, the Hokkaido Development Agency, the Embassy of Japan in Brazil and the General Consulate of Japan at Curitiba. We also wish to express our deepest gratitude to the State Secretariat of Planning and General Coordination and other authorities concerned of Paraná State as well as those of the Federative Republic of Brazil for close cooperation and assistance extended to us.

Very truly yours,

Y. Nakagawa

Yoshio Nakagawa
Team Leader
The Master Plan Study on
the Utilization of Water Resources in
Paraná State in the Federative Republic of Brazil


N
LEGEND
Boundary of River Basin
State Boundary
SCALE
Study Area
MATO GROSSO DO SUL
SÃO PAULO
PARAGUAI
ARGENTINA
SANTA CATARINA
ATLANTIC OCEAN
Paranapanema River
Pirapo River Basin
Ivai River Basin
Piquiri River Basin
Iguaçu River Basin
Cinzas River Basin
Tibagi River Basin
Itararé River Basin
Ribeira River Basin
Litoranea River Basin
Paranavaí
Londrina
Maringá
Arapongas
Apucarana
Umuarama
Toledo
Cascavel
Foz do Iguaçu
Guarapuava
Telemaco Borba
Ponta Grossa
Ivaí
Irati
União da Vitoria
Curitiba
Guaraqueçaba
Paranaguá
Ivai River
Pirapo River
Paraná River
Piquiri River
Iguaçu River
Tibagi River
Cinzas River
Itararé River
Ribeira River

COMPOSITION OF FINAL REPORT

1. EXECUTIVE SUMMARY

2. MAIN REPORT
   - I. Strategy for Paraná State
   - II. Master Plan for Iguaçu River Basin
   - III. Master Plan for Tibagi River Basin

3. SECTORAL REPORT
   - A. Socio-economy
   - B. Meteorology, Hydrology and Surface Water Resources
   - C. Hydrogeology and Groundwater Resources
   - D. Domestic and Industrial Water
   - E. Agriculture
   - F. Hydroelectric Power Generation
   - G. Water Utilization Plan
   - H. Flood Control
   - I. Water Quality and Sewerage
   - J. Soil Erosion and Forest
   - K. Ecology
   - L. Water Environment Management
   - M. Institution
   - N. Cost Estimate, and Economic and Financial Assessment

4. DATA BOOK

THE MASTER PLAN STUDY ON
THE UTILIZATION OF WATER RESOURCES IN PARANA STATE
IN THE FEDERATIVE REPUBLIC OF BRAZIL

MAIN REPORT II
MASTER PLAN FOR IGUAÇU RIVER BASIN
TABLE OF CONTENTS

List of Tables

List of Figures

List of Abbreviation

CEPA	:	State Commission for Agricultural Planning *Comissão Estadual de Planejamento Agrícola*
COMEC	:	Coordination of the Metropolitan Area of Curitiba *Coordenação da Região Metropolitana de Curitiba*
CONAMA	:	National Council of Environment *Conselho Nacional do Meio Ambiente*
COPATI	:	Inter Municipal Concessionaire for the Environmental Protection of the Tibagi River Basin *Consórcio Intermunicipal para a Proteção Ambiental de Bacia do Rio Tibagi*
COPEL	:	Energy Company of the State of Paraná *Companhia Pananaense de Energia*
CORPRERI	:	Permanent Regional Commission Against Floods in the Iguaçu River *Comissão Regional Permanente Contra as Cheias do Rio Iguaçu*
DAGRI	:	Agricultural Operation Department *Departamento Operacional da Agricultura*
DEPEC	:	Livestock Department *Departamento de Pecuária*
DERAL	:	Economy Department *Departamento de Economia*
DNAEE	:	National Department of Water and Electric Energy *Departamento Nacional de Águas e Energia Elétrica*
ELETROBRAS	:	Brazilian Central Electric Joint-stock Company *Centrais Elétricas Brasileiras S.A.*
ELETROSUL	:	Electric Center of the South *Centrais Elétricas do Sul do Brasil S.A.*
EMATER	:	Paraná State Technical Assistance and Rural Extension Company *Empresa Paranaense de Assistência Técnica e Extensão Rural*
EMBRAPA	:	Brazilian Agriculture and Livestock Research Company *Empresa Brasileira de Pesquisa Agropecuária*

FAMEPAR	:	Institute for Municipal Assistance of Paraná State *Instituto de Assistência aos Municípios do Estado do Paraná*
FAO	:	Food and Agriculture Organization *Fundo das Nações Unidas para Alimentação e Agricultura*
IAP	:	Environmental Institute of Paraná *Instituto Ambiental do Paraná*
IAPAR	:	Agricultural Research Institute of Paraná *Instituto Agronômico do Paraná*
IBAMA	:	Brazilian Institute of Environment and Renewable Natural Resources *Instituto Brasileiro do Meio Ambiente e de Recursos Naturais Renováveis*
IBDF	:	Brazilian Forest Development Institute (current IBAMA) *Instituto Brasileiro de Desenvolvimento Florestal*
IBGE	:	Brazilian Institute of Geography and Statistic *Instituto Brasileiro de Geografia e Estatística*
IPARDES	:	Economic and Social Development Institute of the State of Paraná *Instituto Paranaense de Desenvolvimento Econômico Social*
JICA	:	Japan International Cooperation Agency *Agência de Cooperação Internacional do Japão*
MERCOSUL	:	South Common Market in Brazil, Argentina, Uruguay and Paraguay *Merca do Cone Sul*
MINEROPAR	:	Paraná State Mineral Company *Minerais do Paraná S/A*
PROSAM	:	Environmental Sanitation Program for Curitiba Metropolitan Region *Programa de Saneamento de Região Metropolitan de Curitiba*
SANEPAR	:	Sanitation Company of the State of Paraná *Companhia de Saneamento do Paraná*
SEAB	:	State Secretariat of Agriculture and Supply *Secretaria de Estado da Agricultura e do Abastecimento*
SEDU	:	State Secretariat of Urban Development *Secretaria de Estado do Desenvolvimento Urbano*

SEFA	:	State Secretariat for Treasury Secretaria de Estado da Fazenda
SEID	:	State Secretariat for Industry, Commerce and Economic Development *Secretaria de Estado da Indústria, Comércio e do Desenvolvimento Econômico*
SEMA	:	State Secretariat of Environment *Secretaria de Estado do Meio Ambiente*
SEPL	:	State Secretariat of Planning and General Coordination *Secretaria de Estado do Planejamento e Coordenação Geral*
SETR	:	State Secretariat of Transport *Secretaria de Estado dos Transportes*
SIMEPAR	:	Meteorological System of Paraná *Sistema Meteorológico do Paraná*
SETI	:	State Secretariat of Science, Technology and Higher Education *Secretaria de Estado da Ciência, Technologia e Ensino Superior*
SUCEAM	:	Superintendency of Erosion Control and Environmental Sanitation *Superintendência do Controle de Erosão e Saneamento Ambiental*
SUREHMA	:	Superintendency of Water Resources and Environment *Superintendência dos Recursos Hidricos e Méio Ambriente*
UEL	:	State University of Londrina *Universidade Estadual de Londrina*
UNDP	:	United Nation Development Program *Programa das Nações Unidas para o Desenvolvimento*

CHAPTER 1 INTRODUCTION

1.1 Background of Study

The state of Paraná is located in the south of Brazil and has an area of approximately 200 thousand km^2, equivalent to 87% of Japan's main island, Honshu, and a population of about 8.5 million inhabitants. Regarding economy, north and north-eastern Brazil are not well developed, while about 80% of the economy, including the agricultural and industrial sectors, is concentrated in eastern and southern Brazil. The state of Paraná is one of the wealthiest states in Brazil together with Rio De Janeiro and São Paulo.

Agriculture was the main sector in the state of Paraná; however, agro-industry, chemical industry, paper industry etc. have been expanding around urban areas in line with the industrialization policy of the state government. This expansion of industry has promoted a concentration of population around large cities, such as Curitiba, Londrina, Maringa, Cascavel and Ponta Grossa causing shortages of domestic and industrial water. In addition, water pollution due to sewage and waste water from factories has become an important issue and the turbidity of river water has been increased by soil erosion on the large plateau.

The topography of Paraná is mainly plateau and most cities and agricultural lands are located on the plateau. Since the major rivers flow in valleys eroding the plateau, it is popular to utilize the smaller tributary rivers which flow on the plateau, or groundwater, for city and agriculture use. As a result, it has tended to be difficult to distribute enough water to each sector, despite the fact that rainfall is quite plentiful.

To account for the situation described above, the state of Paraná urgently needs to formulate a Master Plan for the utilization of water resources with a target year of 2015, including countermeasures for environmental issues such as water pollution, soil erosion, flood mitigation, etc.

With this situations as a background, the Government of the Federative Republic of Brazil requested technical cooperation related to the Master Plan Study on the Utilization of Water Resources in Paraná State (hereinafter referred to as the "Study") from the Government of Japan in August, 1993. The importance of the Study had been realized through the environmental Joint-Programming (JP) carried out as a part of JP between the two governments to find and establish a project which is necessary and worthwhile. In compliance with the request, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched a Preparatory Study Team headed by Mr. Koichi UZUKA in October, 1993, and the Scope of Work and Minutes of Meeting were agreed among the Governor of Paraná state, Secretary of State Secretariat of Urban Development (SEDU), Executive Director of Brazilian Cooperation Agency, Secretary of State Secretariat of Planning and General Coordination (SEPL), Secretary of State Secretariat of Environment (SEMA) and the leader of the Preparatory Study Team. With these agreements, a study team headed by Mr. Yoshio NAKAGAWA (Study Team) commenced the Study at the middle of March 1994.

1.2 Implementation of the Study

The objectives of the Study are as follows:

1) To formulate a Master Plan for the utilization of water resources, which contributes to urban, industrial, agricultural, hydropower development and environment conservation, in Paraná state aiming at the target year of 2015.

2) To promote technology transfer to the Brazilian counterparts during the Study.

The area covered by the Study is the whole of the state of Paraná as shown in Figure at frontispiece and consists of 11 main river basins.

The Study was divided into three phases as follows:

Phases I: To determine the methodology to formulate a Master Plan considering not only utilization of water resources but also environmental conservation in river basins, such as flood control, water quality improvement, ecosystem preservation, soil erosion control, etc.

Phase II: Based on the above mentioned methodology, to formulate the Strategy regarding utilization of water resources and environmental conservation in river basins in Paraná state and select pilot river basin(s) for the Master Plan considering importance and urgency of water utilization and environmental issues.

Phase III: To formulate the Master Plan for the selected pilot river basin(s).

After Phase II, two pilot basins, Iguaçu river basin and Tibagi river basin, were selected for the Master Plan Study in Phase III.

This report, Main Report II, deals with the Master Plan Study for the Iguaçu river basin.

CHAPTER 2 SUMMARY OF MATER PLAN

The summary of the Master Plan for the Iguaçu river basin is as shown in Table-2.1.

Table-2.1 (1) Summary of Master Plan for Iguaçu River Basin

Contents of Master Plan	Development Water (m^3/day)	Development Method	Cost 10⁶ US$	Implementation Schedule: Present - 2000	2001 - 2005	2006 - 2010	2011 - 2015
1.Water Supply			962.40				
(1) Domestic and Industrial Water			957.80				
Area of Project							
1) Large Urban Areas: Population more than 100,000 in 2015			819.10				
(a) Curitiba Metropolitan Area	625,000		760.00				
Well Stage I	111,000	29 wells	110.60				
Well Stage II	103,000	27 wells	157.90				
Irai Dam	121,000	Dam	135.40				
Piraquara II Dam	65,000	Dam	60.40				
Pequeno Dam	69,000	Dam	78.50				
Alto Miringuava Dam	52,000	Dam	96.90				
Cotia Despique Dam	104,000	Dam	120.30				
(b) Cascavel			38.90				
San Jose River I	13,000	Direct Intake	7.10				
San Jose River II	13,000	Direct Intake	7.10				
Well Stage I	16,000	9 wells	17.70				
Well Stage II	10,000	1 well	7.00				
(c) Foz do Iguacu			11.10				
Parana River I	30,000	Direct Intake	3.70				
Parana River II	30,000	Direct Intake	3.70				
Parana River III	30,000	Direct Intake	3.70				
(d) Guarapuava			9.10				
Bananas River I	13,000	Direct Intake	4.60				
Bananas River II	12,000	Direct Intake	4.50				
2) Medium Urban Areas: Population more than 50,000 in 2015			35.80				
(a) Francisco Beltrao			4.70				
Marrecas River I	10,000	Direct Intake	2.40				
Marrecas River II	10,000	Direct Intake	2.30				
(b) Pato Branco							
Chopim River	10,000	Direct Intake	9.10				
(c) Medianeira							
Well	11,000	1 well	4.30				
(d) Dois Vizinhos							
Chopim River	12,000	Direct Intake	9.10				
(e) Palmas							
Caldeiras River	6,000	Direct Intake	4.90				
(f) Uniao da Vitoria							
Iguacu River	3,000	Direct Intake	3.70				
3) Other 76 Urban Areas	72,000	Direct Intake & Wells	102.90				
(2) Agricultural Water Supply							
Whole River Basin	33,000	Direct Intake	4.60				

Table-2.1 (2) Summary of Master Plan for Iguaçu River Basin

Contents of Master Plan	Cost 10^4 US$	Implementation Schedule: Present - 2000	2001 - 2005	2006 - 2010	2011 - 2015
2. Flood Control	97.00				
(1) Non-structural Measures (Zoning, FFWS[1], Evacuation, Proofing ,Operation Rule) for Curitiba Metropolitan Area, Sao Mateus do Sul, Porto Amazonas, Reboucas, Guarapuava, Uniao da Vitoria, Rio Negro, Foz do Iguacu, Capanema	N.A				
(2) Structural Measures	97.00				
1) Curitiba Metropolitan Area					
(a) Continuation of PROSAM (Channel, Landscape Restoration, Park, Resettlement etc.)	(34.30)				
(b) Extension of PROSAM	N.A				
Channel Excavation					
Dams with Flood Control Function					
2) Sao Mateus do Sul					
Dike System with a Sluice	11.10				
3) Uniao da Vitoria					
Dike System (L=17 km, H=5m) with Sluices	85.90				
3. Sewerage Treatment	344.00				
(1) Development of Sewerage System					
Area — Sewerage Treatment Volume (m^3/day)					
(a) Curitiba Metropolitan Area 420,000	294.00				
(b)Cascavel 45,000	50.00				
4. Soil Erosion Control	143.90				
(1) Terrace for Crop Land 10,781 km^2	43.10				
(2) Non Tillage 7,520 km^2	35.50				
(3) Improvement of Farm Road 21,560 km	32.30				
(4) Maintenance of Farm Road	33.00				
(5) Agronomic Measures and Soil Management	N.A				
5. Ecosystem Conservation	8.63				
(1) Preservation Program	5.33				
1) Fish Population Inventory	0.90				
2) Fish Population Dynamics	0.50				
3) Endemic Fish Population	0.50				
4) Reservoir Fish Assessment	2.60				
5) Management Plan for Conservation	0.03				
6) Serra Baitaca Preservation	0.60				
7) Eng. Bley Preservation	0.20				
8) Biodiversity Institute	N.A.				
(2) Environmental Education Program	0.90				
1) Water Environment Education	0.90				
(3) Monitoring Program	2.40				
1) Bioindicator Monitoring	1.30				
2) River Margin Vegetation	0.70				
3) Sand Fly Monitoring	0.40				
6. Afforestation	168.00				
(1) Afforestation for Conservation of the Water Environment: 900 km^2	33.00				
(2) Commercial Afforestation: 1,900 km^2	135.00				
7. Establishment of Monitoring System	2.13				
(1) Completion of SIMEPAR's System	(35.00)				
(2) Strengthening of Monitoring System	0.19				
1) 4 Meteorological Observations	0.03				
2) 103 rainfall gauges	0.16				
(3) Provision of 11 Stream Gauges	0.11				
(4) Integrated Monitoring System for Surface and Subsurface Water Resources in Curitiba Area	1.43				
1) 5 Stream Gauges	0.05				
2) 17 Boreholes in the Karst	0.41				
3) 20 Boreholes in the Guabirootuba	0.34				
4) 44 Boreholes in the Other Urban Areas	0.63				
(5) Aquatic Ecological Monitoring	0.33				
(6) Integrated Data System with 7 sets of Computer Systems and Telephone Line Network	0.07				

Note 1) FFWS: Flood Forecasting and Warning Systems

Table-2.1 (3) Summary of Master Plan for Iguaçu River Basin

Contents of Master Plan	Cost 10⁶ US$	Implementation Schedule: Present - 2000	2001 - 2005	2006 - 2010	2011 - 2015
8. Institutional Improvement Program (1) Organizational Strengthening through Implementation of the Current Re-Organization (2) Strengthening Groundwater Management (3) Enhancement in the Enforcement of Environmental Regulations (4) Legal Arrangement for the Control of Soil, Sand and Stone Taking in river areas (5) Cost Recovery of Water Environment Management (6) Promotion of Residents Participation through Information Publication	N.A.		to be continued		
(7) Introduction of River Basin Management and Establishment of Competent Entities (8) Promotion of Coordination for Comprehensive Management (9) Establishment of Public Hearing System into the Water Granting Procedure (10) Comprehensive Water Quality Management by River Basin (11) Enhanced Administration of Water Resources Development (12) Water Pricing and Charging for Optimal Water Allocation and Demand Control	N.A.				
Sub Total	1,726				
9. Hydropower 3-stations, Total Installation Capacity: 1,400 MW	1,194				
Grand Total	2,920				

Note (1) Price level in August 1994 is applied with the exchange rate 1 US$ = 0.89 R$.
(2) Costs for continuation of PROSAM and SIMEPAR's System are not included in the total.

CHAPTER 3 NATURAL AND SOCIO-ECONOMIC BACKGROUND

3.1 Topography

The area of Iguaçu River Basin is bordered by the Coastal Mountains in the east, the Paraná River in the west, the ridges passing through Cascavel and Guarapuava in the north, and the Branches of Santa Catarina State in the south. The topographic features of it are generally characterized by the following three areas from east to northwest (Figure-3.1):

- the First Plateau
- the Second Plateau
- the Third Plateau

The First Plateau consists of the upland planes such as Curitiba City and hills with gentle gradients, and it is restricted to the Coastal Mountains in the east and the cuesta mountains in the west and/or northwest. The upland planes are ranging in altitude from 800 to 1,000 m and the cuesta mountains show the inclination of the geological formations trending to the west. The river system in this area which is composed of the Iguaçu River, the Negro River and the tributataries are mainly flowing into the Paraná River from the east to the west.

The Second Plateau consists of the planes and hills with gentle gradients ranging in altitude from 600 to 1,000 m. It is restricted to two cuesta mountains in the east and the west. In this Plateau the river system is mainly composed of the Iguaçu River and the Negro River.

The Third Plateau consists of the planes and hills ranging in altitude from 300 to 800 m. It is restricted to the cuesta mountains in the east and the Paraná River in the west. The hills in this Plateau are generally steeper than the hills of the other plateaus.

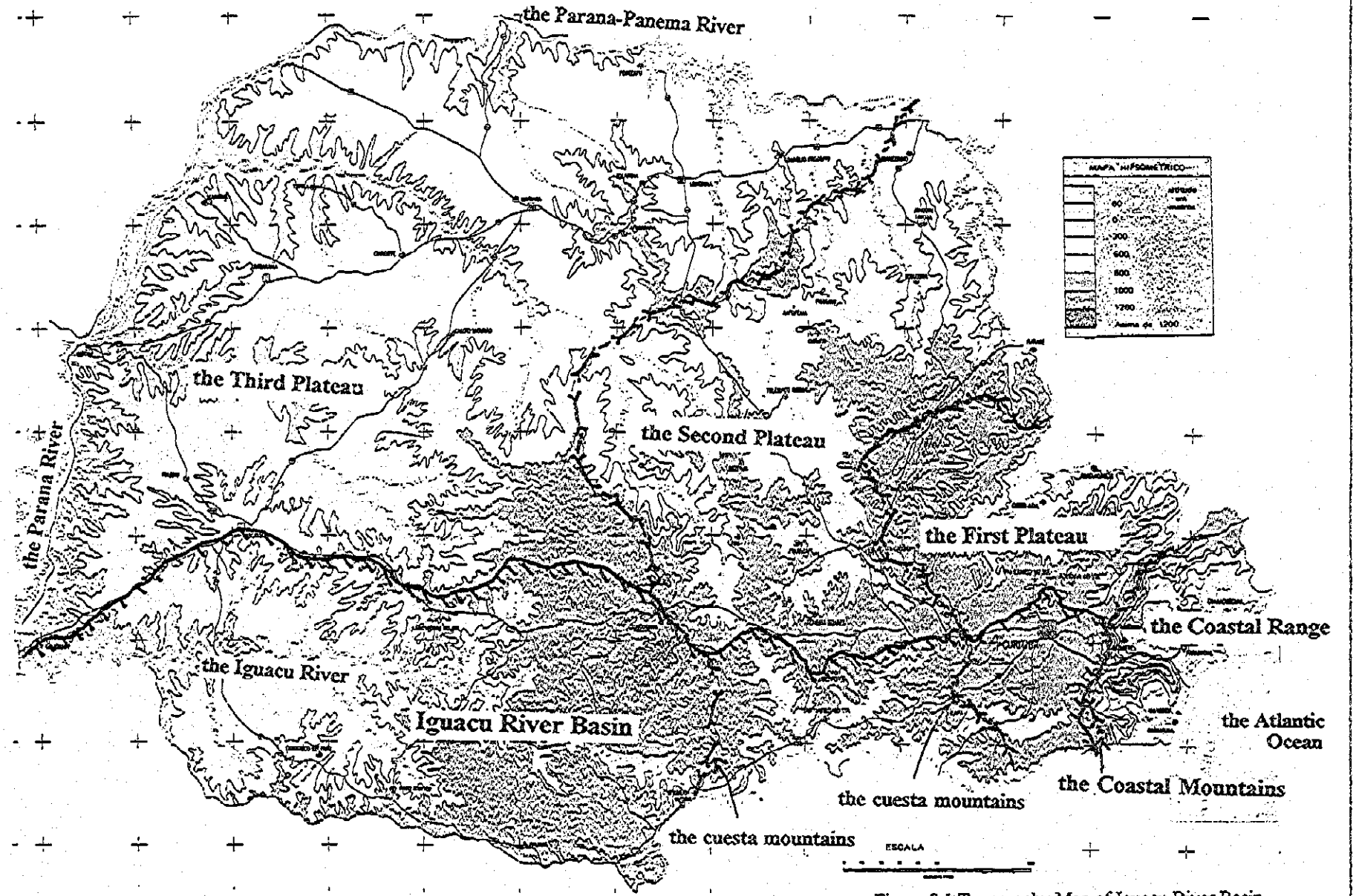


Figure-3.1 Topography Map of Iguaçu River Basin

3.2 Meteorology

3.2.1 Rainfall

The rainfall data in Iguaçu river basin has been measured with different agencies and different observation periods by stations. Using the last 20 years annual mean rainfall data, an Iso-hyetal map was developed as shown in Figure-3.2. In Iguaçu river basin, the following rain characteristics can be observed;

a) The region including Curitiba at the western side of the coast mountains range has the lowest annual rainfall.

b) The middle Iguaçu river basin including Palmas has second highest annual rainfall volume in Paraná because of high altitude between 1100 m and 1200 m, and annual rainfall volume has a tendency to decrease from the middle Iguaçu river basin toward the lower Iguaçu river basin.

3.2.2 Temperature

Annual mean temperature in Paraná State has generally range between 16°C and 22°C throughout the year. Figure-3.3 shows Iso-thermal map of annual mean temperature, and annual temperature in both upper and middle Iguaçu river basins with a mean of 1,000 m altitude is an constant annual mean temperature between 17°C and 18°C. Annual temperature increase toward the lower Iguaçu river basin.

According to collected data in Paraná State, minimum temperature -6.8°C at Palmas and Guarapuava was recorded during the recent 20 years.

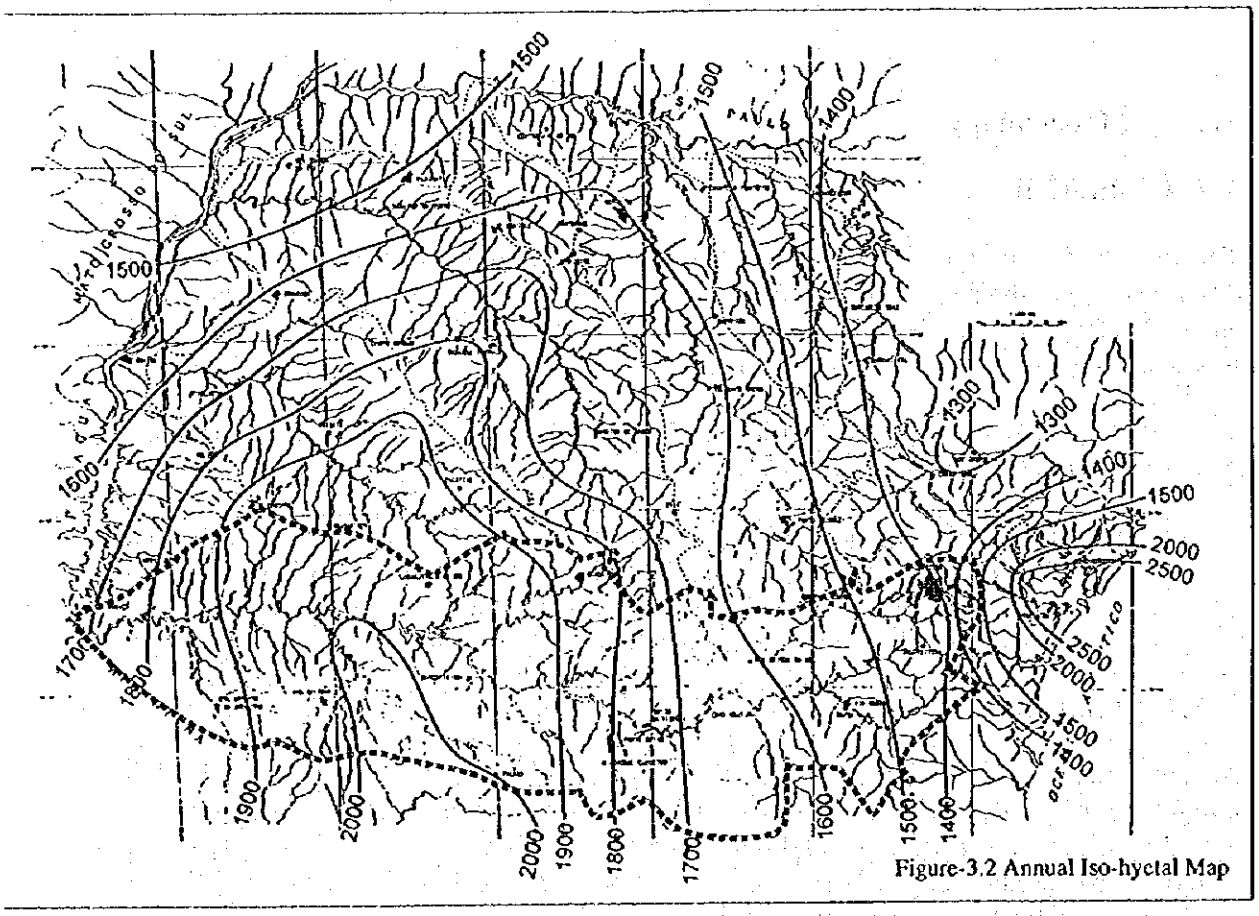


Figure-3.2 Annual Iso-hyetal Map

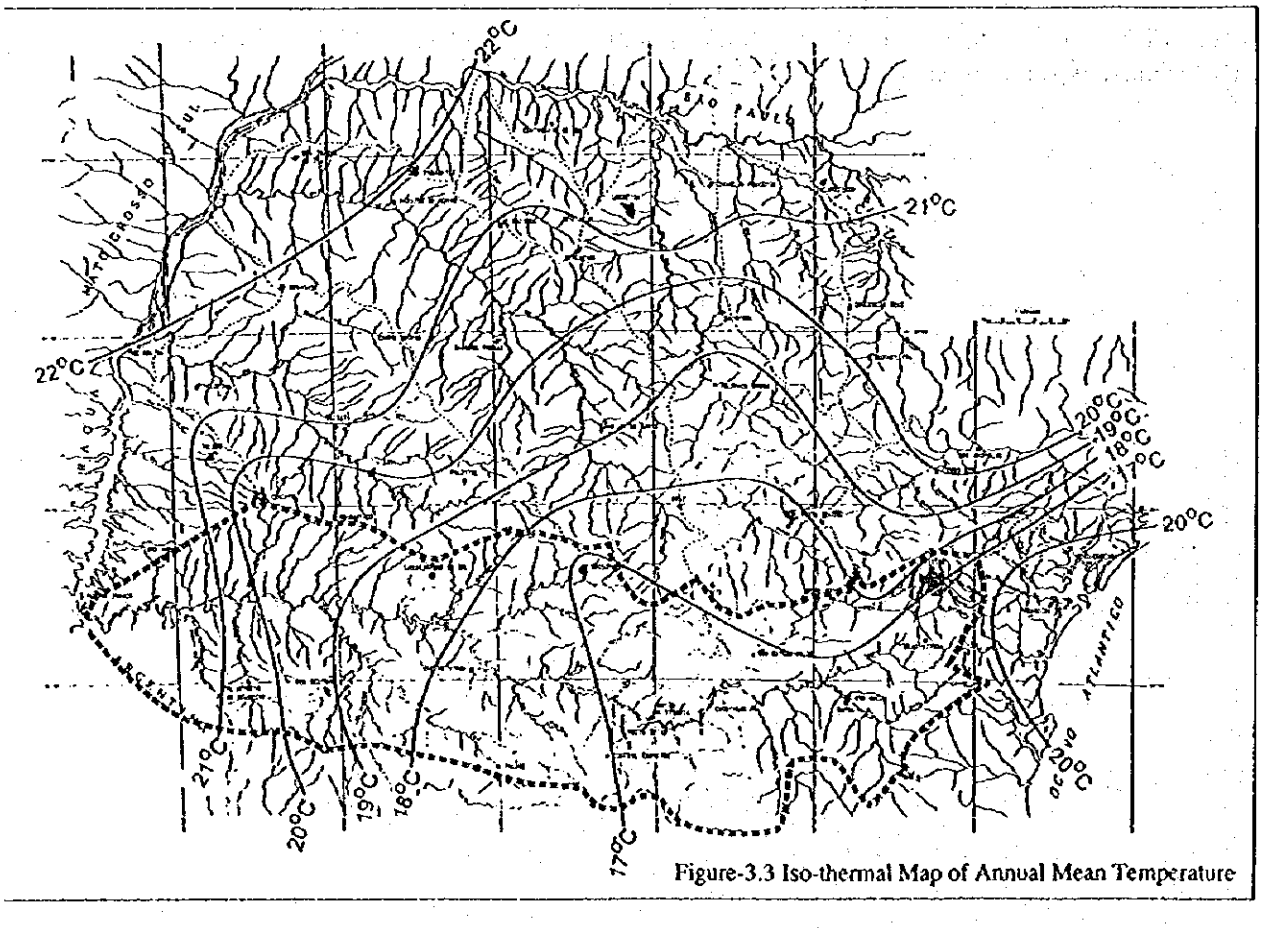


Figure-3.3 Iso-thermal Map of Annual Mean Temperature

3.3 Hydrology

3.3.1 Runoff Analysis

Based on the river flow data for the last 20 years period (1974-1993), daily discharge at each discharge reference point were determined, and the missing daily discharge were determined by monthly discharge correlation analysis among the stations.

The flow regime shows the annual condition using the calculated daily discharge at a certain hydrological station and shall be indicated by the daily discharge and number of exceeded days. The annual flow regime of each selected stations in the Study area shows as follows;

- High Discharge (95th daily discharge from the greatest)
- Normal Discharge (185th daily discharge from the greatest)
- Low Discharge (275th daily discharge from the greatest)
- Drought Discharge (355th daily discharge from the greatest)

The flow regime is commonly used to find the fluctuation in the daily discharge, and utilized for determining the potential water characteristics in Japan.

The flow regime computed by station was adapted for 20 years period (1974-1993), and mean value of the 95th, 185th, 275th and 355th daily discharge for the last 20 years period were calculated. The results of mean flow regime for the last 20 years period are summarized in Table-3.1.

Table-3.1 Flow Regime (mean values for the last 20 years period (1974 - 1993))

Basin	River	No.	St. No.	St.Name	Area (km2)	Daily Discharge (m3/sec)			
						95 day	185 day	275 day	355 day
Itarare	Jaguariaiva	1	64-242-000	Tamandua	1,622	33.86	23.56	18.13	13.04
Cinzas	Cinzas	2	64-360-000	Tomazina	2,015	38.19	25.11	18.09	12.20
		3	64-370-000	Andira	5,622	88.26	50.03	34.18	22.32
Tibagi	Tibagi	4	64-444-000	Uvala	4,450	116.02	64.61	40.56	24.83
		5	64-465-000	Tibagi	8,948	229.39	132.92	87.08	51.89
		6	64-491-000	Barra Rib.das Antas	15,600	381.96	230.94	153.34	95.24
		7	64-507-011	Jataizinho (Extendido)	21,955	502.08	312.46	211.73	128.70
Pirapo	Pirapo	8	64-550-000	Vila Silva Jardim	4,627	79.54	61.38	49.43	37.74
Ivai	Ivai	9	64-625-000	Tereza Cristina	3,672	80.26	38.23	21.57	10.98
		10	64-645-000	Porto Espanhol	8,600	220.04	115.48	67.89	37.24
		11	64-675-002	Porto Bananeiras	24,200	561.65	311.65	199.13	120.84
		12	64-685-000	Porto Paraiso do Norte	28,427	650.69	381.95	262.71	173.69
		13	64-693-000	Novo Porto Taquara	34,432	777.78	491.69	355.97	246.35
Piquiri	Piquiri	14	64-771-500	Porto Guarani	4,223	120.83	60.39	33.58	16.61
		15	64-795-000	Ponte do Piquiri	11,303	345.65	186.73	111.87	65.20
		16	64-820-000	Porto Formosa	17,500	498.85	316.78	219.41	143.22
		17	64-830-000	Balsa do Santa Maria	20,982	551.77	368.49	262.97	172.25
Iguacu	Iguacu	18	65-010-000	Fazendinha	110	3.13	1.66	1.29	0.85
		19	65-025-000	Guajuvira	2,304	68.29	35.78	22.03	12.53
		20	65-035-000	Porto Amazonas	3,662	84.96	49.48	30.73	17.17
		21	65-060-000	Sao Mateus do Sul	6,065	136.44	78.47	50.85	30.30
		22	65-310-000	Uniao da Vitoria	24,211	656.67	365.42	232.03	131.34
		23	65-895-002	Salto Osorio	45,824	1310.22	829.66	532.17	262.67
		24	65-993-000	Salto Cataratas	67,317	1690.20	1126.20	792.05	436.78
	Negro	25	65-175-000	Divisa	7,970	195.67	112.64	76.21	49.50
	Timbo	26	65-260-000	Foz do Cachoeira	693	22.90	12.47	7.92	4.52
	Jordao	27	65-825-000	Santa Clara	3,913	128.17	77.18	49.67	28.19
	Chopim	28	65-960-000	Aguas do Vere	6,696	224.80	131.11	78.13	40.14
Ribeira	Ribeira	29	81-200-000	Capela do Ribeira	7,262	130.63	101.75	86.87	72.80
Litoranea	Nhundiaquara	30	82-170-000	Morretes	217	14.43	8.04	4.86	2.56
	Marumbi	31	82-195-002	Morretes	53	5.02	2.77	1.61	0.77

3.3.2 Runoff Ratio

Using the annual rainfall depth and annual surface runoff over the same catchment area, surface runoff volume and surface runoff ratio by stations were shown in Table-3.2 and Figure-3.4. The runoff ratio of main stream and main tributaries are 43 % and 47 % respectively with a mean of 44 %.

Table-3.2 Summary of Mean Annual Surface Runoff Ratio

(Simulation Period: 1974 - 1993, 20 Years)

Basin	River	No.	St. No.	St.Name	Area (km2)	Rainfall (mm/year)	Runoff (mm/year)	Balance (mm/year)	Runoff Ratio
Itarare	Jaguariaiva	1	64-242-000	Tamandua	1,622	1335.4	632.4	703.0	0.47
Cinzas	Cinzas	2	64-360-000	Tomazina	2,015	1491.3	565.8	925.4	0.38
		3	64-370-000	Andira	5,622	1440.3	480.5	959.8	0.33
Tibagi	Tibagi	4	64-444-000	Uvaia	4,450	1560.2	640.7	919.4	0.41
		5	64-465-000	Tibagi	8,948	1565.7	639.8	925.9	0.41
		6	64-491-000	Barra Rib.das Antas	15,600	1569.7	622.3	947.4	0.40
		7	64-507-011	Jataizinho (Extendido)	21,955	1587.6	604.9	982.6	0.38
Pirapo	Pirapo	8	64-550-000	Vila Silva Jardim	4,627	1615.2	492.7	1122.4	0.31
Ivai	Ivai	9	64-625-000	Tereza Cristina	3,572	1694.5	715.8	978.6	0.42
		10	64-645-000	Porto Espanhol	8,600	1659.9	729.7	930.3	0.44
		11	64-675-002	Porto Bananeiras	24,200	1665.1	648.9	1016.2	0.39
		12	64-685-000	Porto Paraiso do Norte	28,427	1657.6	646.9	1010.7	0.39
		13	64-693-000	Novo Porto Taquara	34,432	1642.2	645.1	997.1	0.39
Piquiri	Piquiri	14	64-771-500	Porto Guarani	4,223	1928.9	855.6	1073.2	0.44
		15	64-795-000	Ponte do Piquiri	11,303	1936.9	926.2	1010.8	0.48
		16	64-820-000	Porto Formosa	17,500	1665.1	823.7	1041.4	0.44
		17	64-830-000	Balsa do Santa Maria	20,982	1843.0	763.6	1079.4	0.41
Iguacu	Iguacu	18	65-010-000	Fazendinha	110	1557.3	741.2	816.0	0.48
		19	65-025-000	Guajuvira	2,304	1416.5	634.8	781.8	0.45
		20	65-035-000	Porto Amazonas	3,662	1445.9	591.8	854.0	0.41
		21	65-060-000	Sao Mateus do Sul	6,055	1483.6	574.8	908.8	0.39
		22	65-310-000	Uniao da Vitoria	24,211	1584.2	663.8	920.4	0.42
		23	65-895-002	Salto Osorio	45,824	1725.6	765.3	960.3	0.44
		24	65-993-000	Salto Cataratas	67,317	1802.9	724.7	1078.3	0.40
	Negro	25	65-175-000	Divisa	7,970	1515.9	616.9	899.0	0.41
	Timbo	26	65-260-000	Foz do Cachoeira	693	1738.7	884.9	853.7	0.51
	Jordao	27	65-825-000	Santa Clara	3,913	1893.4	895.8	997.6	0.47
	Chopim	28	65-960-000	Aguas do Vere	6,696	2003.2	958.8	1044.4	0.48
Ribeira	Ribeira	29	81-200-000	Capela do Ribeira	7,252	1378.1	545.8	832.3	0.40
Litoranea	Nhundiaquara	30	82-170-000	Morretes	217	*) 2537.7	1745.5	792.2	0.69
	Marumbi	31	82-195-002	Morretes	53	*) 3300.0	2646.9	653.1	0.80
Mean	All Basins					1723.9	787.9	936.0	46%
						100%	45%	54%	
	Basins except for Litoranea Area					1641.5	690.8	950.7	42%
						100%	42%	58%	

Note : *) : It was determined by using an existing Iso-hyetal Map (COPEL)

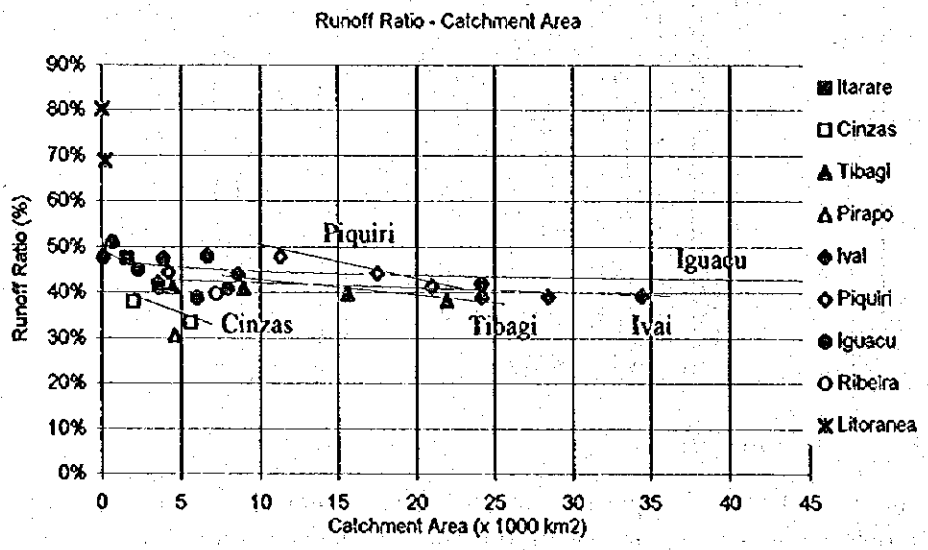


Figure-3.4 Relations between Catchment Area and Runoff Ratio

3.4 Geology and Hydrogeology

Iguaçu River Basin and the neighbor areas of the basin are chiefly occupied by Precambrian (composed of Archean and Proterozoic) metamorphic rocks intruded by granitic intrusive rocks ranging Precambrian-Paleozoic age, and sedimentary rocks of Paleozoic to Cenozoic with Mesozoic volcanics as shown in Figure-3.5.

Precambrian occupies the most upper part of the Iguaçu River consisting of Curitiba Metropolitan Area which is almost the same area as the First Plateau in the Iguaçu river Basin. Paleozoic occupies the Second Plateau and the upper area of the Iguaçu River Basin. Mesozoic occupies the Third Plateau. Cenozoic formations are overlying on the Precambrian in Curitiba Metropolitan Area. The sequences of geology are overlapping from the east to the west in order of age from Paleozoic to Mesozoic. The overlapping trends to incline gently in monoclinic structure from the east to the west.

There are seven aquifers in the area of the Iguaçu River Basin as described below:

(1) the "Karst"

This aquifer consist of carbonate rocks intercalated with non-carbonate semi-schists of Precambrian intruded by dorelite dikes. It occurs in an area of about 3,480 km^2.

(2) Crystalline Rocks

This aquifer is composed of open fractures in granitic rocks and metamorphic rocks in the age from Precambrian to Cambrian. It is exposed in about 7,540 km^2 of the area.

(3) Lower to Middle Paleozoic

This Aquifer is composed of Castro Group and Paraná Group and it is exposed in about 7,150 km^2 of the narrow area.

(4) Middle to Upper Paleozoic

This aquifer is composed of Itarare Group and Guata Group and it is exposed in about 17,400 km^2 of the area.

(5) Late Paleozoic

This aquifer is composed of Passa Dois Group with partial porous media and it is exposed in about 17,400 km^2 of the area.

(6) Mesozoic

1) Botucatu Formation

This aquifer is overlain by Serra Geral Formation within the Third Plateau, and then the distribution of it expands to the neighbor states and countries. Botucatu Formation composed of high permeable sandstones (effective porosity ; $\geq$ 25 %) and the high permeable sandstones form better and bigger reservoirs in the Paraná River Basin.

2) Serra Geral Formation south

The lithology of this aquifer is composed of basalt lavas intercalated with sandstone lenses and the aquifer is exposed in about 32,000 km^2.

3) Serra Geral Formation north

The lithology of this aquifer is same as Serra Geral Formation south, and the aquifer is exposed in the surroundings of Cascavel and about 1,900 km^2 of the area within this pilot basin

(7) Cenozoic

Guabirotuba Formation

The reservoirs of this aquifer is restricted to Curitiba Metropolitan Area (about 1,130 km^2), and the reservoirs are composed of porous media of sandstones and conglomerates in the lower horizon of Guabirotuba Formation.

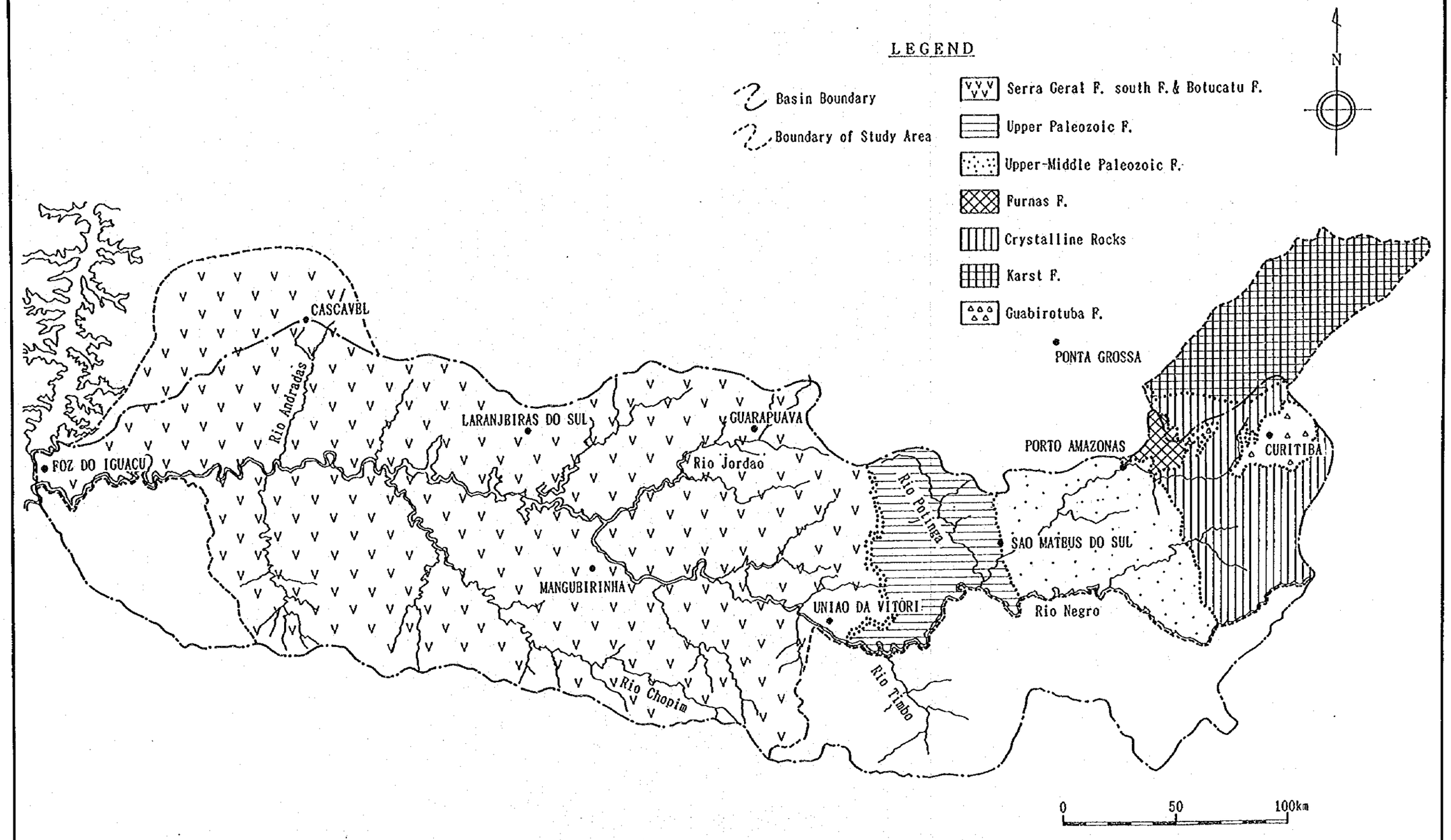


Figure-3.5 Aquifer Distribution in Iguaçu Pilot Basin

3.5 Landuse

SANEPAR conducted the GIS computation based on IAP satellite imagery analysis (1990 & 1994) in order to identify the landuse in Iguaçu river basin. The result is shown in Table-3.3.

Table-3.3 Landuse in Iguaçu River Basin

	Total Area (km^2)	Swamp (%)	Sand Bank (%)	Forest (%)	2nd Veg.(%)	Ref. (%)	Pasture (%)	Crop (%)	Others (%)
Iguacu river basin	55,320	—	—	14.3	27.0	1.7	17.6	37.9	1.5
Parana State	197,880	0.1	0.2	9.0	26.0	3.2	23.1	37.6	0.8

2nd Veg.: Secondary Vegetation, Ref.: Reforestation
Area of Iguacu river basin is only within Parana state.
Source: SANEPAR GIS Computation based on IAP Satellite Imagery Analysis (1990 & 1994)

37.9 % (21,000 km^2) and 17.6 % (9,700 km^2) of Iguaçu river basin are currently utilized as crop land and pasture, while the state average is 37.6 % and 23.1 %, respectively. More than half of the river basin area is used for agriculture spreading all over the basin. 28 % of crop land and 21 % of pasture in the state belongs to Iguaçu river basin.

Natural forest and reforestation in Iguaçu river basin cover 14.3 % (7,900 km^2) and 1.7 % (900 km^2) of its area, respectively. The total area of natural forest in the state is approximately 17,800 km^2 and 44.4 % of them belongs to Iguaçu river basin. The natural forest is mainly located in the coastal mountain range, the upstream end, and the downstream of the basin. In contrast to the preservation of natural forest, the area of reforestation is limited.

Secondary vegetation where the natural bush grows after some use, such as slash and burn farming, extends 27 % (14,900 km^2) of the river basin area. The proper landuse of this area is recommended, for example conversion into reforestation, preservation of native vegetation and so on. It spreads over the basin; however it is more concentrated in the upstream of Iguaçu river basin, around Lapa and Palmeira regions.

The satellite imagery analysis is based on the data of 1989 and 1990. Since this is the most recent landuse available, it was adopted throughout the study assuming that the current landuse does not vary from the one in 1990.

3.6 Socio-Economy

3.6.1 Regional Unit and Zoning of the Study

According to the regional unit of collected data concerning the socio-economic area, it was decided to use the municipalities as a regional unit. Therefore, the zoning lines for the Study should be drawn following the boundary lines of the municipalities. However, as the Study should be made by river basin, it was decided to use the following criteria for inclusion (or exclusion) of municipalities that straddle other river basins, in the zoning of the Study:

- All municipalities that have their urban center located within the river basin, regardless if only a part of the urban area is inside the river basin, were included in the zoning.
- If the urban center of the municipality is not included in this basin, but there is a chance that this municipality will start to use a small river that belongs to this river basin in the future, the municipality is included in the zoning.
- In the case of only a small part of the rural area of the municipality, approximately less than 10% of total area, be included in this river basin, the municipality is excluded of the zoning.
- The recommendation of the Counterpart Team was considered as to the inclusion of municipalities in the zoning, in accordance to the criteria, such as water supply system of undertakers.

The zoning for this river basin is composed of 101 municipalities, and is presented in Figure-3.6.

3.6.2 Population per Municipality

Based on the census of 1970, 1980 and 1991, issued by IBGE and provided by IPARDES, the population per Municipality, in each year, of the 101 municipalities that compose the Study's zoning area are shown in Table-3.4 (1), Table-3.4 (2) and Table-3.4 (3) divided per MRH (Homogeneous Micro-Regions) - refer to Main Report I for data concerning population per MRH. It is important to say that some municipalities have been created recently and, therefore, these new municipalities do not have the number of inhabitants included in the table mentioned above.

3.6.3 Gross Regional Domestic Product (GRDP) per Municipality

Based on the estimated GRDP per MRH (Table-5.10 of Main Report I), on the data of Financial Economic Statistics - 74/85, 86/87, 88/89 issued by SEFA and on the Municipalities' Participation Fund - Preliminary Indexes - 95, issued by SEFA, the GRDP of the 101 municipalities from the years of 1981 to 1991 was estimated and is shown in Table-3.5 (1), Table-3.5(2) and Table-3.5(3).

3.6.4 GRDP by Secondary Sector per Municipality

GRDP by Secondary Sector per Municipality, during the year of 1981 to 1991, was estimated based on the same data mentioned above, while this estimation was presented in the Sectorial Report Vol. A.

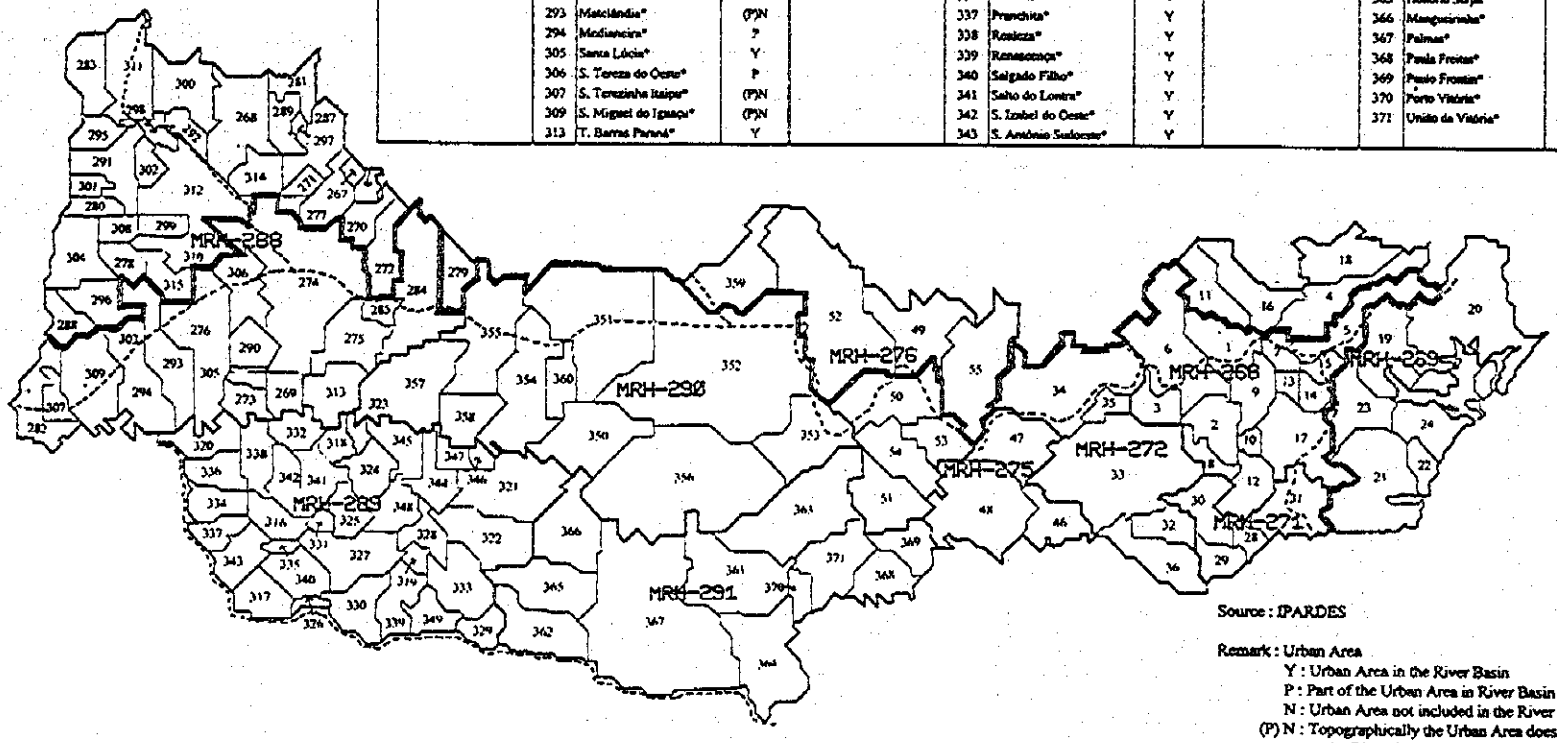
Municipalities in Iguaçu River Basin

No. and Name of MRH	No.	Name	Urban Area
MRH 268	1	Alm. Tamandaré*	Y
Curitiba	2	Araucária*	Y
	3	Balsa Nova*	Y
	5	Campina Grande do Sul*	(P)N
	6	Campo Largo*	Y
	7	Colombo*	Y
	8	Contenda*	Y
	9	Curitiba*	Y
	10	Fazenda Rio Grande*	Y
	12	Mandirituba*	Y
	13	Pinhais*	Y
	14	Pirequara*	Y
	15	Quatro Barras*	Y
	17	S. José dos Pinhais*	Y
MRH 271	28	Agudos do Sul*	Y
Alto Rio Negro	29	Piên*	Y
	30	Quitandinha*	Y
	31	Tijucas do Sul*	Y

No. and Name of MRH	No.	Name	Urban Area
MRH 272	32	Campo do Tenente*	Y
Campos da Lapa	33	Lapa*	Y
	34	Palmeira*	Y
	35	Porto Amazonas*	Y
	36	Rio Negro*	Y
MRH 275	46	Antônio Olinto*	Y
São Mateus do Sul	47	São João Triunfo*	Y
	48	São Mateus do Sul*	Y
MRH 276	50	Irati*	N
Col. de Irati	51	Mallet*	Y
	53	Rebouças*	Y
	54	Rio Azul*	Y
MRH 288	269	B. Vista Aparecida*	Y
Est.Oeste Paranaense	273	C. Leão, Marques*	Y
	274	Cascavel*	P
	275	Catanduvas*	Y
	276	Céu Azul*	(P)N
	282	Foz do Iguaçu*	(P)N
	284	Guaraniaçu*	(P)N
	285	Iberna*	P
	290	Lindoeste*	Y
	293	Matelândia*	(P)N
	294	Medianeira*	P
	305	Santa Lúcia*	Y
	306	S. Tereza do Oeste*	P
	307	S. Terezinha Itaipu*	(P)N
	309	S. Miguel do Iguaçu*	(P)N
	313	T. Barras Paraná*	Y

No. and Name of MRH	No.	Name	Urban Area
MRH 289	316	Ampére*	Y
Sudoeste Paranaense	317	Barracão*	Y
	318	Boa Esperança do Iguaçu*	Y
	319	Bom Sucesso do Sul*	Y
	320	Capanema*	Y
	321	Chopinzinho*	Y
	322	Coronel Vivida*	Y
	323	Cruzeiro do Iguaçu*	Y
	324	Dois Vizinhos*	Y
	325	Enéas Marques*	Y
	326	Flor da Serra do Sul*	Y
	327	Francisco Beltrão*	Y
	328	Itapejara do Oeste*	Y
	329	Mariópolis*	Y
	330	Marmeleiro*	Y
	331	N. Esperança do Sudoeste	Y
	332	N. Prata do Iguaçu*	Y
	333	Pato Branco*	Y
	334	Pérola do Oeste*	Y
	335	Pinhal Sao Bento*	Y
	336	Planalto*	Y
	337	Pranchita*	Y
	338	Realeza*	Y
	339	Renascença*	Y
	340	Salgado Filho*	Y
	341	Salto do Lontra*	Y
	342	S. Izabel do Oeste*	Y
	343	S. Antônio Sudoeste*	Y

No. and Name of MRH	No.	Name	Urban Area
MRH 289	344	São João*	Y
Sudoeste Paranaense (cont)	345	São Jorge do Oeste*	Y
	346	Saudade do Iguaçu*	Y
	347	Sulina*	Y
	348	Verê*	Y
	349	Vitorino*	Y
MRH 290	350	Candói*	Y
Campos de Guarapuava	351	Cantagalo*	Y
	352	Guarapuava*	Y
	353	Inácio Martins*	Y
	354	Laranjeiras do Sul*	Y
	355	Nova Laranjeiras*	Y
	356	Pinhão*	Y
	357	Quedas do Iguaçu*	Y
	358	Rio Bonito Iguaçu*	Y
	360	Virmond*	Y
MRH 291	361	Bituruna*	Y
Médio Iguaçu	362	Clevelândia*	Y
	363	Cruz Machado*	Y
	364	General Carneiro*	Y
	365	Honório Serpa*	Y
	366	Mangueirinha*	Y
	367	Palmas*	Y
	368	Paula Freitas*	Y
	369	Pinto Frontin*	Y
	370	Porto Vitória*	Y
	371	União da Vitória*	Y



Source : IPARDES

Remark : Urban Area
- Y : Urban Area in the River Basin
- P : Part of the Urban Area in River Basin
- N : Urban Area not included in the River Basin
- (P) N : Topographically the Urban Area does not belong to the River Basin, but the Study will consider it as a part of it

Figure-3.6 Zoning of the Study

Table-3.4 (1) Population per Municipality in 1970, 1980 and 1991/Iguaçu River Basin

No. and Name of MRH	No. and Name of Municipality		Population 1970			Population 1980			Population 1991		
			Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
	No.	Name									
MRH 268		TOTAL of MRH	656,469	164,764	821,233	1,325,275	115,351	1,440,626	1,877,232	123,573	2,000,805
Curitiba	1	Alm. Tamandaré	4,288	11,011	15,299	27,063	7,105	34,168	59,080	7,079	66,159
	2	Araucária	5,473	11,644	17,117	27,128	7,671	34,799	54,262	7,627	61,889
	3	Balsa Nova	1,234	3,470	4,704	1,262	4,026	5,288	2,430	5,085	7,515
	5	Campina G. do Sul	319	7,572	7,891	3,783	6,015	9,798	12,722	6,621	19,343
	6	Campo Largo	15,927	18,478	34,405	37,401	17,438	54,839	53,892	18,631	72,523
	7	Colombo	1,092	18,166	19,258	54,979	7,902	62,881	110,273	7,494	117,767
	8	Contenda	1,122	6,102	7,224	3,498	4,058	7,556	4,823	4,118	8,941
	9	Curitiba	584,481	24,545	609,026	1,024,975	—	1,024,975	1,315,035	—	1,315,035
	10	Fazenda Rio Grande	—	—	—	—	—	—	—	—	—
	12	Mandirituba	1,364	9,672	11,036	7,216	8,236	15,452	26,237	12,099	38,336
	13	Pinhais	—	—	—	—	—	—	—	—	—
	14	Piraquara	12,113	9,140	21,253	60,927	9,713	70,640	91,438	15,444	106,882
	15	Quatro Barras	1,105	2,961	4,066	3,493	2,217	5,710	8,132	1,875	10,007
	17	S. José dos Pinhais	21,475	12,649	34,124	56,804	13,830	70,634	111,952	15,503	127,455
	Sub-Total of Municipalities of Basin		649,993	135,410	785,403	1,308,529	88,211	1,396,740	1,850,276	101,576	1,951,852
	Sub-Total of Municipalities not of Basin		6,476	29,354	35,830	16,746	27,140	43,886	26,956	21,997	48,953
MRH 271		TOTAL of MRH	2,529	26,959	29,488	3,327	28,246	31,573	5,958	32,505	38,463
A. Rio Negro	28	Agudos do Sul	767	4,665	5,432	653	4,547	5,200	779	5,297	6,076
	29	Piên	131	5,224	5,355	262	5,728	5,990	1,432	6,313	7,745
	30	Quitandinha	1,242	9,611	10,853	1,587	10,804	12,391	2,476	11,942	14,418
	31	Tijucas do Sul	389	7,459	7,848	825	7,167	7,992	1,271	8,953	10,224
	Sub-Total of Municipalities of Basin		2,529	26,959	29,488	3,327	28,246	31,573	5,958	32,505	38,463
	Sub-Total of Municipalities not of Basin		0	0	0	0	0	0	0	0	0
MRH 272		TOTAL of MRH	34,492	43,417	77,909	44,843	42,862	87,705	58,986	45,345	104,331
Campos da Lapa	32	Campo do Tenente	940	3,471	4,411	1,059	2,806	3,865	2,043	3,198	5,241
	33	Lapa	10,566	21,556	32,122	14,374	20,647	35,021	19,472	20,678	40,150
	34	Palmeira	0	0	0	0	0	0	0	0	0
	35	Porto Amazonas	2,180	730	2,910	1,900	1,008	2,908	2,393	1,186	3,579
	36	Rio Negro	12,677	5,759	18,436	15,838	5,838	21,676	20,200	6,115	26,315
	Sub-Total of Municipalities of Basin		26,363	31,516	57,879	33,171	30,299	63,470	44,108	31,177	75,285
	Sub-Total of Municipalities not of Basin		8,129	11,901	20,030	11,672	12,563	24,235	14,878	14,168	29,046
MRH 275		TOTAL of MRH	7,492	33,616	41,108	13,682	30,894	44,576	19,375	33,816	53,191
São Mateus do Sul	46	Antônio Olinto	210	6,967	7,177	353	6,436	6,789	618	7,115	7,733
	47	São João Triunfo	1,163	9,133	10,296	1,899	8,914	10,813	2,830	9,490	12,320
	48	São Mateus do Sul	6,119	17,516	23,635	11,430	15,544	26,974	15,927	17,211	33,138
	Sub-Total of Municipalities of Basin		7,492	33,616	41,108	13,682	30,894	44,576	19,375	33,816	53,191
	Sub-Total of Municipalities not of Basin		0	0	0	0	0	0	0	0	0
MRH 276		TOTAL of MRH	36,598	98,159	134,757	49,976	98,491	148,467	69,230	102,442	171,672
Col. Irati	50	Irati	0	0	0	0	0	0	0	0	0
	51	Mallet	2,605	7,345	9,950	3,249	6,798	10,047	5,528	6,280	11,808
	53	Rebouças	3,038	8,092	11,130	3,834	7,081	10,915	5,396	7,552	12,948
	54	Rio Azul	1,776	7,905	9,681	2,519	8,170	10,689	3,206	9,200	12,406
	Sub-Total of Municipalities of Basin		7,419	23,342	30,761	9,602	22,049	31,651	14,130	23,032	37,162
	Sub-Total of Municipalities not of Basin		29,179	74,817	103,996	40,374	76,442	116,816	55,100	79,410	134,510

(To be continued)

Table-3.4 (2) Population per Municipality in 1970, 1980 and 1991/Iguaçu River Basin

(Continuation)

No. and Name of MRH	No. and Name of Municipality		Population 1970			Population 1980			Population 1991		
	No.	Name	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
MRH 288		TOTAL of MRH 288	149,516	602,916	752,432	484,504	476,205	960,709	728,448	288,033	1,016,481
Ext. Oeste Paranaense	269	B. Vista Aparecida	—	—	—	—	—	—	3,228	7,142	10,370
	273	C. Leôn. Marques	3,451	19,805	23,256	10,317	30,506	40,823	7,783	10,060	17,843
	274	Cascavel	34,961	54,960	89,921	123,698	39,761	163,459	177,766	15,224	192,990
	275	Catanduvas	2,191	23,535	25,726	8,625	27,706	36,331	3,712	6,109	9,821
	276	Céu Azul	4,183	19,036	23,219	11,754	13,690	25,444	5,831	4,755	10,586
	282	Foz do Iguaçu	20,147	13,819	33,966	101,330	34,991	136,321	186,385	3,738	190,123
	284	Guaraniaçu	3,552	25,097	28,649	7,567	26,901	34,468	8,623	17,389	26,012
	285	Ibema	—	—	—	—	—	—	3,795	2,311	6,106
	290	Lindoeste	—	—	—	—	—	—	938	5,939	6,877
	293	Matelândia	2,651	21,910	24,561	10,016	23,410	33,426	10,385	6,944	17,329
	294	Medianeira	7,247	23,895	31,142	24,375	24,986	49,361	29,572	9,093	38,665
	305	Santa Lúcia	—	—	—	—	—	—	—	—	—
	306	S. Tereza do Oeste	—	—	—	—	—	—	3,307	2,811	6,118
	307	S. Terezinha Itaipu	—	—	—	—	—	—	11,655	2,494	14,149
	309	S. Miguel do Iguaçu	2,178	23,064	25,242	7,881	26,366	34,247	10,773	13,948	24,721
	313	T. Barras Paraná	—	—	—	—	—	—	4,104	10,878	14,982
	Sub-Total of Municipalities of Basin		80,561	225,121	305,682	305,563	248,317	553,880	464,629	111,693	576,322
	Sub-Total of Municipalities not of Basin		68,955	377,795	446,750	178,941	227,888	406,829	260,591	169,198	429,789
MRH 289		TOTAL of MRH	80,157	366,203	446,360	166,906	354,343	521,249	225,666	252,460	478,126
Sudoeste Paranaense	315	Ampére	2,352	10,894	13,246	5,012	10,611	15,623	6,037	7,176	13,213
	317	Barracão	2,065	14,140	16,205	2,704	15,441	18,145	4,491	10,201	14,692
	318	B. Esper. Iguaçu	—	—	—	—	—	—	—	—	—
	319	B. Sucesso do Sul	—	—	—	—	—	—	—	—	—
	320	Capanema	3,733	17,984	21,717	7,708	18,075	25,783	7,936	11,432	19,368
	321	Chopinzinho	2,377	24,665	27,042	7,681	27,494	35,175	8,282	16,305	24,587
	323	Cruzeiro do Iguaçu	—	—	—	—	—	—	—	—	—
	322	Coronel Vivida	3,587	18,826	22,413	10,144	16,808	26,952	12,339	12,801	25,140
	324	Dois Vizinhos	4,149	33,004	37,153	12,286	30,186	42,472	22,202	18,065	40,267
	325	Enéas Marques	1,175	12,707	13,882	1,721	12,556	14,277	2,115	10,281	12,396
	326	Flor da Serra do Sul	—	—	—	—	—	—	—	—	—
	327	Francisco Beltrão	13,413	23,394	36,807	28,289	20,473	48,762	45,622	15,650	61,272
	328	Itapejara do Oeste	2,130	7,945	10,075	3,066	7,037	10,103	3,909	5,136	9,045
	329	Mariópolis	1,850	5,016	6,866	2,314	3,889	6,203	2,855	3,425	6,280
	330	Marmeleiro	1,991	10,660	12,651	3,265	11,113	14,378	5,763	11,350	17,113
	331	N. Espera. Sudoeste	—	—	—	—	—	—	—	—	—
	332	N. Prata do Iguaçu	—	—	—	—	—	—	4,171	7,444	11,615
	333	Pato Branco	15,420	18,388	33,808	31,470	14,467	45,937	43,406	12,269	55,675
	334	Pérola do Oeste	1,483	13,790	15,273	2,961	13,727	16,688	3,234	9,021	12,255
	335	Pinhal Sao Bento	—	—	—	—	—	—	—	—	—
	336	Planalto	2,217	14,978	17,195	3,650	16,631	20,281	4,075	11,017	15,092
	337	Pranchita	—	—	—	—	—	—	2,609	5,995	8,604
	338	Realeza	3,313	13,424	16,737	8,744	12,951	21,695	9,300	7,846	17,146
	339	Renascença	1,665	7,615	9,280	2,103	5,800	7,903	2,161	5,385	7,546

(To be continued)

Table-3.4 (3) Population per Municipality in 1970, 1980 and 1991/Iguaçu River Basin (Continuation)

No. and Name of MRH	No. and Name of Municipality		Population 1970			Population 1980			Population 1991		
	No.	Name	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
MRH 289 (cont.)	340	Salgado Filho	885	11,420	12,305	1,583	13,954	15,537	2,062	11,767	13,829
Sudoeste Paranaense	341	Salto do Lontra	2,254	29,194	31,448	7,083	27,166	34,249	4,624	9,673	14,297
	342	S. Izabel do Oeste	2,542	12,361	14,903	4,411	11,575	15,986	4,647	7,863	12,510
	343	S Antônio Sudoeste	4,987	24,546	29,533	9,124	26,070	35,194	8,992	11,298	20,290
	344	São João	1,732	13,722	15,454	3,706	13,386	17,092	4,775	8,886	13,661
	345	São Jorge do Oeste	2,560	9,476	12,036	3,980	9,736	13,716	3,847	6,474	10,321
	346	Saudade do Iguaçu	—	—	—	—	—	—	—	—	—
	347	Sulina	—	—	—	—	—	—	951	4,271	5,222
	348	Verê	1,082	11,627	12,709	1,805	10,468	12,273	2,657	7,555	10,212
	349	Vitorino	1,195	6,427	7,622	2,096	4,729	6,825	2,604	3,874	6,478
	Sub-Total of Municipalities of Basin		80,157	366,203	446,360	166,906	354,343	521,249	225,666	252,460	478,126
	Sub-Total of Municipalities not of Basin		0	0	0	0	0	0	0	0	0
MRH 290		TOTAL of MRH	54,427	135,403	189,830	138,931	157,905	296,836	176,072	157,602	333,674
Campos de Guarapuava	350	Candói	—	—	—	—	—	—	—	—	—
	351	Cantagalo	—	—	—	—	—	—	5,690	19,807	25,497
	352	Guarapuava	43,264	67,639	110,903	89,951	68,636	158,587	116,210	43,424	159,634
	353	Inácio Martins	979	6,668	7,647	2,063	8,396	10,459	2,513	11,263	13,776
	354	Laranjeiras do Sul	6,394	33,257	39,651	21,242	41,591	62,833	21,994	32,108	54,102
	355	Nova Laranjeiras	—	—	—	—	—	—	—	—	—
	356	Pinhão	3,192	17,164	20,356	12,790	20,665	33,455	10,666	24,344	35,010
	357	Quedas do Iguaçu	598	10,675	11,273	12,885	18,617	31,502	16,155	15,354	31,509
	358	Rio Bonito Iguaçu	—	—	—	—	—	—	—	—	—
	360	Virmond	—	—	—	—	—	—	—	—	—
	Sub-Total of Municipalities of Basin		54,427	135,403	189,830	138,931	157,905	296,836	173,228	146,300	319,528
	Sub-Total of Municipalities not of Basin		0	0	0	0	0	0	2,844	11,302	14,146
MRH 291		TOTAL of MRH	47,336	79,876	127,212	77,837	79,866	157,703	102,446	76,187	178,633
Médio Iguaçu	361	Bituruna	1,434	7,670	9,104	3,448	8,267	11,715	5,575	7,277	12,852
	362	Clevelândia	8,212	5,424	13,636	11,949	4,839	16,788	13,347	4,710	18,057
	363	Cruz Machado	653	12,907	13,560	1,782	13,359	15,141	2,473	14,095	16,568
	364	General Carneiro	807	6,003	6,810	2,975	6,000	8,975	6,078	5,209	11,287
	365	Honório Serpa	—	—	—	—	—	—	—	—	—
	366	Mangueirinha	1,188	14,242	15,430	2,286	18,871	21,157	4,982	20,622	25,604
	367	Palmas	10,001	15,810	25,811	16,732	14,144	30,876	24,890	10,372	35,262
	368	Paula Freitas	588	4,107	4,695	646	3,875	4,521	1,473	3,192	4,665
	369	Paulo Frontin	790	4,522	5,312	994	4,378	5,372	1,573	4,985	6,558
	370	Porto Vitória	683	2,421	3,104	1,509	2,018	3,527	1,854	1,918	3,772
	371	União da Vitória	22,980	6,770	29,750	35,516	4,115	39,631	40,201	3,807	44,008
	Sub-Total of Municipalities of Basin		47,336	79,876	127,212	77,837	79,866	157,703	102,446	76,187	178,633
	Sub-Total of Municipalities not of Basin		0	0	0	0	0	0	0	0	0
TOTAL OF MUNICIPALITIES OF THE BASIN			956,277	1,057,446	2,013,723	2,057,548	1,040,130	3,097,678	2,899,816	808,746	3,708,562

Source : Census of 1970, 1980 and 1991 / IBGE, IPARDES

Remark : Municipalities without number of population had not been created until the respective year

: Figure of Irati/MRH 276 and Palmeira/MRH 272 are listed in Tibagi River Basin

Table - 3.5 (1) GRDP per Municipality in 1981, 1983, 1985, 1987, 1989 and 1991 / Iguaçu River Basin

No. and Name of MRH	No. and Name of Municipality		YEAR													
			1981		1983		1985		1987		1989		1991			
	No.	Name	%	US$ million	%	US$ million	%	US$ million	%	US$ million	%	US$ million	%/ State	%/ MRH	US$ million
MRH 268		TOTAL of MRH	100.00	5,437.50	100.00	5,936.60	100.00	5,789.10	100.00	8,317.40	100.00	9,379.30	36.72205	100.00	9,265.14
Curitiba	1	Alm. Tamandaré	0.37	20.14	0.42	24.95	0.52	30.34	0.41	34.11	0.58	54.19	0.16895	0.46	42.62
	2	Araucária	39.09	2,125.52	38.00	2,255.68	30.67	1,775.63	22.81	1,896.89	18.22	1,708.96	7.10329	19.34	1,791.80
	3	Balsa Nova	0.67	36.46	0.67	39.72	0.58	33.81	0.48	39.62	0.81	75.64	0.34736	0.95	87.62
	5	Campina G. do Sul	0.14	7.40	0.11	6.79	0.13	7.68	0.24	19.80	0.31	29.49	0.13114	0.36	33.08
	6	Campo Largo	2.94	159.74	2.20	130.64	2.89	167.09	3.43	285.37	4.07	381.59	1.02403	2.79	258.31
	7	Colombo	1.18	64.02	0.95	56.60	1.15	66.70	1.42	117.86	1.52	142.36	0.52668	1.43	132.86
	8	Contenda	0.22	12.09	0.18	10.81	0.25	14.47	0.18	14.74	0.15	13.89	0.06847	0.19	17.27
	9	Curitiba	48.72	2,649.06	51.18	3,038.44	54.60	3,160.59	61.83	5,142.59	63.41	5,947.30	23.14956	63.04	5,839.48
	12	Mandirituba	0.14	7.62	0.13	7.78	0.20	11.71	0.18	14.76	0.23	21.98	0.04258	0.12	10.74
	13	Pinhais	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.69687	1.90	175.79
	14	Piraquara	0.66	35.69	0.85	50.37	1.04	60.42	1.88	156.73	1.63	152.50	0.05654	0.15	14.26
	15	Quatro Barras	0.61	33.18	0.45	26.96	0.47	27.05	0.44	36.24	0.44	41.34	0.19760	0.54	49.84
	10	Faz. Rio Grande	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03852	0.10	9.72
	17	S. José dos Pinhais	2.59	140.66	2.72	161.51	4.79	277.17	4.57	380.43	6.27	588.34	2.23923	6.10	564.85
	Subtotal of Municipalities of Basin		97.32	5,291.58	97.87	5,810.25	97.30	5,632.65	97.86	8,139.15	97.64	9,157.57	35.79082	97.46	9,028.23
	Subtotal of Municipalities not of Basin		2.68	145.92	2.13	126.35	2.70	156.45	2.14	178.25	2.36	221.73	0.93123	2.54	234.90
MRH 271		TOTAL of MRH	100.00	17.50	100.00	15.90	100.00	21.70	100.00	21.00	100.00	23.00	0.13076	100.00	32.98
Alto Rio Negro	28	Agudos do Sul	8.54	1.49	11.09	1.76	8.96	1.94	8.50	1.79	7.88	1.81	0.01055	8.07	2.66
	29	Piên	29.24	5.12	37.14	5.90	35.86	7.78	35.49	7.45	36.51	8.40	0.03971	30.37	10.02
	30	Quitandinha	43.58	7.63	28.93	4.60	33.38	7.24	23.29	4.89	26.13	6.01	0.02957	22.62	7.46
	31	Tijucas do Sul	18.65	3.26	22.84	3.63	21.80	4.73	32.72	6.87	29.47	6.78	0.05093	38.95	12.85
	Subtotal of Municipalities of Basin		100.00	17.50	100.00	15.90	100.00	21.70	100.00	21.00	100.00	23.00	0.13076	100.00	32.98
	Subtotal of Municipalities not of Basin		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00000	0.00	0.00
MRH 272		TOTAL of MRH	100.00	164.30	100.00	151.20	100.00	187.40	100.00	214.50	100.00	271.50	1.08390	100.00	273.41
Campos da Lapa	32	Campo do Tenente	1.12	1.84	1.01	1.53	1.60	2.99	1.56	3.35	1.48	4.01	0.02356	2.17	5.94
	33	Lapa	21.32	35.03	24.48	37.01	30.28	56.75	20.95	44.94	20.84	56.59	0.26275	24.24	66.28
	35	Porto Amazonas	0.71	1.17	0.77	1.16	1.01	1.89	1.23	2.63	1.21	3.27	0.01544	1.42	3.89
	36	Rio Negro	46.71	76.74	48.47	73.28	38.16	71.51	42.01	90.11	50.99	138.43	0.49132	45.33	123.94
	Subtotal of Municipalities of Basin		69.86	114.78	74.72	112.98	71.05	133.14	65.75	141.04	74.51	202.31	0.79307	73.17	200.05
	Subtotal of Municipalities not of Basin		30.14	49.52	25.28	38.22	28.95	54.26	34.25	73.46	25.49	69.19	0.29083	26.83	73.36
MRH 275		TOTAL of MRH	100.00	36.30	100.00	28.40	100.00	51.20	100.00	51.40	100.00	191.70	0.26584	100.00	67.06
S. Mateus do Sul	46	Antônio Olinto	9.13	3.31	8.13	2.31	7.36	3.77	8.57	4.41	11.58	22.19	0.01351	5.08	3.41
	47	São João Triunfo	13.99	5.08	14.82	4.21	11.85	6.07	12.24	6.29	12.58	24.11	0.02851	10.72	7.19
	48	São Mateus do Sul	76.88	27.91	77.05	21.88	80.79	41.36	79.19	40.70	75.85	145.40	0.22382	84.19	56.46
	Subtotal of Municipalities of Basin		100.00	36.30	100.00	28.40	100.00	51.20	100.00	51.40	100.00	191.70	0.26584	100.00	67.06
	Subtotal of Municipalities not of Basin		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MRH 276		TOTAL of MRH	100.00	126.70	100.00	111.70	100.00	160.90	100.00	173.20	100.00	191.70	0.94978	100.00	199.87
Col. Irati	50	Irati	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00000	0.00	0.00
	51	Mallet	9.60	12.17	13.41	14.97	13.24	21.30	16.67	28.87	17.36	33.27	0.06537	8.25	16.49
	53	Rebouças	7.60	9.63	5.43	6.07	9.52	15.32	7.67	13.28	8.08	15.49	0.04631	5.84	11.68
	54	Rio Azul	9.83	12.45	9.26	10.34	6.46	10.40	5.63	9.74	5.70	10.94	0.04575	5.77	11.54
	Subtotal of Municipalities of Basin		27.03	34.25	28.10	31.38	29.22	47.02	29.97	51.89	31.14	59.70	0.15743	19.86	39.71
	Subtotal of Municipalities not of Basin		72.97	92.45	71.90	80.32	70.78	113.88	70.03	121.30	68.86	132.00	0.31296	39.50	78.94

(To be continued)

Table - 3.5 (2) GRDP per Municipality in 1981, 1983, 1985, 1987, 1989 and 1991 / Iguaçu River Basin

(Continuation)

No. and Name of MRH	No. and Name of Municipality		YEAR											
			1981		1983		1985		1987		1989		1991		
	No.	Name	%	US$ million	%	US$ million	%	US$ million	%	US$ million	%	US$ million	%/ State	%/ MRH	US$ million
MRH 288		TOTAL of MRH	100.00	1,875.90	100.00	1,940.90	100.00	2,354.50	100.00	2,654.20	100.00	3,329.90	16.46638	100.00	4,153.64
Ext. Oeste Paranaense	269	B. Vista Aparecida	0,00	0.00	0.31	6.00	0.25	6.00	0.91	24.13	0.14	4.81	0.01607	0.10	4.05
	273	C. Leôn. Marques	1.75	32.79	0.87	16.81	0.62	14.62	0.45	12.02	0.34	11.26	0.03226	0.20	8.14
	274	Cascavel	20.51	384.41	17.45	338.62	17.43	410.36	19.74	523.97	15.45	514.56	1.82089	11.06	459.32
	275	Catanduvas	2.21	41.46	1.03	19.91	1.20	28.22	1.07	28.32	1.01	33.51	0.05698	0.35	14.37
	276	Céu Azul	2.13	39.83	2.22	43.06	2.03	47.72	2.28	60.40	1.12	37.17	0.17173	1.04	43.32
	282	Foz do Iguaçu	7.47	140.00	5.90	114.57	5.54	130.44	7.01	186.12	20.39	678.81	8.62572	52.38	2,175.84
	284	Guaraniaçu	0,00	0.00	0,00	0.00	0,00	0.00	1.39	36.88	1.13	37.60	0.08286	0.50	20.90
	285	Ibema	0,00	0.00	0,00	0.00	0,00	0.00	0,00	0.00	0,00	0.00	0.03299	0.20	8.32
	290	Lindoeste	0,00	0.00	0,00	0.00	0,00	0.00	0,00	0.00	0.00	0.00	0.01479	0.09	3.73
	293	Matelândia	2.65	49.74	2.41	46.82	2.13	50.20	1.24	32.89	0.99	33.07	0.12039	0.73	30.37
	294	Medianeira	4.72	88.36	4.02	78.10	3.54	83.32	2.80	74.39	3.02	100.71	0.33490	2.03	84.48
	305	Santa Lúcia	0,00	0.00	0,00	0.00	0,00	0.00	0,00	0.00	0.00	0.00	0.01190	0.07	3.00
	306	S. Tereza do Oeste	0,00	0.00	0,00	0.00	0,00	0.00	0,00	0.00	0.00	0.00	0.02473	0.15	6.24
	307	S. Terezinha Itaipu	0,00	0.00	1.97	38.17	1.12	26.44	0.76	20.29	0.69	22.90	0.05226	0.32	13.18
	309	S. Miguel do Iguaçu	3.32	62.28	2.52	48.97	3.17	74.59	2.60	68.94	4.53	150.95	0.19222	1.17	48.49
	313	T. Barras Paraná	0,00	0.00	1.09	21.14	0.52	12.22	0.47	12.58	0.32	10.78	0.03648	0.22	9.20
	Subtotal of Municipalities of Basin		44.77	838.88	39.48	766.19	37.30	878.12	39.82	1,056.80	48.99	1,631.34	11.61110	70.51	2,928.90
	Subtotal of Municipalities not of Basin		55.23	1,035.02	60.52	1,174.71	62.70	1,476.38	60.18	1,597.40	51.01	1,698.56	4.83921	29.39	1,220.69
MRH 289		TOTAL of MRH	100.00	656.50	100.00	593.90	100.00	785.50	100.00	792.90	100.00	866.10	3.15132	100.00	794.92
Sudoeste Paranaense	316	Ampére	2.09	13.70	2.34	13.87	2.28	17.90	1.59	12.62	1.60	13.82	0.06288	2.00	15.86
	317	Barracão	1.77	11.59	0.94	5.60	0.67	5.26	0.62	4.89	0.93	8.01	0.01897	0.60	4.79
	318	B. Esperança Iguaçu	0,00	0.00	0,00	0.00	0,00	0.00	0,00	0.00	0,00	0.00	0.02204	0.70	5.56
	319	B. Sucesso do Sul	0,00	0.00	0,00	0.00	0,00	0.00	0,00	0.00	0,00	0.00	0.01969	0.62	4.97
	320	Capanema	4.93	32.38	5.24	31.11	4.29	33.74	2.86	22.65	2.51	21.77	0.07648	2.43	19.29
	321	Chopinzinho	4.92	32.31	4.82	28.62	4.97	39.01	4.91	38.90	13.44	116.37	0.25072	7.96	63.24
	322	Coronel Vivida	4.81	31.59	5.20	30.86	4.16	32.68	4.75	37.63	4.20	36.40	0.11096	3.52	27.99
	323	Cruzeiro do Iguaçu	0,00	0.00	0,00	0.00	0,00	0.00	0,00	0.00	0,00	0.00	0.06429	2.04	16.22
	324	Dois Vizinhos	8.94	58.72	10.53	62.56	12.82	100.73	14.71	116.63	8.10	70.15	0.51525	16.35	129.97
	325	Enéas Marques	1.53	10.05	1.19	7.06	1.57	12.30	1.52	12.02	1.04	9.02	0.03492	1.11	8.81
	326	Flor da Serra do Sul	0,00	0.00	0,00	0.00	0,00	0.00	0,00	0.00	0,00	0.00	0.01523	0.48	3.84
	327	Francisco Beltrão	15.86	104.14	17.17	101.99	18.41	144.60	20.41	161.81	19.01	164.68	0.50992	16.18	128.63
	328	Itapejara do Oeste	2.30	15.11	2.92	17.33	2.41	18.96	1.85	14.67	1.44	12.44	0.05214	1.65	13.15
	329	Mariópolis	2.22	14.57	2.08	12.34	1.64	12.88	1.62	12.88	1.56	13.48	0.04282	1.36	10.80
	330	Marmeleiro	2.41	15.80	2.00	11.85	2.39	18.78	2.26	17.94	1.87	16.17	0.04887	1.55	12.33
	331	N. Esperança Sudoest.	0,00	0.00	0,00	0.00	0,00	0.00	0,00	0.00	0,00	0.00	0.01862	0.59	4.70
	332	N. Prata do Iguaçu	0,00	0.00	2.66	15.82	2.72	21.39	2.03	16.12	1.45	12.58	0.04314	1.37	10.88
	333	Pato Branco	14.19	93.16	12.63	75.01	13.08	102.75	15.40	122.07	16.39	141.93	0.44132	14.00	111.32
	334	Pérola do Oeste	1.96	12.85	1.61	9.56	1.80	14.15	1.51	11.96	1.08	9.37	0.03147	1.00	7.94
	335	Pinhal de São Bento	0,00	0.00	0,00	0.00	0,00	0.00	0,00	0.00	0,00	0.00	0.00488	0.15	1.23
	336	Planalto	2.74	17.97	2.47	14.69	2.54	19.96	1.60	12.72	1.27	11.03	0.04036	1.28	10.18
	337	Pranchita	0,00	0.00	1.71	10.16	2.23	17.48	2.15	17.02	1.18	10.25	0.04065	1.29	10.25
	338	Realeza	5.98	39.24	4.51	26.81	3.83	30.06	3.43	27.20	2.64	22.84	0.07918	2.51	19.97
	339	Renascença	2.14	14.08	2.60	15.46	2.39	18.76	2.00	15.84	1.78	15.45	0.06122	1.94	15.44

(To be continued)

Table - 3.5 (3) GRDP per Municipality in 1981, 1983, 1985, 1987, 1989 and 1991 / Iguaçu River Basin

(Continuation)

No. and Name of MRH	No. and Name of Municipality		YEAR												
			1981		1983		1985		1987		1989		1991		
	No.	Name	%	US$ million	%	US$ million	%	US$ million	%	US$ million	%	US$ million	% / State	% / MRH	US$ million
MRH 289 (cont.)	340	Salgado Filho	1.09	7.15	0.87	5.19	0.82	6.47	0.73	5.78	0.61	5.25	0.02061	0.65	5.20
Sud. Paranaense	341	Salto do Lontra	3.98	26.10	2.79	16.60	2.05	16.11	1.78	14.10	1.60	13.84	0.04248	1.35	10.72
	342	S. Izabel do Oeste	2.03	13.34	2.17	12.86	2.44	19.19	1.67	13.24	1.78	15.44	0.05622	1.78	14.18
	343	S. Antônio Sudoeste	4.32	28.38	2.43	14.42	1.98	15.57	1.83	14.51	1.69	14.61	0.04472	1.42	11.28
	344	São João	3.13	20.56	3.09	18.35	2.67	21.00	3.07	24.32	3.13	27.09	0.09876	3.13	24.91
	345	São Jorge do Oeste	3.27	21.46	2.33	13.85	2.06	16.22	1.96	15.57	5.75	49.77	0.14896	4.73	37.58
	346	Saudade do Iguaçu	0,00	0.00	0,00	0.00	0,00	0.00	0,00	0.00	0,00	0.00	0.02532	0.80	6.39
	347	Sulina	0,00	0.00	0,00	0.00	0,00	0.00	0,00	0.00	1.04	8.98	0.02814	0.89	7.10
	348	Verê	1.77	11.62	1.96	11.65	2.06	16.16	1.77	14.01	1.65	14.27	0.04416	1.40	11.14
	349	Vitorino	1.62	10.62	1.73	10.27	1.70	13.36	1.99	15.79	1.28	11.09	0.03593	1.14	9.06
	Subtotal of Municipalities of Basin		100.00	656.50	100.00	593.90	100.00	785.50	100.00	792.90	100.00	866.10	3.15132	100.00	794.92
	Subtotal of Municipalities not of Basin		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00000	0.00	0.00
MRH 290		TOTAL of MRH	100.00	423.10	100.00	396.10	100.00	470.50	100.00	671.10	100.00	909.50	3.26796	100.00	824.34
Campos de Guarapuava	350	Candói	0,00	0.00	0,00	0.00	0,00	0.00	0,00	0.00	0,00	0.00	0.27647	8.46	69.74
	351	Cantagalo	0,00	0.00	1.39	5.49	3.74	17.61	2.21	14.85	1.78	16.16	0.05682	1.74	14.33
	352	Guarapuava	71.30	301.69	67.28	266.51	67.75	318.77	70.67	474.27	59.05	537.05	1.62612	49.76	410.19
	353	Inácio Martins	3.02	12.77	2.12	8.40	2.07	9.75	1.61	10.82	0.97	8.86	0.03566	1.09	9.00
	354	Laranjeiras do Sul	9.95	42.09	9.41	37.27	8.59	40.44	6.82	45.74	15.87	144.33	0.22609	6.92	57.03
	355	Nova Laranjeiras	0,00	0.00	0.00	0.00	0,00	0.00	0,00	0.00	0,00	0.00	0.03091	0.95	7.80
	356	Pinhão	8.09	34.21	7.76	30.73	10.07	47.40	9.59	64.37	7.47	67.92	0.33101	10.13	83.50
	357	Quedas do Iguaçu	7.64	32.34	10.27	40.69	8.55	40.22	6.86	46.03	12.48	113.50	0.37014	11.33	93.37
	358	Rio Bonito do Iguaçu	0,00	0.00	0.00	0.00	0,00	0.00	0,00	0.00	0,00	0.00	0.19229	5.88	48.51
	360	Virmond	0,00	0.00	0,00	0.00	0,00	0.00	0,00	0.00	0,00	0.00	0.01597	0.49	4.03
	Subtotal of Municipalities of Basin		100.00	423.10	96.84	383.59	97.04	456.58	95.55	641.23	95.84	871.67	2.82819	86.54	713.41
	Subtotal of Municipalities not of Basin		0,00	0.00	2.97	11.77	2.85	13.42	4.35	29.22	4.09	37.17	0.10648	3.26	26.86
MRH 291		TOTAL of MRH	100.00	287.50	100.00	227.10	100.00	288.90	100.00	380.60	100.00	473.00	1.77866	100.00	448.67
Médio Iguaçu	361	Bituruna	6.09	17.51	5.07	11.52	4.77	13.78	4.86	18.51	11.05	52.27	0.26764	15.05	67.51
	362	Clevelândia	14.38	41.35	19.94	45.28	20.79	60.07	12.69	48.31	11.87	56.13	0.22545	12.68	56.87
	363	Cruz Machado	2.33	6.69	2.11	4.79	2.98	8.61	2.61	9.92	8.36	39.56	0.22866	12.86	57.68
	364	General Carneiro	4.14	11.90	5.60	12.72	7.15	20.66	6.97	26.54	6.06	28.66	0.08164	4.59	20.59
	365	Honório Serpa	0,00	0.00	0,00	0.00	0,00	0.00	0,00	0.00	0,00	0.00	0.03617	2.03	9.12
	366	Mangueirinha	14.30	41.11	13.78	31.29	15.15	43.77	14.78	56.25	8.96	42.36	0.11415	6.42	28.79
	367	Palmas	22.94	65.94	17.62	40.03	15.56	44.94	19.61	74.64	15.28	72.26	0.20869	11.73	52.64
	368	Paula Freitas	1.05	3.03	1.19	2.70	0.96	2.79	1.47	5.59	0.93	4.41	0.01483	0.83	3.74
	369	Paulo Frontin	1.30	3.74	1.59	3.61	1.76	5.09	1.55	5.91	1.40	6.60	0.02272	1.28	5.73
	370	Porto Vitória	1.51	4.35	1.46	3.32	1.25	3.62	1.41	5.37	1.76	8.34	0.04294	2.41	10.83
	371	União da Vitória	31.95	91.87	31.63	71.84	29.62	85.56	34.04	129.56	34.34	162.41	0.53577	30.12	135.15
	Subtotal of Municipalities of Basin		100.00	287.50	100.00	227.10	100.00	288.90	100.00	380.60	100.00	473.00	1.77866	100.00	448.67
	Subtotal of Municipalities not of Basin		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL OF THE MUNICIPALITIES OF THE BASIN			—	7,700.38	—	7,969.69	—	8,294.82	—	11,276.01	—	13,476.38	—	—	14,253.94

Source : Estatística Econômico Financeira (Finance Economic Statistics) 74/85, 86/87, 88/89 - SEFA; Fundo de Participação dos Municípios - Índices Provisórios - 95 (Municipalities' Participation Fund - Preliminary Indexes - 95) - SEFA

Remark : Figures of Irati/MRH 276 and Palmeira/MRH 272 are listed in Tibagi River Basin

: In the figures of 1989 and 1991 was included the value of contribution of Hydropelectric Power Stations

CHAPTER 4 FUTURE SOCIO-ECONOMIC FRAMEWORK

4.1 Population Projection Per Municipality

The population projection per municipality was carried out based on the preliminary estimation by IPARDES for the years of 1993, 1995 and 2000 (estimated rural population, urban population and total population per municipality). However, new figures provided by IPARDES in 1995 were applied to the urban population of Mandirituba - MRH 268/Curitiba, Piên - MRH 271/A. Rio Negro and Cafelândia - MRH 288/Extr. Oeste Paranaense, and to the rural population of Foz do Iguaçu - MRH 288/Extr. Oeste Paranaense.

The projection for the target years was carried out by JICA Team, as follows: 1) the population of all municipalities of each MRH, which includes any of the municipalities belonging to the zoning, was estimated based on the trend of increase (or decrease) of the municipalities' population in 1993, 1995 and 2000, divided into urban population and rural population; 2) the total of urban and rural population of these municipalities was adjusted tentatively to the estimated urban and rural population of the MRH to which they belong; 3) finally, the municipalities of each MRH that are included by the zoning and, therefore, belong to the river basin, were separated from those that are not included in the river basin. The estimated population per municipality in 1993 by IPARDES and 2005 and 2015 by JICA Team are shown in Table-4.1 (1), Table-4.1 (2), Table-4.1 (3) and Table-4.1 (4).

4.2 Projection of Gross Regional Domestic Production (GRDP) per Municipality and GRDP by Secondary Sector per Municipality

4.2.1 GRDP per Municipality

GRDP per municipality in 1993 was estimated by the same method mentioned in Section-3.6.3, but by excluding the contribution of hydroelectric power stations of some municipalities. And the GRDP per Municipality for the target years 2005 and 2015 was estimated individually, based on the past trend of GRDP per municipality during the years of 1981 to 1991 (shown in Table-3.5 (1)/Table-3.5 (3)) also excluding the contribution of hydroelectric power stations of some municipalities in 1989 and 1991, and on 1993, by adjusting the estimated GRDP per MRH to the years to which they belong.

The estimated GRDP per Municipality of the 101 municipalities in 1993, 2005 and 2015 are shown in Table-4.2 (1) and Table-4.2 (2).

4.2.2 GRDP by Secondary Sector per Municipality

GRDP by Secondary Sector per Municipality in 1993, 2005 and 2015 was estimated using the same method mentioned in Section-4.2.1. This estimation, however, is presented in Section-5.2.

4.2.3 Future Socio-Economic Framework

Based on the population projection per municipality (shown in Table-4.1 (1)/Table-4.1 (4)), and GRDP projection per municipality in 1993, 2005 and 2015 (shown in Table-4.2 (1) and Table-4.2 (2)), the future socio-economic framework of this river basin can be estimated and

conceived through the classification of the 101 municipalities into four categories. There are three remarkable points, as follows:

1) 11 large size municipalities (classified in 1st and 2nd classes) will occupy approximately 80% of the total urban population and 81% of the GRDP of this river basin in 2015, respectively.

2) 24 large and medium size municipalities will occupy 91% of the urban population and 90% of the GRDP of this river basin in 2015, respectively.

3) 14 municipalities in Curitiba Metropolitan Area will share about 62% of the urban population and 68% of the GRDP of this river basin in 2015, respectively.

The classification of these 101 municipalities with their participation, in percentage, in this river basin's urban population and GRDP in 1993, 2005 and 2015, are shown in Table-4.3.

Table-4.1 (1) Projected Population per Municipality in 1993, 2005 and 2015, and Area per Municipality/ Iguaçu River Basin

No. and Name of MRH	No. and Name of Municipality		Population									Urban Area	Area		
			1993			2005			2015				Total Area	Area involved	
	No.	Name	URBAN	RURAL	TOTAL	URBAN	RURAL	TOTAL	URBAN	RURAL	TOTAL			%	Km²
MRH 268		Total of MRH	1,949,043	126,226	2,075,269	2,582,200	113,700	2,695,900	3,112,700	96,700	3,209,400	—	—	—	—
CURITIBA	1	Alm. Tamandaré	65,600	7,045	72,645	121,910	6,530	128,440	169,730	6,230	175,960	Y	521.3	36.31	189.3
	2	Araucária	59,259	7,680	66,939	102,280	7,120	109,400	138,700	6,800	145,500	Y	503.7	100.00	503.7
	3	Balsa Nova	2,627	5,266	7,893	4,350	4,910	9,260	5,810	4,170	9,980	Y	321.9	99.32	319.7
	5	Campina Grande do Sul	15,192	6,750	21,942	40,100	5,870	45,970	61,440	4,980	66,420	(P)N	554.4	14.28	79.2
	6	Campo Largo	55,837	18,791	74,628	72,070	15,930	88,000	85,590	13,520	99,110	Y	1,262.9	23.53	297.2
	7	Colombo	120,802	7,404	128,206	208,640	6,420	215,060	283,000	5,750	288,750	Y	189.6	67.29	127.6
	8	Contenda	4,925	4,118	9,043	6,000	3,850	9,850	6,890	3,690	10,580	Y	222.2	100.00	222.2
	9	Curitiba	1,337,892	0	1,337,892	1,546,490	0	1,546,490	1,717,150	0	1,717,150	Y	431.7	100.00	431.7
	10	Fazenda Rio Grande	26,498	3,401	29,899	76,310	3,760	80,070	119,160	3,190	122,350	Y	110.9	100.00	110.9
	12	Mandirituba	4,669	9,452	14,121	6,700	9,460	16,160	8,410	8,030	16,440	Y	392.3	100.00	392.3
	13	Pinhais	75,045	3,843	78,888	102,520	4,490	107,010	125,690	3,810	129,500	Y	98.2	100.00	98.2
	14	Piraquara	20,482	12,847	33,329	25,580	13,470	39,050	29,650	11,440	41,090	Y	171.9	100.00	171.9
	15	Quatro Barras	9,149	1,825	10,974	18,150	1,420	19,570	25,810	1,120	26,930	Y	183.2	54.32	99.5
	17	S. José dos Pinhais	122,604	16,652	139,256	210,330	14,920	225,250	284,590	12,660	297,250	Y	916.1	73.60	674.2
	Subtotal of Municipalities of Basin		1,920,581	105,074	2,025,655	2,541,430	98,150	2,639,580	3,061,620	85,390	3,147,010	—	—	—	—
	Subtotal of Municipalities not of Basin		28,462	21,152	49,614	40,770	15,550	56,320	51,080	11,310	62,390	—	—	—	—
MRH 271		Total of MRH	6,081	33,468	39,549	9,100	36,200	45,300	11,200	36,100	47,300	—	—	—	—
A. RIO NEGRO	28	Agudos do Sul	752	5,451	6,203	740	5,890	6,630	640	5,870	6,510	Y	259.6	100.00	259.6
	29	Piên	1,541	6,464	8,005	3,420	6,830	10,250	4,770	6,820	11,590	Y	261.7	100.00	261.7
	30	Quitandinha	2,508	12,239	14,747	3,310	12,950	16,260	3,910	12,910	16,820	Y	419.4	100.00	419.4
	31	Tijucas do Sul	1,280	9,314	10,594	1,630	10,530	12,160	1,880	10,500	12,380	Y	678.9	62.25	422.6
	Subtotal of Municipalities of Basin		6,081	33,468	39,549	9,100	36,200	45,300	11,200	36,100	47,300	—	—	—	—
	Subtotal of Municipalities not of Basin		0	0	0	0	0	0	0	0	0	—	—	—	—
MRH 272		Total of MRH	60,616	46,044	106,660	73,600	46,400	120,000	84,800	44,100	128,900	—	—	—	—
C. DA LAPA	32	Campo do Tenente	2,243	3,276	5,519	3,900	3,530	7,430	5,310	3,510	8,820	Y	314.0	100.00	314.0
	33	Lapa	20,074	20,809	40,883	24,860	19,810	44,670	28,970	18,010	46,980	Y	2,203.9	100.00	2,203.9
	34	Palmeira	0	0	0	0	0	0	0	0	0	N	1,500.8	18.22	273.4
	35	Porto Amazonas	2,435	1,223	3,658	2,820	1,380	4,200	3,150	1,420	4,570	Y	206.8	73.98	153.0
	36	Rio Negro	20,643	6,203	26,846	24,120	6,180	30,300	27,140	5,820	32,960	S	603.2	100.00	603.2
	Subtotal of Municipalities of Basin		45,395	31,511	76,906	55,700	30,900	86,600	64,570	28,760	93,330	—	—	—	—
	Subtotal of Municipalities not of Basin		15,221	14,533	29,754	17,900	15,500	33,400	20,230	15,340	35,570	—	—	—	—
MRH 275		Total of MRH	20,122	34,552	54,674	26,300	35,000	61,300	31,500	33,100	64,600	—	—	—	—
S. MATEUS DO SUL	46	Antônio Olinto	675	7,268	7,943	1,120	7,390	8,510	1,490	7,000	8,490	Y	482.5	100.00	482.5

(To be continued)

Table-4.1 (2) Projected Population per Municipality in 1993, 2005 and 2015, and Area per Municipality/ Iguaçu River Basin

(Continuation)

No. and Name of MRH	No. and Name of Municipality		Population									Urban Area	Area		
			1993			2005			2015				Total Area	Area involved	
	No.	Name	URBAN	RURAL	TOTAL	URBAN	RURAL	TOTAL	URBAN	RURAL	TOTAL			%	Km²
MRH 275	47	São João Triunfo	2,958	9,679	12,637	4,060	9,600	13,660	5,000	8,940	13,940	Y	712.2	99.43	708.1
C. DE PONTA GROSSA	48	São Mateus do Sul	16,489	17,605	34,094	21,120	18,010	39,130	25,010	17,160	42,170	Y	1,332.8	100.00	1,332.8
Cont.	Subtotal of Municipalities of Basin		20,122	34,552	54,674	26,300	35,000	61,300	31,500	33,100	64,600	—	—	—	—
	Subtotal of Municipalities not of Basin		0	0	0	0	0	0	0	0	0	—	—	—	—
MRH 276		Total of MRH	71,821	103,597	175,418	90,400	103,300	193,700	105,900	97,300	203,200				
Col. de IRATI	50	Irati	0	0	0	0	0	0	0	0	0	N	896.8	45.51	408.1
	51	Mallet	5,948	6,146	12,094	9,040	5,170	14,210	11,610	4,160	15,770	Y	672.8	100.00	672.8
	53	Rebouças	5,579	7,636	13,215	7,000	7,680	14,680	8,190	7,280	15,470	Y	504.7	98.85	498.9
	54	Rio Azul	3,260	9,426	12,686	3,710	10,090	13,800	4,090	10,010	14,100	Y	642.6	100.00	642.6
	Subtotal of Municipalities of Basin		14,787	23,208	37,995	19,750	22,940	42,690	23,890	21,450	45,340	—	—	—	—
	Subtotal of Municipalities not of Basin		57,034	80,389	137,423	70,650	80,360	151,010	82,010	75,850	157,860	—	—	—	—
MRH 288		Total of MRH	765,125	265,796	1,030,921	1,069,000	160,800	1,229,800	1,320,500	100,300	1,420,800	—	—	—	—
Ext.Oeste Paranaense	269	B. Vista Aparecida	3,140	7,020	10,160	2,770	6,210	8,980	2,430	5,230	7,660	Y	232.2	100.00	232.2
	273	C. Leôn. Marques	5,799	5,996	11,795	5,630	2,280	7,910	5,440	960	6,400	Y	279.8	100.00	279.8
	274	Cascavel	185,746	14,184	199,930	250,280	9,020	259,300	303,280	5,890	309,170	P	2,157.5	57.57	1,198.90
	275	Catanduvas	5,050	5,693	10,743	6,230	3,700	9,930	7,180	2,450	9,630	Y	593.9	100.00	593.9
	276	Céu Azul	5,720	3,637	9,357	6,520	3,330	9,850	7,210	3,090	10,300	(P)N	1,185.0	79.09	937.2
	282	Foz do Iguaçu	204,365	3,738	208,103	353,920	1,020	354,940	479,380	330	479,710	(P)N	476.1	65.58	312.2
	284	Guaraniaçu	7,965	12,965	20,930	9,500	9,120	18,620	10,720	6,470	17,190	(P)N	1,052.5	47.03	495
	285	Ibema	4,018	2,274	6,292	5,630	2,080	7,710	6,960	1,810	8,770	P	151.7	97.79	148.3
	290	Lindoeste	847	5,472	6,319	480	3,250	3,730	290	2,000	2,290	Y	273.2	100.00	273.2
	293	Matelândia	8,529	4,551	13,080	9,580	2,010	11,590	10,400	960	11,360	(P)N	611.4	98.37	601.4
	294	Medianeira	30,268	8,392	38,660	36,360	5,040	41,400	41,230	3,130	44,360	P	799.2	77.72	621.1
	305	Santa Lúcia	1,874	2,725	4,599	1,810	1,280	3,090	1,740	640	2,380	Y	137.1	100.00	137.1
	306	S. Tereza do Oeste	3,370	2,571	5,941	3,900	1,470	5,370	4,320	880	5,200	P	423.3	55.64	235.5
	307	S. Terezinha Itaipu	12,189	2,329	14,518	16,410	1,490	17,900	19,880	970	20,850	(P)N	289.8	55.94	162.1
	309	S. Miguel do Iguaçu	10,321	9,401	19,722	12,850	4,390	17,240	14,900	2,210	17,110	(P)N	997.2	45.70	455.7
	313	T. Barras Paraná	4,040	10,060	14,100	3,940	6,160	10,100	3,830	3,890	7,720	Y	521.7	100.00	521.7
	Subtotal of Municipalities of Basin		490,101	93,988	584,089	723,040	55,640	778,680	919,190	40,910	960,100	—	—	—	—
	Subtotal of Municipalities not of Basin		271,884	164,788	436,672	343,190	98,950	442,140	401,310	59,390	460,700	—	—	—	—
MRH 289		Total of MRH	235,122	238,203	473,325	305,400	162,100	467,500	366,300	93,500	459,800	—	—	—	—
Sudoeste Paranaense	316	Ampére	6,043	6,760	12,803	6,700	4,200	10,900	7,050	1,870	8,920	Y	307.9	100.00	307.9
	317	Barracão	4,815	9,140	13,955	7,420	5,360	12,780	9,410	2,010	11,420	Y	386.4	100.00	386.4
	318	Boa Esperança do Iguaçu	541	3,129	3,670	900	1,940	2,840	1,190	1,160	2,350	Y	249.4	100.00	249.4

(To be continued)

Table-4.1 (3) Projected Population per Municipality in 1993, 2005 and 2015, and Area per Municipality/ Iguaçu River Basin

(Continuation)

No. and Name of MRH	No. and Name of Municipality		Population									Urban Area	Area		
			1993			2005			2015				Total Area	Area involved	
	No.	Name	URBAN	RURAL	TOTAL	URBAN	RURAL	TOTAL	URBAN	RURAL	TOTAL			%	Km²
MRH 289	319	Bom Sucesso do Sul	1,036	2,799	3,835	1,350	2,510	3,860	1,570	2,040	3,610	Y	135.3	100.00	135.3
Sudoeste Paranaense	320	Capanema	7,798	10,662	18,460	7,360	6,060	13,420	6,760	2,040	8,800	Y	403.9	100.00	403.9
Cont.	321	Chopinzinho	8,437	11,159	19,596	9,790	7,380	17,170	10,640	3,800	14,440	Y	992.5	100.00	992.5
	322	Coronel Vivida	12,518	12,285	24,803	14,240	8,820	23,060	15,260	5,330	20,590	Y	681.5	100.00	681.5
	323	Cruzeiro do Iguaçu	2,045	3,136	5,181	3,400	1,930	5,330	4,460	1,160	5,620	Y	96.6	100.00	96.6
	324	Dois Vizinhos	21,463	10,350	31,813	35,060	5,600	40,660	45,560	3,000	48,560	Y	372.7	100.00	372.7
	325	Enéas Marques	1,423	5,822	7,245	1,580	4,210	5,790	1,660	2,570	4,230	Y	234.7	100.00	234.7
	326	Flor da Serra do Sul	304	4,884	5,188	360	4,400	4,760	390	3,600	3,990	Y	94.7	100.00	94.7
	327	Francisco Beltrão	48,417	15,017	63,434	73,320	10,760	84,080	100,490	6,500	106,990	Y	696.7	100.00	696.7
	328	Itapejara do Oeste	3,962	4,903	8,865	4,600	3,350	7,950	5,000	1,850	6,850	Y	246.0	100.00	246.0
	329	Mariópolis	2,896	3,368	6,264	3,280	2,860	6,140	3,500	2,190	5,690	Y	232.1	100.00	232.1
	330	Marmeleiro	6,197	9,225	15,422	9,870	9,390	19,260	12,700	8,530	21,230	Y	449.9	100.00	449.9
	331	N. Esperança do Sudoeste	713	4,730	5,443	820	4,430	5,250	900	3,750	4,650	Y	176.9	100.00	176.9
	332	N. Prata do Iguaçu	4,147	6,790	10,937	4,200	3,650	7,850	4,120	1,950	6,070	Y	333.0	100.00	333.0
	333	Pato Branco	43,856	9,210	53,066	56,450	7,310	63,760	67,550	5,140	72,690	Y	570.2	100.00	570.2
	334	Pérola do Oeste	3,219	8,454	11,673	3,280	5,050	8,330	3,240	2,030	5,270	Y	330.1	100.00	330.1
	335	Pinhal Sao Bento	544	2,193	2,737	630	1,480	2,110	690	810	1,500	Y	107.6	100.00	107.6
	336	Planalto	4,064	10,336	14,400	4,200	6,210	10,410	4,190	2,530	6,720	Y	337.1	100.00	337.1
	337	Pranchita	2,729	5,579	8,308	3,750	3,200	6,950	4,500	1,120	5,620	Y	297.1	100.00	297.1
	338	Realeza	9,173	7,231	16,404	8,980	4,150	13,130	8,540	2,340	10,880	Y	351.9	100.00	351.9
	339	Renascença	2,120	5,348	7,468	2,010	4,820	6,830	1,850	3,920	5,770	Y	434.7	100.00	434.7
	340	Salgado Filho	1,804	9,278	11,082	2,150	7,370	9,520	2,380	5,180	7,560	Y	506.4	100.00	506.4
	341	Salto do Lontra	4,798	8,601	13,399	6,300	5,030	11,330	7,380	1,860	9,240	Y	336.9	100.00	336.9
	342	S. Izabel do Oeste	4,573	7,388	11,961	4,470	4,560	9,030	4,250	2,010	6,260	Y	330.5	100.00	330.5
	343	S Antônio Sudoeste	8,554	8,431	16,985	9,740	5,040	14,780	10,540	2,010	12,550	Y	313.8	100.00	313.8
	344	São João	4,899	8,343	13,242	5,930	5,070	11,000	6,630	2,130	8,760	Y	408.9	100.00	408.9
	345	São Jorge do Oeste	3,746	6,097	9,843	3,330	3,750	7,080	2,880	1,620	4,500	Y	385.1	100.00	385.1
	346	Saudade do Iguaçu	1,943	2,656	4,599	2,290	2,220	4,510	2,520	1,670	4,190	Y	147.8	100.00	147.8
	347	Sulina	931	3,964	4,895	820	2,330	3,150	700	1,340	2,040	Y	158.5	100.00	158.5
	348	Verê	2,769	7,186	9,955	3,730	4,800	8,530	4,420	2,540	6,960	Y	345.6	100.00	345.6
	349	Vitorino	2,645	3,749	6,394	3,090	2,860	5,950	3,380	1,900	5,280	Y	326.1	100.00	326.1
	Subtotal of Municipalities of Basin		235,122	238,203	473,325	305,400	162,100	467,500	366,300	93,500	459,800	—	—	—	—
	Subtotal of Municipalities not of Basin		0	0	0	0	0	0	0	0	0	—	—	—	—

(To be continued)

Table-4.1 (4) Projected Population per Municipality in 1993, 2005 and 2015, and Area per Municipality/, Iguaçu River Basin (Continuation)

No. and Name of MRH	No. and Name of Municipality		Population									Urban Area	Area		
			1993			2005			2015				Total Area	Area involved	
	No.	Name	URBAN	RURAL	TOTAL	URBAN	RURAL	TOTAL	URBAN	RURAL	TOTAL			%	Km²
MRH 290		Total of MRH	179,566	157,625	337,191	230,700	159,500	390,200	276,000	152,100	428,100				
C. de Guarapuava	350	Candói	1,811	17,459	19,270	2,320	19,970	22,290	2,520	19,790	22,310	Y	999.8	100.00	999.8
	351	Cantagalo	6,792	20,200	26,992	17,910	22,170	40,080	39,360	21,960	61,320	Y	1,844.5	41.97	774.1
	352	Guarapuava	117,385	27,041	144,426	154,360	29,050	183,410	179,920	28,780	208,700	Y	4,152.2	81.95	3,402.70
	353	Inácio Martins	2,527	11,858	14,385	2,850	14,660	17,510	2,830	14,520	17,350	Y	897.5	98.04	879.9
	354	Laranjeiras do Sul	19,954	11,473	31,427	19,380	7,850	27,230	17,020	5,750	22,770	Y	1,182.5	89.20	1,052.70
	355	Nova Laranjeiras	316	12,035	12,351	310	9,840	10,150	270	8,410	8,680	Y	1,283.7	45.09	578.8
	356	Pinhão	10,068	24,076	34,144	7,760	26,820	34,580	5,620	26,580	32,200	Y	2,875.2	100.00	2,875.2
	357	Quedas do Iguaçu	16,343	14,885	31,228	19,260	12,170	31,430	19,880	10,380	30,260	Y	1,192.9	100.00	1,192.9
	358	Rio Bonito Iguaçu	694	4,502	5,196	680	3,690	4,370	600	3,150	3,750	Y	459.3	100.00	459.3
	360	Virmond	611	2,847	3,458	600	2,330	2,930	540	1,990	2,530	Y	198.4	100.00	198.4
	Subtotal of Municipalities of Basin		176,501	146,376	322,877	225,430	148,550	373,980	268,560	141,310	409,870	—	—	—	—
	Subtotal of Municipalities not of Basin		3,065	11,249	14,314	5,270	10,950	16,220	7,440	10,790	18,230	—	—	—	—
MRH 291		Total of MRH	105,048	75,963	181,011	131,700	70,900	202,600	154,800	63,100	217,900				
Medio Iguaçu	361	Bituruna	5,881	7,170	13,051	8,510	6,030	14,540	10,630	4,830	15,460	Y	1,209.7	100.00	1,209.7
	362	Clevelândia	13,277	4,718	17,995	13,450	4,410	17,860	13,400	3,920	17,320	Y	708.4	100.00	708.4
	363	Cruz Machado	2,540	14,275	16,815	3,160	14,530	17,690	3,650	13,920	17,570	Y	1,500.5	100.00	1,500.5
	364	General Carneiro	6,670	5,123	11,793	11,800	4,300	16,100	16,050	3,420	19,470	Y	1,063.7	100.00	1,063.7
	365	Honório Serpa	803	7,075	7,878	1,530	7,590	9,120	2,130	7,570	9,700	Y	806.6	100.00	806.6
	366	Mangueirinha	4,783	13,912	18,695	9,090	14,450	23,540	12,660	14,040	26,700	Y	801.3	100.00	801.3
	367	Palmas	25,957	9,860	35,817	35,420	6,630	42,050	45,210	3,800	49,010	Y	3,125.5	100.00	3,125.5
	368	Paula Freitas	1,639	3,091	4,730	3,200	2,410	5,610	4,490	1,760	6,250	Y	417.0	100.00	417.0
	369	Paulo Frontin	1,648	5,060	6,708	2,360	5,460	7,820	2,940	5,470	8,410	Y	377.5	100.00	377.5
	370	Porto Vitória	1,871	1,916	3,787	2,060	1,750	3,810	2,180	1,530	3,710	Y	220.2	100.00	220.2
	371	União da Vitória	39,979	3,763	43,742	41,120	3,340	44,460	41,460	2,840	44,300	Y	773.9	100.00	773.9
	Subtotal of Municipalities of Basin		105,048	75,963	181,011	131,700	70,900	202,600	154,800	63,100	217,900	—	—	—	—
	Subtotal of Municipalities not of Basin		0	0	0	0	0	0	0	0	0	—	—	—	—
TOTAL OF MUNICIPALITIES OF THE BASIN			3,013,738	782,343	3,796,081	4,037,850	660,380	4,698,230	4,901,630	543,620	5,445,250	—	—	—	—

Source: IPARDES - Population in 1993, SANEPAR - Area of Municipality

Remark: Population in 1993 projected by IPARDES, and in 2005 and 2015 were projected by JICA Team.

Population of Mandirituba / MRH 268, Pién / MRH 271 and Foz do Iguaçu, Cafelândia / MRH 288 in 1993 were reviwed by IPARDES in 1995

Figure of Irati/MRH 276 and Palmeira/MRH 272 are listed in Tibagi River Basin

Urban Area: Y = Urban Area in the River Basin, P = Part of the Urban Area in the River Basin, N = Urban Area not included in the River Basin, (P)N = Topographically the Urban Area does not belong to the River Basin, but the Study will consider it as part of of the Basin

Table - 4.2 (1) Estimated GRDP per Municipality in 1993, 2005 and 2015 - excluding contribution of Hydroelectric Power Station / Iguaçu River Basin

Unit: US$ million

No. and Name of MRH	No.	No. and Name of Municipality	1993	2005	2015
MRH 268		TOTAL of MRH	10,538.30	20,213.73	34,326.41
Curitiba	1	Almirante Tamandaré	66.17	128.74	228.89
	2	Araucária	2,297.79	2,282.11	2,875.49
	3	Balsa Nova	93.81	199.23	355.53
	5	Campina Grande do Sul	30.64	79.66	150.19
	6	Campo Largo	233.92	573.15	963.60
	7	Colombo	175.80	365.45	650.79
	8	Contenda	12.22	22.41	33.39
	9	Curitiba	6,542.87	13,980.55	24,458.37
	12	Mandirituba	11.65	11.65	11.65
	14	Piraquara	12.42	93.68	170.78
	15	Quatro Barras	54.47	98.92	167.62
	10	Fazenda Rio Grande	14.13	52.54	94.39
	13	Pinhais	162.28	374.34	683.10
	17	São José dos Pinhais	589.51	1,488.28	2,701.15
		Subtotal of Municipalities of Basin	10,297.68	19,750.71	33,544.94
		Subtotal of Municipalities not of Basin	240.62	463.02	781.47
MRH 271		TOTAL of MRH	32.22	61.37	105.60
Alto Rio Negro	28	Agudos do Sul	2.22	4.02	6.49
	29	Pien	11.69	21.76	37.43
	30	Quitandinha	6.62	8.61	11.87
	31	Tijucas do Sul	11.69	26.98	49.81
		Subtotal of Municipalities of Basin	32.22	61.37	105.60
		Subtotal of Municipalities not of Basin	0.00	0.00	0.00
MRH 272		TOTAL of MRH	362.82	667.94	1,163.22
Campos da Lapa	32	Campo do Tenente	6.44	14.31	25.86
	33	Lapa	65.04	125.42	209.12
	34	Palmeira	0.00	0.00	0.00
	35	Porto Amazonas	3.08	8.20	14.53
	36	Rio Negro	211.77	374.27	672.59
		Subtotal of Municipalities of Basin	286.33	522.20	922.10
		Subtotal of Municipalities not of Basin	76.49	145.74	241.12
MRH 275		TOTAL of MRH	85.74	160.89	282.33
São Mateus do Sul	46	Antônio Olinto	2.41	9.89	16.45
	47	São João do Triunfo	5.63	14.01	23.37
	48	São Mateus do Sul	77.70	136.99	242.51
		Subtotal of Municipalities of Basin	85.74	160.89	282.33
		Subtotal of Municipalities not of Basin	0.00	0.00	0.00
MRH 276		TOTAL of MRH	200.55	383.92	637.92
Colonial Irati	50	Irati	0.00	0.00	0.00
	51	Mallet	13.89	34.09	57.62
	53	Rebouças	8.23	19.54	32.98
	54	Rio Azul	9.80	17.11	28.27
		Subtotal of Municipalities of Basin	31.92	70.74	118.87
		Subtotal of Municipalities not of Basin	168.63	313.18	519.05
MRH 288		TOTAL of MRH	3,234.55	5,711.90	9,048.13
Extremo Oeste Paranaense	269	Boa Vista da Aparecida	5.90	13.32	21.25
	273	Capitão Leônidas Marques	14.24	14.24	14.24
	274	Cascavel	717.99	1,338.17	2,244.42
	275	Catanduvas	19.55	23.53	27.10
	276	Céu Azul	52.80	87.18	121.09
	282	Foz do Iguaçu	929.14	2,278.95	4,195.54
	284	Guaraniaçu	21.85	96.08	171.66
	285	Ibema	13.27	15.69	18.97
	290	Lindoeste	3.51	6.90	11.02
	293	Matelândia	32.97	32.97	32.97
	294	Medianeira	86.01	145.46	193.77
	305	Santa Lúcia	2.78	2.78	2.78
	306	Santa Tereza do Oeste	6.64	13.06	20.85
	307	Santa Terezinha do Itaipu	13.63	23.97	26.38
	309	São Miguel do Iguaçu	61.04	157.74	229.13
	313	Três Barras do Paraná	13.10	24.63	36.14
		Subtotal of Municipalities of Basin	1,994.42	4,274.67	7,367.31
		Subtotal of Municipalities not of Basin	1,240.13	1,437.23	1,680.82
MRH 289		TOTAL of MRH	1,006.21	1,545.04	2,428.76
Sudoeste Paranaense	316	Ampere	24.29	34.99	55.79
	317	Barracão	5.30	5.30	5.30
	318	Boa Esperança do Iguaçu	4.12	7.25	12.03

(to be continued)

Table - 4.2 (2) Estimated GRDP per Municipality in 1993, 2005 and 2015 - excluding contribution of Hydroelectric Power Station / Iguaçu River Basin

Unit: US$ million (continuation)

No. and Name of MRH	No.	No. and Name of Municipality	1993	2005	2015
MRH 289	319	Bom Sucesso do Sul	6.17	10.85	18.02
Sudoeste Paranaense (cont.)	320	Capanema	32.32	32.32	32.32
	321	Chopinzinho	93.67	165.73	275.31
	322	Coronel Vivida	34.00	46.36	62.41
	323	Cruzeiro do Iguaçu	10.53	18.53	30.76
	324	Dois Vizinhos	128.57	207.56	345.24
	325	Eneas Marques	6.77	11.91	19.77
	326	Flor da Serra do Sul	2.24	3.94	6.54
	327	Francisco Beltrão	207.72	330.21	561.93
	328	Itapejara do Oeste	15.78	15.78	15.78
	329	Mariópolis	14.33	16.05	20.03
	330	Marmeleiro	16.36	22.01	29.60
	331	Nova Esperança do Sudoeste	3.49	6.14	10.19
	332	Nova Prata do Iguaçu	18.78	34.41	56.90
	333	Pato Branco	132.78	223.69	371.86
	334	Pérola do Oeste	8.52	8.52	8.52
	335	Pinhal de São Bento	0.72	1.27	2.10
	336	Planalto	13.91	13.91	13.91
	337	Pranchita	11.51	26.43	43.26
	338	Realeza	30.14	30.14	30.14
	339	Renascença	12.21	16.63	19.01
	340	Salgado Filho	6.99	9.50	13.29
	341	Salto do Lontra	20.06	35.29	58.59
	342	Santa Izabel do Oeste	17.91	25.67	37.60
	343	Santo Antônio do Sudoeste	20.64	36.31	60.28
	344	São João	30.39	40.55	63.58
	345	São Jorge do Oeste	28.69	34.04	39.26
	346	Saudade do Iguaçu	15.20	26.74	44.40
	347	Sulina	10.69	18.81	31.22
	348	Verê	11.39	15.67	19.42
	349	Vitorino	10.02	12.53	14.40
		Subtotal of Municipalities of Basin	1,006.21	1,545.04	2,428.76
		Subtotal of Municipalities not of Basin	0.00	0.00	0.00
MRH 290		TOTAL of MRH	1,022.30	2,000.58	3,480.28
Campos de Guarapuava	350	Candói	90.60	167.65	276.90
	351	Cantagalo	14.71	27.22	44.96
	352	Guarapuava	543.10	955.40	1,644.84
	353	Inácio Martins	12.61	12.95	16.92
	354	Laranjeiras do Sul	59.32	136.83	248.49
	355	Nova Laranjeiras	6.82	15.73	28.57
	356	Pinhão	98.53	186.11	326.19
	357	Quedas do Iguaçu	87.15	220.60	390.26
	358	Rio Bonito do Iguaçu	70.98	163.73	297.33
	360	Virmond	8.96	20.67	37.53
		Subtotal of Municipalities of Basin	992.78	1,906.89	3,311.99
		Subtotal of Municipalities not of Basin	29.52	93.69	168.29
MRH 291		TOTAL of MRH	452.69	790.96	1,416.72
Médio Iguaçu	361	Bituruna	44.62	100.34	195.25
	362	Clevelândia	45.03	70.53	109.07
	363	Cruz Machado	27.73	77.61	154.26
	364	General Carneiro	21.89	44.23	78.76
	365	Honório Serpa	6.92	8.93	15.79
	366	Mangueirinha	70.73	91.06	161.36
	367	Palmas	87.42	117.53	201.66
	368	Paula Freitas	4.10	7.02	12.02
	369	Paulo Frontin	6.00	10.87	19.16
	370	Porto Vitória	6.71	14.31	26.39
	371	União da Vitória	131.54	248.53	443.00
		Subtotal of Municipalities of Basin	452.69	790.96	1,416.72
		Subtotal of Municipalities not of Basin	0.00	0.00	0.00
TOTAL OF THE MUNICIPALITIES OF THE BASIN			13,179.99	29,083.47	49,498.62

Source: Fundo de Participação dos Municípios - Índices Provisórios - 95 (Municipalities' Participation Fund - Preliminary Indexes - 95) - SEFA

Remark: Values in US$ were estimated by the JICA Team

: Palmeira/MRH 272 and Irati/MRH 276 were listed in Tibagi River Basin

Table - 4.3 Classification of Municipalities Related to Urban Population and GRDP per Municipality in 1993, 2005 and 2015/Iguaçu River Basin

				1993				2005				2015			
				Urban Population		GRDP		Urban Population		GRDP		Urban Population		GRDP	
Classification	No. and Name of MRH	No. and Name of Municipality		Population	%	Million US$	%	Population	%	Million US$	%	Population	%	Million US$	%
1st Class	MRH 268/Curitiba	9	Curitiba	1,337,892	44.39	6,542.87	43.10	1,546,490	38.02	13,980.55	48.07	1,717,150	35.03	24,458.37	49.41
2nd Class	MRH 268/Curitiba	1	Almirante Tamandaré	65,600	2.18	66.17	0.44	121,910	3.00	128.74	0.44	169,730	3.46	228.89	0.46
		2	Araucária	59,259	1.97	2,297.79	15.14	102,280	2.51	2,282.11	7.85	138,700	2.83	2,875.49	5.81
		7	Colombo	120,802	4.01	175.8	1.16	208,640	5.13	365.45	1.26	283,000	5.77	650.79	1.31
		10	Fazenda Rio Grande	26,498	0.88	14.13	0.09	76,310	1.88	52.54	0.18	119,160	2.43	94.39	0.19
		13	Pinhais	75,045	2.49	162.28	1.07	102,520	2.52	374.34	1.29	125,690	2.56	683.10	1.38
		17	São José dos Pinhais	122,604	4.07	589.51	3.88	210,330	5.17	1,488.28	5.12	284,590	5.81	2,701.15	5.46
	MRH 288/Extremo Oeste Paranaense	274	Cascavel	185,746	6.16	717.99	4.73	250,280	6.15	1,338.17	4.60	303,280	6.19	2,244.22	4.53
		282	Foz do Iguaçu	204,365	6.78	929.14	6.12	353,920	8.70	2,278.95	7.84	479,380	9.78	4,195.54	8.48
	MRH 289/Sudoeste Paranaense	327	Francisco Beltrão	48,417	1.61	207.72	1.37	73,320	1.80	330.21	1.14	100,490	2.05	561.93	1.14
	MRH 290/Campos de Guarapuava	352	Guarapuava	117,385	3.89	543.10	3.58	154,360	3.79	955.40	3.29	179,920	3.67	1,644.84	3.32
			Sub-Total	1,025,721	34.03	5,703.63	37.57	1,653,870	40.66	9,594.19	32.99	2,183,940	44.56	15,880.34	32.08
3rd Class	MRH 268/Curitiba	5	Campina Grande do Sul	15,192	0.50	30.64	0.20	40,100	0.99	79.66	0.27	61,440	1.25	150.19	0.30
		6	Campo Largo	55,837	1.85	233.92	1.54	72,070	1.77	573.15	1.97	85,590	1.75	963.60	1.95
		14	Piraquara	20,482	0.68	12.42	0.08	25,580	0.63	93.68	0.32	29,650	0.60	170.78	0.35
		15	Quatro Barras	9,149	0.30	54.47	0.36	18,150	0.45	98.92	0.34	25,810	0.53	167.62	0.34
	MRH 272/C. da Lapa	33	Lapa	20,074	0.67	65.04	0.43	24,860	0.61	125.42	0.43	28,970	0.59	209.12	0.42
		36	Rio Negro	20,643	0.68	211.77	1.40	24,120	0.59	374.27	1.29	27,140	0.55	672.59	1.36
	MRH 275/São Mateus do Sul	48	São Mateus do Sul	16,489	0.55	77.7	0.51	21,120	0.52	136.99	0.47	25,010	0.51	242.51	0.49
	MRH 288/Extr. Oeste Paranaense	294	Medianeira	30,268	1.00	86.01	0.57	36,360	0.89	145.46	0.50	41,230	0.84	193.77	0.39
	MRH 289/Sudoeste Paranaense	324	Dois Vizinhos	21,463		128.57	0.85	35,060	0.86	207.56	0.71	45,560	0.93	345.24	0.70
		333	Pato Branco	43,856	1.46	132.78	0.87	56,450	1.39	223.69	0.77	67,550	1.38	371.86	0.75
	MRH 290/Campos de Guarapuava	351	Cantagalo	6,792	0.23	14.71	0.10	17,910	0.44	27.22	0.09	39,360	0.80	44.96	0.09
	MRH 291/Médio Iguaç	367	Palmas	25,957	0.86	87.42	0.58	35,420	0.87	117.53	0.40	45,210	0.92	201.66	0.41
		371	União da Vitória	39,979	1.33	131.54	0.87	41,120	1.01	248.53	0.85	41,460	0.85	443	0.89
			Sub-Total	326,181	10.82	1,266.99	8.35	448,320	11.02	2,452.08	8.43	563,980	11.51	4,176.90	8.44
4th Class	Other 77 Municipalities		Sub-Total	323,944	10.75	1,666.50	10.98	419,170	10.30	3,056.65	10.51	436,560	8.91	4,983.01	10.07
TOTAL OF THE MUNICIPALITIES OF THE BASIN				3,013,738	100.00	15,179.99	100.00	4,067,850	100.00	29,083.47	100.00	4,901,630	100.00	49,498.62	100.00

Remark: GRDP per Municipality not including contribution of Hydroelectric Power Stations

CHAPTER 5 PRESENT SITUATION AND WATER DEMAND PROJECTION FOR 2005 AND 2015

5.1 Domestic Water

As described in Main Report I, the present average unit consumption rate of Paraná State and the present unit consumption rate per MRH, and future unit consumption rate were estimated as shown below in Table-5.1, Table-5.2 and Table-5.3.

Table-5.1 Average Unit Consumption Rate of Paraná State - 1993, 2005 and 2015

	Average Unit Consumption Rate (l / person . day)								
	Residential Water			Non-Residential Water			Total Domestic Water		
	1993	2005	2015	1993	2005	2015	1993	2005	2015
Urban Population	90	115	140	25	30	40	115	145	180
Rural Population	70	75	80	0	0	0	70	75	80

Remark: Unit rate of residential water for rural population was estimated as unit rate of the 3rd Category of the classification of MRH (shown in Table-5.2 and Table-5.3)

Table-5.2 Unit Consumption Rate per MRH - 1993

			Unit Consumption Rate (l / person . day)		
	Classification	No. of MRH	Residential Water	Non-Residential Water	Total Domestic Water
Urban Population	1st Category	MRH 268, 281, 282	100	30	130
	2nd Category	MRH 269, 270 MRH 272 to MRH 276, MRH 279 to MRH 280 MRH 283 to MRH 286 MRH 288 to MRH 291	85	20	105
	3rd Category	MRH 271, 277, 278, 287	70	15	85
Rural Population	—	All MRH	70	—	70

Table-5.3 Unit Consumption Rate per MRH - 2005 and 2015

			Unit Consumption Rate (l / person . day)					
			Residential Water		Non-Residential Water		Total Domestic Water	
	Classification	No. of MRH	2005	2015	2005	2015	2005	2015
Urban Population	1st Category	MRH 268, 281, 282, 288	125	155	35	45	160	200
	2nd Category	MRH 269, 270, MRH 272 to MRH 276, MRH 279 to MRH 280, MRH 283, MRH 285 to MRH 286, MRH 289 to MRH 291	100	125	30	35	130	160
	3rd Category	MRH 271, 277, 278, 284, 287	75	80	20	25	95	105
Rural Population	—	All MRH	75	80	—	—	75	80

5.1.1 Present Unit Consumption Rate per Municipality

Each MRH was composed of municipalities with different sizes in terms of population and GRDP, therefore the Team collected the data of present unit consumption volume of residential water of some large-medium size municipalities in this river basin. Based on the information provided by ABC/SANEPAR, the unit consumption volume of 12 selected municipalities is presented in Table-5.4.

(1) Unit Consumption Rate of Residential Water for Urban Population per Municipality

According to Table-5.2 and Table-5.4, this unit rate was estimated tentatively between unit rate of large-medium size municipalities and other municipalities, by adjusting it to the total water demand per MRH to which they belong, calculated by multiplying the unit rate per MRH by the urban population per MRH.

(2) Unit Consumption Rate of Non-Residential Water for Urban Population per Municipality

This unit was estimated by the same method mentioned above, approximately in the same proportion between the unit rate of residential water and non-residential water of the MRH to which they belong.

(3) Unit Consumption Rate for Rural Population per Municipality

This unit rate was estimated using the same figure of the unit consumption rate per MRH and average unit consumption rate of Paraná State. It means that the same unit rate was applied to all municipalities.

According to what was mentioned above, present unit consumption rate per municipality for urban population and rural population is shown in Table-5.5.

Table-5.4 Present Unit Consumption Volume of Large and Medium Size Municipalities - 1993

No. and Name of MRH	No. and Name of Municipality		Average Consumption Volume per Month (m^3)	Service Population Estimated by SANEPAR	Estimated Consumption Volume per Capita (l/day)
MRH 268/Curitiba	2	Araucária	129,776	56,128	77.07
	9	Curitiba	4,470,662	1,340,585	111.16
	17	S. José dos Pinhais	231,614	95,719	80.66
MRH 272/Campos da Lapa	36	Rio Negro	47,658	19,612	81.00
MRH 275/S. Mateus do Sul	48	São Mateus do Sul	40,512	16,758	80.58
MRH 288/Extr. O. Paranaense	274	Cascavel	468,394	171,538	91.02
	282	Foz do Iguaçu	533,569	168,849	105.33
	312	Toledo	187,816	68,430	91.49
MRH 289/Sud. Paranaense	322	Coronel Vivida	28,327	11,900	79.35
	327	Francisco Beltrão	118,736	45,193	87.58
	333	Pato Branco	119,193	43,432	91.48
MRH 290/C. Guarapuava	352	Guarapuava	152,056	101,722	84.62

Source : APC/SANEPAR

5.1.2 Future Unit Consumption Rate per Municipality

(1) Unit Consumption Rate of Residential Water for Urban Population per Municipality

Based on the unit consumption rate per MRH in 2005 and 2015 (shown in Table-5.3) and present unit consumption rate per municipality (shown in Table-5.4), this unit rate was estimated by the same method mentioned in Section-5.1.1 (1), approximately in the same proportion of present unit consumption rate between large-medium size municipalities and other municipalities.

(2) Unit Consumption Rate of Non-Residential Water for Urban Population per Municipality

Based on the unit consumption rate per MRH in 2005 and 2015, this unit rate was estimated by the same method of present unit consumption rate per municipality.

(3) Unit Consumption Rate for Rural Population per Municipality

This unit rates in 2005 and 2015 were estimated using the same figure of the unit consumption rate per MRH in 2005 and 2015, respectively.

According to what was mentioned above, the unit consumption rate per municipality in 2005 and 2015 is shown in Table-5.6 and Table-5.7, respectively.

5.1.3 Water Demand Projection

Water Demand in 1993, 2005 and 2015 was estimated by multiplying the urban and rural population per municipality of each year (shown in Table-4.1 (1), Table-4.1 (2), Table-4.1 (3) and Table-4.1 (4)), by the unit consumption rate per municipality of the corresponding year (shown in Table-5.5, Table-5.6 and Table-5.7), and is presented in Section-5.4.

Table-5.5 Present Unit Consumption Rate of Domestic Water per Municipality - 1993

Classification of MRH	No. and Name of MRH	Classification of Municipality	Unit Consumption Rate (l / person . day)			
			Urban Population			Rural Population
			Residential Water	Non-Residential Water	Total Domestic Water	Domestic Water
1st Category	MRH 268/Curitiba	Curitiba	110	35	145	70
		Other Municipalities	80	20	100	70
2nd Category	MRH 272/Campos da Lapa MRH 275/S. Mateus do Sul MRH 276/Col. Irati MRH 290/C. Guarapuava MRH 291/Médio Iguaçu	All Municipalities	85	20	105	70
	MRH 288/Extr. Oeste Paranaense	Foz do Iguaçu	105	35	140	
		Cascavel	90	20	110	
		Other Municipalities	70	15	85	70
	MRH 289/Sud. Paranaense	Pato Branco, Francisco Beltrão	90	25	115	
		Other Municipalities	80	20	100	70
3rd Category	MRH 271/A. Rio Negro	All Municipalities	70	15	85	70

Source : APC/SANEPAR

Remark : Toledo in MRH 288 does not belong to the Basin but is estimated in the same way as Cascavel
Unit rate of Residential Water for rural population was estimated as the same figure as the unit rate of the 3rd Category of MRH Classification

Table-5.6 Future Unit Consumption Rate of Domestic Water per Municipality - 2005

Classification of MRH	No. and Name of MRH	Classification of Municipality	Unit Consumption Rate (l / person . day)			
			Urban Population			Rural Population
			Residential Water	Non-Residential Water	Total Domestic Water	Domestic Water
1st Category	MRH 268/Curitiba	Curitiba	140	40	180	
		Other Municipalities	100	30	130	75
	MRH 288/Extr. Oeste Paranaense	Foz do Iguaçu	140	40	180	
		Cascavel	125	35	160	
		Other Municipalities	110	30	140	75
2nd Category	MRH 272/Campos da Lapa MRH 275/S. Mateus do Sul MRH 276/Col. Irati MRH 290/C. Guarapuava MRH 291/Médio Iguaçu	All Municipalities	100	30	130	75
	MRH 289/Sud. Paranaense	Pato Branco, Francisco Beltrão	110	35	145	
		Other Municipalities	95	25	120	75
3rd Category	MRH 271/A. Rio Negro	All Municipalities	75	20	95	75

Remark: Toledo in MRH 288 does not belong to the Basin but is estimated in the same way as Cascavel
Unit rate of Residential Water for rural population was estimated as the same figure as the unit rate of the 3rd Category of MRH Classification

Table-5.7 Future Unit Consumption Rate of Domestic Water per Municipality - 2015

Classification of MRH	No. and Name of MRH	Classification of Municipality	Unit Consumption Rate (l / person . day)			
			Urban Population			Rural Population
			Residential Water	Non-Residential Water	Total Domestic Water	Domestic Water
1st Category	MRH 268/Curitiba	Curitiba	170	50	220	
		Other Municipalities	135	40	175	80
	MRH 288/Extr. Oeste Paranaense	Foz do Iguaçu	165	50	215	
		Cascavel	155	45	200	
		Other Municipalities	135	40	175	80
2nd Category	MRH 272/Campos da Lapa MRH 275/S. Mateus do Sul MRH 276/Col. Irati MRH 290/C. Guarapuava MRH 291/Médio Iguaçu	All Municipalities	125	35	160	80
	MRH 289/Sud. Paranaense	Pato Branco, Francisco Beltrão	135	40	175	
		Other Municipalities	115	30	145	80
3rd Category	MRH 271/A. Rio Negro	All Municipalities	80	25	105	80

Remark: Toledo in MRH 288 does not belong to the Basin but is estimated in the same way as Cascavel
Unit rate of Residential Water for rural population was estimated as the same figure as the unit rate of the 3rd Category of MRH Classification

5.2 Industrial Water

5.2.1 Unit Consumption Rate per Value Added (V.A.) per Municipality

During the study of the "Master Plan for Pilot River Basin(s)", complementary data regarding industrial water consumption could not be collected, therefore the Team decided to use the same unit consumption rate used for the estimation per MRH for the estimation of industrial water per municipality, as shown in Table-5.8.

Table-5.8 Average Unit Consumption Rate per Value Added (V.A.) - 1993, 2005 and 2015

Unit Rate - 1993 Unit Rate with Present recovery Rate m^3/day . US$ 1,000.00 (V.A.)	Unit Rate - 2005 Increase of Water Recovery Rate: 19% m^3/day . US$ 1,000.00 (V.A.)	Unit Rate - 2015 Increase of Water Recovery Rate: 37.50% m^3/day . US$ 1,000.00 (V.A.)
0.059	0.048	0.037

5.2.2 Gross Regional Domestic Product (GRDP) by Secondary Sector per Municipality

For the estimation of industrial water demand for the target years, GRDP by Secondary Sector per Municipality was estimated as follows:

(1) GRDP by Secondary Sector per Municipality in 1993

Based on the estimated GRDP by Secondary Sector per MRH (shown in Table-5.10 of Main Report I) and on the Municipalities' Participation Fund - Preliminary Indexes/95 issued by SEFA, the GRDP by Secondary Sector of 101 municipalities in 1993 was estimated by excluding the contribution of hydroelectric power stations, and is presented in Table-5.9 (1) and Table-5.9 (2).

(2) GRDP by Secondary Sector per Municipality in 2005 and 2015

Based on the past trend of GRDP by Secondary Sector per Municipality during the years 1981 to 1991 (shown in Sectorial Report Vol. A) by excluding the contribution of hydroelectric power stations in the values of 1989 and 1991, and on the one of 1993 mentioned above, the GRDP of the Secondary Sector per Municipality was estimated per each municipality, adjusting the estimated GRDP by Secondary Sector per MRH (shown in Table-5.10 of Main Report I) to the years to which they belong, and is presented also in Table-5.9 (1) and Table-5.9 (2).

5.2.3 Water Demand Projection in 1993, 2005 and 2015

Water demand of industrial water per municipality was estimated by multiplying the average unit consumption rate per value added by GRDP by Secondary Sector per Municipality of each year, and is presented in Section-5.4.

In this Study, it was considered that all industrial activity was located in the urban area. Therefore, some municipalities included in the study zoning, but with their urban area outside this river basin, were considered as having industrial water demand equal to zero.

Table-5.9 (1) Estimated GRDP by Secondary Sector per Municipality in 1993, 2005 and 2015 - excluding contribution of Hydroelectric Power Station/Iguaçu River Basin

(Unit: US$ million)

No. and Name of MRH	No. and Name of Municipality	1993	2005	2015
MRH 268	TOTAL of MRH	4,261.84	7,743.53	12,844.63
Curitiba	1 Almirante Tamandare	27.86	53.18	95.10
	2 Araucaria	1,152.47	1,308.39	1,800.25
	3 Balsa Nova	52.32	99.02	175.85
	5 Campina Grande do Sul	11.14	33.34	65.91
	6 Campo Largo	110.76	252.93	415.65
	7 Colombo	74.63	151.44	266.46
	8 Contenda	1.44	2.66	5.06
	9 Curitiba	2,390.16	4,815.82	8,196.53
	10 Fazenda Rio Grande	4.48	9.19	17.29
	12 Mandirituba	1.53	3.07	5.76
	13 Pinhais	65.55	192.75	357.12
	14 Piraquara	3.94	11.65	21.59
	15 Quatro Barras	28.35	41.98	67.79
	17 Sao Jose dos Pinhais	212.77	573.91	1,040.71
	Subtotal of Municipalities of Basin	4,137.40	7,549.32	12,531.06
	Subtotal of Municipalities not of Basin	124.44	194.21	313.57
MRH 271	TOTAL of MRH	6.77	12.89	24.16
Alto Rio Negro	28 Agudos do Sul	0.14	0.37	0.69
	29 Pien	4.22	6.93	12.34
	30 Quitandinha	0.43	0.98	1.89
	31 Tijucas do Sul	1.98	4.61	9.24
	Subtotal of Municipalities of Basin	6.77	12.89	24.16
	Subtotal of Municipalities not of Basin	0.00	0.00	0.00
MRH 272	TOTAL of MRH	144.48	259.40	461.01
Campos da Lapa	32 Campo do Tenente	0.30	0.18	0.23
	33 Lapa	14.23	18.09	28.49
	34 Palmeira	0.00	0.00	0.00
	35 Porto Amazonas	0.88	2.51	4.73
	36 Rio Negro	108.77	190.81	340.92
	Subtotal of Municipalities of Basin	124.18	211.59	374.37
	Subtotal of Municipalities not of Basin	20.30	47.81	86.64
MRH 275	TOTAL of MRH	30.25	48.95	91.88
Sao Mateus do Sul	46 Antonio Olinto	0.26	0.53	0.85
	47 Sao Joao do Triunfo	0.46	0.25	0.21
	48 Sao Mateus do Sul	29.53	48.16	90.82
	Subtotal of Municipalities of Basin	30.25	48.95	91.88
	Subtotal of Municipalities not of Basin	0.00	0.00	0.00
MRH 276	TOTAL of MRH	53.75	102.17	179.22
Colonial Irati	50 Irati	0.00	0.00	0.00
	51 Mallet	4.19	9.86	17.47
	53 Reboucas	1.12	2.05	3.09
	54 Rio Azul	2.08	4.05	7.50
	Subtotal of Municipalities of Basin	7.39	15.96	28.06
	Subtotal of Municipalities not of Basin	46.36	86.21	151.16
MRH 288	TOTAL of MRH	424.10	626.89	850.15
Extremo Oeste Paranaense	269 Boa Vista da Aparecida	0.27	0.35	0.48
	273 Capitao Leonidas Marques	0.58	0.84	1.14
	274 Cascavel	147.45	171.48	232.55
	275 Catanduvas	0.41	0.68	0.93
	276 Ceu Azul	14.74	27.20	36.89
	282 Foz do Iguacu	20.18	31.55	42.79
	284 Guaraniacu	0.58	0.81	1.10
	285 Ibema	4.16	6.15	8.34
	290 Lindoeste	0.10	0.15	0.20
	293 Matelandia	2.25	4.33	5.88
	294 Medianeira	12.55	23.33	31.64
	305 Santa Lucia	0.09	0.10	0.14
	306 Santa Tereza do Oeste	0.36	0.71	0.96
	307 Santa Terezinha de Itaipu	1.45	1.77	2.40
	309 Sao Miguel do Iguacu	5.86	7.09	9.61
	313 Tres Barras do Parana	0.55	0.68	0.92
	Subtotal of Municipalities of Basin	211.58	277.24	375.98
	Subtotal of Municipalities not of Basin	212.52	349.65	474.17

(to be continued)

Table-5.9 (2) Estimated GRDP by Secondary Sector per Municipality in 1993, 2005 and 2015 - excluding contribution of Hydroelectric Power Station/Iguaçu River Basin

(Unit: US$ million)

No. and Name of MRH	No. and Name of Municipality	1993	2005	2015
MRH 289	TOTAL OF MRH	168.98	400.32	746.02
Sudoeste Paranaense	316 Ampere	6.65	12.44	23.19
	317 Barracao	0.34	0.79	1.47
	318 Boa Esperanca do Iguacu	0.03	0.06	0.11
	319 Bom Sucesso do Sul	0.07	0.12	0.22
	320 Capanema	1.09	2.27	4.23
	321 Chopinzinho	2.18	6.28	11.71
	322 Coronel Vivida	4.23	11.86	22.10
	323 Cruzeiro do Iguacu	3.43	13.59	25.33
	324 Dois Vizinhos	45.50	123.23	229.66
	325 Eneas Marques	0.13	0.30	0.56
	326 Flor da Serra do Sul	0.07	0.20	0.37
	327 Francisco Beltrao	73.34	142.24	265.08
	328 Itapejara do Oeste	2.08	4.04	7.54
	329 Mariopolis	1.02	2.54	4.73
	330 Marmeleiro	1.32	4.29	7.99
	331 Nova Esperanca do Sudoeste	0.06	0.09	0.17
	332 Nova Prata do Iguacu	0.35	1.14	2.13
	333 Pato Branco	12.47	41.23	76.84
	334 Perola do Oeste	0.37	0.83	1.54
	335 Pinhal Sao Bento	0.02	0.03	0.06
	336 Planalto	0.40	0.89	1.65
	337 Pranchita	0.42	1.50	2.80
	338 Realeza	1.53	4.19	7.80
	339 Renascenca	1.83	4.62	8.60
	340 Salgado Filho	0.25	0.58	1.08
	341 Salto do Lontra	0.29	0.72	1.35
	342 Santa Izabel do Oeste	0.40	0.79	1.48
	343 Santo Antonio do Sudoeste	1.28	3.24	6.05
	344 Sao Joao	0.46	1.00	1.87
	345 Sao Jorge do Oeste	0.52	1.16	2.16
	346 Saudade do Iguacu	1.25	2.35	4.37
	347 Sulina	4.66	9.38	17.49
	348 Vere	0.40	0.97	1.80
	349 Vitorino	0.54	1.34	2.50
	Subtotal of Municipalities of Basin	168.98	400.32	746.02
	Subtotal of Municipalities not of Basin	0.00	0.00	0.00
MRH 290	TOTAL of MRH	180.50	315.38	600.43
Campos de Guarapuava	350 Candoi	3.84	5.05	9.62
	351 Cantagalo	1.89	4.16	7.92
	352 Guarapuava	99.44	183.56	349.47
	353 Inacio Martins	5.53	8.00	15.23
	354 Laranjeiras do Sul	5.17	8.41	16.00
	355 Nova Laranjeiras	0.78	1.37	2.61
	356 Pinhao	12.78	14.89	28.35
	357 Quedas do Iguacu	24.51	46.82	89.14
	358 Rio Bonito Iguacu	7.75	10.80	20.56
	360 Virmond	0.72	1.29	2.46
	Subtotal of Municipalities of Basin	162.41	284.35	541.36
	Subtotal of Municipalities not of Basin	18.09	31.03	59.07
MRH 291	TOTAL of MRH	147.33	260.82	323.05
Medio Iguacu	361 Bituruna	10.99	24.83	31.88
	362 Clevelandia	14.72	21.37	17.95
	363 Cruz Machado	3.35	17.42	24.20
	364 General Carneiro	9.88	19.67	24.75
	365 Honorio Serpa	0.30	0.30	0.40
	366 Manguelrinha	21.92	25.26	34.16
	367 Palmas	34.95	53.91	71.84
	368 Paula Freitas	0.30	0.46	0.62
	369 Paulo Frontin	0.44	0.89	1.14
	370 Porto Vitoria	0.36	2.03	1.74
	371 Uniao da Vitoria	50.12	94.66	114.35
	Subtotal of Municipalities of Basin	147.33	260.82	323.05
	Subtotal of Municipalities not of Basin	0.00	0.00	0.00
TOTAL OF THE MUNICIPALITIES OF THE BASIN		4,996.29	9,061.44	15,035.94

Source: Fundo de Participação dos Municípios-Índices Provisórios-95 (Municipalities'Participation Fund-Preliminary Indexes-95)/SE

Remark: Values in US$ were estimated by JICA Team

: Figures of Palmeira/MRH 272 and Irati/MRH 276 are listed in Tibagi River Basin

5.3 Agricultural Water Inclusive of Livestock and Fishery

The data concerning agriculture was collected from EMATER database with municipality wise. In the case that a municipality extends over other river basins, the data was split by the area weighted average assuming that the data is uniformly spread in the municipality.

5.3.1 Current Agriculture

According to SANEPAR GIS computation (1994) based on IAP satellite imagery analysis (1990 and 1994), 37.9 % (21,000 km^2) and 17.6 % (9,700 km^2) of Iguaçu river basin are currently utilized as crop land and pasture, while the state average is 37.6 % and 23.1 %, respectively. Dividing the river basin into three as shown in Figure-5.1, characteristics of agriculture was identified and the result is shown in Table-5.10.

Table-5.10 Agricultural Characteristics of Iguaçu River Basin (1994)

Region	Total Crop Area (km^2)	Item	Cotton	Sugarcane	Beans	Maize	Soybean	Cassava	Potato	Wheat
I	5,180	Area Ratio to Total (%)	0.0	0.0	31.1	55.2	6.9	0.2	6.6	0.6
		Productivity (ton/ha)	-	-	1.0	2.8	2.4	13.9	14.5	1.5
		Mechanization (%)	-	-	78.0	76.0	96.9	45.8	99.0	91.0
		Implementation of Conservation (%)	-	-	24.4	25.8	65.0	4.2	10.0	55.6
		Implementation of Non-tillage (%)	-	-	0.3	2.1	23.2	-	-	12.4
II	6,780	Area Ratio to Total (%)	0.0	0.0	14.2	54.1	30.3	1.3	0.1	2.5
		Productivity (ton/ha)	-	-	0.9	3.1	2.5	16.5	18.1	2.1
		Mechanization (%)	-	-	51.2	59.4	99.6	23.6	99.0	97.9
		Implementation of Conservation (%)	-	-	21.4	35.8	87.3	5.8	10.0	86.0
		Implementation of Non-tillage (%)	-	-	0.0	26.3	64.6	-	-	68.1
III	9,020	Area Ratio to Total (%)	1.1	0.6	11.1	53.9	30.5	2.8	0.0	9.7
		Productivity (ton/ha)	1.6	37.9	1.0	3.3	2.3	25.4	-	1.5
		Mechanization (%)	71.3	33.3	56.3	62.3	90.7	53.8	-	84.7
		Implementation of Conservation (%)	64.6	50.5	51.7	51.8	79.2	38.2	-	72.5
		Implementation of Non-tillage (%)	-	-	0.9	6.5	19.6	-	-	13.7
River Basin Average	20,980	Area Ratio to Total (%)	0.5	0.3	17.0	54.3	24.7	1.6	1.6	5.1
		Productivity (ton/ha)	1.6	37.4	1.0	3.1	2.4	22.7	14.6	1.6
		Mechanization (%)	71.3	32.1	64.7	64.8	94.7	45.8	99.0	86.9
		Implementation of Conservation (%)	64.6	48.4	31.2	40.1	81.5	28.7	10.0	74.1
		Implementation of Non-tillage (%)	-	-	0.4	11.8	37.9	-	-	22.1

		Scale of Farmers	Small	Medium	Large	Total (household)
I		Number of Household (%)	89.0	9.0	2.0	37,200
II		Scale of Farmers	Small	Medium	Large	Total (household)
		Number of Household (%)	76.0	16.9	7.1	25,200
III		Scale of Farmers	Small	Medium	Large	Total (household)
		Number of Household (%)	89.0	9.3	1.7	76,900
River Basin		Scale of Farmers	Small	Medium	Large	Total (household)
		Number of Household (%)	86.7	10.6	2.7	139,300

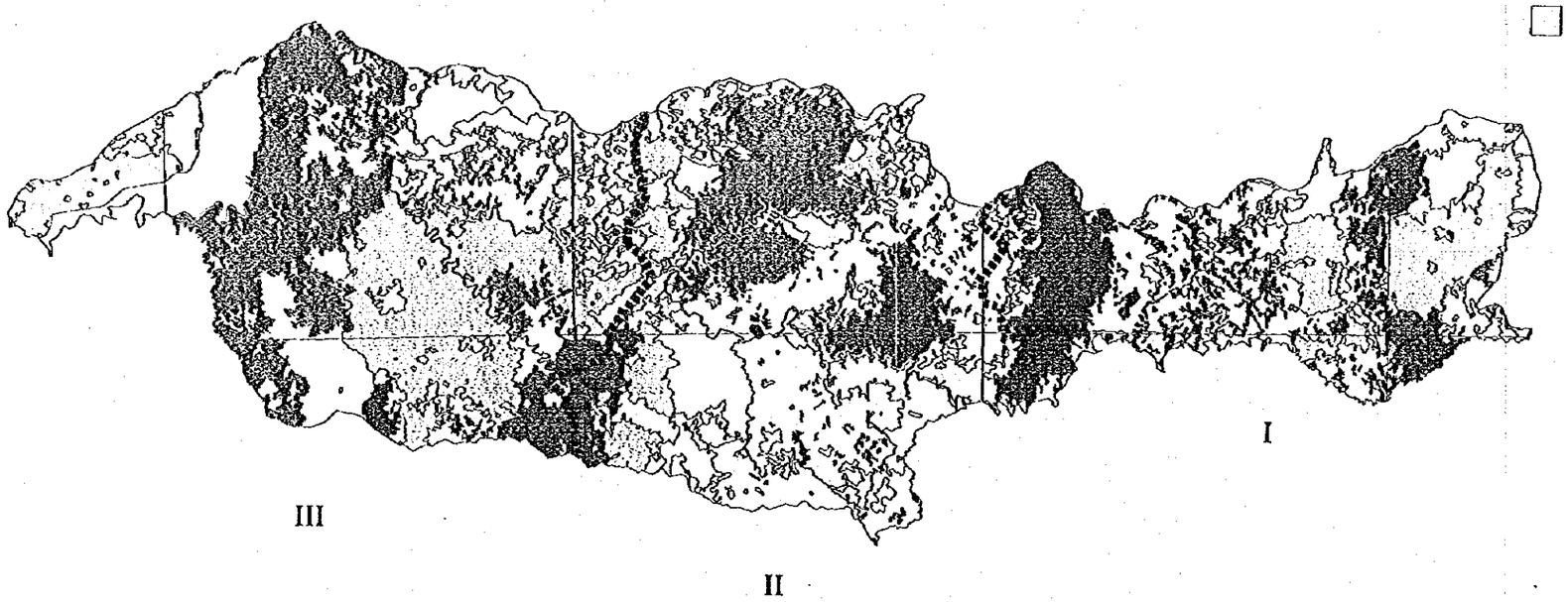
Note: Size of Farmers; Small < 50 ha, Medium 50 - 250 ha, Large >250 ha

Source: adapted and enlarged from EMATER for Agricultural Data as of 1994
SANEPAR GIS computation based on IAP satellite imagery analysis for Crop Area

IGUACU RIVER BASIN

Region	Total Area (km2)	Forest (%)	2od Vegetation (%)	Reforestation (%)	Pasture (%)	Crop (%)	Others (%)
I	13,270	7.5	34.7	5.1	10.3	39.0	2.1
II	19,770	21.1	27.2	0.4	16.6	34.3	1.1
III	22,280	12.3	22.2	0.8	22.8	40.5	1.5
Whole Basin	55,320	14.3	27.0	1.7	17.6	37.9	1.5

Source: SANEPAR GIS computation (1994)



LEGEND

- Crop-Land
- Crop-Land (65%) + Secondary Vegetation (35%)
- Crop-Land (65%) + Pasture (35%)
- Crop-Land (55%) + Secondary Vegetation (30%) + Pasture (15%)
- Crop-Land (55%) + Pasture (30%) + Secondary Vegetation (15%)

Scale ; 1 / 2,150,000

Source ; GIS Computation by SANEPAR
Landuse Map by IAP (1990 & 1994)

Figure-5.1 Sub-division and Landuse in Iguaçu River Basin

The most distinct characteristic of agriculture in Iguaçu river basin is potato culture. Almost all potato of Paraná state is produced in the upstream of Iguaçu around Curitiba and Lapa despite the fact that its cropping area is limited. Beans and maize culture extend over the whole river basin; however, other dominant crops vary with location.

The total number of farmers in Iguaçu river basin is 139,300 in 1994. Among them, 86.7 % is classified as the small size, which owes less than 50 ha, and the medium (between 50 and 250 ha) and large (greater than 250 ha) size are limited to 10.6 and 2.7 %, respectively. In contrast with the state tendency, which shows the expansion of medium size farmers, small size farmers are dominant in Iguaçu river basin.

5.3.2 Current Water Consumption and Future Water Demand

(1) Current Water Consumption

The necessity of irrigation was examined in the Strategy study. Crop water requirements of dominant crops in Paraná were computed and compared with effective rainfall to examine the necessity of irrigation. Its conclusion was that rain-fed agriculture is practically adequate in Paraná as long as the favorable weather will continue. Although there are a few cases of irrigation in pilot river basins, especially the suburb of Curitiba for horticulture, its area and water consumption are considered as negligibly small. Therefore, the agricultural water in Iguaçu river basin consists of water for livestock and fish pond.

(2) Future Agriculture

The population growth of livestock and expansion of fish pond were projected for the year of 2005 and 2015 in accordance with the Strategy formulated. Each municipality may differ in future livestock growth and expansion of fish pond area. Trend analysis for each municipality requires individually to specify the market, price, raising method and so on, however, such detail study should follow after the Master Plan. And further, the state trend integrating all relevant information is considered to be more reliable. Therefore, the state trend was applied to project the future livestock population and fish pond area.

The growth of cattle and chicken population was assessed during the Strategy study by means of the linear regression of population in the last 20 years. As a result, cattle and chicken are expected to increase approximately 174 thousand and 1.837 million heads/year respectively in the whole Paraná state. And pig population in the state will be stabilized at around 4 million heads by the year of 2000. Applying the same rate, the population of livestock was projected with the following equation.

$$\text{Cattle (1,000 head)} = 174.256 \times \text{Year} - 337839$$

$$\text{Chicken (million head)} = 1.83697 \times \text{Year} - 3591.68$$

During the Strategy study, it was assumed that the annual expansion of fish pond area is 2 %. The same rate was applied to pilot river basins to estimate its area in 2005 and 2015.

The result of projection is shown in Table-5.12 with the current livestock population and fish pond area as of 1994.

(3) Water Demand Projection

Although the rates of water consumption of livestock and fish pond may vary with location due to the difference of climate, variety of livestock species, soil properties etc., such variation is negligible at this study. Therefore, the rates determined during the Strategy study was adopted with the following assumptions.

1) An livestock of 100 kg live weight requires 10 liter/day as the total water requirement.
2) Natural pasture contains as much as 80 % of water during the growth period. Therefore, amount of water actually supplied to cattle is a part of total water requirement which cannot be provided by moisture content of forage. It was assumed that the actual water supply to cattle is 33 % of total water requirement.
3) Since pigs and chickens are not herbivores, it was assumed that there is no water intake by means of food. Therefore, their water requirements depend on an average live weight.

The rates of water requirement of each livestock is shown in Table-5.11.

Table-5.11 Water Requirement of Livestock

Livestock	Average Live Weight (kg)	Total Water Requirement (liter/head/day)	Actual Water Supply (liter/head/day)
Pig	40	4.0	4.0
Cattle	300	30.0	10.0
Chicken	2	0.2	0.2

Total water requirement includes water intake by forage.
Actual water supply is a supply in liquid phase.

For the water consumption of fish ponds, the rate of 1 mm/day was adopted with the following assumptions.

1) There is no change of water in a pond.
2) The bottom of a pond is well coated with clay. Therefore, no seepage occurs or seepage ceases after the long use.
3) 60 % of annual rainfall is stored in a pond and 40 % is overflowed. An average rainfall and evaporation are 1,700 mm and 1,300 mm, respectively. Thus, annual water loss from a fish pond is approximately 300 mm (= 1,300 - 1,700 x 0.6).

The current water consumption and future water demand are just multiplication of livestock population or fish pond area by the above rates. The result is discussed in the Section-5.4.

Table-5.12 (1) Projection of Livestock Population and Fish Pond Area

Div	Code	Municipality	Area (km²)	1994 Cattle (1,000 head)	2005 Cattle (1,000 head)	2015 Cattle (1,000 head)	1994 Pig (1,000 head)	2005 Pig (1,000 head)	2015 Pig (1,000 head)	1994 Chicken (1,000 head)	2005 Chicken (1,000 head)	2015 Chicken (1,000 head)	1994 Fish Pond Area (ha)	2005 Fish Pond Area (ha)	2015 Fish Pond Area (ha)
	I-001	Campina Grande do Sul	79.2	0.2	0.2	0.3	0.1	0.1	0.1	0.0	0.0	0.0	8	10	13
	I-002	Quatro Barras	99.5	1.0	1.2	1.3	1.0	1.1	1.1	0.0	0.0	0.0	8	10	12
	I-003	Piraquara	171.9	2.7	3.2	3.7	1.1	1.2	1.2	0.0	0.0	0.0	1	1	1
	I-004	Sao Jose dos Pinhais	674.2	8.5	10.1	11.7	16.6	18.5	18.5	468.1	600.6	721.3	12	15	18
	I-005	Colombo	127.6	1.0	1.3	1.4	2.9	3.2	3.2	13.5	17.5	20.9	7	8	10
	I-006	Pinhais	98.2	1.5	1.8	2.1	0.6	0.7	0.7	0.0	0.0	0.0	0	0	1
	I-007	Almirante Tamandare	189.3	1.7	2.0	2.3	5.3	5.9	5.9	237.5	305.0	366.0	2	2	3
	I-008	Curitiba	431.7	1.1	1.3	1.5	0.6	0.7	0.7	100.0	128.0	154.0	0	0	0
	I-009	Campo Largo	297.2	2.4	2.9	3.3	7.1	7.9	7.9	14.1	18.1	21.6	10	12	15
	I-010	Araucaria	503.7	2.6	3.1	3.6	2.4	2.7	2.7	600.0	770.0	925.0	25	31	38
	I-011	Fazenda Rio Grande	110.9	1.8	2.2	2.5	2.3	2.6	2.6	467.0	599.0	720.0	10	12	15
	I-012	Mandirituba	392.3	2.3	2.7	3.1	8.0	8.9	8.9	3,112.0	3,995.0	4,797.0	22	27	33
	I-013	Tijucas do Sul	422.6	2.7	3.2	3.7	4.7	5.3	5.3	560.3	719.0	863.4	2	3	4
	I-014	Balsa Nova	319.7	1.4	1.6	1.9	0.9	1.1	1.1	0.0	0.0	0.0	15	19	23
I	I-015	Contenda	222.2	7.4	8.8	10.1	9.2	10.3	10.3	0.0	0.0	0.0	6	7	9
	I-016	Quitandinha	419.4	2.8	3.3	3.8	11.0	12.3	12.3	330.0	424.0	509.0	41	51	62
	I-017	Agudos do Sul	259.6	2.8	3.3	3.8	5.0	5.6	5.6	64.0	82.0	99.0	30	37	45
	I-018	Pien	261.7	3.0	3.5	4.1	5.0	5.6	5.6	525.0	674.0	809.0	16	20	24
	I-019	Rio Negro	603.2	8.8	10.6	12.2	8.2	9.2	9.2	990.0	1,271.0	1,526.0	3	4	5
	I-020	Campo do Tenente	314.0	7.4	8.8	10.1	1.4	1.5	1.5	96.0	123.0	148.0	7	9	11
	I-021	Lapa	2,203.9	32.4	38.9	44.7	20.0	22.3	22.3	700.0	899.0	1,079.0	14	17	21
	I-022	Porto Amazonas	153.0	2.4	2.8	3.3	2.6	2.9	2.9	173.9	223.4	267.8	1	1	2
	I-023	Palmeira	273.4	6.7	8.0	9.2	4.7	5.3	5.3	91.1	117.0	140.5	3	3	4
	I-024	Sao Jose do Triunfo	708.1	6.0	7.2	8.3	6.0	6.7	6.7	0.0	0.0	0.0	2	2	3
	I-025	Antonio Olinto	482.5	3.7	4.5	5.2	13.5	15.1	15.1	0.0	0.0	0.0	6	7	9
	I-026	Sao Mateus do Sul	1,332.8	15.3	18.4	21.1	18.0	20.1	20.1	250.0	321.0	385.0	10	12	15
	I-027	Rebouças	498.9	6.2	7.5	8.6	3.0	3.3	3.3	227.4	291.6	350.9	10	12	15
	I-028	Irati	408.1	4.6	5.5	6.4	8.2	9.2	9.2	0.0	0.0	0.0	12	15	18
	I-029	Rio Azul	642.6	7.5	9.0	10.4	6.4	7.1	7.1	50.0	64.0	77.0	42	52	64
	I-030	Mallet	672.8	6.4	7.6	8.8	20.0	22.3	22.3	864.0	1,109.0	1,332.0	20	25	30
		Sub-total	13,374.2	154.3	184.5	212.5	195.8	218.7	218.7	9933.9	12751.2	15312.4	345.0	424.0	523.0
	I-031	Paulo Frontin	377.5	4.5	5.4	6.2	12.1	13.6	13.6	870.0	1,117.0	1,341.0	27	34	41
	I-032	Paula Freitas	417.0	4.6	5.5	6.4	3.5	3.9	3.9	650.0	834.0	1,002.0	1	1	2
	I-033	Uniao da Vitoria	773.9	27.9	33.5	38.5	5.0	5.6	5.6	120.0	154.0	185.0	15	19	23
	I-034	Porto Vitoria	220.2	2.9	3.5	4.1	3.2	3.5	3.5	0.0	0.0	0.0	4	5	6
	I-035	General Carneiro	1,063.7	20.1	24.1	27.7	3.8	4.2	4.2	0.0	0.0	0.0	10	12	15
	I-036	Bituruna	1,209.7	19.5	23.4	26.9	25.0	27.9	27.9	50.0	64.0	77.0	350	435	530
	I-037	Cruz Machado	1,500.5	15.7	18.8	21.6	57.0	63.7	63.7	139.0	178.0	214.0	56	70	85
II	I-038	Inacio Martins	879.9	8.6	10.4	11.9	10.2	11.4	11.4	0.0	0.0	0.0	59	74	89
	I-039	Guarapuava	3,402.7	56.2	67.4	77.6	41.8	46.7	46.7	0.0	0.0	0.0	180	225	273
	I-040	Pinhao	2,875.2	67.3	80.6	92.8	28.3	31.6	31.6	0.0	0.0	0.0	0	0	0
	I-041	Palmas	3,125.5	64.8	77.7	89.4	6.5	7.3	7.3	0.0	0.0	0.0	190	236	288
	I-042	Clevelandia	708.4	30.5	36.5	42.0	7.6	8.5	8.5	288.0	370.0	444.0	125	155	189
	I-043	Honorio Serpa	806.6	8.5	10.1	11.7	4.7	5.3	5.3	0.0	0.0	0.0	1	1	2
	I-044	Mangueirinha	801.3	22.0	26.3	30.3	9.9	11.1	11.1	0.0	0.0	0.0	10	12	15
	I-045	Candoi	999.8	61.8	74.0	85.2	18.8	21.0	21.0	0.0	0.0	0.0	0	0	0
	I-046	Cantagalo	774.1	13.5	16.2	18.6	16.8	18.8	18.8	0.0	0.0	0.0	0	0	1
		Sub-total	19,936.0	428.4	513.4	590.9	254.2	284.1	284.1	2,117.0	2,717.0	3,263.0	1,028.0	1,279.0	1,559.0
	I-047	Irati	198.4	4.2	5.0	5.8	11.8	13.2	13.2	0.0	0.0	0.0	0	0	0
III	I-048	Laranjeiras do Sul	1,052.7	20.7	24.8	28.5	14.6	16.3	16.3	0.0	0.0	0.0	20	26	31
	I-049	Chopinzinho	992.5	44.0	52.8	60.7	19.2	21.5	21.5	1,824.0	2,341.0	2,812.0	60	75	91
	I-050	Coronel Vivida	681.5	33.6	40.3	46.3	22.1	24.7	24.7	170.0	218.0	262.0	36	45	55
	I-051	Pato Branco	570.2	25.8	30.9	35.6	13.1	14.6	14.6	3,658.0	4,696.0	5,639.0	15	19	23
	I-052	Mariopolis	232.1	9.6	11.5	13.2	5.0	5.6	5.6	480.0	616.0	740.0	6	7	9
	I-053	Vitorino	326.1	11.1	13.3	15.3	17.0	19.0	19.0	1,360.0	1,746.0	2,096.0	17	21	26
	I-054	Renascenca	434.7	17.0	20.4	23.5	12.0	13.4	13.4	500.0	642.0	771.0	40	50	61
	I-055	Bom Sucesso do Sul	135.3	13.4	16.1	18.5	10.0	11.2	11.2	600.0	770.0	925.0	30	37	45

Table-5.12 (2) Projection of Livestock Population and Fish Pond Area

Div	Code	Municipality	Area (km²)	1994 Cattle (1,000 head)	2005 Cattle (1,000 head)	2015 Cattle (1,000 head)	1994 Pig (1,000 head)	2005 Pig (1,000 head)	2015 Pig (1,000 head)	1994 Chicken (1,000 head)	2005 Chicken (1,000 head)	2015 Chicken (1,000 head)	1994 Fish Pond Area (ha)	2005 Fish Pond Area (ha)	2015 Fish Pond Area (ha)
	I-056	Itapejara D'Oeste	246.0	12.1	14.5	16.7	23.4	26.1	26.1	2,700.0	3,466.0	4,162.0	10	12	15
	I-057	Vere	345.6	16.2	19.4	22.4	13.0	14.5	14.5	900.0	1,155.0	1,387.0	32	40	49
	I-058	Sao Joao	408.9	26.1	31.3	36.1	16.3	18.2	18.2	3,966.0	5,091.0	6,114.0	11	14	17
	I-059	Sulina	158.5	13.4	16.1	18.5	7.5	8.4	8.4	132.0	169.0	203.0	16	20	24
	I-060	Saudade do Iguacu	147.8	11.2	13.4	15.5	3.0	3.4	3.4	1,000.0	1,284.0	1,542.0	4	5	6
	I-061	Rio Bonito do Iguacu	459.3	5.9	7.0	8.1	7.4	8.2	8.2	0.0	0.0	0.0	0	0	0
	I-062	Nova Laranjeiras	578.8	17.1	20.5	23.6	6.8	7.6	7.6	40.6	52.3	62.7	0	0	0
	I-063	Guaraniacu	495.0	40.2	48.2	55.5	10.7	12.0	12.0	626.4	804.2	965.5	6	7	8
	I-064	Quedas do Iguacu	1,192.9	35.8	42.9	49.4	12.0	13.4	13.4	318.0	408.0	490.0	7	9	11
	I-065	Sao Jorge do Oeste	385.1	16.4	19.7	22.6	8.0	8.9	8.9	900.0	1,155.0	1,387.0	21	26	32
	I-066	Cruzeiro do Iguacu	96.6	7.4	8.9	10.2	5.0	5.6	5.6	3,498.0	4,490.0	5,392.0	1	1	2
III	I-067	Boa Esperanca do Iguacu	249.4	11.1	13.3	15.3	10.7	12.0	12.0	312.0	401.0	481.0	10	12	15
	I-068	Dois Vizinhos	372.7	22.4	26.8	30.9	46.0	51.4	51.4	5,000.0	6,419.0	7,708.0	7	9	11
	I-069	Eneas Marques	234.7	15.3	18.3	21.0	26.2	29.3	29.3	372.0	478.0	573.0	4	5	6
	I-070	Francisco Beltrao	696.7	34.1	40.8	47.0	37.5	41.9	41.9	2,270.0	2,914.0	3,499.0	104	129	158
	I-071	Marmeleiro	449.9	15.3	18.3	21.1	30.0	33.5	33.5	650.0	834.0	1,002.0	15	19	23
	I-072	Flor da Serra do Sul	94.7	10.4	12.5	14.4	14.3	15.9	15.9	205.0	263.0	316.0	92	114	139
	I-073	Barracao	386.3	20.9	25.0	28.8	6.7	7.4	7.4	150.0	193.0	231.0	5	6	8
	I-074	Salgado Filho	506.4	35.0	42.0	48.3	20.0	22.3	22.3	800.0	1,027.0	1,233.0	4	5	6
	I-075	Santo Antonio do Sudoeste	313.8	19.1	22.9	26.3	1.4	1.6	1.6	380.0	488.0	586.0	66	82	100
	I-076	Pranchita	297.1	10.3	12.3	14.2	15.3	17.1	17.1	150.0	193.0	231.0	30	37	45
	I-077	Pinhal de Sao Bento	107.6	3.5	4.2	4.8	8.0	8.9	8.9	120.0	154.0	185.0	7	9	11
	I-078	Ampere	307.9	14.7	17.6	20.3	17.0	19.0	19.0	4,600.0	5,905.0	7,091.0	4	5	6
	I-079	Nova Esperanca do Sudoeste	176.9	17.8	21.3	24.5	18.8	21.0	21.0	1,000.0	1,284.0	1,542.0	3	4	5
	I-080	Salto do Lontra	336.9	17.9	21.5	24.7	16.0	17.9	17.9	3,950.0	5,070.0	6,089.0	55	68	83
	I-081	Santa Izabel do Oeste	330.5	15.8	19.0	21.8	17.0	19.0	19.0	1,200.0	1,540.0	1,850.0	4	5	6
	I-082	Nova Prata do Iguacu	333.0	31.5	37.8	43.5	54.0	60.3	60.3	198.0	254.0	305.0	9	11	14
	I-083	Perola do Oeste	330.1	13.2	15.8	18.2	22.0	24.6	24.6	60.0	77.0	92.0	9	11	14
	I-084	Planalto	337.1	34.0	40.7	46.9	20.3	22.7	22.7	0.0	0.0	0.0	5	6	8
	I-085	Realeza	351.9	25.2	30.2	34.7	19.5	21.8	21.8	160.0	205.0	247.0	3	4	5
	I-086	Capanema	403.9	30.4	36.5	42.0	10.0	11.2	11.2	800.0	1,027.0	1,233.0	25	31	38
	I-087	Tres Barras do Parana	521.7	33.6	40.2	46.3	21.2	23.7	23.7	420.0	539.0	647.0	5	6	8
	I-088	Ceanduvas	593.9	18.6	22.2	25.6	10.1	11.2	11.2	346.0	444.0	533.0	12	15	18
	I-089	Ibema	148.3	8.5	10.2	11.7	2.1	2.3	2.3	352.0	451.8	542.7	11	14	17
	I-090	Cascavel	1,198.9	39.3	47.1	54.2	25.0	27.9	27.9	1,264.8	1,623.8	1,950.0	27	33	41
	I-091	Boa Vista da Aparecida	232.2	16.7	20.0	23.1	1.8	2.0	2.0	240.0	308.0	370.0	2	2	3
	I-092	Capitao Leonidas Marques	279.8	16.6	19.9	22.9	8.5	9.5	9.5	1,100.0	1,412.0	1,696.0	15	19	23
	I-093	Santa Lucia	137.1	20.6	24.7	28.5	3.7	4.1	4.1	192.0	246.0	296.0	0	0	0
	I-094	Lindoeste	273.2	33.5	40.2	46.2	8.0	8.9	8.9	125.0	160.0	193.0	8	10	12
	I-095	Santa Tereza do Oeste	235.5	9.5	11.3	13.1	6.4	7.1	7.1	70.1	90.1	107.9	7	9	11
	I-096	Ceu Azul	937.2	20.9	25.1	28.9	27.7	30.9	30.9	403.4	518.0	621.6	6	8	9
	I-097	Matelandia	601.4	26.9	32.3	37.1	27.1	30.2	30.2	346.3	444.6	534.1	25	30	37
	I-098	Medianeira	621.1	31.6	37.9	43.6	37.8	42.3	42.3	598.4	767.9	922.5	32	40	48
	I-099	Sao Miguel do Iguacu	455.7	23.4	28.1	32.3	16.6	18.5	18.5	159.0	204.3	245.0	15	18	22
	I-100	Santa Terezinha de Itaipu	162.1	9.5	11.3	13.0	3.1	3.4	3.4	47.0	60.4	72.2	2	3	3
	I-101	Foz do Iguacu	312.2	9.5	11.4	13.1	2.8	3.1	3.1	32.8	42.0	50.5	8	10	12
		Sub-total	22,465.8	1097.8	1315.7	1514.3	850.5	949.7	949.7	50746.8	65141.4	78225.7	968.0	1203.0	1470.0
		Total	55,776.0	1,681.0	2,014.0	2,318.0	1,301.0	1,453.0	1,453.0	62,798.0	80,610.0	96,801.0	2,341.0	2,906.0	3,552.0

Area: Area within the river basin

Note: The total area of the river basin is slightly different from the area adopted by the Study Team due to roundup during the computation.

Source: SANEPAR GIS Computation based on IAP Satellite Imagery Analysis for Area of Municipality
EMATER for the Population of Livestock and Fish Pond Area as of 1994