8.4 Ecology

8.4.1 Biological Environment

The information contained in this section was made possible mainly through the coordination of the IAP personnel, and the Museum of Natural History of Paraná state.

(1) Flora

Before 1940, Paraná had 83% of it's native forest cover, out of which 43% correspond to Araucaria angustifolia forests. Today, only an estimated 5% is left of the original forest cover, and by the year 2,000, if present conditions persist, it is estimated that only 2.5% will remain.

The percentage of forest cover area per river basin goes from 1.26% of the total basin area for Itarare river basin, up to 80.98% for the Coastal basin, and 81.8% of the river basins of the state are considered to be under critical condition for native forest coverage, see Table-8.22. The Coastal basin is the one with the highest representation of native species.

The floristic condition can be summarized as follows:

1) Iguaçu river basin flora is in advanced state of devastation
2) Ivai river basin forest remanent is practically non-existing
3) Tibagi river basin flora is absorbed by secondary vegetation
4) Piquiri river basin flora is very altered, and the original vegetation is difficult to reconstruct.
5) Paraná, Paranapanema, Cinzas, Itarare and Ribeira river basins have a very small forest cover, and the original floristic composition is difficult to establish.

(2) Conservation Units

The conservation area per river basin goes from 0.01% of the total basin area for the Piquiri river basin, up to 75.44% for the Coastal river basin. See Table-8.22.

No percentage conservation area has been determined for Pirapo, Itarare, and Cinzas river basins. The highest percentages of river basin areas covered by conservation units after the Coastal river basin belong to Tibagi and Iguaçu river basins with 16.87% and 10.21% of the basin area respectively.

(3) Terrestrial Fauna

The basin where the terrestrial fauna is better preserved, is the basin where the vegetation cover is also better preserved, this is the Coastal basin. More than 160 species of mammals reported, represented by 32 families.

Among the mammals reported for the state, 12.5% are considered in the red list, also, 17 species of reptiles, 15 species of butterflies, and 117 species of birds are included in the red list. Birds are the most affected, given the forest disappearance. See Table-8.23.

Table-8.22 Summary of Reported Forest Coverage

	Iguaçu river basin	Ivai river basin	Tibagi river basin	Piquiri river basin	Ribeira river basin	Parana river basin	Coastal river basin	Parana-panema river basin	Pirapo river basin	Itarare river basin	Cinzas river basin
Native Forest Cover (%) of basin area	14.56	5.05	3.80	2.17	5.69	6.75	80.98	4.86	2.49	1.26	2.92
(ha) x 1000	805.40	181.18	93.60	53.60	51.94	88.80	466.93	47.61	12.46	6.54	27.12
Brush (%) of basin area (capoeira)	27.42	31.08	27.84	20.90	51.93	23.00	4.68	18.56	25.29	20.03	13.36
(ha) x 1000	1517.00	1115.00	685.80	516.40	474.10	302.60	26.98	181.83	126.59	104.11	124.12
Reforestation (%) of basin area	1.72	1.80	9.54	0.35	5.34	0.02	3.97	0.00	0.00	21.69	6.21
(ha) x 1000	95.14	64.58	235.00	8.64	48.75	0.26	22.89	0.00	0.00	112.74	57.69
Total Forest coverage area (%) of basin area	43.70	37.93	41.18	23.42	62.95	29.77	89.63	23.42	27.78	42.89	22.49
(ha x 1000)	2417.40	1360.90	1014.40	578.60	574.80	391.60	516.80	229.44	139.06	223.40	208.94
Endangered Species (E, NR,NE)	E	E	E	E	E	E	E	E	E	E	E
Conservation Units (ha) x 1000	565.00	80.00	415.67	0.38	24.00	100.00	435.00	1.58	ND	ND	ND
% of Basin Area	10.21	2.22	16.87	0.01	2.62	7.60	75.44	0.16	ND	ND	ND
Total Area (ha x 1000)	5531.80	3587.89	2463.47	2470.80	912.93	1315.63	576.60	979.70	500.59	519.79	929.07

SOURCE: Williams Mendoza, Remote Sensing/IAP, Gubert,F. Forestry/IAP.1994 and Ziller, S. Forestry/IAP
E= existing, NE= Non Existing, NR= Non reported, ND= No Data

Table-8.23 Summary of Reported Aquifer Bird Fauna

	Iguaçu river basin	Ivai river basin	Tibagi river basin	Piquiri river basin	Ribeira river basin	Parana river basin	Coastal river basin	Parana-panema river basin	Pirapo river basin	Itarare river basin	Cinzas river basin	Parana State
Family (number of)	15	14	9	10	8	17	ND	13	8	8	8	31
Order (number of)	8	7	6	6	6	7	ND	6	6	6	6	10
Species (number of)	65	34	27	22	21	59	ND	27	19	19	19	163
Endangered (number of species)	5	2	0	0	1	7	ND	1	0	0	0	12

SOURCE: Museum of Natural History of Parana State
E= existing, NE= Non Existing, NR= Non reported, ND= No Data

(4) Aquatic Fauna

Extensive fish population studies involving all of a given river basin are scarce in the state, the most comprehensive works have been carried out for the Iguaçu river, the Paraná river, and the Tibagi river. See Table-8.24.

The number of endemic species found in the Iguaçu river is very high (70%), making this a unique habitat, although approximately 50% of the river length has been modified by hydroelectric projects.

The fish population of the Tibagi river requires extensive studies before hydroelectric projects are implemented, existing migratory and economically important species stress this need.

The low fisheries catch in the Paranapanema river is attributed to the disappearance of the river margin vegetation, agrochemical pollution and over fishing. No systematic collections have been carried out in the Ivai, Reveira or Itarare river basins.

(5) Benthic Fauna

The most significant benthic fauna of interest is related with the macro invertebrate community, whereby these species change according to the water quality condition of the area.

Benthic fauna identification projects are being carried out by IAP in Iguaçu, and by Londrina University in Tibagi, and are the baseline for the water environment quality assessment.

(6) Bird Fauna

Bird fauna of fresh water aquatic habitats in the state of Paraná is reported to have at least 156 species belonging to 28 families. See Table-8.23.

The bird fauna is the most affected because of anthropic activities and environmental degradation. The reduced food supply and shelter due to deforestation, the agrochemical pollution and insect biodiversity reduction due to agriculture expansion are the main causes of depletion.

(7) Significant Aquatic Habitats

Approximately 342,822 ha of lowlands along watercourses (varzeas) are reported in 1981 for the Tibagi river basin, including 268,260 ha with some kind of restriction of use for agricultural purposes. By 1989, approximately 9,387 ha had been incorporated into agricultural production.

These habitats have become the botanical areas most modified in the coastal basin. In natural state, this vegetation reaches some 15-20 m in height.

The mangrove habitat covers significant areas in the Guaratuba, Paranagua, Antonina, and Guaraquesaba bays, giving nursery conditions for the bird, fish, mollusc and crustaceans species of economic, scientific, touristic interest. The urban expansion of the port threatens with the reduction of this habitat.

Marshes are also present over alluvial extensions, constituted by Herbaceous communities, and less commonly, by bushes and trees. The areas are adjacent to rivers, and are subject to flooding. The Morretes alluvial plane is an example of this environment. The marsh vegetation covers about 8,000 ha of the coastal basin, and remains still inhabited.

8.4.2 Socioeconomic Environment

(1) Farming

In the 1930's the Northern Paraná Land Company, of British capital acquired some 1 million hectares of land, which where subdivided into smaller parcels for further speculation. Each lot had a water source, lower lands and hilly areas.

Coffee crops were planted in the higher elevations, and grazing areas in the lower elevations. Between the 1930's and 1960's the lower Tibagi region experienced the highest demographic density, but by the 1970's coffee crops declined because of frost, intensive soil use, and low coffee prices.

From the 1970's onward the exodus of farmers to the metropolitan area became the origin of poverty belts, and the agricultural land moved from multiple culture and small-medium parcels to bigger monocultural areas eliminating forest remainders, and river margin vegetation, increasing erosion, water turbidity, and agrochemical pollution.

(2) Fisheries

Fisheries of interest are located in the Paraná river basin and Itaipu reservoir. The main species of commercial interest are restricted to 5 species, and generate an estimated 2,000 MT/year catch. The main species of fish with commercial interest in the Paranapanema river basin are restricted to five.

Fisheries in the Tibagi river are mainly sport fishing and artisanal fisheries composed of approximately 100 fishermen. From the reported fish species of commercial interest in the Tibagi river, 50% are migratory, 27% are endangered, and only 15% are abundant.

No major hydroelectric project is yet installed in the Tibagi river, although several projects are planned, major impacts expected from these projects are attributed to the fish populations with the damming of river sectors. Specific programs to evaluate the fish resource, and to establish the baseline data for restocking endangered species and commercial production of fish are recommendable to mitigate these possible impacts.

(3) Aquaculture

Aquaculture production is incipient, and represented by 14 aquaculture associations with 600-700 small individual producers, the majority of producers are located in the Paraná, Piquiri and Iguaçu river basins.

The total estimated production area is 2,500 ha of ponds. Number of species being cultured is 8, and the most cultured species are Carp (47.04%), and Tilapia (30.88%), major productions are estimated for the culture of Tilapia and African Catfish (10,000 kg/ha/yr)

Table-8.24 Summary of Reported Fish Fauna

	Iguaçu river basin	Ivai river basin	Tibagi river basin	Piquiri river basin	Ribeira river basin	Parana river basin	Coastal river basin	Parana-panema river basin	Pirapo river basin	Itarare river basin	Cinzas river basin
Family (number of)	15	18	9	13	12	25	12	6	16	NR	NR
Genera (number of)	35	33	36	30	39	66	40	14	31	NR	NR
Species (number of)	47	43	42	43	64	170	NR	15	36	NR	NR
Endemic (number of species)	33	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
percent	70	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
introduced (number of species)	4	1	ND	ND	ND	NR	ND	ND	1	ND	ND
percent	8.51	2.32	ND	ND	ND	ND	ND	ND	2.7	ND	ND
Rare (number of species)	4	ND	ND	ND	ND	ND	ND	NR	NR	NR	NR
percent	8.51	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endangered (number of species)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Commercial(number of species)	NR	NR	NR	NR	NR	8	NR	NR	ND	ND	ND
migratory (number of species)	NR	NR	NR	NR	NR	NR	NR	NR	ND	ND	ND

SOURCE: Museum of Natural History of Parana State
E= existing, NE= Non Existing, NR= Non reported, ND= No Data

Aquaculture potential to be developed is foreseen as a possibility in the existing and planned hydroelectric reservoirs of the Iguaçu and Tibagi river, action programs in this direction should include the detailed study of existing endemic species with economic potential before introducing exotic species for culture purposes.

(4) Hydropower

Approximately 50% of the Iguaçu river stretch has been modified by hydroelectric projects, main impacts associated are the transformation from a rapid to a slow water environment, interfering with the natural habitat of the fish, and establishment of migratory barriers to access tributaries.

The environmental impact study performed for Salto Caxias reflects a well structured and comprehensive study approach, including specific programs for the amelioration, prevention or re-habilitation of the impacts foreseen.

The projects proposed for the Tibagi river basin are small scale, will inundate rather small areas, and most of the areas to be inundated are heavily altered by agricultural and anthropic activities, no major population is foreseen to be affected.

Apparently, significant forest resources are compromised in the Maua project, where some 57% of the 97.4 Km^2 to be inundated are covered with natural forest, in the San Jeronimo project, further studies should evaluate the forest extension to be inundated, and the conflict that could arise with the indigenous population by the inundation of some 7 Km^2 of the reserve.

(5) Water Intakes

Main problems in water intakes are attributed to organic pollution generating excessive microalgae growth and eventual oxygen depletion cycles according to SANEPAR limnological laboratory.

The agrochemical runoff from fields located north of the Passauna reservoir, and effluent leaching from the abandoned Lamenha Pequena landfill, domestic sewerage disposal, industrial effluent from paper industry, and pig manure discharge are mentioned as specific problems being faced by the Passauna reservoir.

Water intake locations for the Tibagi river basin have main problems associated with domestic, industrial and agricultural effluent, and increased turbidity from erosion runoff. The urban and industrial expansion tendency without adequate environmental studies towards the water supply areas in Arapongas, Riberao Jacutinga and Ibipora springs is a main concern for COPATI in the Tibagi river basin area.

The biological monitoring of the water intakes is an alternative to be considered for the rapid an continuos assessment of water quality before chemical analysis is required.

(6) Landfills

The total estimated volume of solid waste per day generated in the Iguaçu river basin is estimated in 2,200 MT/day. Seven major urban centers generate 56% of the municipal solid

waste in the Iguaçu basin, the remaining municipalities are estimated to generate some 970 MT (44%) of the total, the system used for disposal goes from open air disposal to municipal landfill.

Most of the municipalities have open air disposal except Curitiba with 1,000 MT/day, and 56% of the total solid waste volume of the basin is organic matter. Main problems related to landfills are associated to the lack of proper equipment, horizontal urban growth pattern making landfills less accessible, lack of environmental education on waste separation and recycling, and improper disposal methods such as open air disposal.

In the Tibagi river basin, the municipal solid waste is left in open dumps (30%), disposed of in sanitary landfills (65%) and 5% is recycled.

(7) Assessment of Significative Environmental Conditions in the Socioeconomic Environment

The following itemized impacts have been identified for the socio-economic environment:

1) Deterioration of the quality of life in populated areas adjacent to polluted waterways.
2) Increased operational cost of water treatment plants because of increased suspended solid concentration.
3) Increased flood damage in lands adjacent to waterways, because of the lack of river margin vegetation.
4) Irregular river flow regime affecting operation of hydropower projects.
5) Loss of in-state supply of endemic wood.
6) Poverty belts around urban areas located in flood prone areas with deficient municipal services as a consequence of urban centralized model.
7) Improper handling and disposal of solid waste could originate pathogen vectors, aggressive odors, and water environment pollution through effluent leaching.

8.4.3 Strategy for Ecological Improvement

(1) Desirable Conditions of Aquatic Ecosystem in Paraná State in the Future

The main sources of the water environment deterioration are attributed to untreated sewerage, industrial effluent, and turbidity caused by deforestation-erosion. Enforcement of effluent and solid waste discharge legislation, regular monitoring of effluent discharges, afforestation and soil conservation projects should have environmental priority in the state. The establishment of a centralized aquatic biology and monitoring interpretation center could improve the aquatic environment conditions. In this circumstance desirable future conditions are described as follows:

1) Reduction of pollutant effluent discharge from industrial and municipal activity, raw sewerage disposal, solid waste, and suspended solid load.
2) Increased re-vegetation of the waterways margins.
3) The biodiversity index for benthos should show increased species diversity.

4) The river maintenance flow in water development projects should consider the endemic ichthyofauna and it's natural history, in order to procure a suitable water environment for the perpetuation of the fish species.

5) The protection of the varzeas (wetlands) should limit the agricultural area expansion, since these areas are known to play an important role in the nursing of different species.

6) The mangrove and estuarine areas should be fully protected from urban encroachment, wood extraction, over fishing and pollutant discharges which hamper their role as nurseries.

(2) Proposed Structural and Non-Structural Measures in 2005 and 2015

In order to attain the foregoing desirable conditions of the aquatic ecosystem in Paraná state the following structural and non-structural measures are proposed.

1) Structural measures

Present to 2005

a) Planning of municipal solid waste recycling, composting and landfilling projects.

b) Establishment of urban green areas and parks, specially in lowlands subject to flood.

c) Introduction of fauna into the urban green belts as environmental education and recreation program.

d) Allocate resources, area and laboratory equipment for a centralized aquatic ecology laboratory which will deal with ecotoxicology and aquatic biota.

e) Allocate resources, area and laboratory equipment for an native fish reproduction facility for the state.

2006 to 2015

a) Allocation of solid waste disposal areas for recycling, composting and landfilling for urban areas.

b) Linkage of the green urban areas of the Curitiba metropolitan area with adjacent preserved areas to establish a corridor for flora and fauna linking urban areas and preserved areas.

c) Continue with the introduction of fauna into the green belts of the urban area as an environmental education program.

d) Centralized aquatic ecology laboratory in full operation and providing data base information, monitoring, guidelines and standards for the preservation and maintenance of the aquatic ecosystem.

e) Laboratory for the reproduction of native fish species at full operational scale.

2) Non-structural measures

Present to 2015

a) Continue the ongoing project for the monitoring and assessment of water quality through benthic community by 2005, and feedback pollution control agencies to act accordingly after 2006.

b) To continue with the ongoing project for ecotoxicological study of agrochemicals by 2005, and to feedback on official agencies to act accordingly after 2006.

c) To continue the fish population inventory for the different rivers by 2005, and to feedback into fish reproduction programs to evaluate re-stocking of endemic species after 2006.

d) Review, evaluate, modify, and adapt the environmental pollution legislation to the existing conditions.

e) Continue the research project for the reproductive cycle of endemic fish species, and evaluate re-stocking of endemic species.

f) To enhance environmental education program to broaden the concept of sustained development by 2005 and continue with advanced environmental education programs oriented toward sustained development after 2006.

g) To enforce mangrove protection legislation and avoid destruction of the existing mangrove ecosystem continuously.

h) To declare periodically inundated area, and to continue enforcing the areas as public interest to minimize change in the use of these lands into agricultural lands.

i) To review, adapt and enhance the existing re-cycling programs and policies to minimize solid waste disposal in waterway.

j) To review, adapt and promote regulations, programs and policies that will incentivate reforestation of endemic species as a business activity, in order to move the private sector to invest in this activity.

k) To review and continue promoting regulations and legislation to limit the importation of wood from other states, and enhance reforestation efforts in the state through this.

l) To develop and continue implementing a screening mechanism to regulate the entrance of exotic aquaculture species.

m) To enforce population dynamics studies of the fish population by new projects dealing with the water environment, and enforce regulations for these projects to procure mitigation and prevention of impacts on fish population.

n) To organize and centralize scattered information from the pertient organizations and institutions to develop the data base bank for the ecological data base center.

(3) Objective of Preservation of Ecosystem Data Base Center in Paraná

1) The data base center will establish a species catalog for aquatic and terrestrial organisms, which will be readily accessible for research and development.
2) The data base center will be the reference point to evaluate present and future ecosystem status and its relative deterioration or improvement.
3) The data base center will be a source of information for the research and development of new biotechnology such as medicinal plant extracts, and other pharmaceutical with economic potential for development.
4) The data base center will provide the information to assess the location and status of natural seed banks for the regeneration of degraded ecosystems where species diversity has been deteriorated.
5) The data base center will provide updated lists of threatened, endangered and endemic aquatic, terrestrial and avian species.
6) The data base center will develop an ecotoxicological and hazardous chemical and agrochemical catalog supported by macro invertebrate monitoring and bio-toxicity tests.

(4) Proposed List of Monitoring Items in Ecology,

- Fish population of endemic, introduced, threatened and endangered species.
- Reforested area and river margin vegetation extension.
- Aquatic bird population and it's geographic distribution.
- Water environment quality through the use of bioindicators

The integration concept between monitoring and preservation is illustrated in Figure-8.7.

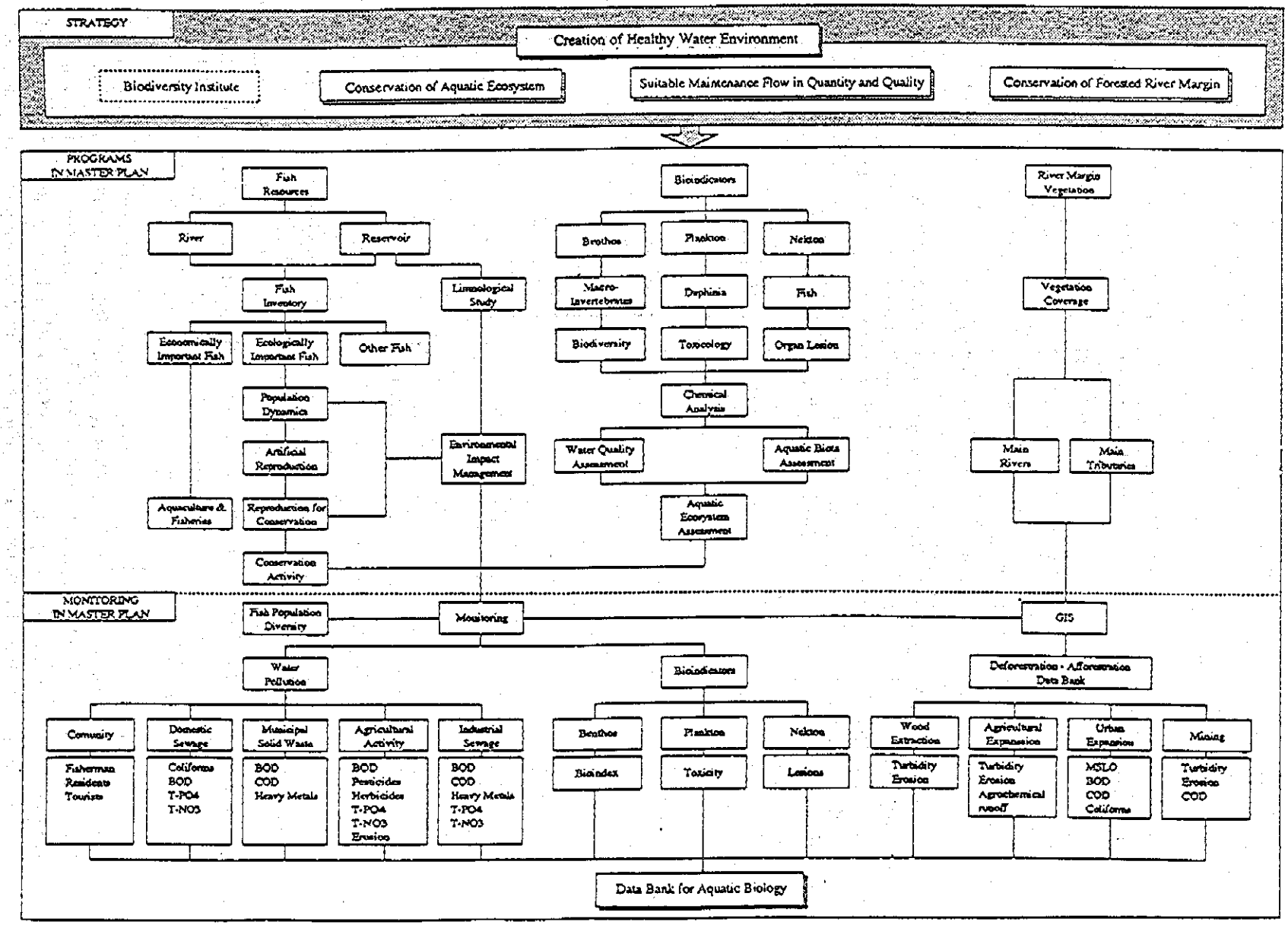


Figure-8.7 Interrelationship Between Monitoring and Preservation Programs

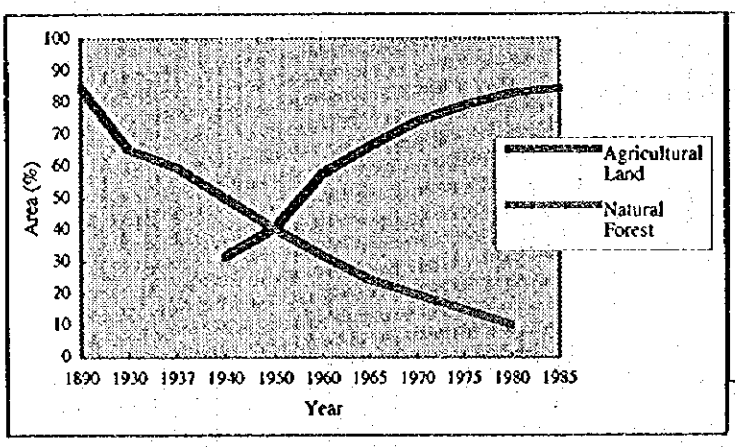
8.5 Forest

8.5.1 Deforestation

Native species in Paraná vary with location. The followings are considered as the main species in terms of the use, such as agroforestry, fuel wood and timber.

Scientific name	Local name
Araucaria angustifolia	Araucaria
Ilex paraguariensis	Erva mate
Mimosa scabrella	Bracatinga

According to Maack (1968) and IBDF (1980), natural forest covered 84.8 % of Paraná state in 1890 and declined to 10.1 % in 1980 as shown in Figure-8.8. At the beginning of the century, the degradation of natural forest was due to the timber industries. From 1920's, the agriculture had spread rapidly in the state inducing the sharp decline of the natural forest area. Deforestation had expanded from the first plateau to the third plateau as the progress of immigrants.



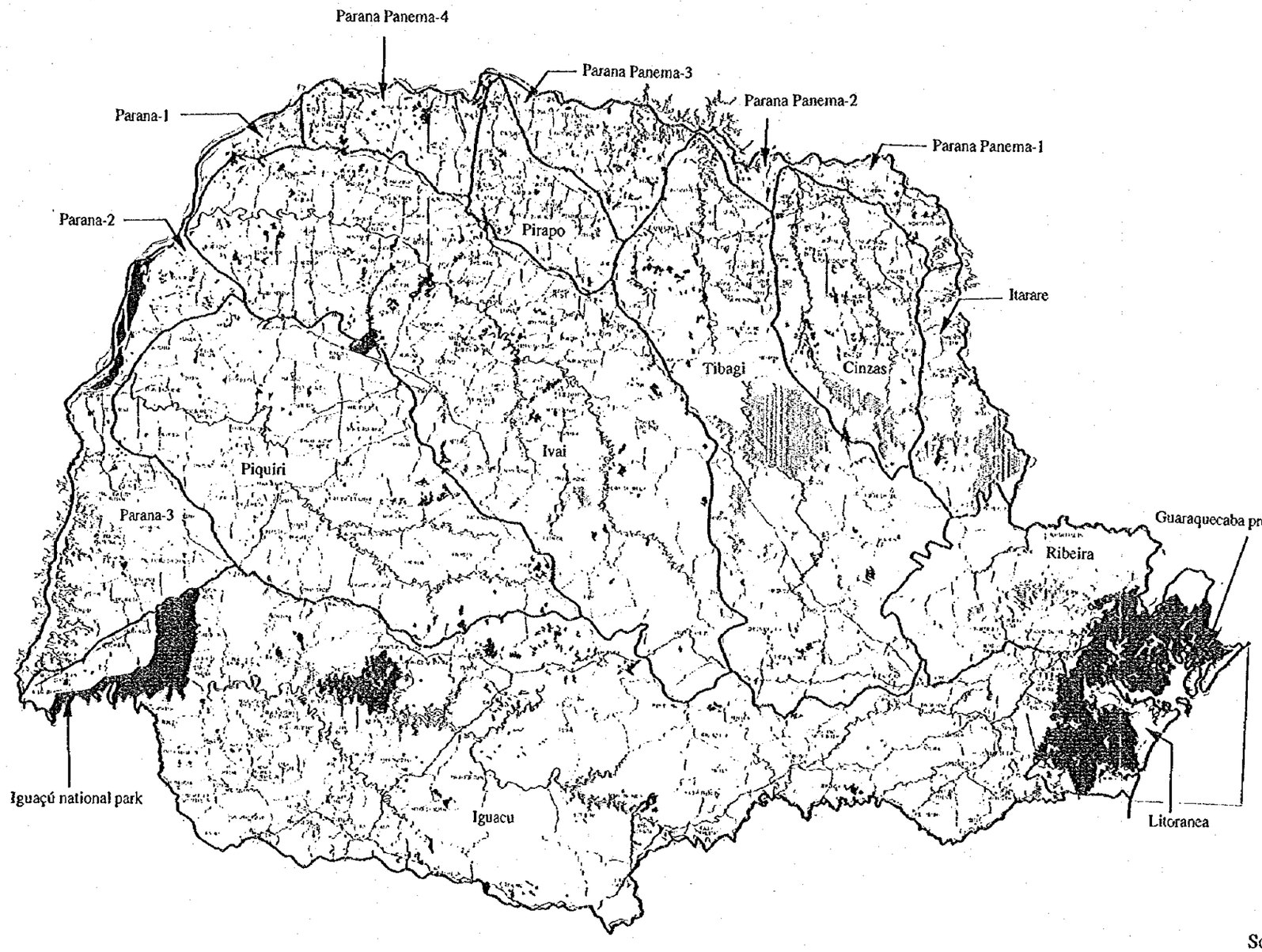
Year	Agricultural Land		Natural Forest	
	Area (1000km²)	Area (%)	Area (1000km²)	Area (%)
1890			167.8	84.8
1930			129.0	65.2
1937			118.0	59.6
1940	62.5	31.6		
1950	80.3	40.6	79.8	40.3
1960	113.8	57.5		
1965			48.1	24.3
1970	146.3	73.9		
1975	156.3	79.0		
1980	163.8	82.8	20.0	10.1
1985	167.0	84.4		

Source ; Agricultural Land 1940-1985 ; Agricultural and Livestock Census(1985) IBGE
Natural Forest 1890-1965 ; Maack(1968), Natural Forest 1980 ; IBDF

Figure-8.8 Expansion of Deforestation and Agricultural Land

The forest area in 1990 is available from SANEPAR as a result of GIS computation based on the satellite imagery analysis conducted by IAP (1990 and 1994). Natural forest occupied only 9.0 % of the state and reforestation covers 3.2 % in 1990, equivalent to approximately 17,800 km^2 and 6,300 km^2 respectively. The forest and reforestation coverage of each river basin, and the location of natural forest and reforestation as of 1990 are shown in Figure-8.9.

As shown in Figure-8.9, natural forest is mainly conserved in Litoranea and Iguaçu river basin; while afforestation is practiced in Cinzas, Itarare, Ribeira and Tibagi river basins. According to Milano (1990), the forest area conserved by the federal government in terms of parks and preservation area was approximately 5,000 km^2 and one by the state was 1,000 km^2. The federal one consists of Iguaçú national park, Guaraquecaba preservation area and so on, indicated as natural forest in Figure-8.9.



		Total Area (km^2)	Land Use (%)	
			Forest	Re
	State	197882.0	9.0	3.2
River Basin	Cinzas	9290.7	2.9	6.2
	Iguacu	55318.0	14.3	1.7
	Itarare	5197.7	1.3	21.7
	Ivai	35878.9	5.0	1.8
	Litoranea	5766.0	68.9	3.9
	Parana	13156.3	7.5	0.0
	Paranapnema	9797.0	4.9	0.0
	Piquiri	24707.9	2.1	0.3
	Pirapo	5005.9	2.5	0.0
	Ribeira	9129.3	5.7	5.3
	Tibagi	24634.7	3.8	9.4

Re : Reforestation

Source: GIS Computation by SANEPAR (1994)

Land Use Map by IAP (1990)

Figure-8.9 Existence of Natural Forest and Afforestation

8.5.2 Afforestation

Until 1987, the federal government assisted to promote afforestation in terms of loan; however, it has ceased for a long time. Afforestation during the federal government assistance, 1966 to 1987, has been registered at IBAMA. The total area of afforestation during this period is summarized in Table-8.25 with EMATER division (refer to Section 6.3, EMATER division map). The total area of afforestation means the area planted, and the existence of afforested area and areas felled are not counted.

Ponta Grossa, Curitiba and Paranagua regions were more benefited by the government assistance compared to other region and the result is obvious in Figure-8.9 as reforestation. Main species for afforestation are pine tree, araucaria and eucalyptus. All of them are for the commercial use such as, timber industry, paper industry and so on.

DAGRI/SEAB has conducted currently an afforestation program, Program for Integrated Forest Development. The objectives are to motivate the implementation of afforestation aiming at preservation and production of forest in terms of loan, 50 % of the cost at maximum. The program has focused on supporting municipalities and regional associations. Since the program has started in January, 1994, its effect on the environment and rural economy is not assessed yet.

Since 1991, IAP has conducted the project of conservation and recuperation of riverian vegetation along rivers for the public water supply (Projeto Agua Limpa) in association with SANEPAR, city hall, and relative institutions. As of 1994, the implementation reached the planting of 2 million native forest seedlings to cover the riverian vegetation of 1,300 km of river length (Carmo, 1994).

Table-8.25 Afforestation registered at IBAMA (1966 - 1987)

unit: km2

EMATER No.	Municipality	Total Area
EM-17	Apucarana	28.07
EM-13	Campo Mourao	71.87
EM-10	Cascavel	163.26
EM-19	Cornelio Procopio	334.91
EM-2, 3	Curitiba	2,322.05
EM-9	Francisco Beltrao	75.95
EM-7	Guarapuava	877.64
EM-5	Irati	274.51
EM-14	Ivaipora	145.23
EM-20	Jacarezinho	134.31
EM-18	Londrina	11.83
EM-16	Maringa	0.65
EM-1	Paranagua	1,400.03
EM-15	Paranavai	5.86
EM-8	Pato Branco	230.15
EM-4	Ponta Grossa	3,068.01
EM-11	Toledo	15.63
EM-12	Umuarama	16.28
EM-6	Uniao da Vitoria	425.63

Source: IBDF, IBAMA

Curitiba region includes Lapa region.

8.5.3 Effect of Deforestation and Necessity of Afforestation

Deforestation decreases surface cover of land and increases rainfall impact to the surface simultaneously. Afterward, evapotranspiration decreases due to less biomass activities and soil erosion increases due to less surface cover. As a consequence, increase in surface

runoff induces flood, while increase in sediment yield degrades water quality in downstream. These effects of deforestation on the water environment are summarized schematically in Figure-8.10.

If the whole land were covered by forest, there would be no problem associated with soil erosion as long as the normal erosion, one caused by nature, is considered as permissible level. The accelerated erosion, one caused by human activities, has been induced primarily by deforestation. Successively, it has been enlarged by improper land use. Therefore, soil erosion coincides with deforestation.

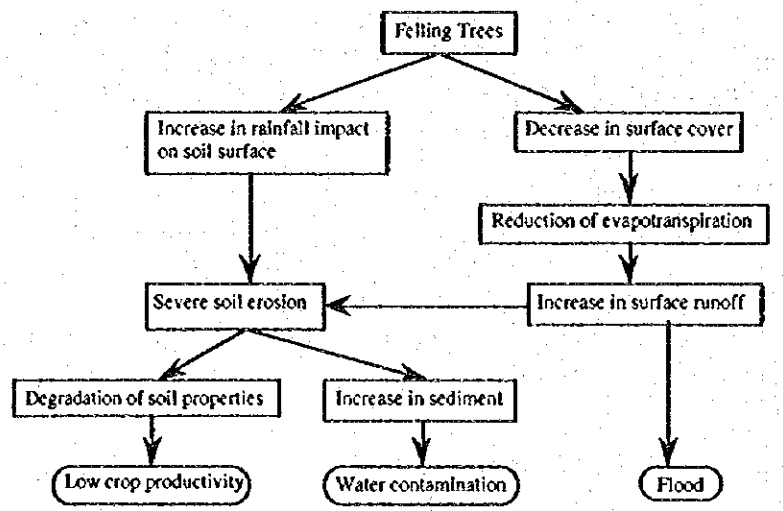


Figure-8.10 Effects of Deforestation

Proper management of forest contributes to sustainable level of production of timber, preservation of environment, erosion control, maintenance of soil fertility and so on. On the other hand, regional development plans, such as expansion of agriculture land, often have negative effect on forest. Since both sides are crucial for the society, the most difficult part regarding environmental issues is the determination of a boundary between preservation and development.

Considering the great reduction in forest area, it is not possible to go back 19 century when the forest area covered 84.8 % of Paraná state; however, afforestation is essential to improve the water environment and is a part of the river basin management. Benefits of afforestation consist of direct and indirect ones. The former is an income from timber production, wood as fuel and perennial crops. The latter is the conservation of the water environment, such as erosion control, flood control, improvement of water quality in a river basin and so on.

8.5.4 Strategy

Future afforestation in Paraná consists of preservation of natural forest, conservation of water environment and commercial use to generate income. Strategy of forest aiming at the year of 2015 is described object by object in the following section and the recommended species and sites are summarized in Table-8.26. EMBRAPA (1985) divided the state in 7 bio-climatic regions with the recommendations of native and exotic forest species. The detail selection of species should refer to the result of EMBRAPA (1985).

Considering the current conditions, the area expansion of forest for conservation and preservation purposes is expected to be gradual. Therefore, afforestation should be promoted by means of commercial afforestation.

Table-8.26 Recommended Species and Sites

Purpose	Direct Benefit	Indirect Benefit	Site Recommended	Recommended Species
Preservation of natural forest	No	Yes	1) Current preservation area 2) Promotion of preservation area to protect ecosystem, landscape and so on	Native forest, Wild Fruits
Conservation of water environment	No	Yes	The area stipulated by law, such as along rivers or any water courses, steep land, etc.	Native Forest, Wild Fruits, Araucaria, Bracatinga
Agroforestry	Yes	Yes	Farm land	Bracatinga, Mate
Energy	Yes	Yes	The land whose slope steepness is less than 25 degree.	Bracatinga, Eucalyptus
Commercial use for timber & paper	Yes	Yes	1) Brush fields 2) The land not suitable for both crop and pasture cultivation	Eucalyptus, Araucaria, Pine

Direct Benefit: to generate income
Indirect Benefit: to conserve the water environment

(1) Preservation of Natural Forest

Currently preserved area must not be exploited as laws control. There are several plans to establish new preservation lands as federal and state parks; however, their areas are limited. Therefore, the area of preservation will not increase much by the year of 2015.

(2) Afforestation for Conservation of Water Environment

Afforestation for conservation contributes preservation of native flora and fauna, erosion control, stabilization of hydrologic cycle and so on. Forest Code (Law 4771/65) defines the areas where afforestation should be implemented for conservation and where the natural vegetation should be preserved permanently as shown in Table-8.27.

The recommended species for this purpose are the native ones because the exotic species often alter the ecosystem. Since this kind of afforestation is not directly profitable, the implementation requires persuasion of the public, legal enforcement and government subsidy.

(3) Afforestation for Direct Benefits

Since income is generated through this afforestation, land with no aptness for agriculture and pasture should be converted to forest. Agroforestry and afforestation for fuel will continue; however, their expansion will be limited even in future. Therefore, afforestation for paper and timber industry will be dominant.

Table-8.27 Afforestation and Preservation Controlled by Law

Countermeasures	Target Area	Law
Afforestation	no aptness for agriculture or livestock	Forest Code (Law 4771/65)
Permanent Preservation	around lagoons, lakes, natural or artificial reservoirs	Forest Code (Law 4771/65)
	in springs	Forest Code (Law 4771/65)
	on the top of hills, mountains and mountain ranges	Forest Code (Law 4771/65)
	on a slope with steepness greater than 100 %	Forest Code (Law 4771/65)
	on estuaries	Forest Code (Law 4771/65)
	on the edges of plateaus	Forest Code (Law 4771/65)
	natural or artificial prairie and natural forests with altitude higher than 1800 m	Forest Code (Law 4771/65)
	along river or any water courses with a certain margin strip depending on the width of a river or water course	Law 7511/86
Prohibition of Clear Felling	areas with steepness greater than 46 %	Forest Code (Law 4771/65)

(4) Future Forest Area

Future forest area was estimated in accordance with the above Strategy. Afforestation for conservation and preservation was not considered because increase in their area will be limited. Therefore, only commercial afforestation for timber and paper industry was considered to estimate the future forest area.

Commercial afforestation should be implemented in where land is not suitable for agriculture and pasture. Brazil Ministry of Agriculture (1981) evaluated land in Paraná in terms of agriculture aptness and drew an agriculture aptness map. According to the map, there are approximately 886,000 ha of the land in Paraná suitable for afforestation but not for agriculture. The land use map in 1990 characterizes the current use of these areas as the combination of crop, pasture, forest and secondary vegetation. As a result of land evaluation by Ministry of Agriculture, productivity of crop or pasture in these areas is very low. Therefore, these areas should be shifted to forest for commercial use so as to generate more income.

Table-8.28 Future Projection of Forest Area

Kind of Forest	Year 1994		2015	
	Area (km^2)	area ratio to whole state (%)	Area (km^2)	area ratio to whole state (%)
Natural Forest	10200	5.1	10200	5.1
Afforestation	5000	2.5	13860	6.9
Total	15200	7.6	24060	12.0

Source: SANEPAR GIS Computation for 1994

If afforestation of 886,000 ha were implemented evenly in the next twenty years, the area of afforestation for each year would be 44,300 ha. During 1974 to 1985, when there was the government subsidy, the average annual area for afforestation is 48,000 ha. Further, the largest area afforested during that period is 93,000 ha. These figures verify that annual afforestation of 44,300 ha is feasible.

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CHAPTER 9 WATER ENVIRONMENT MANAGEMENT

9.1 Existing Operation and Monitoring Systems for Water Environment Management

(1) Existing monitoring system

According to a list of the existing meteorological and hydrological stations in the DNAEE, number of those stations are summarized shown in Table-9.1.

Table-9.1 Existing Meteorological and Hydrological Stations

Item	Total	Automatic Recorder	Telemeterized	Manual Reading
Rainfall	980	171	42	767
Stream flow	283	69	22	192
River-reservoir water quality	193	-	-	-
River-reservoir water ecology	104	-	-	-
Ground water level	Installation data only	-	-	-
Ground water quality	-	-	-	-
Sediment transportation	132	-	-	-

The water quality has been monitored by the SUREHMA since 1970, and its monitoring was succeeded by the IAP from 1989 to present after abolishment of the SUREHMA. The monitoring items are water temperature, dissolved oxygen (DO), coliform fecal, pH, biochemical oxygen demand (BOD), total nitrogen (T-N), total phosphate (T-P), turbidity and total solid. In addition, heavy metals are tested in accordance with necessity by the IAP.

There is no periodical measurement of groundwater level in Paraná state. However, the records of about 2,800 wells are available out of 3,100 registered ones though these are limited to pumping test results for developed wells. According to the right of groundwater use regulation established by the IAP, groundwater quality tests of each well are expected to be conducted every five years, including physical, chemical and bacteriological analysis.

(2) SIMEPAR

The SIMEPAR was established by the Government of Paraná state under the agreement of two (2) related agencies of the IAPAR and COPEL for provision of meteorological and hydrological data with high reliability in 1993. As of 1995, such preparation works as construction of operation center and procurement of equipment are going on in Curitiba.

Figure-9.1 shows the system plan of the SIMEPAR mainly composed of data collection system and computer system in an operation center being constructed in Paraná Federal University in Criutiba. The data collection system is planned to consist of; 1) weather radars at Irati, Catanduva and Apucarana covering the whole Paraná state, 2) satellites image reception of METEOSAT, GOES and TIROS, 3) lightning sensors, 4) telemetering weather stations of 116 nos. in Paraná and Santa Catarina States in the Iguaçu river basin, 5)

telemetering water level gauging stations of 44 nos., 6) atmospheric environmental stations, 7) radio sondes and vertical profiler, and 8) global telecommunication system. The computer system is designed to be composed of data processing system, data storage system and product generation system.

Total project cost is estimated at US$ 35 million which is scheduled to be financed by the Government of Paraná and to be disbursed during 5 years as shown in Figure-9.2.

(3) Existing operation system

The flood forecasting and warning system for the Iguaçu river has been operated by the DNAEE, and its information is distributed to the COPEL and civil defense and municipalities for rescue activities.

Reservoir operation of the COPEL and ELETROSUL is conducted considering interaction between reservoirs along the Iguaçu river for maximizing hydroelectric power generation and control of excess water. The operation direction of each dam is dispatched daily during normal condition and it can be shortened up to every 10 minutes in case of emergency. Data and information collected through the telemetric networks are analyzed for each reservoir and operation directions of next day are decided according to the monthly operation program. All of these dispatches are transferred through telephone or computer networks. There is no remote control in operation.

There are three (3) reservoirs in the Iguaçu river basin which were constructed by the SANEPAR and PETROBRAS for domestic and industrial water supply for Curitiba metropolitan area. Besides, many intake structures are provided for water supply to the municipalities by the SANEPAR and OUTONOMO in the whole Paraná state. These structures has been operated by the aforesaid organizations in consideration to maintain downstream flow rate in accordance with the regulation.

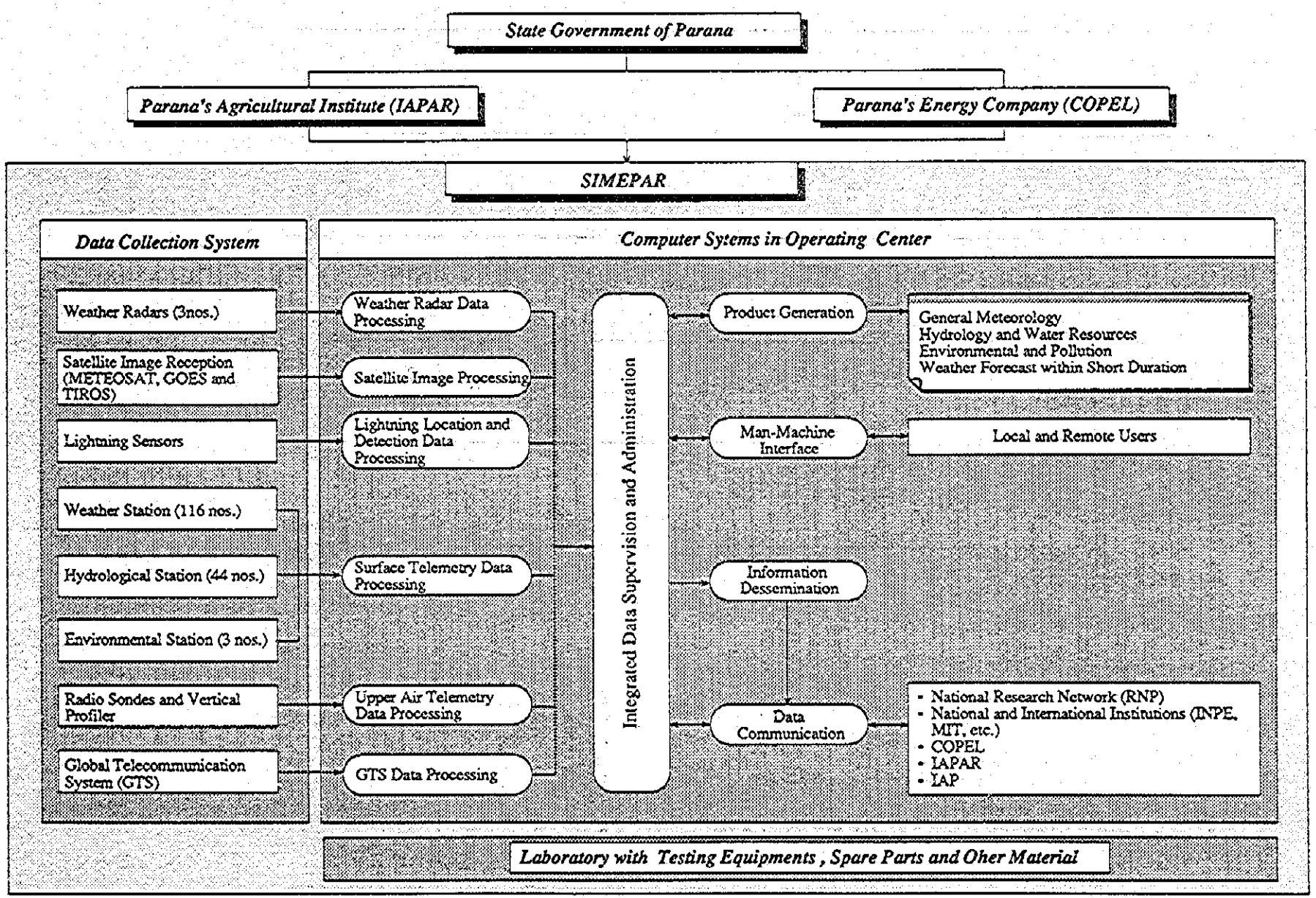

Figure-9.1 Weather System of Paraná (SIMEPAR)

Descriptions	1996	1997	1998	1999	2000
1. Operating Center					
2. Satellite Image Reception					
a) METEOSAT					
b) TIROS					
c) GOES					
3. Weather Radar					
a) Catanduvas					
b) Apucarana					
c) Irati					
4. Lightning Sensor					
5. Upper Air Telemetry					
6. Vertical Profiler					
7. Ground Weather Stations					
a) Phase 1 (6 nos.)					
b) Phase 2 (27 nos.)					
c) Phase 3 (54 nos.)					
d) Phase 4 (29 nos.)					
8. Hydrological Stations					
a) Phase 1 (6 nos.)					
b) Phase 2 (14 nos.)					
c) Phase 3 (24 nos.)					
9. Environmental Stations					
10. Multimedia and Software Equipment					
11. Software Development					
12. Scientific Computing					
13. Communication Antennas					
14. Laboratory					

Source : SIMEPAR's Technical Pre-Specification

Figure-9.2 Implementation Schedule of SIMEPAR

9.2 The Strategy for Water Environment Management

In accordance with the framework of the Strategy for water environment management proposed in Section-3.4, the Strategy comprised of the policy and implementation Strategy is established as described as follows:

9.2.1 Policy for Water Environment Management

In order to reach the goal of the water environment management, it is proposed to arrange the comprehensively and effectively policy composed of; 1) principles, 2) implementation mesaures, and instituional arrangement.

(1) Principles

Principles are to be clearly established as a part of the state policy for water environment in order to materialize the objectives of water environment. The principles provide broad framework which define desirable water environment and basis of setting guidelines, standard, and practices for managing, planning and other necessary activities. The priciples formulated assuming the present and future water environment conditios in Paraná state are those of;

1) symbiosis of human being and natural environment which defines the essential power to establish the water quality and quantity standards not only protecting human life but also for preserving aquatic ecology,

2) hydrological cycle which defines quantitative assessment and sustainable development of surface and groundwater resources, and linkage between waste water treatment and contamination level in the hydrological cycle,

3) multifarious water use essential to meet the needs on; a) diversified and competing future water use; b) effective use of limited quantity of water resources; c) fair and efficient allocation of water resources, and d) preservation of water environment,

4) cleaner production in factory's production process aiming to enhance the production technology to minimize waste yield and use of toxic materials, which covers; a) reduction technology of toxic materials in sewage and solid waste and use of toxic chemical materials in quantity, b) recycle technology to prevent discharge of toxic materials and to confine it in a closed cycle, and c) re-use technology to change toxic and non-toxic materials into non-toxic materials for re-use,

5) risk mangement composed of risk assessment requiring integrated monitoring and operation systems and risk control management giving water quality and quantity standards under the principle of symbiosis, which will be a fundamental tool to minimize risk of encroachment of human life and genetic library due to human influences,

6) risk and benefit which is a yardstick to establish standards for controlling water quality (organic effluents and chemical substances relating to occurrence of cancer, etc.) for both domestic water supply and conservation of ecosystem, to establish an allowable limit of risk, and to assess provision of monetary measures including structural measures,

7) integrated and comprehensive management essential to meet needs on; a) achievement of balanced development for multifarious water demand and sustainable development, b) control of linkage of water and land use management, c) control of linkage of surface and groundwater management for sustainable (or rechargeable) development, d) control of linkage of water quality and quantity for the comprehensive risk management and the principle of symbiosis, and control of smooth implementation and operation management, and

8) proper cost recovery system to be established, including pricing mechanism and charging system essential to approach to the goal of water environment effectively.

(2) Model areas

Table-9.2 indicates the model areas, where the significant problems in water environment are identified or predicted. Among the river basins in Paraná state, the Iguaçu river basin involves the significant problems on water shortage, necessity of groundwater development and management, and water quality control in Curitiba metropolitan area and other urbanized municipalities, and flood control in the flood prone areas widely spread along the river, soil erosion control in the upstream areas in the tributaries, and needs on ecosystem conservation and fish resource development.

(3) Institutional and legal arrangement

At present, the government of Paraná State has been managing fairly well the administration of multiple disciplinary projects for rivers in specially designated areas such as Curitiba Metropolitan area where coordination, cooperation, and collaboration is required among institutions concerned. Management Unit of the Program of Environmental Sanitation of Curitiba Metropolitan Region (PROSAM) and Coordination of the Metropolitan Region of Curitiba (COMEC) are good examples of integrated management. These units are jointly operated by the state (SEMA, IAP and SUCEAM), municipalities, SANEPAR, etc. with collaboration by other organizations.

Therefore, the Study Team has assessed that the existing institutional framework of Paraná State has a high potential to manage the envisaged water environment provided with some improvement and flexible operational arrangement.

Table-9.2 Model Areas for Respective Project Management Sector

Unit of Management	River Basin	Proposed Model Areas	Issues
Surface water supply a) Domestic water b) Industrial water c) Agriculture	Iguacu	10 municipalities with a population of more than 50,000 including Curitiba and Cascavel, identified in M/P	Shortage of water supply
	Tibagi	10 municipalities with a population of more than 50,000, including Londrina, Ponta Grossa and Apucarana, identified in M/P	Shortage of water supply
	Others	Maringa, Umuarama and other municipalities with a population of more than 50,000, facing to water shortage	Shortage of water supply
Groundwater use	Iguacu	8 municipalities with a population of more than 50,000 including Curitiba and Cascavel, identified in M/P	Shortage of water supply
	Tibagi	6 municipalities with a population of with a population of more than 50,000, including Londrina and Apucarana, identified in M/P	Shortage of water supply
	Others	Maringa, Umuarama and other municipalities with a population of more than 50,000, facing to water shortage	Shortage of water supply
Water excess (flood control)	Iguacu	Curitiba Metropolitan Area in Region - 1	Flood damage
		Sao Mateus do Sul in Region - 2	Flood damage
		Uniao da Vitoria and Port Uniao in Region-4	Flood damage
		Rio Negro and Mafra in Region-5	Flood damage
		Foz do Iguacu in Region-6	Flood damage
	Coastal Area	Morretes in Region 7	Flood damage
Hydropower generation	Iguacu	Planned installed capacity : 3434.5 MW	Power demand in Brazil
	Tibagi	1556.0 MW	Power demand in Brazil
	Ivai	886.0 MW	Power demand in Brazil
	Piquri	680.0 MW	Power demand in Brazil
Inland navigation	Ivai	Parana-Ivai route	Waterway (Cargo transport)
	Tibagi	Paranapanema-Tibagi route	Waterway (Cargo transport)
Waste treatment a) Sewage b) Water quality	Iguacu	Curitiba, Campo Largo, Guarapuva Pinhao and Cascavel	D/I sewage
	Tibagi	Ponta Grossa, Londrina, Castro, Cornelio Procopio, Arapongas and Apucarana	D/I sewage
	Ivai	Maringa and Ivai	D/I sewage
	Pirapo	Maringa	D/I sewage
Soil erosion improvement	Iguacu	41 municipalities specified as a severe erosion area by M/P	Soil erosion / Afforestation
	Tibagi	10 municipalities specified as a severe erosion area by M/P	Soil erosion / Afforestation
	Piquiri, Ivai and others	Municipalities facing severe erosion to be identified by the methodology applied by the Study	Soil erosion / Afforestation Soil erosion / Afforestation Soil erosion / Afforestation
Ecosystem conservation	Iguacu	Programs proposed by M/P	Preservation
	Tibagi	Programs proposed by M/P	Preservation
	Others	Programs proposed by Strategy	
Fish culture	Iguacu	Programs proposed by M/P	Preservation & demand
	Tibagi	Programs proposed by M/P	Preservation & demand
	Others	Programs proposed by Strategy	Preservation & demand

9.2.2 Implementation Strategy

Implementation Strategy is composed of the following programs:

(1) Project programs

Concrete project programs for water environment issues are to be formulated for each model areas designated after coordination among federal and state agencies, organizations and municipalities concerned. The project programs are two (2) folds; water resources development (water use) and environmental conservation and improvement.

The project programs will be classified into the following hierarchy:

a) Programs for achieving objectives of water environment management, composed of existing or on-going programs and new programs

b) Programs for the state of urgency when the objectives can not be attained, composed of measures for abnormal drought, flood and water quality

(2) Organization and law

Institutional development and human resources development are strategic elements of the capacity building for implementation. Institutional development includes strengthening of organization and legal framework and development of community participation. Development of human resources includes strengthening of education and training capacity, sharing of knowledge and data and improvement of career structure.

(3) Financing and cost recovery arrangement

The implementation Strategy for financing and cost recovery arrangement is presented in the Sectoral Report (N): Cost Estimate, and Economic and Financial Assessment.

(4) Implementation schedule of project programs

Selection and formulation of comprehensive implementation programs and schedule are to be conducted through screening procedures of the project programs for the model areas after coordination among agencies, organizations and municipalities concerned since all the prospective programs may not be implemented because of financial and time constraints. The SEPL or other relevant institution will be required to support implementation and to appoint an appropriate implementing organization in case of multi-disciplinary approach.

The implementation programs are composed of water resources development programs and environmental conservation and improvement programs.

(5) Implementation Strategy and schedule for project programs

Project programs for respective management sector are to be formulated with the proposed principles. An example of the implementation Strategy for sector project programs for water use management and environmental conservation and improvement management are shown in Table-9.3. It will be proposed to arrange two (2) stages in implementation schedule:

- First stage : present to the year 2005
- Second stage : the year 2006 to 2015.

The project programs to be conducted urgently and/or to be conducted as extension of the present and on-going programs are to be attributed to the first stage. The project programs which are required to achieve the desirable or ideal conditions of water environment in the first quarter of the 21st century are to be attributed to the second stage if conduct of these can be waited to the necessary extent of time.

9.3 Framework of Monitoring and Operation Systems

9.3.1 Task of Operation and Monitoring Systems

Task of the operation and monitoring systems is set up to provide necessary information and data for achieving the objectives of water environment management. The necessary information is to be classified into three (3) categories for; 1) project planning and implementation of multifarious water use and improvement projects, and establishment of guidelines and standards; 2) administration and superintendence including law systems, institutional framework and bulletin to the citizens; and 3) operation and maintenance of water and river facilities such as dams, intakes, and pumping stations.

These data and information provide the basis of interactive management procedure among the management systems and models composed of; 1) global hydrologic cycle model, 2) water use and waste forecasting models, 3) multifarious water use and improvement project management, 4) integrated institutional framework, and 5) operation and monitoring of surface and sub-surface water system.

9.3.2 Target of Operation and Monitoring System

As a part of the policy, three monitoring targets, A, B and C are proposed in order to establish desirable operation and monitoring system, of which linkage among these targets and management items of water environment is illustrated in Figure-9.3.

Target-A indicates establishment of a system with high density and multi-dimensional monitoring for human activities including social needs on water environment and aquatic ecology, global hydrological cycle including surface and sub-surface water, and periodical observation for the mentioned matters.

Target-B aims to enhance the existing monitoring method to an unified system by introducing real time and telemetric systems for simultaneous monitoring of water quality and quantity, flexible operation to emergency, and linkage with surface water and groundwater.

Target-C integrates operation and monitoring systems in order to superintend various monitoring items and standards effectively with consistent and uniform procedure for effective management of water and river facilities including dams, intakes, diversion facilities, outlet facilities, regulation facilities, waste water treatment and water quality control facilities including treatment plants, ponds, and channel.

Table-9.3 Proposed Implementation Strategy for Water Environment Management

Management Sector	Implementation Strategy
1. Surface water use (domestic and industrial water and agricultural use)	- to maintain quality of the existing and planned surface water source by land use and waste disposal control - to develop newly reliable and safe surface water resources taking into consideration future land use plans. - to develop newly alternative fresh water sources such as groundwater and recycle use. - to develop treatment and distribution facilities to meet the water demand.
2. Groundwater use	- to control sustainable use of groundwater with regard to amount of recharge and quality without adverse effect. - to enhance use hydrothermal resources in Botucatu formation for industrial water and energy to reduce use of timber resources.
3. Hydropower generation	- to develop hydropower generation plants in consideration of multifarious water use and preservation of ecosystem
4. Inland navigation	- to develop the Parana - Ivai waterway and Paranapanema - Tibagi waterway in consideration of dam construction and preservation of ecosystem.
5. Fish culture	- to enhance commercial and public fish culture of endemic fishes in the dam reservoirs and swampy areas to protect endangered endemic fish species against fishing.
6. Water excess (flood control)	- to apply nonstructural measures in principal and to supplementally use of structral measures to the areas where the existing land use is highly enhanced. - to apply an integrated view of urban sewage, flood protection, storm drainage and environmental protection.
7. Aquatic ecology	- to protect and reproduct surviving endemic species. - to preserve and reproduct original forest coverage relating to the aquatic ecosystem. - to preserve marshlands, low lands along water courses and dunes. - to minimize impact of human activities to the aquatic ecosystem including discharges of waste and toxic material.
8. Soil erosion	- to apply terracing and tillage to control soil erosion from agricultural land. - to enhance afforestation without significant change in the existing agricultural land use. - to provide forest belts along the riverain for reproducing the aquatic ecosystem.
9. Waste quality	- to introduce and enhance cleaner production technologies to control industrial effluent. - to apply proper combination of public sewerage, village sewerage and household sewerage in order to establish efficient treatment. - to control excessive use of pesticide and toxic material. - to establish comprehensive water quality standard with regard to physical, chemical and biological attributes.
10. Operation and monitoring systems	- to establish high density and multidimensional monitoring (human activity-ecology monitoring), unified and centralized monitoring, and integrated operation and monitoring systems. - to establish state and regional centers for water environment management provided with data bank systems, including genetic library and information network systems accessible to the public.
11. Economic & financial Arrangement	- to apply the principle of risk and benefit. - to establish a proper cost recovery system with the principle of " users (beneficiaries) - to pay " and/or " pollutant - to pay ". - to establish proper cost allocation criteria.
12. Institutional framework	- to improve regulatory and financing power of the SEMA, consisting of IAP and SUCEAM in order to achieve an integrated management of water environment. - to reinforce penalty and charge systems based on the principle of pollutant-to-pay and users-to-pay.

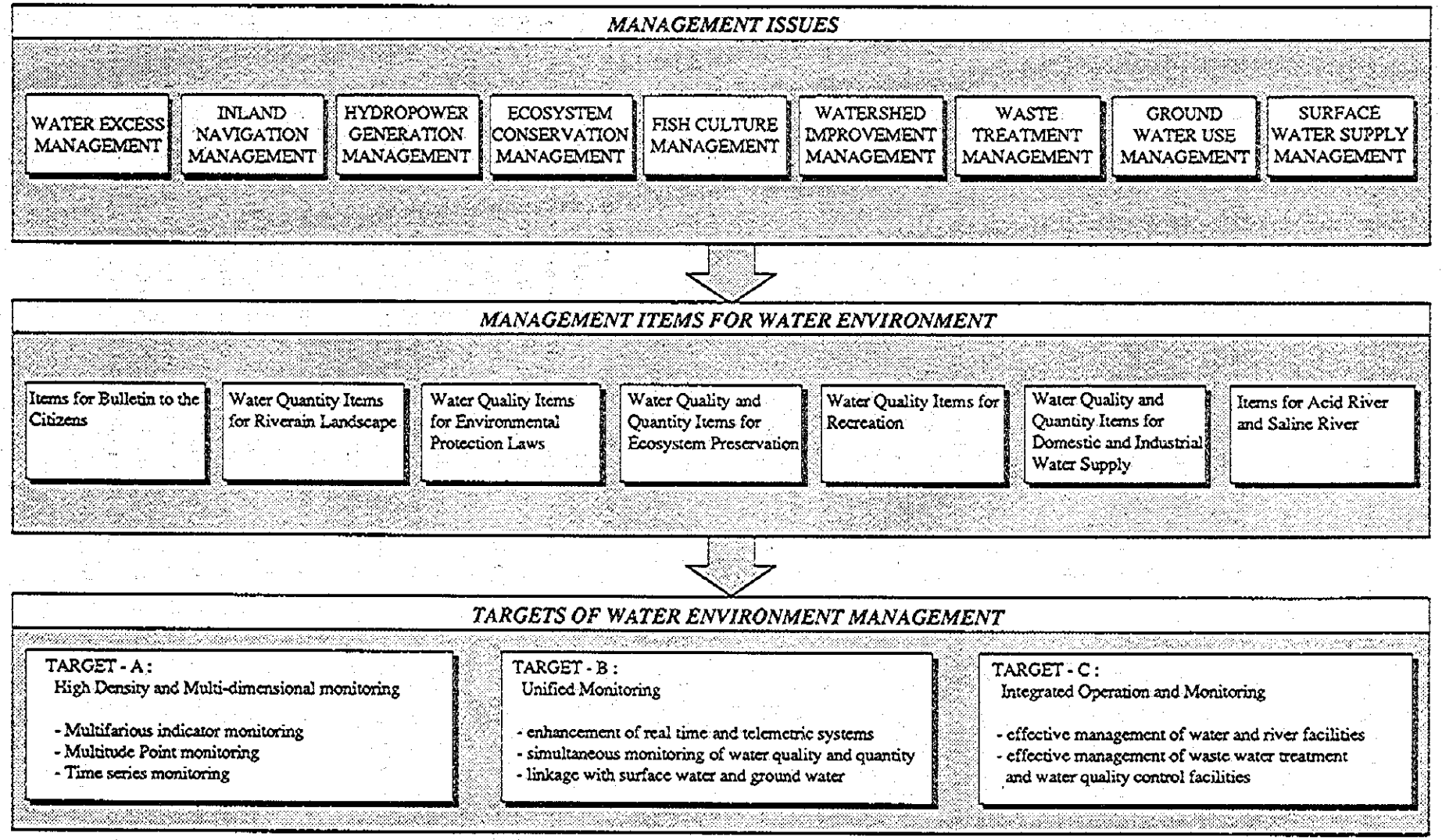

Figure-9.3 Targets and Management Items of Water Environment

9.3.3 Proposed Operation and Monitoring Systems for Water Environment Management

(1) Water environment management centers

The architecture of the monitoring and operation system for desirable water environmental management is proposed as given in Figure-9.4. The proposed State Center will administratively manage water environment all over the state, using the monitored data and information through network connecting the state center and regional centers. The regional centers will monitor water environment and manage the projects at the regional level in the respective river basins and also bulletin data and information on water environment to the public and communities and discuss with communities in order to maintain and/or improve it.

Under the current organization, the SEMA is required to function as the state center and the regional centers are desired to be newly established for the river basins of; 1) the Iguaçu and Paraná III including Curitiba Metropolitan Area, 2) the Piquiri and Paraná II, 3) the Ivai and Paraná I, 4) the Tibagi, Pirapo and Paranapanemas II to IV, 5) the Cinzas, Paranapanema I and Itarare, and 6) the Ribeira and coastal area, under the SEMA.

Figure-9.5 gives the institutional relationship between the state and regional centers and the related agencies, and other public communities. Also, Figure-9.5 proposes the provision of the integrated data base system and a committee for data base management. The data related to water environment observed and collected by the institutions will be registered in the data base in accordance with permission of a committee. When a committee is judged to check accuracy and reliability of data to be stored, a committee is able to provide a working group consisting of engineers belonging to the related institutions.

The COPATI, CORPRERI and COPRENE are acting as a part of water environmental management at the community level. Similar organizations will be established in accordance with the degree of severity of problems and needs. In the project management, it is considered that public and community participation for water environmental management will be expected to be one of indispensable and effective manners in order to smoothly implement the management work and to create healthy water environment by sufficiently reflecting their public intention and opinions. The regional centers will contact closely to these communities therefor. The collected data and information will be analyzed by the state center for managing the water environment in Paraná state and the results are proposed to be compiled into an annual report to be published.

(2) Integrated Operation and monitoring system and information network

The integrated monitoring system is planned to be composed of five (5) sub-systems;1) hydrological cycle monitoring with high density and multi-dimensional observation; 2) ecosystem monitoring for endemic and endangered species of fauna and flora by a field survey and satellite remote sensing; 3) flood forecasting and warning system; 4) a bulletin system to the citizens including preparation of annual report as illustrated in Figures-9.4 and 9.5. An integrated data base and information network is necessary to be provided to function these sub-systems effectively.

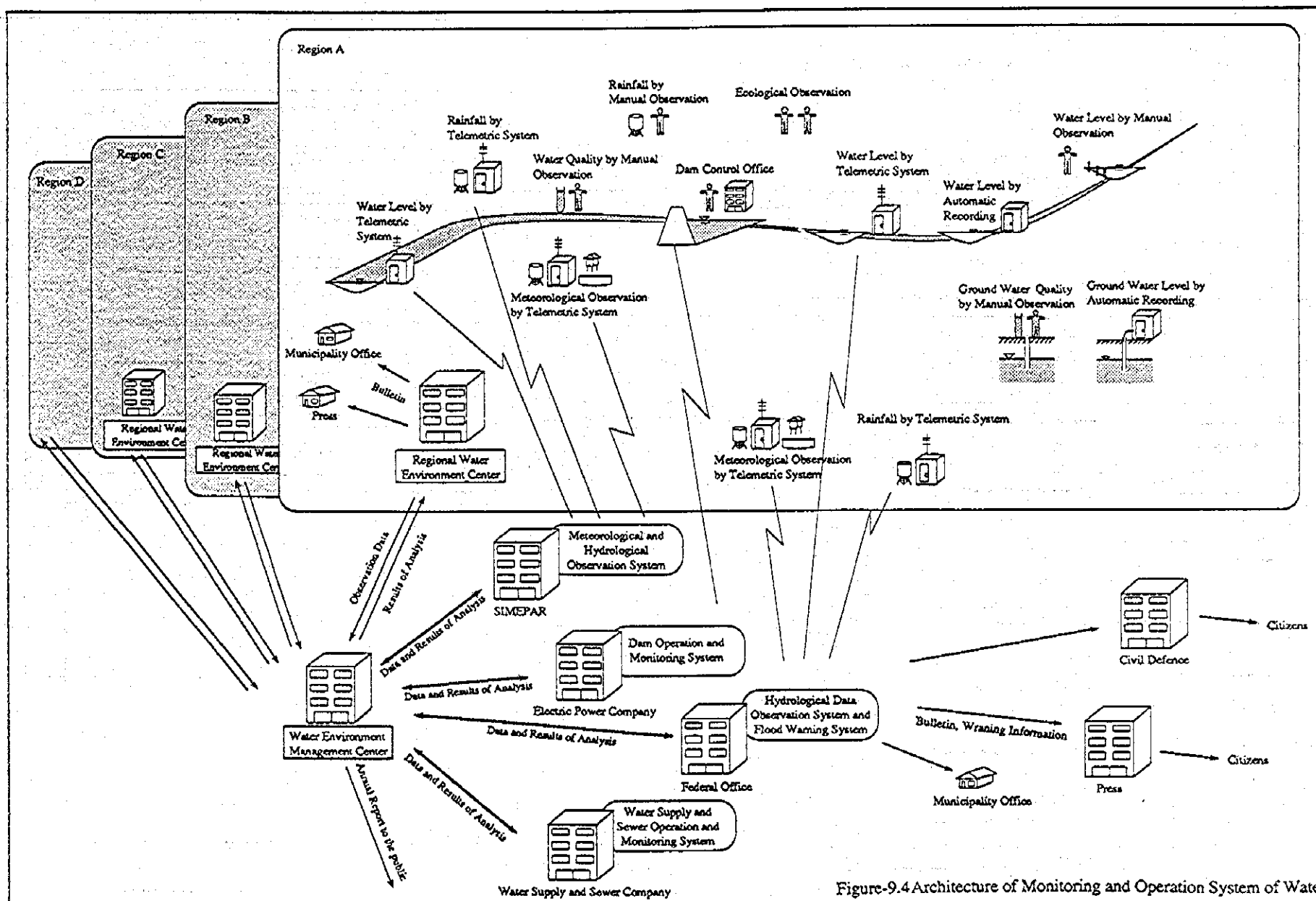

Figure-9.4 Architecture of Monitoring and Operation System of Water Environment Management (TARGET- B & C)

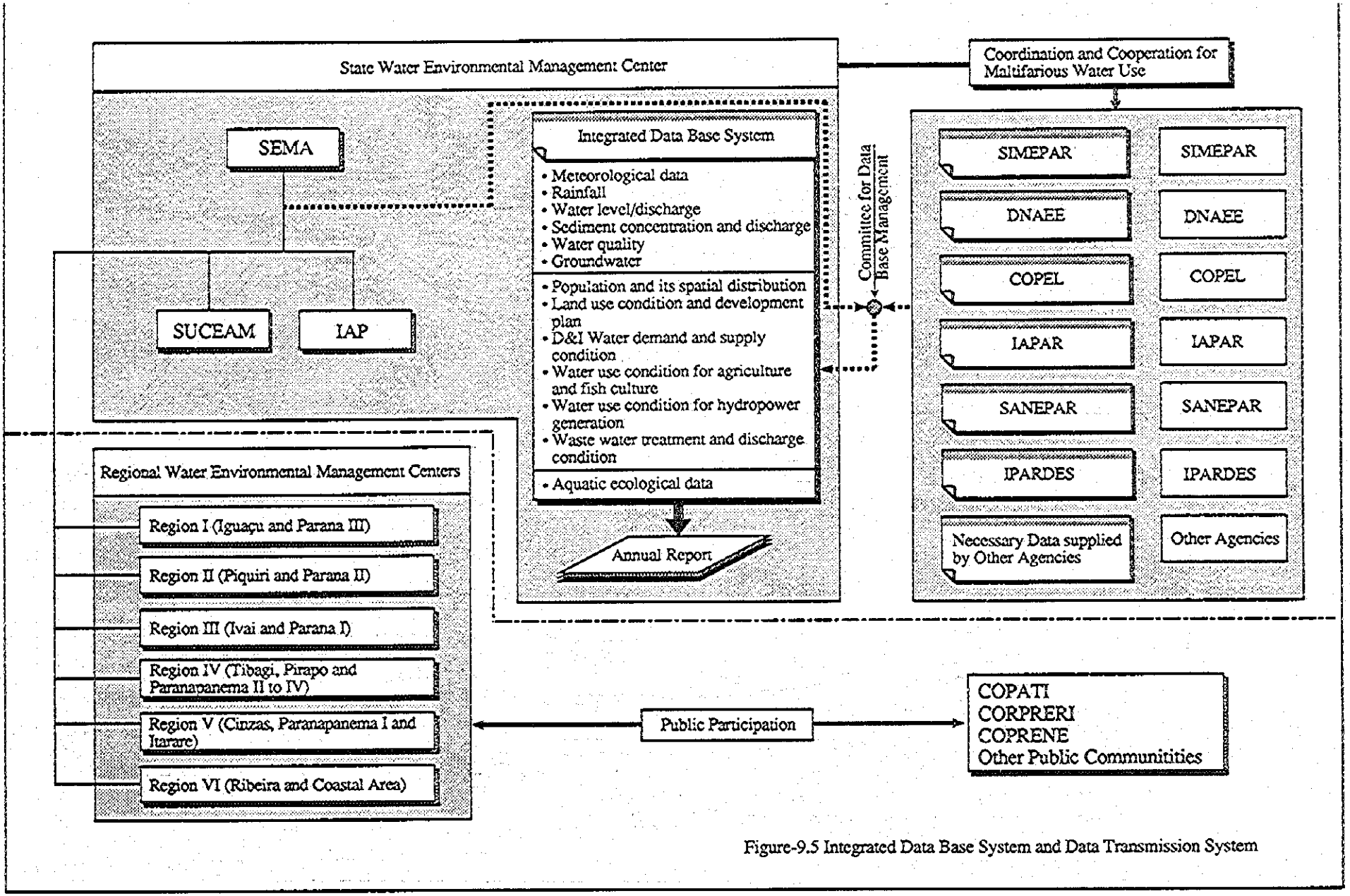

Figure-9.5 Integrated Data Base System and Data Transmission System

(3) Implementation schedule

It is recommended to activate the desirable operation and monitoring systems step by step by the target year 2015. The proposed implementation schedule are presented in Figure-9.6. Monitoring system for the urgent issues is proposed to be established in the first stage and be expanded and upgraded till the target levels in the second stage. The institutional arrangement covers provision of a state center and six (6) regional centers for actual operation and maintenance and organizational and legal arrangement.

Center	System - 1		System - 2		System - 3		System - 4	
	Hydrologic cycle monitoring and simultaneous monitoring of water quality and quantity		Monitoring ecosystem library		Flood forecasting and warning systems		A bulletin system to citizens	
	1st stage Present - 2005	2nd stage 2006 - 2015	1st stage Present - 2005	2nd stage 2006 - 2015	1st stage Present - 2005	2nd stage 2006 - 2015	1st stage Present - 2005	2nd stage 2006 - 2015
1) A State Center for Water Environment Management	△	◎	○	◎	○	◎	○	◎
2) Regional Centers for Water Environment Management (Branch offices of the State Center)	△	◎	△	◎	△	◎	△	◎

Note:

× : No Provision
△ : Partial Operation
○ : Full scale operation with introductory level and moderate density
◎ : Full scale operation with advance level and high density

Information Through Network	State Center		Regional Center		Federal Offices		State Companies (COPEL, SANEPAR, etc.)		Municipalities	
	1st stage Present - 2005	2nd stage 2006 - 2015	1st stage Present - 2005	2nd stage 2006 - 2015	1st stage Present - 2005	2nd stage 2006 - 2015	1st stage Present - 2005	2nd stage 2006 - 2015	1st stage Present - 2005	2nd stage 2006 - 2015
Water Environment Information	○	◎	△	○ ~ ◎	○	◎	○	◎	△	○ ~ ◎
Warning Information	○	◎	△	○ ~ ◎	○	◎	○	◎	△	○ ~ ◎
Bulletin	○	◎	△	○ ~ ◎	○	◎	○	◎	△	○ ~ ◎

Note:

× : No Provision
△ : Partial Operation
○ : Full scale operation with introductory level and moderate density
◎ : Full scale operation with advance level and high density

Figure-9.6 Proposed Implementation Schedule of Operation and Monitoring System

CHAPTER 10 INSTITUTION

10.1 Current Institutional Framework

10.1.1 Legislation in Force on Water Environment

(1) Ownership and Administration of Water

The Constitution, promulgated in 1988, gives to the Union (the Federal Republic) the ownership of water as follows (Art. 20):

- the lakes, rivers and any watercourse in land within its domain, or that wash more than one state, that serve as boundaries with other countries, or that extends into foreign territory or from there proceed, as well as bank lands and river beaches (III);
- the hydraulic energy potentials (VIII);

The Union has the exclusive power to legislate (Art. 22) on i) waters and energy (IV); and ii) regime of the ports and lake, river, ocean, air and aerospace navigation (X).

The properties of the States include (Art. 26):

- surface or subterranean waters, flowing, emerging or in deposit, with the exception, in this case, of those resulting from work carried out by the Union, as provided by law (I).

According to the above stipulation, the ownership of main stream river water in the State except hydraulic energy potential is as follows, while water of the tributaries and ground-water exclusively situated in the State other than the energy is the property of the State.

Table-10.1 Classification of the River Basins in Paraná State

No.	River Basin	Administrative Classification (main stream)	Population in 2000 *1	Catchment Area (Km^2) *2
1	Cinzas	State (Tributary of the Paranapanema River)	281,507	9,291
2	Iguaçu	Federal (International-Brazil, Argentina)	3,697,820	55,318
3	Itararé	Federal (Paraná, Saõ Paulo, Tributary of the Paranapanema River)	131,916	5,198
4	Ivai	State (Tributary of the Paraná River)	1,184,726	35,879
5	Litoranea	State	209,398	5,766
6	Paraná	Federal (International-Brazil, Paraguay)	375,336	13,156
7	Paranapanema	Federal (Paraná, Saõ Paulo)	751,314	9,797
8	Piquiri	State (Tributary of the Paraná River)	693,897	24,708
9	Pirapo	State (Tributary of the Paranapanema River)	474,693	5,006
10	Ribeira	Federal (Paraná, Saõ Paulo)	154,143	9,129
11	Tibagi	State (Tributary of the Paranapanema River)	1,376,764	24,635
		Total of the State	9,331,514	197,882

*1: Population in the State (Estimated by the Team)
*2: Area in the State

Ownership of water by municipalities, as provided in the Water Code, Federal Decree No. 24643 of 1934, was abolished by the promulgation of the Constitution.

(2) Use of Water and Water Right

Derivation of water of the Federal or State domain requires concession, authorization or permission, provided that the water use for the first necessity of life is free in case that the access to the water is lawful (Water Code, Art. 34). Based on the Water Code, the State Regulation by SUREHMA (currently being merged to the SUCEAM - Superintendency of Erosion Control and Environmental Sanitation), No. 004/89, 1989 gives provisions for the use of water of the State domain.

The regulation stipulates that all water use or derivation shall be made with administrative grants issued by the SUCEAM. The grants are classified into three types as follows:

1) Concession; in case of use for public utility, maximum 20 years, to be ineffective in case of no use in consecutive 3 years,

2) Authorization; in case of use other than public utility, maximum 10 years, to be ineffective in case of no use in consecutive 2 years,

3) Permission; in case of use other than public utility and of insignificant use, which is neither more than 20% of the minimum discharge of recurrence in 10 years and lasting 7 consecutive days nor more than 10 liter per second, maximum 5 years, to be ineffective in case of no use in consecutive 1 year.

An application for the use shall be presented with a study, content of the project and other information following the rules established by the SUCEAM. Concessions, authorizations and permissions are renewable through written request made 6 months prior to the expiry.

Authorizations or permissions may be canceled with or without compensation when the public interest does so demand. In case of cancel or ineffectiveness mentioned in the above, the user is obliged to remove all works as previous conditions according to the criteria and terms established by the SUCEAM. In case of long droughts or water shortage, the SUCEAM can modify the granted conditions, giving preference to the public supply. The derivation or intake can be modified due to the public interest. The notified user is liable for the payment for the modification, granted a certain period of time to take necessary steps.

The fee for a concession, an authorization or a permission does not vary according to the amount of the water use. The fee for a concession, an authorization or a permission is US$ 121.5, U$ 81.0 or US$ 24.3 respectively as of September 1994. The fee for an examination of the application is US$ 24.3 for any type of granting.

(3) Water Resources Development

The works necessary to derive or intake water shall be planned and constructed under the responsibility of a certified professional registered in CREA (Regional Council of Engineers and Architects). Any alternation or any part of alternation and any change in intakes or dikes are subject to the approval of the SUCEAM.

(4) Water Resources Conservation

The Water Codes prohibit degrading or contaminating waters by discharging effluent. The Code orders the entity who causes the nuisance to take remedial activities at the polluter's expense and to compensate for the loss or damage caused by the effluent discharge.

In the State domain, the SUCEAM or the IAP (Environmental Institute of Paraná) can demand of the water user to prevent waste of water, to control, and to protect against pollution. The authorized technicians of the SUCEAM or the IAP have free access to the public or private property in order to supervise or inspect for the time necessary to carry out their duties. Failing to follow the SUCEAM's or the IAP's demand concerning to the effluent discharge into water courses or aquifers will result in revocation of the authorization or permission. The revocation does not invalidate the sanctions or penalties stated in the legislation related to environmental pollution.

Other major environmental enactment related to water resources conservation is as follows:

Table-10.2 Laws and Regulations Related to Water Environment

Laws and Regulation	Subject
Federal Law No. 6938, 1981 and Federal Decree 99274, 1990	National Environmental Policy
State Law No. 7109, 1979 and State Decree No. 857, 1979	State Environmental Protection System
Federal Decree No. 1413, 1975, Federal Decree No. 76389, 1975, State Law No. 6513, 1973 and State Decree No. 5316, 1973	Industrial Pollution Control
Federal Law No. 6902, 1981, State Law No. 10247 and State Decree No. 2320	Ecosystem (Fauna and Flora) Preservation
State Law No. 9491, 1990, State Complementary Law No. 59 and State Decree 974, 1991	Ecological ICMS (Tax on Circulation of Commercial Goods)
Federal Law No. 7802	Control of Agrotoxics
State Law No. 8014, 1984	Preservation of Agricultural Soil
Federal Law No. 4771, 1965, and Federal Law No. 7803, 1989	Forest Code and its partial amendment
Resolution of CONAMA No. 01, 1986	Environmental Impact Assessment
Resolution of CONAMA No. 20, 1986	Classification of Water Quality

Salient legal enactment for linkage with land use control and water environment management appears in the Federal Law 6766, 1979 and the State Decree 2963, 1980. The Federal Law prohibits the land allotments for urban purposes in swampy or flood prone areas before taking precautions against water flow, and in land belt of 15m along water courses (actually the land belt of 30m to 500m corresponding to the width of rivers shall be reserved for permanent forest or natural vegetation according to the Forest Code), as well as in areas for ecological preservation, and polluted areas before the recovery. The law requires some portion in land allotment for community facilities, including those for water supply, sewerage, electric power supply and storm water collection. The State Decree No. 2963 and No. 2964, 1980 designates areas of the special interest and protection, as provided in the Federal Law, such as areas contained in the water divisions of surface run-off which contribute as sources of public potable water supply, and the managing entity for the regulation. The State Law No. 8935, 1989, and an additional stipulation by the State Law No. 11055, 1995, prohibits installation, operation, or implementation of highly polluting industries, hospital establishments, waste disposal sites and parcels of land for high population density, in catchment areas of sources for the public water supply.

10.1.2 Current Organizational Framework

(1) Federal Level

(a) Water Resources Administration

Water resources administration at the Federal level is discharged by the National Department

of Water and Electric Energy (DNAEE) of the Ministry of Mines and Energy (MME). The Brazilian Central Electric Joint-stock Company (ELETROBRÁS) and the Electric Center of the South (ELETROSUL) manage electric energy services at the Federal and the Regional level, respectively. Although the Constitution provided that the flood control is the federal matter, the National Department of Sanitation Works (DNOS), which was the competent organization under the Ministry of Agriculture, was abolished in 1990.

(b) Environmental Entities

The National Council of Environment (CONAMA) and the Brazilian Institute of Environment (IBAMA) administer environmental conservation, preservation of ecosystem and pollution control, including water quality management, under the Ministry of Environment and Legal Amazon.

(2) State Level

Generally, the State Secretariats themselves have regulatory functions, while statutory bodies attached to each secretariat discharge operational functions as executing agencies, as shown in Figure-10.1. State Councils with deliberative functions are established for major sectors of the Government administration.

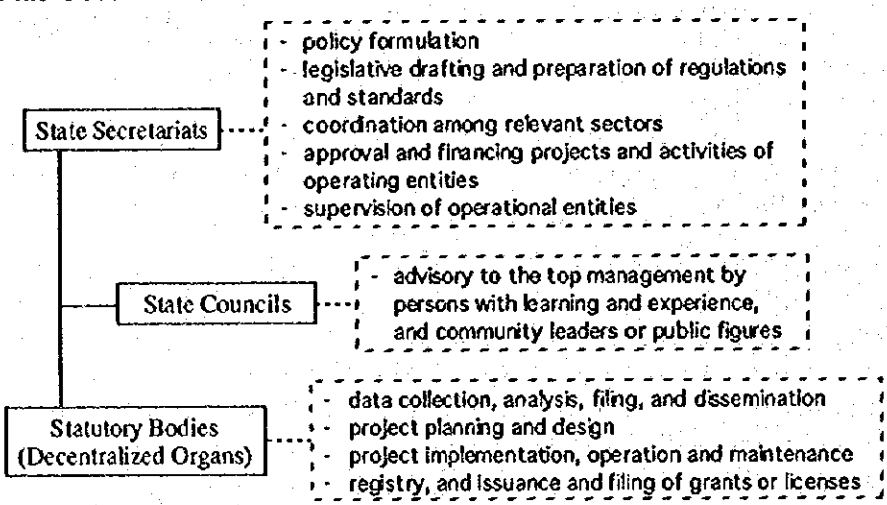

Figure-10.1 General Organizational Structure of the State Secretariats

The prime institute of water environment administration at the State level is the State Secretariat of Environment (SEMA), subordinating Superintendency of Erosion Control and Environmental Sanitation (SUCEAM) and Environmental Institute of Paraná (IAP). These organs have been in the course of re-organization and strengthening since January, 1995. Competent entities by relevant sector of water environment administration and management are listed in Table-10.3.

(3) Municipal Level

Participation in water environment administration by the Municipalities varies according to the level of their establishment and capabilities. Some Municipalities, such as the City of Curitiba, discharge major responsibilities in water environment management, while many of Municipalities have been raised very recently and are still in the courses of their consolidation.

Table-10.3 Relevant Entities of Water Environment Administration and Management

Sector	Operational Functions	Regulatory Functions	Deliberative Functions
Water Resources Assessment and Allocation	(IAP) → SUCEAM	SEMA	{State Environment Council}
Domestic and Municipal Water Supply	SANEPAR	(SEDU) → Governor	****
Industrial Water Supply	SANEPAR, industries	(SEDU) → Governor	****
Irrigation, Livestock Watering, Fishing and Aqua-culture	EMATER, CODAPAR, farmers	SEAB/DAGRI, DEPEC	State Council of Irrigation and Drainage, State Council of Fishing
Hydropower	COPEL, (ELETROSUL)	(Federal), Governor	----
Navigation	navigation companies	SETR	Commercial Transportation Council
Waste Water Treatment	SANEPAR, industries	(SEDU) → Governor	State Environment Council
Pollution Control	IAP, industries	SEMA	State Environment Council
Soil Erosion and Sedimentation Control	SUCEAM, EMATER	SEMA, SEAB	State Environment Council
Eco-system Conservation	IAP	SEMA	State Environment Council
Water Excess Management	SUCEAM	SEMA, (Federal)	----
Drought Relief	SUCEAM	SEMA, (Federal)	----
Multi-purpose Facility Management	****	****	****

****; not clearly assigned, { }; not active for the sector, ( ) → ; being transfered in 1995,
---- ; not assignned to the State, Governor; the Governor of the State, ( ); not for the State

10.2 Institutional Issues

10.2.1 Concepts and Approach for Institutional Improvement

The following two concepts are employed to formulate institutional improvement programs:

Concept I: *Promotion of Appropriateness, Effectiveness and Efficiency through Remedial Measure against Current Problems*

Concept II: *Responding to Future Needs for Integrated Water Environment Management*

The first concept should be applied everywhere in the world for the improvement every sector of management and government administration. Considering the Concept I, current institutional problems are identified and analyzed for compiling remedial measures to solve the problems.

Since water resources development incurs huge costs and long period for project implementation and the resources conservation will affect future generations, water environment management should cover long term perspectives. Future needs and corresponding institutional responsibilities of government administration are discussed under the Concept II.

Introduction of successful models practiced in other countries, including those in Japan, which might be suitable to Paraná State, is applied as a basic approach in programming institutional improvement measures under both of the two concepts, especially those under the Concept II.

10.2.2 Identified Institutional Problems

(1) Identified Problems throughout the Study

Problems identified throughout the Study, their whole structure and their relation to each of the management sector in water environment management are discussed in Chapter 3, followed by detail studies in chapters of relevant sectors. Major institutional problems and their cause-effect relations can be summarized as follows:

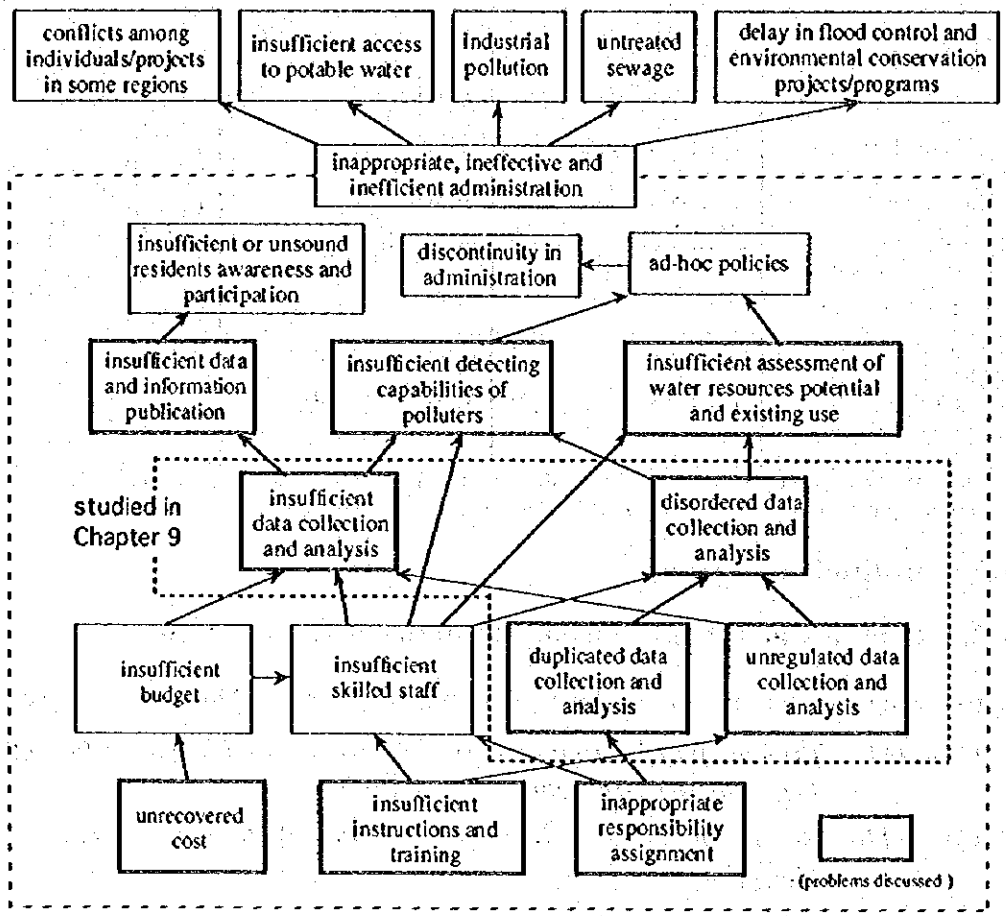

Figure-10.2 Institutional Problems and their Cause-Effect Relations

(2) Institutional Problems Discussed

Out of the above problems, those related to monitoring and database systems are mainly discussed in Chapter 9. Other institutional problems are discussed to formulate remedial programs, *except* those where reference to principles or models obtained or extracted from experiences and practices of other countries might not contribute to the solution.

10.2.3 Institutional Responsibility corresponding to the Future Needs

Population growth, accompanied by agricultural and industrial development, boosts water demands for the production. Agricultural and industrial expansion will lead to increase in polluting loads as well, reducing quality water available. Raised living standards increase recreational and environmental demands. The water environment management will incur more cost. In order to meet increasing demands with limited budget, water environment management requires much more efficiency. The management at this stage should be

integrated in inter-related modern society, in order to achieve optimal use of limited water resources and efficient resources conservation. Responsibilities for water environment administration will largely grow corresponding to socio-economic development.

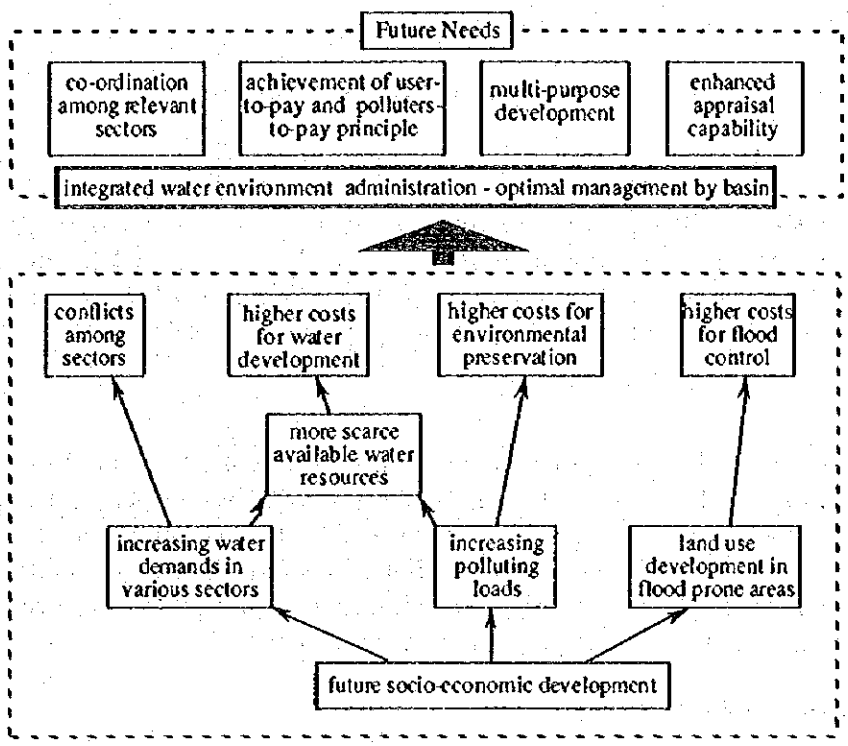

Figure-10.3 Future Needs for Integrated Water Environment Management

10.3 Strategy for Institutional Improvement

10.3.1 Principles for Institutional Improvement

The following seven principles are set up based on the above discussion.

Concept I: Promotion of Appropriateness, Effectiveness and Efficiency through Remedial Measure against Current Problems

1) Definite Assignment of Operational and Regulatory Responsibilities and Configuration of Line Responsibilities
2) Enhanced Enforcement of Legislation on Water Environment Management and Administration
3) Establishment of Proper Cost Recovery System
4) Encouragement of Public Participation

Concept II: Responding to Future Needs for Integrated Water Environment Management

5) Water Basin Management and Establishment of the Competent Entity
   - Equitable and Definite Policy Formulation on Water Allocation and Water Quality Control
   - Comprehensive Planning, Evaluation and Regulation
6) Coordinated Administration and Management among Relevant Administrative Sectors

- Linkage of Water- and Land-use Management
- Linkage of Quantity and Quality Management
- Linkage of Surface Water and Groundwater Management

7) Equitable Water Pricing

10.3.2 Phased Development of Institutional Programs

(1) Geographic Coverage

The programs under the Concept I are recommended as institutional ***strategy*** to cover the whole state, while the programs under the Concept II are proposed for the management mainly in Pilot River Basins as institutional ***Master Plan*** in general, where complexity of water environment management will grow to satisfy all society's demands.

(2) Time Frame

The programs under the Concept I are recommended for ***immediate*** implementation, while the programs under the Concept II are generally proposed for longer term implementation ***after*** the completion of the programs under the Concept I. Generally, the programs under the Concept I would be a prerequisite for the implementation of programs under the Concept II. Continuous upgrade of water environment management could be achieved through the introduction and implementation programs under the Concept II.

10.4 Institutional Strategy

10.4.1 Recommended Institutional Programs under the Concept I

<Program 1 Organizational Strengthening through Implementation of the Current Re-organization>

Current re-organization of the SEMA, the SUCEAM and the IAP will achieve well-configured responsibility allocation and recover many of the current deficiencies. However, enhancement in staff allocation and training or re-training, especially for the staff who change their duties, might be necessary, following the typical re-organization procedure as described below. Budget appropriation should follow in order for all of re-organized sections and divisions to discharge the assigned responsibilities properly. Re-organizations of the relevant regional branches should also be conducted, followed by elaboration of instructions and manuals on data collection, monitoring and check, inspection, and for extension services, and by explanation to the field technicians and clerks.

- to prepare inventories of necessary tasks
- to identify procedures for implementation of each task
- to identify procedures to secure appropriate control of the performance of each task
- to group works in the above procedures into clusters which enables effective and efficient implementation
- to allocate the works to operational and regulatory entities
- to assess the current and required resources, such as staff and finance
- to prepare staff training program

- to identify required instructions, standards or norms
- to prepare proposal for re-organization or staff transfer and subsequent office arrangement

<Program 2 Strengthened Groundwater Management>

The enforcement of the State Regulation of water use granting has not covered all water use, especially for groundwater abstraction. Governments in many countries, as in Brazil, have asserted themselves as guardians of the groundwater resource because of its increasing role in meeting the growing water demands with the limit of the surface water potential and of its high quality as a source of supply. Current groundwater use granting, however, seems to face the following problems.

- Some of the water uses are made without grants or registrations.
- Enough consideration of the existing use is impossible mainly because of the above problem
- Potential of aquifers is not often assessed before the start of borehole drilling, which means that the information on aquifer potential is not accessible at project planning or formulation of groundwater development policy.

(1) Potential Assessment

As currently conducted in the Study, the first step of the groundwater management is the assessment of the potential, sustainable yields of clean water from aquifers. The methodology is described in the groundwater sector of the Reports.

(2) Strengthened Inspection of Water Use and Promotion of Registration

A field survey team would be necessary for the inspection, with some legal status, such as entry to the private land or building for the inspection. The team would also be responsible for the inspection of conformity to the granting, including that of surface water use. Some measures for the encouragement of registration, such as moratorium during when the registration fee would be exempted or lowered, would be necessary coupled with after the period fines should be charged for the negligence of registration or incorrect information.

(3) Enhanced Control of Groundwater Development and Use

Typical process of the groundwater development and abstraction might be as follows:

- registration and control of professional drillers
- application of borehole drilling and well construction with project plan and attached information
- filing and examination of the plan
- issuance of a permit with or without modification or limitation to the plan or denial of the project
- design and construction of the borehole or well
- application of modification in the design of borehole, pump or other facilities, in the course of design and construction if necessary
- issue a permit with or without modification or limitation to the modified design
- application for abstraction with pumping test data and quality monitoring result

- inspection of completed borehole and other facilities, and granting the abstraction with or without the order of modification or limitation to the abstraction

A certain period should be provided for the examination, thus the application should be submitted prior to the commencement of the construction. As the conditions of the aquifers are not visible, there might some cases that the potential of the aquifers can be not known exactly. It might be necessary to include some stipulation in the regulation that the grants of borehole construction or groundwater use shall not incur any responsibility of the competent entity without any assertion of the use by the authority, while the authority should make as much effort for the assessment to manage properly and to avoid conflicts as possible.

Even though the reporting of the result of the pumping test and quality monitoring would be the responsibility of prospective user at the own cost, cancellation of the registry of the professional driller or other penalties could be imposed when negligence or fabrication of the data occurs.

(4) Expansion of Water Source Preservation Regulation to Aquifers

The laws and decree on land use control for surface water source preservation are recommendable for groundwater source preservation as well. Generally, solid waste disposal sites, use of agrotoxics and fertilizer, and infiltration of effluent from industries are known as major sources of groundwater contamination. Even though agricultural land use is designated as preferable land use at catchment areas, some types of agricultural activities with intensive use of agrotoxics (already stated in the State Decree) or fertilizer and with contamination of soil and groundwater could be restricted in recharging areas of aquifers, when it serves or will serve as sources of public water supply.

<Program 3 Enhancement in the Enforcement of Environmental Regulations>

(1) Establishment and Enforcement of Reporting Obligation of Operation and Accidents by Water User to the Competent Entity

Current water quality administration seems to place Environmental Impact Assessment (EIA) as the major instrument of the water quality control. The scheme would render quality control possible only at the design phase, even though it would be the most efficient measure for the water quality management. Reporting system coupled with enforcement of the EIA scheme would be necessary for the effective water quality management.

Legislation in many countries requires the person or the entity who discharges effluent to the public water to meet due obligations of monitoring effluent out of the actual operation and of keeping or submitting the records for the inspection to the entity in charge of the water quality management. An adequate enforcement of this regulation would make water quality control substantially more effective.

Although industries themselves may not be able to monitor their effluent according to the effluent standards, the industries can contract with laboratories, public or private, or universities in the area. A nomination of qualified institutes would be necessary by the competent entity to encourage the contracts. Listed institutes should be responsible for fair monitoring and reporting of the results through a control of the competent entity.

(2) Effluent Standards by Scale and Type of Industry

Current effluent standards in the Resolution of the CONAMA on Water Quality and Effluent Standards, No.20, 1986, have only a set of limits for harmful substances, ignoring scales and types of industries or capability or availability of treatment technology. Even though ultimately the standards may not necessarily consider the capability of effluent treatment, strict enforcement cannot be promoted without an examination of the capablity of the treatment by type and scale of industries. The effluent standards can be set by type of industry or according to the volume of the discharge. Construction of effluent treatment plants for small scale industries would also be recommendable, especially in the case that the factories with similar process are concentrated in an area.

(3) Phased Enhancement of Detecting Capability of Problems and Inconformity to the Effluent and the Water Quality Standards

Detecting capability of contaminating sources is the basis for the effective control of water quality and pollution. Counter-measures can be planned or designed only after identification of problems and the analysis of the mechanism. Although the Resolution No. 20 sets 29 limits of harmful substances to human health for effluent standards and 66 limits of those for Water Quality Standards (class 2), many of them are not monitored at the water quality monitoring stations operated by the IAP. Once designated for quality standards indices, these items should be monitored and controlled, otherwise industries or farmers might ignore the water quality management, and further the whole of government administration and legislation.

Under the current conditions, however, phased enhancement in management and enforcement could be recommendable. Monitoring and analysis of all designated items in the Resolution at all monitoring station might actually incur much more costs than those currently appropriated to the competent entity (IAP). The analyses of some harmful substances require sophisticated equipment and necessitate many technicians and much costs. Even though the analysis could be outsourced, the costs might be huge.

After the analysis of industrial effluent, examination on agrotoxic use and use of chemical products in the daily life of citizens and some experimental monitoring covering all items designated in the Resolution at all monitoring stations, as well as the examination of harmful effect caused by the discharging of the items, phased nomination of the items could be made for the continuous and intensive monitoring for all stations.

(4) Effluent Standards for Infiltration to the Ground.

Although conservation of the groundwater quality may require a different approach in legislation and in practice, the current effluent standards seem not to consider waste water infiltration to the ground. Effluent discharge into the ground should generally be prohibited, because once contaminated the quality of groundwater could be more hard or impossible to be recovered. In the areas without sewerage services, the sanitary conditions around the projected borehole or well should be checked upon the examination of the application.

(5) Enhanced Control of Agrotoxic Use

The Federal Law No. 7802, 1989 well covers research, development, production, packaging and labeling, storing, marketing, advertising, utilization, import, export, final destination of residue, classification, control and inspection and surveillance of toxic

agricultural chemicals and similar products. Current agrotoxic use control seems to have the following major problems.

- Degree of contamination and its impact on human health or on the environment are not sufficiently monitored to elaborate effective and efficient countermeasures.
- Since huge numbers of agrotoxic products have emerged in the market, the examination and registry can not catch up with the market change.
- Much of contamination seems to be caused by disordered use, storing, disposal and washing devices for spraying of agricultural toxics, including use of prohibited chemicals.

Immediate activities can be concentrated on the control of agrotoxic use by farmers through extension services of the agricultural sector of the Government, such as the EMATER, supported with environmental sectors, such as the IAP. The followings could be effective or efficient.

- notification and dissemination of information with some recommendations, such as that of prohibited products, effective products with less contamination, adequate amount and timing of use against over use, proper methods of storing, disposal and cleansing of spraying devices
- promotion of coordinated use among neighboring farmers

<Program 4 Legal Arrangement for the Control of Soil, Sand and Stone Taking in River Areas>

As proposed in Section 8.1 of this Report, non-structural measures are often efficient with less cost in flood control. Although, land use control is a major component of flood plain management as properly provided in the laws, control of taking soil, sand or stones in river areas should be encouraged as well. Some granting procedures are recommendable. Typical procedures might be as follows:

- application with required information (purpose of taking, location, volume of taking, time and period, methods of taking, etc.) with fee
- investigation of the effect of the taking on river run off and water quality, including sedimentation
- issuance of a permit with or without modification or limitation with fee charging, or denial
- inspection of conformity of the taking with the granted conditions

<Program 5 Cost Recovery of Water Environment Management>

Cost recovery by users' charges and charging for water is and should be discussed in dual connotations of; i) charging for the use of the raw resource, i.e., paying for the privilege of diverting, storing of the natural resources, ii) charging for water being supplied through public utility networks.

(1) Cost Recovery of Resources Assessment and Environmental Monitoring

As stipulated in the Constitution, water is the property of the Federal Republic or the State according to the administrative attribution. Use of water, especially its commercial use including that for hydro-electric generation, can be charged as high as the value lost by the

use rather than the other use, known as "opportunity cost". The benefits of water and water courses cover many spheres of lives, such as those in sustaining lives of the people, agricultural and industrial production, power generation, washing away waste water, running off excess water, eco-system conservation, recreational activities, giving amenity, etc., so that the measurement of amount of benefits of water would be extremely complicated. Therefore, water pricing or adoption of "users-to-pay" principle for the direct derivation varies coupled with complexity in affordability of users to pay, chargability, and governments' policy on subsidies and tax collection.

At present, government organs in charge of the property management, such as water resources assessment and water quality control, suffer from insufficient budget, while fees at water use granting seem to cover only costs of examination and filing.

As introduced in many countries, charging for water right can be made according to the volume of the granted water use. Although ideal or ultimate charging should be conducted based on the opportunity cost, current discussion could be encouraged in the light of budgetary supplement and affordability of the users to pay. Exemption could be made in the use for public water supply as given in many countries. Further discussion with full consideration of regional conditions should be promoted.

(2) Cost Recovery of Water Supply and Sanitation

Cost Recovery of Water Supply and Sanitation is discussed in two points of view; i) tariff level and ii)cost saving by leak detection. Generally, once the tariff falls under the preferable level, often by political reasons, insufficiency in operation funds occurs, causing deterioration in quality and reliability of the services, resulting in less consumers' willingness to pay and in further scarce funds, and a vicious circle follows. To escape from the vicious circle is normally a hard and long task.

(a) Continuous Revision of Tariff Tables

The expansion of the services to the areas with low density, as well as the upgrading demand for the sewerage treatment level in the future will incur substantial increase in the unit cost. The tariff table should be revised continuously.

Long run marginal cost (LRMC) pricing, which charges incremental costs on the community of satisfying marginal demands, is found efficient in many counties. The system contributes to equitable demand control and to optimal development plan, avoiding over investment corresponding to increased demands enjoyed by the community with low tariff. Since LRMC pricing is also applied in electricity supply services, and the COPEL has much experience for this pricing, coordinated studies in the theories and practices as well as tariff setting policies should be promoted.

Progressive or increasing block tariff, where succeeding blocks of units of water are sold at higher and higher prices, is commonly introduced in developing countries with the objectives of ; i) income re-distribution with narrow tax base and ii) encouragement of water saving with scarce resources availability

Even though progressive block tariff structure is of less interest in developed countries, many municipalities in Japan adopt this tariff system with the two objectives:

- to reflect increased costs of the development of new water resources on the

charge imposed on consumers demanding a great amount of water

- to promote the consumption reduction effect

In tariff setting based on progressive block tariff, a base line consumption and a basic charge, and progressive ratios in excess use should be examined. Both criteria vary according to the life style, income distribution structure, price elasticity of the services, subsidies to water supply schemes, etc. Even though some examples are given in the Sector Report, further study by the relevant authorities would be necessary.

(b) Enhanced Leak Detection

SANEPAR's records show, around 60% of the produced water is supplied to the customers, which means production cost of supplied water per cubic meter, excluding distribution cost, is as high as 1.67 times of that of produced water.

The loss less than 25% is generally difficult to attain, requiring higher cost for recovery than the cost saved. Against the loss over that level, efforts for inspection of the leakage in distribution network should be necessary, establishing Inspection Teams for identification of leakage or stolen water and advice to the technical or administrative section for the remedial.

<Program 6 Promotion of Residents Participation through Information Publication>

Public awareness through information publication is inevitable to encourage sound residents' participation. In Japan, data collected and analyzed, and current issues, as well as government policies are published annually as "White Papers" for major sectors of the government administration.

Even though the Federal Law No. 6938, 1981, titled as "National Environment Policy", provide that publication of annual "Environment Quality Report" is one of the basic instrument for environment conservation (Art. 9, X), such reports are not published periodically on water environment. Report publication should be made in order to promote sound residents' participation.

10.4.2 Programs under the Concept II

As the programs under the Concept II are recommended as pilot implementation in the Pilot River Basins, the programs are described in the Main Report II and III of the Study.

Literature Cited

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3. Harald D. Frederiksen, "Water Resources Institution", the World Bank, 1992
4. John R. Teerink, Masahiro Nakashima, "Water Allocation Rights and Pricing", the World Bank, 1993
5. "Resettlement and Development", Environment Department of the World Bank, 1994
6. "Pricing of Water Services", Organisation for Economic Co-operation and Development, 1987

CHAPTER 11 ECONOMIC AND FINANCIAL ASPECTS OF STRATEGY

11.1 Financial Requirement

The project costs required for the implementation of strategy for major sectors were roughly estimated and summarized as shown in Table-11.1.

The cost estimate was carried out taking into consideration the following items.

1) The cost was estimated based on the price level and exchange rate (1 US$ = 0.89 R$) in August 1994.

2) The cost for water supply sector was estimated by modifying the cost estimate in the document "The Master Plan of Water Supply in the Metropolitan Region of Curitiba, June, 1991 - SANEPAR".

3) The cost for sewage treatment sector was estimated by modifying the cost estimate in the document "The Master Plan of Sewage Treatment in the Metropolitan Region of Curitiba, September, 1993 - SANEPAR".

4) The cost for terracing was estimated based on the data of EMATER.

5) The cost for non-tillage was estimated by assuming machinery cost, it's durability, capacity, etc.

6) The cost for hydroelectric power generation was estimated by converting the cost estimated by COPEL to 1994 price level.

Table-11.1 Rough Project Cost for Strategy Implementation

Sector		Scale of Sector	Project Cost (10⁶US$)	Remarks
Domestic Water Supply		1,183,000 m³/day	1,294	For all urban areas excluding rural areas
Industrial Water Supply		495,000 m³/day	502	ditto
Agricultural Water Supply		88,000 m³/day	12	For livestock and fish pond
Sewage Treatment		920,000 m³/day	704	For 6 river basins
Flood Control			200(1)	Structural Measures for 4 urban areas
Soil Erosion Protection	Terracing	6,000,000 ha	241	
	Non Tillage	3,150,000 ha	202	
	Sub Total	9,150,000 ha	443	
Total			3,155	
Hydroelectric Power Generation		3,095 MW	3,381	
Grand Total			6,536	

Note (1): Roughly estimated based on the cost estimate in the Master Plan

11.2 Magnitude of the Proposed Investment

11.2.1 Public Investment

The required total project cost for implementation of the proposed Strategy excluding the hydropower sector on which investment amounts US$ 3.2 billion is through different channels. On the other hand, the amount of the recent GDP, government's revenue and expenditure of the state as well as public investment are shown in Table-11.2. Public investment is estimated with the assumption that the ratio of the government's revenue to the GDP and the ratio of the public investiment to the expenditure will remain 6 % and 7 %, respectively in the future. Cumulative public investment from 1995 to 2015 will amount to US$ 4.4 billion according to the estimate based on Table-11.2.

The total project cost is approximately 72 % of the cumulative public investment. The comparison of the total cost with projected cumulative public investment might show some financial feasibility of the magnitude of the total cost, even though the public investment includes those for development of housing establishment, transportation and telecommunication networks etc., and substantial parts of the total cost except those for flood control and ecology conservation, will be invested by relevant State or private companies or entities.

Table-11.2 GDP, Government's Revenue and Expenditure, and Public Investment of the State

	1988	1989	1990	1991	1992	1993	2005	2015
1) GDP	25,352	25,619	24,286	25,225	26,486	27,811	49,945	81,354
2) Revenue	1,625	1,533	1,859	1,637	1,609	1,744	2,997	4,881
3) Expenditure	1,991	2,079	1,787	1,637	1,566	1,586	2,997	4,881
4) Investment	28.7	27.2	38.8	128.8	117.2	92.5	209.8	341.7
3) / 1) (%)	7.9	8.1	7.4	6.5	5.9	5.7	6.0	6.0
4) / 1) (%)	1.4	1.3	2.2	7.9	7.5	5.8	7.0	7.0

11.2.2 Investment of Water Supply and Sanitation, and Hydropower Sector

The financial requirement estimated in the section 11.1 was reviewed in the light of the past investment achievement of related organizations. The data of SANEPAR and COPEL were collected. Their past investments account for the most part of water-related investment in the past. SANEPAR's total investment figures are the following.

1992 : US$ 78,290 thousand

1993 : US$ 51,050 thousand

1994 : US$ 79,531 thousand

Total : US$ 208,871 thousand

The proportions of the water supply and sewerage components are 75% and 25% on average. Regarding the source of investment fund, the SANEPAR's own fund accounted for 42%. Other major sources include the national bank, state government fund and the state government. No foreign fund was recorded during this period.

The investment record of COPEL was collected between 1975 and 1995. During this period, three major hydropower projects were implemented or committed: Areia Project, Segredo Project and Salto Caxias Project. In the present analysis, the data between 1980 and 1994

were used since the price adjustment index is available only for this period. The total investment amount during this period was US$ 912 million. The data on the source of fund were available only for the Segredo Hydropower Project as follows.

- World Bank : 8.3 %
- FINAME : 11.6 %
- ELETROBRAS : 17.9 %
- State government : 8.6 %
- COPEL : 49.4 %
- Previous selling to private large consumers : 4.2 %

The records collected as above were converted to 1994 price level using an index prepared by COPEL to correct for deviation between the change in exchange rate and inflation rate. Based on the adjusted figures, annual average figures were derived to be compared with the investment cost proposed by the Strategy. The result is shown in Table-11.3.

Table-11.3 Comparison of Proposed Investment and Past Investment

(10^6 US$)

Sector	Proposed Investment		Past Investment
	(Total*)	(Annual**)	Annual
Water Supply			
Domestic	1,309	65	—
Industrial	502	25	—
Sub-total	1,811	90	57
Sewerage	704	35	19
Total	2,279	114	76
Hydropower	3,381	169	94

* The proposed investment amount between 1996 and 2015.

** These figures are annual average figures for 20 years between 1996 and 2015.

The proposed investment for the water supply sector is by about 58 % higher than the past investment on an annual basis (US$ 90 million vs. US$ 57 million.) A reservation should be made, however, regarding the industrial water supply. In reality, there is a number of possible choices for industrial water supply such as direct abstraction of surface water and groundwater, development of independent industrial water supply system separate from domestic water supply and a system both for domestic and industrial water supply such as assumed in the present study. A realistic comparison might be that between the planned investment for domestic water supply system (US$ 65 million) and SANEPAR's past investment on water supply (US$ 57 million) because the past investment for the sector was mainly destined for domestic water supply. Based on this concept, these two figures are judged to stay within almost the same range.

The proposed investment for sewerage at US$ 35 million annually is about 85 % higher than the past record at US$ 19 million. This deviation can be explained by the following two factors:

1) Until now, the focus of SANEPAR's investment has been placed on water supply rather than on sewerage, having resulted in degradation of water quality.

2) In the proposed Strategy, the emphasis on water quality improvement is reflected in the target that planned water quality fully complies with the CONAMA resolution. This target results in the planned investment cost higher than the past achievement.

The following directions are recommended to be pursued for fund raising for the future investment need.

- possibility of charging on direct water abstraction and direct discharge
- review of the present tariff system
- participation of the private sector

Planned investment amount for hydropower development is judged to be within a reasonable range. In the past external fund has been mobilized for hydropower development in Paraná to cope with the situation that nearly a half of the electricity produced in Paraná is transmitted to neighboring states. The deviation of 80 % as shown above (US$ 169 million per year vs. US$ 94 million per year) is expected to be met by external sources.

11.3 Economic and Financial Measures for the Strategy

11.3.1 Objective

Non-structural measures such as economic and financial measures are as important as structural measures in improving the water environment in Paraná. Success in improving the water environment through non-structural measures would lead to easing the burden on the public sector for investment on structural measures. The investment requirement can be minimized by controlling the demand side behavior through various incentives and disincentives. In this sense, the present study has paid attention to a number of economic and financial measures such as follows to indicate general directions for further detailed analysis.

- charging on direct water abstraction
- charging on direct discharge of wastewater
- review of the existing tariff level
- cleaner production
- economic efficiency in sewerage planning
- ecological ICMS

11.3.2 Charging on Direct Abstraction

A new charging system for direct water abstraction is proposed for consideration. The objective of this new charging system is to provide an incentive for direct abstractors to save the amount of water use. At present, once direct abstractors acquire the water right and put up their own water intake facilities, they are free to abstract as much water as they need within the permitted range. There is no incentive to save water use, since the cost they bear is not affected by the amount of water they use. A simple analysis shows that the cost paid by the representative direct abstractor for direct abstraction is about one-fortieth of the tariff imposed by SANEPAR for industrial use. In the areas like the Curitiba Metropolitan Area where water supply and demand balance is becoming tight, the introduction of this system would be valid and effective.

In the case of surface water, direct abstraction charge can be set such that direct abstractors share the cost of water resources development that would make direct abstraction possible.

Where the volume of natural flow is sufficient to allow for direct abstraction, this new charging system is not appropriate. For groundwater, the charge level can be set so that the demand would be reduced down to the point of the maximum allowable abstraction amount which can be estimated by a technical analysis.

Outside Brazil, there is a number of cases where the system such as above has been adopted and successful. They are presented in the Sectoral Report N "Cost Estimates, and Economic and Financial Assessment" in detail.

11.3.3 Charging on Direct Discharge

Charging on direct discharge is also a system introduced in a number of countries. A survey on this issue would be worth conducting from the viewpoint of providing a new incentive for water quality improvement and fund raising for wastewater management. The best approach would be a combination of the existing regulation and a new charging mechanism below a certain water quality level.

11.3.4 Review of the Existing Tariff System

An indicative analysis was made to evaluate the present tariff levels of SANEPAR in view of the development cost of the proposed Master Plan and the Strategy. The objective is to clarify the present status of the existing tariff levels in comparison with the future need for investment. A detailed analysis on the tariff system should be made separately from the present study. The conclusion of the analysis is that there would be a necessity for upward adjustment for water tariff, whereas the present sewerage tariff level would be appropriate to cover the development cost.

Table-11.4 summarizes the derived cost of water.

Table-11.4 Unit Cost of Water Supply

Unit: US$/$m^3$

Area	Average Incremental Cost	OM Cost		Total
		Direct	Indirect	
Iguacu	0.291	0.247	0.250	0.788
Tibagi	0.137	0.116	0.250	0.503
Curitiba M.A.	0.353	0.300	0.250	0.903
Parana	0.318	0.247	0.250	0.815

Average incremental costs were derived by annualizing the investment costs with a discount rate of 10% and a discount period of 30 years and dividing them by the corresponding annual water volume. Direct OM costs include actual expenses needed to operate the systems, while indirect OM cost comprises administrative costs etc. In all the cases, direct OM cost is assumed to be 9% annually of the investment cost before annualized.

The average domestic water tariff actually collected by SANEPAR is US$ 0.62/m^3. The cost of water for Paraná is estimated to be US$ 0.82/m^3, about 32% higher than the present level. The following points are concluded.

a) Overall water tariff level needs to be raised on the basis of economic efficiency as well as cost recovery, on the ground that every cost minimizing effort is made.

b) Regional variation in the tariff level should be allowed such that the tariff level reflect the cost of water of each region.

c) As a prerequisite, utmost effort should be made on the part of SANEPAR to minimize various costs before adjusting the tariff level. The decision on tariff adjustment can be made by incorporating social and political consideration.

d) A detailed analysis on the tariff structure should be made covering all the relevant aspects such as engineering, financial and institutional factors.

Table-11.5 summarizes the cost of sewage treatment for the four cities.

Table-11.5 Unit Cost of Sewerage Treatment

Unit: US$/m³

Area	Average Incremental Cost	OM Cost		Total
		Direct	Indirect	
Curitiba	0.200	0.020	0.250	0.470
Cascavel	0.320	0.040	0.250	0.610
Ponta Grossa	0.280	0.030	0.250	0.560
Londrina	0.250	0.040	0.250	0.540

The present domestic sewage treatment charge is set at 80% of water tariff, US$ 0.50/m^3. The average tariff level of domestic and industrial sewage treatment actually collected by SANEPAR is US$ 0.58/m^3. These levels are almost within a similar range as the costs derived above. Based on this result, it is judged that no adjustment is needed for sewage treatment charge.

11.3.5 Cleaner Production

" Cleaner Production " is an important concept of water environment management. The concept of cleaner production indicates the adoption of a new manufacturing technology that generates smaller amount of wastewater and solid waste compared with conventional production technology. It can be referred to as "in-process-technology" as opposed to "end-of-pipe technology". From the viewpoint of the state government, the expansion of cleaner production technology leads to lessened need for providing public sewerage system as a result of the reduction in the industrial wastewater volume.

A number of cases worldwide have been reported in which the adoption of cleaner production technology is more cost efficient than the conventional end-of-pipe technology. The Sectoral Report N "Cost Estimates, and Economic and Financial Assessment" presents a number of examples in this sense. In Paraná, Klabin company, a paper company, is reported to have recently adopted a new whitening technology using nitrogen peroxide in the production of cellulose with the advice of the state government. A detail in economic efficiency is not known.

The adoption of cleaner production technology should be encouraged by the state government by taking the following actions.

- compilation of information
- human resources development

- information dissemination
- legislative measures for financial support, if found necessary
- preparation of a water quality management plan incorporating cleaner production
- coordination of water quality management plan and industrial development plan

11.3.6 Economic Efficiency in Sewerage Planning

The strategy for water quality improvement proposes to develop the sewerage systems in six major river basins: Cinzas, Tibagi, Pirapo, Ivai, Iguaçu and Ribeira. In the future, the coverage of the sewerage system is expected to expand along with further urbanization in Paraná. An important issue in sewerage planing in the future would be cost efficiency of the sewerage system. As the need for sewerage system development reaches smaller cities with lower population density, the selection of an appropriate technology becomes more important. It has been found in Japan that in lower density areas the individual wastewater treatment system is more cost efficient than the collective sewerage system. This is so because the costs for pipes per head rises in lower density areas. A study in Japan shows the threshold population density is 4,000 per square kilometer.

In the planning of sewerage development for smaller cities in the future, the following aspects should be duly considered and an appropriate system be selected.

- technology actually available
- costs of pipes, treatment facilities and individual system
- threshold point of density (e.g. population, household)

11.3.7 Ecological ICMS

The ecological ICMS is a form of allocating commodity tax revenue for environmental preservation purpose. Those municipalities with environmentally important areas, either green area or water source area, make an application to IAP and, if judged qualified, receive fund from the state government for preserving the designated area or other purposes. The idea is that the opportunity for economic development lost due to preservation should be compensated by the whole population in Paraná. The system has been adopted since 1991, the first case in Brazil followed by four states establishing similar systems.

While a number of problematic cases to misuse the system have been reported, largely due to a young history of the system, they will be overcome by a continued effort by the state government in implanting the system. More fundamentally, the following actions are recommended.

a) A consistent land use strategy for the state is to be established that would serve as the basic framework for evaluating the appropriateness of the ecological ICMS fund application.

b) An evaluation of the opportunity cost should be made from a broad perspective of economic impact of ecological preservation, not limited to short-term commercial value.

CHAPTER 12 SELECTION OF PILOT RIVER BASINS

12.1 Factors and Significance Criteria

After the Strategy for the whole Paraná State was established, the pilot river basins were selected for phase III, Master Plan Study for the pilot river basin(s).

In order to determine the pilot river basin(s), the following factors were studied. After examination of each factor on each basin, significance of a factor in each basin was evaluated and classified into five groups from A to E in accordance to degree of significance, as shown bellow. After that, integrated judgment of each basin was made for selection of pilot river basin(s) taking into consideration significance degree of each factor.

The method proposed in this chapter is one example of evaluating water environmental factors only for selection of pilot river basin(s) in this Study and neither standards nor conventional method in Japan. To apply this method to other studies in future, careful consideration will be required.

Factor to be considered:

1) Socio Economy (population and Gross Domestic Product)
2) Water Demand
3) Flood Damage
4) Water Quality
5) Soil Erosion
6) Ecology

Degree of Significance:

A: Serious Significance
B: High Significance
C: Medium Significance
D: Low Significance
E: Negligible Significance

Degree of significance was judged according to the classification criteria for index in each factor as shown in Table-12.1. Where there are two indexes in a factor, higher degree of significance was adopted as the significance for the factor.

Table-12.1 Criteria of Degree of Significance

Factor	Index	Degree Of Significance				
		A	B	C	D	E
Socio- Economy	Population in 2015 (10^3 persons)	≥2,000	≥1,500	≥1,000	≥500	500>
	GDP in 2015 (10^6 US$)	≥15,000	≥10,000	≥5,000	≥1,000	1,000>
Water Demand	Newly Developed Water (m3/sec)	≥10.0	≥5.0	≥2.5	≥1.0	1.0>
Flood Damage	Degree of Flood Damage	Serious or High	Medium	Low	Negligible	Non
Water Quality	Number of IQA(1) data under 51	≥10	≥5	≥3	≥1	1>
	BOD Load from(2) Industry(kg/day)	≥20,000	≥15,000	≥10,000	≥5,000	5,000>
Soil Erosion	Gross Erosion (ton/ha/year)	≥32	≥25	≥17	≥9	9>
	Suspended Sediment (ton/km^2 •year)	≥121	≥91	≥61	≥31	31>
Ecology	Integrated Evaluation(3)	Serious	High	Medium	Low	Negligible

Note: (1)Number of IQA (Integrated Water Quality) data under 51, acceptable and poor water quality among total data of 746 which were observed in the 144 stations from 1970 to present.
(2)BOD load from industry based on IAP's data in 1992.
(3)Integrated evaluation taking into consideration ecological population, development situation for aquatic culture, hydroelectric, agricultural, industrial projects, deforestation and conservation unit.
(4)Where there are two Indexes in a factor, higher degree of significance is adopted for the factor.

12.2 Selection of Pilot River Basin(s)

The Paraná State is composed of 16 river basins, 9 major river basins in the State and 4 residual river basins of the Paranapanema River and 3 residual basins of the Paraná River. The pilot river basin(s) was to be selected among the 9 major river basins.

The degree of significance for each factor examined in each river basin is shown in Table-12-2. Based on the integrated assessment of the degree of significance for each factor, the priority for pilot river basin seems to be given firstly to Iguaçu river basin, and secondly to Tibagi river basin.

As pilot river basins, the Study Team recommended Iguaçu and Tibagi river basins. And the both river basins were accepted by the Brazilian side.

Table-12.2 Selection of Pilot River Basins

	River Basin	Cinzas	Iguacu	Itarare	Ivai	Litoranea	Piquiri	Pirapo	Ribeira	Tibagi
Factor	Socio Economy	D	A	E	C	E	D	D	D	B
	Water Demand	D	A	E	C	E	C	D	E	B
	Flood Damage	E	A	E	D	B	E	E	E	D
	Water Quality	C	A	D	D	E	C	D	D	B
	Soil Erosion	A	B	B	A	D	B	C	B	C
	Ecology	E	A	E	C	E	C	C	E	A
	Priority Order for Selection		1							2

CHAPTER 13 TECHNOLOGY TRANSFER

It is one of important purposes to promote technology transfer and exchange of accumulated technical experience between Japanese side and Brazilian side through implementation of the study. The following activities were carried out to attain this purpose.

(1) One-the-Job Training

On-the-job training was provided by the Study Team to the Brazilian counterparts through joint works for data collection, field survey, study work, technical discussion etc. during the Study period.

(2) Steering Committee and Technical Committee Meetings

The Steering Committee for policy making for and overseeing the Study, and the Technical Committee for decision and discussion of technical matters for the Study were establish at Brazilian side.

In the meetings between the Study Team and Committees, various technical and administration matters on the Study were discussed, resulting in effective technology transfer.

The Steering Committee and Technical Committee meetings were held 6 times each during the Study period.

(3) Technical Seminars

The seminars held during the Study period are as shown in Table-13.1.

(4) Training in Japan

Three Brazilian counterparts took part in the JICA training course in Japan for about one month.

Table-13.1 Technical Seminars held during the Study Period

Date	Name	Technical Subjects	Place
Jan. 26, '95 & Jan. 27, '95	Technical Seminar (1)	1) Policy of Water Environment in Public Works of Japan 2) Case Study of Flood Control in Japan 3) Hydrological Data Management in Paraná 4) Hydrological Data Management in Japan 5) Environmental Protection of Passauna 6) Case Study of Water Resources Development by Dam-Reservoir in Japan 7) Water Resource Management System in the Paraná State	Auditorium of COPEL
June 28, '95	Technical Seminar (2)	1) Approach to Sustainable Development of Groundwater Resources of Paraná. 2) Aquifer Potential of Paraná 3) Concept of River Basin Management in Japan 4) Future Utilization of the Water Resource of the Metropolitan Region of Curitiba	Auditorium of COPEL
June 29, '95	Symposium	1) Policy of Water Environment for Wealthy and Secure Human Life 2) Water Resources Management 3) Panel Discussion	Auditorium of COPEL
July 1 to July 16, '95	Panel Exhibition	Water Environment in Japan and Paraná	Governor's Official Residence

CHAPTER 14 RECOMMENDATIONS

14.1 Studies for Urgent Implementation

Such studies as described below were recommended to be conducted urgently, following this Study.

(1) Study on Comprehensive Regional Plan on Water Environment for the Curitiba Metropolitan Region

The following issues regarding water environment were identified and clarified throughout the Study in Curitiba Metropolitan Region.

1) water supply by dam development
2) water supply by groundwater development
3) water quality control and sewerage development
4) flood control

A study on comprehensive regional plan on water environment should be conducted with more preciseness, containing the above issues. Feasibility studies should follow, after selection of programs or projects of priority regarding the above four issues.

(2) Feasibility Study on Flood Control in Uninão da Vitoria

A feasibility study on flood control is recommendable for Uninão da Vitoria, where the largest damage over the State by flood occurs.

(3) Feasibility Study on Water Supply and Sanitation in Londrina

Londrina has the second largest water demands, next to Curitiba. A feasibility study on water supply is necessary to be conducted, coupled with a study on sewerage development, taking into account of prospective water contamination in downstream rivers due to the location of the city on mountain top.

(4) Feasibility Study on Water Supply and Sanitation in Cascavel

Water demand in Cascavel will grow rapidly corresponding to the urban development. Although the Study proposes the sources of water supply from surface and underground water, a feasibility study for more precise plans is required. A feasibility study on sewerage development to prevent water contamination in downstream rivers would be necessary because of the similar geographical conditions to Londrina.

(5) Feasibility Study on Water Supply and Sanitation in Ponta Grossa

Ponta Grossa has sufficient potential to develop as a satellite area of Curitiba. The population and industries will grow in the near future, causing problems in water supply and sanitation. Therefore, a feasibility study on the matters will be required.

14.2 Master Plan Study for Other River Basins than the Pilot River Basins of the Study

The Study formulates the Strategy to cover the whole state, and the Master Plan for Iguaçu and Tibagi River Basins, after the selection of the two basins as the Pilot River Basins. For other seven (7) river basins, Master Plan studies should be conducted as soon as possible. The Steering and the Technical Committees established for the Study are expected to facilitate those Master Plan studies.

14.3 Review of Other Development Plans

The Strategy and the Master Plan proposed in the Study are formulated from the viewpoint of water environment applying various assumptions and estimates on socio-economic conditions. In other development plans, such as those for socio-economic development, regional development, industrial development of various sectors, and transportation and road network development, programs and projects should be planned taking into account of the proposals made in the Study from the viewpoint of water environment. For example, in order to restrain the population concentration occurred in the Curitiba Metropolitan Region and to distribute the population and industries to regional poles, concrete schemes should be examined and programmed in regional development plans.

14.4 Implementation and Review of the Proposed Projects

In order to promote socio-economic development and to raise the living standards and to enjoy conserved or improved water environment, projects and programs proposed in the Study should be implemented steadily. Since the projects and programs are planned based on the estimated socio-economic framework in target years of 2005 and 2015, the plans should be reviewed every five years or when necessary, according to the changes in socio-economic conditions.

APPENDIX - I

The Members and Assignment Schedule of the Study Team

The Members and Assignment Schedule of the Study Team

Assignment	Name	1994 3	4	5	6	7	8	9	10	11	12	1995 1	2	3	4	5	6	7	8	9	10	11	12	Remarks
Team Leader / Water Resource Development	Yoshio NAKAGAWA																							YEC
Flood Control	Yukihiro MIZUTANI																							NK
Flood Damage Survey	Luise Rosado																							NK
Hydrological Statistics	Takeshi WATANABE																							YEC
Surface Water	Norio HANAOKA																							YEC
Groundwater	Keiji NAKANO																							NK
Soil Conservation / Agriculture	Kazuhiko OTANI																							YEC
Water Quality / Sewerage	Hiroshi SUMIKAWA																							YEC
Water Environment Management	Shigeru NAKAMURA																							NK
	Masanobu SAKAMOTO																							NK
Ecosystem	Enrique RAMIREZ-GUIER																							NK
Power Development	Masayuki SHINZAWA																							NK
Water Facility	Jun'ich KOJIMA																							YEC
Land Use / Remote Sensing	Mishra Krishna KUMAR																							YEC
Regional Planning / Economic Development	Atsuhiko UEHARA																							YEC
Institution	Naoki HARA																							YEC
Economic & Financial Analysis	Haruo YAMANE																							NK
Coordinator	Takeshi NAGASAWA																							YEC
	Katsumi Fujii																							YEC
Report			IC/R		P/O					PR(1)			IT/R		PR(2)			PR(3)				DF/R		F/R	

Legend : work in Brazil work in Japan work in Costa Rica, YEC; Yachiyo Engineering Co., Ltd.
NK; Nippon Koei Co., Ltd.

APPENDIX - 2

List of Committee Members

1. JICA Advisory Committee

Name	Position	Assignment Period
Koichi UZUKA	Chairman	March 1994 - December 1994
Satoru KONDO	Chairman	January 1995 - December 1995
Yasuro IDE	Member	March 1994 - December 1995

2. Steering Committee

(1) March 1994 - December 1994

No.	Name	Position	Organization
1	Carlos Artur Kruger Passos	Secretary	SEPL
2	Eduardo Requião de Mello e Silva	Secretary	SEMA
3	Roberto Lobo Blasi	Secretary	SETR
4	José Carlos Tiburcio	Secretary	SEAB
5	Adhail Sprenger Pssos	Secretary	SEIC
6	Reinaldo José Rodrigues dos Santos	Secretary	SEDU
7	João Carlos Cascaes	President	COPEL
8	Mariano de Matos Macedo	President	IPARDES
9	Gonçalo Signorelli	President	IAPAR
10	José Henrique Popp	President	MINEROPAR
11	Marco Antonio Cenovicz	President	SANEPAR
12	Oscar Alberto Bordin	President	FAMEPAR
13	Alexandre Modesto Cordeiro	Superintendent	SUCEM
14	Luiz Henrique Bonna Turra	Coordinator	COMEC

(2) January 1995 - December 1995

No.	Name	Position	Organization
1	Cassio Taniguchi	Secretary	SEPL
2	Hitoshi Nakamura	Secretary	SEMA
3	Deni Lineu Schwartz	Secretary	SETR
4	Hermas Eurides Brandão	Secretary	SEAB
5	Alexandre Fontana Beltrão	Secretary	SEID
6	Lubomir Ficinski Dunin	Secretary	SEDU
7	Ingo Henrique Hubert	President	COPEL
8	Romar T. Nogueira	President	IPARDES
9	Wilson Pan	President	IAPAR
10	José Henrique Popp	President	MINEROPAR
11	Carlos Afonso Teixeira de Freitas	President	SANEPAR
12	Omar Akel	President	FAMEPAR
13	Hirotoshi Taminato	Superintendent	SUCEAM
14	Luiz Hayakawa	President	COMEC

3. Technical Committee Member

(1) March 1994 - December 1994

No.	Name	Organization
1	Arnaldo José de Souza Abud (General Coordinator)	SEDU
2	Pericles Weber / Elizabeth Siqueira	SANEPAR
3	Emilio H. Gomes Jr. / Helio Mitsuo Sugai	COPEL
4	Raul Pecioli	COMEC
5	Marlene Zanin / Mauri C. B. Pereira	SEMA / IAP
6	Wagner Delano Hawthorne / Telesforo Oliveira	SUCEAM
7	José Moraes Neto / Joel E. Kersten	SEPL
8	Orlando Bizzoni / José Mauricio Manzochi	DNAEE
9	Edir Edenir Arioli / Otavio A. B. Licht	MINEROPAR
10	Manoel J. Lacerda Jr.	SETR
11	José Luiz C. Salles / Nestor Bragagnolo	SEAB
12	Celia Regina Gapski Yamamoto / Ary Talamini Jr.	FAMEPAR
13	Elvina Chaves / Maria L. Urban Kleinke	IPARDES
14	Francisco Striquer Soares	UEL

(2) January 1995 - December 1995

No.	Name	Organization
1	José Antônio Zem (General Coordinator)	SEPL
2	Péricles Weber / Elizabeth Siqueira	SANEPAR
3	Emílio H. Gomes Jr. / Hélio Mitsuo Sugai	COPEL
4	João Lech Samek / Álvaro Amoretti Lisboa	SEMA/IAP
5	Ivo Heissler Jr.	SUCEAM
6	Gil F. Bueno Polidoro / Ricardo Antônio A. Bindo	COMEC
7	Fábio Bonatto	SEPL
8	Orlando Bizzoni / José Maurício Manzochi	DNAEE
9	Marcos Vitor Fabro Dias / Otávio A. B. Licht	MINEROPAR
10	Olivo Zanella / Eurípedes Patápio Smanioto	SETR
11	José Luiz C. Salles / Nestor Bragagnolo	SEAB
12	Kencho Yamada	FAMEPAR
13	Maria L. M. S. Marques Dias / Maria L. Urban Kleinke	IPARDES
14	Francisco Striquer Soares	UEL
15	Roberto Dimas Del Santoro / Geraldo Luiz Farias	SEDU
16	Marcos Lacerda Pessoa	SITE
17	Eduardo Alvin Leite	SIMEPAR
18	Enéas Souza Machado	PROSAM