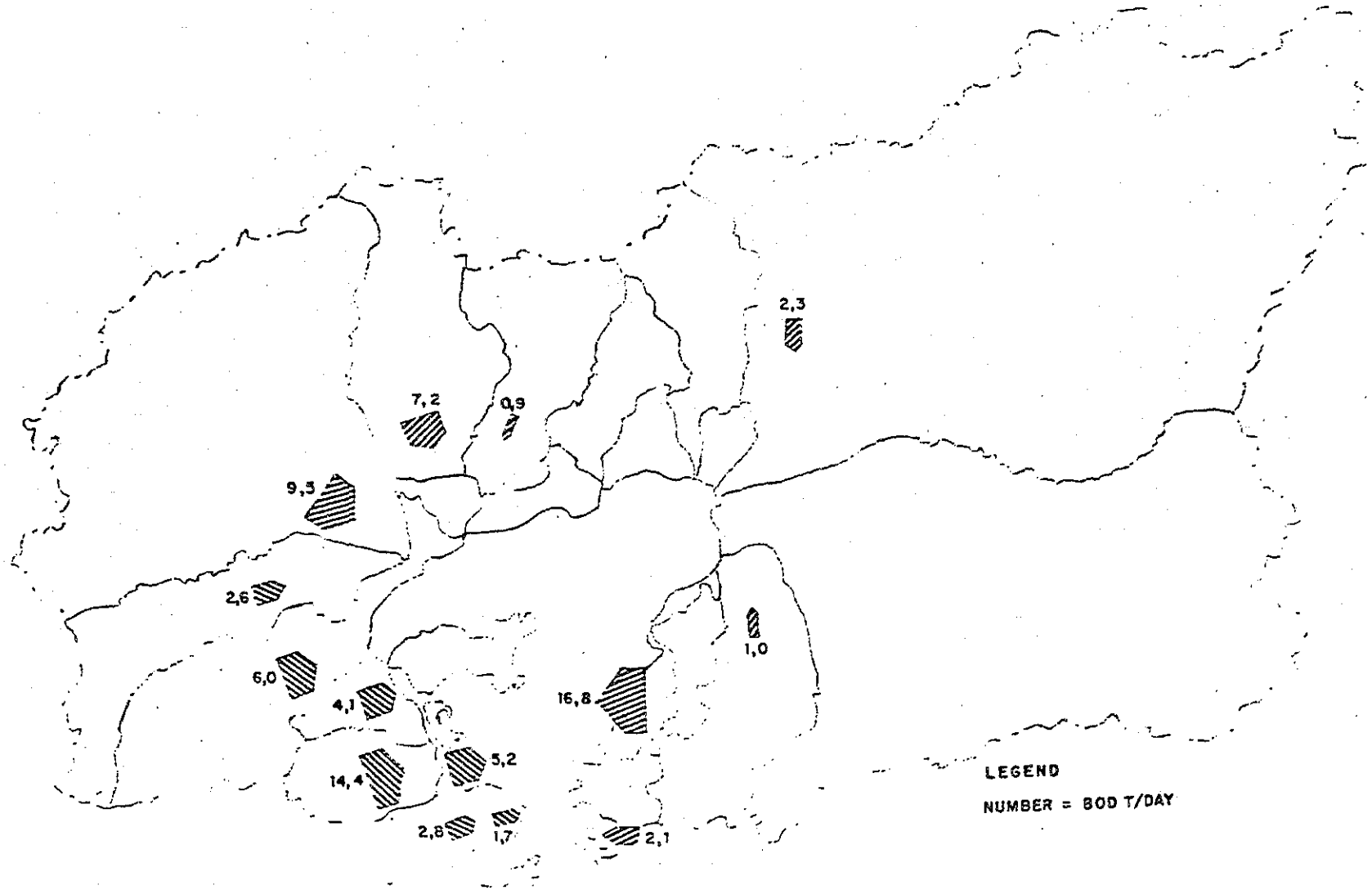

Fig. 4.2-2 Distribution of Industrial Organic Loads according to Turbutary Basin.

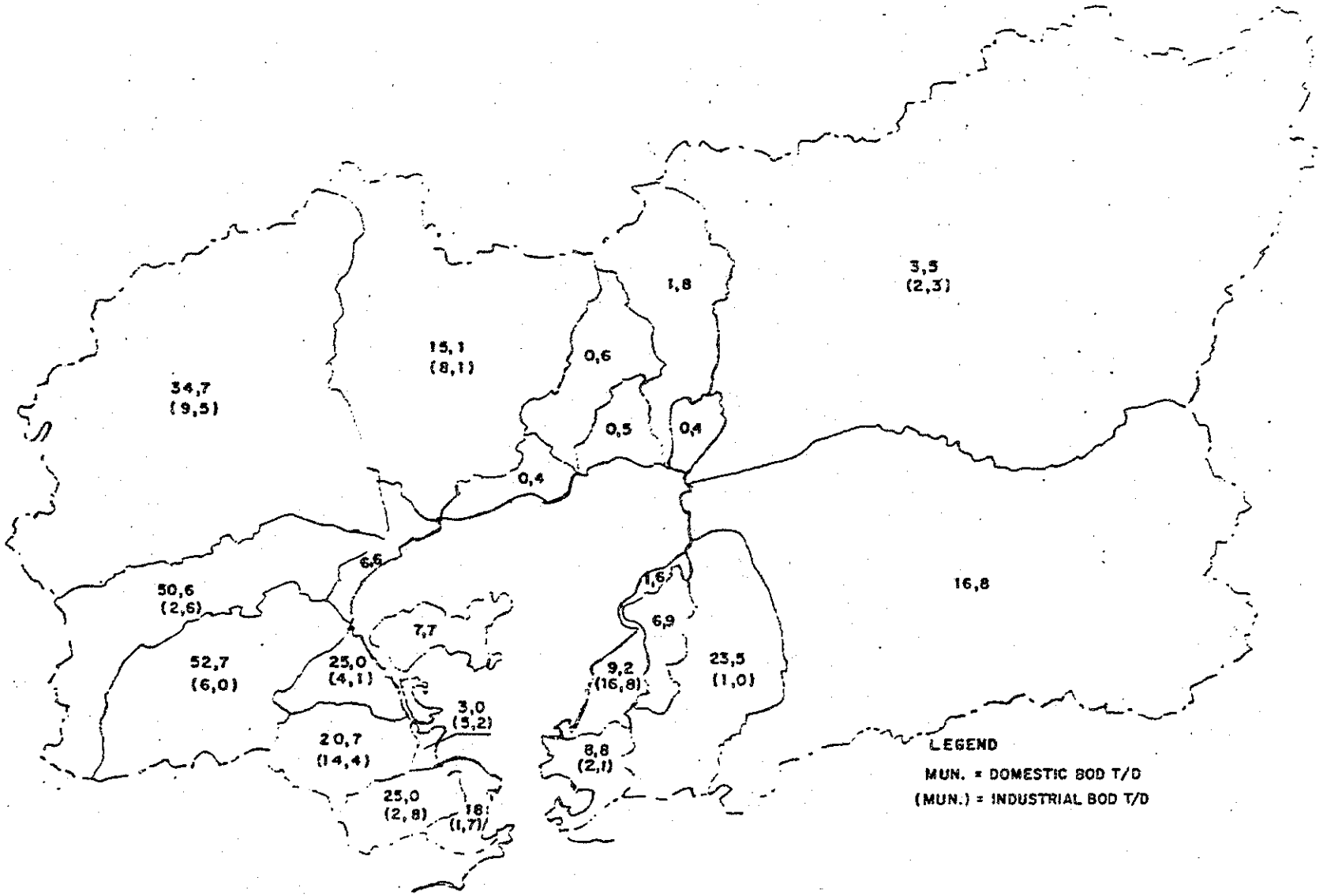

Fig. 4.2-3 Comarison Between Dovestic and Industrial BOD Contribution.

4.3 Industrial Effluent Survey

(1) Selection of Industry

Although FEEMA has used a lot of pollution load data, it was recognized the necessity to obtain more comprehensive and consistent information of the wastewater of the main industries within the industrial park. Due to the lack of time, eight (8) factories from the four (4) most significative industries were chosen.

In terms of organic matter, the food industry is the greatest contributor to pollutant loads. Three factories of the eight were chosen because of this reason. Although Reduc and Bayer have treatment facilities, they were selected considering the complexity of the effluent characteristics from petrochemical and chemical industrial processes.

Besides the industries mentioned above, one was chosen from each industry category of metal finishing, textile and paper which also represent important position in terms of pollution contribution into the Guanabara Bay basin.

The names of these selected factories and their categories are shown bellow:

1 Food Industry

Leite MIMO
QUAKER Produtos Alimenticios
Sadia

2 Chemical Industry

REDUC - Refinaria de Duque de Caxias
BAYER do Brasil

3 Metal Finishing

WESTINGHOUSE (ELETROMAR)

4 Textile

Cia. de Produtos Industriais do Brasil

5 Paper

CIBRAPEL

The beverage industry can also be considered one of the most important contributors to organic loads, but it was not included in this survey program since Cia. Cervejaria Brahma, the biggest, is now working less due to the low demand in this season.

Table 4.3-1 Waste water Parameters Analysed according to each Industry

Industries	Parameters Analysed
Leite Mimo Quaker Sadia Cibrapel	BOD, COD(Cr), COD(Mn), SS TP, TN, pH oil - only Quaker
Bayer	BOD, COD(Cr), COD(Mn), SS TN, TP, CN, Cr^{+}, Cd, Ni Zn, Cu, pH, phenol
Reduc	BOD, COD(Cr), COD(Mn), SS TN, TP, Hg, Cr^{+}, Cd, Ni Zn, Cu, phenol, sulphide oil, pH
Cia. Produtos Industriais do Brasil (Bangu)	BOD, COD(Cr), COD(Mn), SS TN, TP, Cr^{+}, Cn, Cu, phenol pH
Eletromar (Westinghouse)	BOD, COD(Cr), COD(Mn) CN, Cd, Pb, Cu, Cr, Ni Zn, SS, pH

(2) Collection of Samples

At all factories, sampling was performed over two days. The collection times were decided according to the working hours of each factory.

At Reduc, Bayer, Leite Mimo and Cia. de Produtos Industriais do Brasil, 24 hour sampling was performed, and 11 hour sampling at Westinghouse, 15 hour at Sadia and 12 hour at Quaker.

Samples were collected every 30 minutes. From these samples, two composite samples were analysed every day. The flow of effluent was measured at every thirty minutes.

At the factories with treatment facilities, two composite samples from the process effluent and one composite sample from the treatment effluent were collected.

An assessment of the analysed parameters from the effluents of each factory are shown in the **Table 4.3-1.**

(3) Results of Survey

Mean concentrations and loads of all parameters analysed from the 8 surveys are summarized in **Tables 4.3-2** to **4.3-6.** The brief comments concerning results are presented as follows.

Quaker Produtos Alimenticios S/A. (Table 4.3-2)

This industry is considered the heaviest organic matter contributor in the Guanabara Bay basin. The industry processes approximately 80 ton/day of fish (sardine and tuna) as raw material, of which about 75% is effectively used to production of can and the rest is manufactured into fish meal.

Dissolued air flotation air flotation is the only treatment facility in operation presently in this factory, obtaining however, a very low treatment efficiency. It was recommended to introduce pH control in addition to a chemical coagulant to improve its operation condition.

The effluent of this system has high concentrations of BOD, suspended solids, oil and grease as well as P and N. BOD, S.S. and oil loads were computed, 4.5 ton/day, 2.0 ton/day and 2.5 ton/day respectively, which indicates a significative contribution to water pollution of the bay.

Table 4.3-2 Effluent Flow and BOD Loads Unit Value of some type of Industry

INDUSTRY	TYPE	RAW MATER.	UNIT.	UNIT OF EFFL. FLOW (m3)	UNIT OF BOD LOAD (kg)
QUAKER Produtos Alimenticios	food	fish	t	15,5	68
SADIA Concordia S/A.	food	poultry	t	2,2	2,5
LEITE MINO	food	milk	m3	0,7	0,3
Cia. Prod. Indust. do Brasil	textile	textile	t	212,0	17,5
CIBRAPEL	paper	paper	t	16,3	9,9

Table 4.3-3 Water Quality of The Industrial Wastewater

QUAKER PRODUTOS ALIMENTICIOS

PRODUCTS: Can and fish meal

PRIMARY MATTER: sardine 64 t/d
tuna 16 t/d
35% of primary matter can be used effectively for final products
Final Products
320000 cans of sardine/day
57000 cans of tuna/day
10 t of fish meal/day

NUMBER OF EMPLOYEES: 650

TREATMENT FACILITIES:

dissolued air floatation

CHARACTERISTICS OF EFFLUENT

PARAMETER		CONCENTRATION FINAL EFLUENT	LOAD (kg)
FLOW m3/d		1237	
pH		6,3	
BOD	mg/l	3650	4515
COD (Cr)		6550	8102
COD (Mn)		510	631
TP		53	66
TN		243	301
S.S.		1540	1905
H. extrac.		2025	2505

SADIA CONCORDIA S/A IND. COM.

PRODUCTS: Sausage, mortadela, hum.
130 - 150 ton/day

NUMBER OF EMPLOYEES: 1100

TREATMENT FACILITIES:

dissolued air floatation - oxidation ditch - filter press

CHARACTERISTICS OF EFFLUENT

PARAMETER		CONCENTRATION		EFFICIENCY %	LOAD (kg/d)
		Before treat.	After treat.		
Flow m3/d		312	312		
BOD	mg/l	1108	490	56	153
COD (Cr)		1995	1090	34	340
COD (Mn)		57	55	--	17
TP		33,3	34,5	--	10,8
TN		55,3	37	33	11,5
S.S.		513	660	--	205,9

Table 4.3-4 Water Quality of The Industrial Wastewater

SPAN (Leite Mimo)

PRODUCTS: 240000 l/day milk
2500 l/day iogult
14000 kg/day butter

NUMBER OF EMPLOYEE: 240

TREATMENT FACILITIES

aeration lagoon - settling tank

CHARACTERISTICS OF EFFLUENT

PARAMETER		CONCENTRATION Before treat.	CONCENTRATION After treat.	EFFICIENCY %	LOAD (kg/d)
Flow m3/d		222	222		
pH		9.1	7.5		
BOD	mg/l	425	15	96	3.3
COD (Cr)		1003	35	97	7.8
COD (Mn)		100	8	92	1.8
TP		5.9	0.43	93	0.1
TN		21.8	6	72	1.3
S.S.		268	10	96	2.2

REDUC (REFINARIA DE CAXIAS)

PRODUCTS: Petroleum refinary (Raw petroleum consum = 16000 m3/day)
Production:
Gasoline from 1964
Lubificant oil from 1984
Natural gas from 1988

NUMBER OF EMPLOYEES: 62000

POLLUTION SOURCES
- open system cooling tower - 6m3/s supplied by pumped water from Guanabara bay without any treatment
- closed system cooling tower + non point source pollution (run off of the industrial area) - 0,22m3/s

TREATMENT FACILITIES

oil separater - equalization tank - 2 aeration lagoons

CHARACTERISTICS OF EFFLUENT

PARAMETER		CONCENTRATION Biol. treat. effluent	CONCENTRATION Open cooler effluent	LOAD (kg/d) Biol. treat. effluent	LOAD (kg/d) Open cool effluent
Flow m3/d		19128	528 x 10^3		
BOD	mg/l	10	17	191	8976
COD (Cr)		159	375	3041	198000
COD (Mn)		14.4	7.3	275	3854
Phenol		20.1	< 0.1	--	--
T.P.		2.6	0.4	50	211
T.N.		11.0	2.6	210	1373
S.S.		22.8	21.5	438	11352
H.estrac.		64	54	1224	28512
Sulfide		4.1	1.5	78	792
Ni		< 0.05	< 0.05	--	--
Cu		< 0.02	< 0.02	--	--
Cr		< 0.05	< 0.05	--	--
Hg		< 0.0001	< 0.0001	--	--
Zn		0.45	0.11	--	--

Table 4.3-5 Water Quality of The Industrial Wastewater

BAYER DO BRASIL

PRODUCTS: Approximately 100 kind of products
Concerning:
Biocide
Veterinary
Pharmacy
Intermediates

NUMBER OF EMPLOYEES: 1320

TREATMENT FACILITIES IN OPERATION

neutralization tank – primary sed. tank – activate sludge – secundary sed. tank

Hazard waste treatment
- Incinerator
  cap. 3000 t/year
- waste disposal land (4 layers sealed with polietilen film)

CHARACTERISTIC OF EFFLUENT

PARAMETER		CONCENTRATION Before treat.	CONCENTRATION After treat.	EFFICIENCY %	LOAD (kg/d)
Flow m3/d		140,3	140,2		
pH		2,6	7,2		
BOD	mg/l	815	320	61	45
COD (Cr)		2828	1850	35	259
COD (Mn)		223	50	78	7
TOC					
Phenol		0,3	< 0,1	--	--
TP		140,3	125	11	17,5
TN		119,0	114	4	0,6
S.S.		107,5	140	-23	19,6
Cd		< 0,01	< 0,01	0	
Pb		0,8	0,2	75	0,28
Cu		0,45	0,4	10	0,56
Cr		1,60	0,25	84	0,35
Ni		0,05	0,1	0	0,14
Zn		0,09	0,1	11	0,14

GUILHERME TELL (Cia. Produtos Ind. do Brasil)

PRODUCTS: texture and dye
12 ton/day

NUMBER OF EMPLOYEES: 250

TREATMENT FACILITIES: no system

CHARACTERISTICS OF EFFLUENT

PARAMETER		CONCENTRATION FINAL EFFLUENT	LOAD (kg)
FLOW m3/d		2539,3	
pH		12,5	
BOD	mg/l	83	211
COD (Cr)		609	1546
COD (Mn)		28	71
TP		3,9	9,9
TN		18,3	465
S.S.		19,3	49,0
Phenol		< 0,1	--
CN		0,09	0,23
Cu		0,27	0,69
Cr		0,19	0,48

Table 4.3-6 Water Quality of The Industrial Wastewater

CIBRAPEL S/A

PRODUCTS: packegepaper
132 t/day

NUMBER OF EMPLOYEE: 270

TREATMENT FACILITIES

primary sedimentation tank

CHARACTERISTICS OF EFFLUENT

PARAMETER		CONCENTRATION		EFFICIENCY %	LOAD (kg/d)
		Before treat.	After treat.		
Flow m3/d		2156,5	2156,5		
pH		4,9	5,1		
BOD	mg/l	605	510	16	1100
COD (Cr)		1387,5	785	43	1693
COD (Mn)		62	34,4	45	74
TP		1,13	0,75	34	1,6
TN		7,5	2,0	73	4,3
S.S.		1012,5	75,0	9	162

ELETROMAR (WESTINGHOUSE)

PRODUCTS: WESTINGHOUSE Div. Components
Garvanic parts
900000 parts/day

NUMBER OF EMPLOYEES: 1100

TREATMENT FACILITIES

pH ajustament – 4 coagulation/sedimentation tanks – settling tank

CHARACTERISTICS OF EFFLUENT

PARAMETER		CONCENTRATION		EFFICIENCY %	LOAD (kg/d)
		Before treat.	After treat.		
Flow m3/d		140	140		
BOD	mg/l	7	7		1
COD (Cr)		600	18	97	2,5
COD (Mn)		11	3,5	68	0,5
CN		14,5	0,38	97	0,05
Cd		0,6	< 0,01		--
Pb		0,9	< 0,1		--
Cu		53,0	0,3	99,4	0,04
Cr		132,5	0,16	99,9	0,02
Ni		81,0	0,8	99,0	0,11
Zn		231,0	0,08	99,96	0,01
S.S.		1440,0	< 2	99,99	--

Sadia Concordia S/A. (Table 4.3-3)

From 130 to 150 ton/day of poultry are processed for the production of sausage, ham, and mortadela.

The treatment facility in operation is made up of a dissolued air flotation, oxidation ditch and a sludge dry bed. A filter press was purchased recently to replace the dry bed that breeds a lot of flies. Dissoluted air flotation is not as efficient as the one one operation at QUAKER Products Alimenticios S/A. The oxidation ditch, also, has a low efficiency because the system was constructed almost ten years ago and is now not large enough to treat all sewage generated at the factory. It is planned to construct a new oxidation ditch to supplement this shortage.

Due to such operational deficiencies, final effluent contains high concentrations of BOD and S.S., 153 kg and 206 kg of daily load, respectively.

Span (Leite Mimo) (Table 4.3-4)

This factory produces 240000 l of milk, 2500 l of yogurt and 14000 kg of butter per day. The sewage is being treated in aeration lagoons with a high efficiency. Final effluent is excellent with very low concentrations of BOD, COD and SS. All parameters analysed had a removal efficiency in the range 92 to 97%, except TN that registered 72%.

The contribution loads into river are extremely low because of excellent treatment.

Reduc (Refinaria de Caxias) (Table 4.3-5)

REDUC's effluent can be divided into two main effluents: one is that from a open cooling tower system that introduces, approximately, $6cm^3/s$ of water from Guanabara Bay and discharges into the Rio Iguacu through a refrigeration lagoon. The other is the effluent originating from a closed cooling tower system and run off water from all industrial process areas. This treatment facility contain an oil separator, equalization tank and two aeration lagoons.

According to the results, final effluent of biological treatment system has a low BOD concentration but a high COD (COD/BOD ratio = 16), indicating the presence of large amounts of non biodegradable organic matter, some of which could belong to toxic substances that are mutagenic.

The effluent of Polo Petroquimica do Rio Grande do Sul, Brasil, can be cited as a good example of the hazards of this kind of sewage. Many deformed fish have been found in the tertiary treatment lagoon over the past 10 years even

though all sewage generated in the factories of Polo was treated intensively by biological process with a long detention time before discharge into the lagoon. Because of the intensive commercialization of fish in Guanabara Bay, urgent control of the substances contained in REDUC refinery effluent required.

Oil contribution from this effluent was computed at 1225kg/d that corresponds to about 25% of all oil pollution loads estimated entering the bay. Heavy metal concentrations were found lower than that established in the effluent standards.

Regarding the effluent of open cooling tower, a significative concentration of oil was measured (56 ng/l), obtaining extremely high discharge of this substance into the Iguacu River (28.5 ton/day). This fact had never been reported, therefore, a more detailed investigation should be done.

Bayer do Brasil (Table 4.3-6)

The factory produces approximately 100 kinds of products related to pharmacy, veterinary, biocides and intermediates. The liquid waste treatment system contains a neutralization tank and an activated sludge process, incinerator with capacity of 300 ton/day and land fill basin sealed with polyethylene film for solid waste disposal.

Results of analyses show low efficiency of the biological process. A high COD/BOD ratio was observed in the final effluent (6/1) indicating the presence of biopersistent toxic substances as was the case with the REDUC refinery. High concentrations of T-N and TP before and after treatment. Significant amounts of heavy metals was not found.

CIA. Produtos Industriais do Brasil (Table 4.3-7)

This plant produces, daily, 12 ton of dyed material. There is no treatment facility. The effluent contains high values for pH and COD due to dye substances, contributing, approximately, 1.5 ton of COD/day. All heavy metal analyses showed lower concentrations than the established standards.

Cibrapel (Table 4.3-8)

CIBRAPEL Produces about 130 ton of package paper per day. Sewage initially enters the setting tank to remove fiber and discharge to a receiving body. BOD was reduced by only 16% in this tank, contributing significantly to the amount of organic matter in the river (1.100 kg/day).

Eletromar (Westinghouse) (Table 4.3-9)

Eletromar (Westinghouse) (Table 4.3-9)

ELETROMAR produces approximately 900,000 electroplated components. The treatment facility made up of pH adjustment tanks and 4 coagulation and sedimentation tanks in operation being maintained in very good operational condition. The sewage with high concentrations of several heavy metals, such as CN, Cd, Cr, Ni and Zn suffers drastic reduction in the treatment system, only very low concentrations were found in the final effluent.

(4) Unit Effluent flow and BOD Load (Table 4.3-10)

Based on the obtained data, unit contribution of effluent flow and BOD per raw material consumed or produced was evaluated according to each industrial activity. In the food industry, fish products contributed the greatest effluent flow and BOD load per ton of raw material.

The textile industry has the largest unit effluent flow due to washing processes.

It was not possible to evaluate these unit values for 3 chemical and electroplating factories because of a lack of consistent information regarding processes and products. The Department of Pollution Control (DECOM) of FEEMA will continue to work to fill such lacuna.

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CHAPTER 5

LAW AND SYSTEM FOR THE POLLUTION CONTROL

5.1 Law and Regulation for Water Quality Conservation

With the growth of industry and the concentration of population to urban area, there has been a gradual increase in wastewater giving rise to the problems of water pollution.

Especially, the waters in the Guanabara bay have been effected heavily by waste waters, because the waters in the bay is little replaced by the geographical reason as closed waters and where pollutants tend to accumulate. Above all in waters in whose hinterland there exist significant sources of pollution.

In this situation, the Federal government and Rio de Janeiro state established many regulations to enable them to take measures against water pollutions.

5.1.1 Historical Review of Legislation

The legislations concerning the water pollution in Federal level and Rio de Janeiro state of Brazil are summarized in Table 5.1-1.

The first legislation relating to the conservation of water quality, Decree No.24643 (Water Code), was established in 1934, which specified the concept of water resources protection for public health and aquatic life preservation. This decree was revised in 1938 as Decree No.852.

In 1961, it was set out to legally control the effluent from factories that waste water could be discharge in the water resources after treatment in Decree No.49.974A (National Health Code), and the first environmental standards for water quality were established in Decree No.50.877 for the indexes of Coliforms, BOD, DO and pH.

After the United Nation's Conference on the Human Environment in Stockholm in 1972, the Federal Agency for Environmental Control (SEMA) was established in 1973 for environmental conservation, result in the administrative management authorities of water environment had integrated into the organization. Successively, State Foundation for Environmental Engineering (FEEMA) and State Commission for Environmental Control (CECA) were created as state organizations in 1975.

In the decade from the late 1970's, many legislations concerning water quality conservation were established in both federal level and state level. Norm No.13 (1976) was the first one which classified the water resources according principal uses and established water quality criteria and standards for four (4) classes in fresh waters. This norm was reviewed in 1986 as Resolution CONAMA No.20, which was new water quality criteria and standards classifying the water resources into nine (9) classes including brackish waters and salt waters.

The new national policy for environmental control was published in Law No.6.938 (Policy of Environmental) in 1981 including the setting up of CONAMA and SISNAMA, and its details in 1983 as Decree No.88.351. It was also established that the requirements for Environmental Impact Assement and Permit System (LP, LI and LO).

A new federal constitution was promulgated in 1988, in which a special chapter on environments (Chapter VI, Article 225) was introduced. Also, the state constitution introduced a special chapter on environments (Chapter VII), in which it was defined that the sewage discharge on the coast had to be preceded of primary treatment in Article 274 and that the Guanabara bay had to be preserved permanently as an important area on ecology in Article 265.

Further, new environmental secretariats such as SEMA,

CONAMA and IBAMA were created in Law No.8.028 in 1990, which was the amendment of Law No.6.938 in 1981, accompanying the heavy reorganization of the new federal government by the inauguration of President Collor.

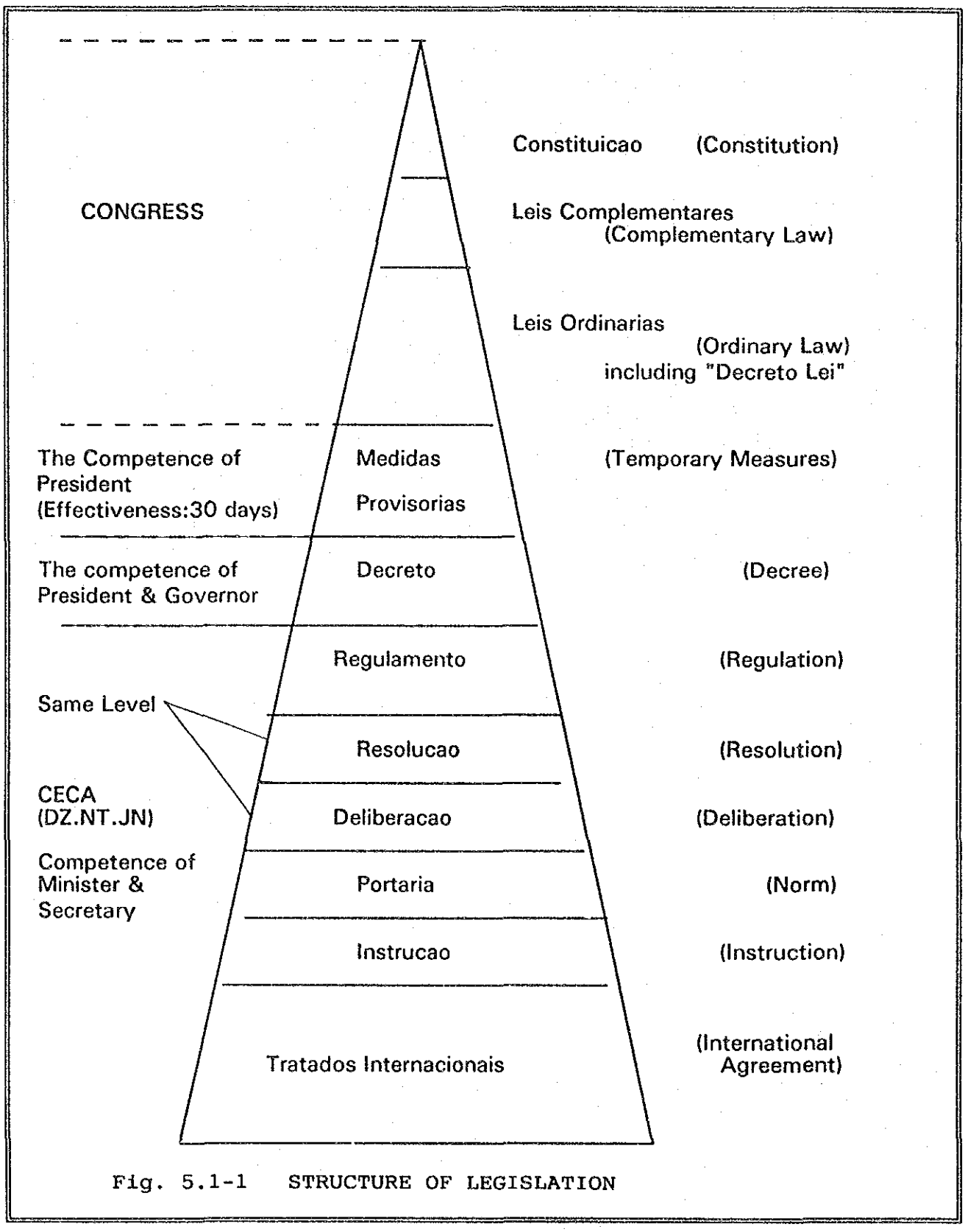


Fig. 5.1-1 STRUCTURE OF LEGISLATION

Table 5.1-1 Historical Review of Legislation

YEAR	LEGISLATION	STATE OR FEDERAL LEVEL	MAIN SUBJECTS
1934	Decree No. 24.673 10.07.34 Water Code	Federal	The concept of water resource protection for purposes of public health and aquatic life preservation was established.
1938	Law No. 852 11.11.38	Federal	Some modifications were introduced into Water Code.
1940	Decree No. 2.848 12.07.40 Penal Code	Federal	Penalties for water contamination used for public supply were introduced.
1943	Consolidation of Labor Laws	Federal	On the articles 221 and 222, penalties were established for industrial activity managers that did not adequately dispose their industrial residues.
1961	Decree No. 49.974-A 21.01.61 National Health Code	Federal	It was required that new industries presented a Liquid Waste Disposal Plan to Authorities. Also, it was established that liquid wastes could just be discharged in water resources after treatment.
	Decree No. 50.877 29.06.61	Federal	The first environmental standards for water quality were established, including pH, DO, BOD and coliforms.
1961		State	The Sanitary Engineering Institute - IES (Instituto de Engenharia Sanitaria) was created. One of its main purpose was the Air and Water Pollution Control.
1967		State	The State Agency for Environmental Control in Sao Paulo (CETESB) was created.
	Law No. 5.357 17.11.67	Federal	Penalties for oil discharge from boats, ships and maritime terminals were established.
1972			The United Nations Conference on the Human Environment took place in Stockholm-Sweden with influence in Brazil
1973	Decree No. 73.030 30.10.73	Federal	The Federal Agency for Environmental Control -SEMA (Secretaria Especial do Meio Ambiente) was created, as part of

YEAR	LEGISLATION	STATE OR FEDERAL LEVEL	MAIN SUBJECTS
1975	Law No. 39 24.03.75	State	The Governor authorized the creation of State Foundation for Environmental Engineering-FEEMA (Fundacao Estadual de Engenharia do Meio Ambiente).
	Norm No. 003/SEMA 11.04.75	Federal	Water quality standards for mercury were established for coastal waters and public supply waters.
	Law No. 134 16.06.75	State	The Legal Environmental System was established by the inauguration of FEEMA-State Foundation for Environmental Engineering and CECA - State Comission for Environmental Control (Comissao Estadual de Controle Ambiental).
	Law No. 1.413 14.08.75	Federal	Pollution control measures for industrial activities were enforced.
	Decree No. 76.389 03.10.75	Federal	The requirements for pollution control, established in Decree No.1413 were detailed SEMA would be responsible for the establishement of standards and criteria using, when possible, the assimilative capacity of the environment. The States and Municipalities could enforce the requirements for industrial pollution control, according their competence.
1976	Norm GM 013 15.06.76	Federal	The water resources were classified according principal uses. Water quality criteria and standards for fresh waters were established. Also, effluent standards were enforced.
	DZ-101 Water resources- Benefit Uses	State	These instructions classified the benefic uses of water resources in Rio de Janeiro State.
	NT-305 to NT-335 JN-306 to JN-336	State	It was established, in several norms, the water quality standards for each benefic use classified by DZ-101.
1977	DZ-106 Instructions for Classification of Guanabara Bay Rivers 08.12.77	State	This instruction classified the Guanabara Bay rivers, according their benefic uses.

YEAR	LEGISLATION	STATE OR FEDERAL LEVEL	MAIN SUBJECTS
1977	Decree No. 1.633 21.12.77	State	The Permit System for Polluting Activities was established, based on Decree No.134.
	Decree No. 1.632 21.12.77	State	The criteria for penalty application were established, based on Decree No.134.
1978	NT-202-R3 Effluent Standards and Criteria 08.03.78	State	State effluent standards were established for conventional and toxic parameters. For BOD, the requirements were dependent on DO conditions and assimilative capacity of water resources
	JN-203-R1 Technical Basis of NT-202 08.08.78	State	The criteria used on the establishement of effluent standards were justified.
1979	Decree No. 83.540 06.04.79	Federal	The International Conventional on Civil Responsibility in Case of Damages Caused by Oil Pollution started to be applied in Brazil.
1980	DZ-105 Instructions for Classification of Guanabara Bay 10.03.80	State	The coastal waters of Guanabara Bay were classified, according their benefic uses and based on the segments used in the 1975-steady-state model.
1981	Law No. 6.938 31.01.81	Federal	The National Policy on Environment was approved. SISNAMA and CONAMA were set up. SISNAMA - National System of Environment (Sistema Nacional de Meio Ambiente) Composed by local environmental agencies. CONAMA-National Council of Environment(Conselho Nacional de Meio Ambiente) Multidisciplinary comission that supports Federal Agency. The requirements for Environmental Impact Assessment and the Permit System were established.
1983	Decree No. 88.351 06.01.83	Federal	The principles established on the National Policy on Environment were detailed.

YEAR	LEGISLATION	STATE OR FEDERAL LEVEL	MAIN SUBJECTS
1983	Resolution CONAMA No. 003 05.06.84		The executive Secretariat of CONAMA was required to review Norm GM 013, in relation to water quality standards and criteria.
1985	March and April	Federal	The Military Government changed to Civil Government. Tancredo Neves, the first civil president elected by the Congress (indirect vote) died and his vice-president José Sarney was inaugurated.
	Resolution CONAMA No. 004	Federal	The criteria for ecological reserve identification were established.
1986	Resolution CONAMA No.1 23.01.86	Federal	The basic criteria for Environmental Impact Assessment application and implementation were established.
	Decree No. 8.974 23.01.86	State	The criteria for penalty application were reviewed and detailed, based on Decree 134.
	Resolution CONAMA No. 20 18.06.86	Federal	New water quality criteria and standards were established, classifying the water resources in classes according main uses. At this time, standards for brackish water and salt water were included. Fresh water standards and effluent standards were reviewed.
	NT-202-R10 Effluent Standards and Criteria 04.12.86	State	New effluent standards were established, based mainly on Resolution No.20 CONAMA.
	JN-203-R8 Technical Basis of NT-202 04.12.86	State	The criteria used on the establishement of effluent standards were justified.
	DZ-205-R4 Instructions for Organic Load Control from Industries 04.12.86	State	This instruction established new criteria for BOD removal in industrial wastes. The required BOD removal was dependent on the load of BOD produced and its relative contribution to the basin.
1987	Decree No. 9.847 15.03.87	State	The State Secretariat of Environment-SEMAM (Secretaria Estadual de Meio Ambiente) was structured.

YEAR	LEGISLATION	STATE OR FEDERAL LEVEL	MAIN SUBJECTS
1987	Decree No. 9.991 05.06.87	State	The State Council of Environment - CONEMA (Conselho Estadual de Meio Ambiente) was instituded, having as main purpose, the elaboration of the State Policy of on Environment.
	DZ-209 Instructions for Industrial Wastewater Control 25.06.87	State	The concept of minimum requirements for different industrial typologies was introduced.
1988	Law No. 7.661 16.05.88	State	The National Plan for Coast Management was established.
	Decree No. 11.376 02.06.88	State	The State Committee for Coast Defense - CODEL-RJ (Comitê de Defesa do Litoral do Estado do Rio de Janeiro) was instituded.
	Law No. 1.376 05.10.88	State	The state criteria for Environmental Impact Assessement application were established.
	Federal Constitution 05.10.88	Federal	For the first time, a special chapter on Environment was introduced into the Constitution - Chapter VI - Article 225. The requirements for Environmental Impact Assesssment were enforced.On article 24, it was established that the Union and States can legislate competitively about Environmental Protection and Pollution Control. The general norms would be established by the Union and the States would legislate supiementarily.
	"Our Nature Program " October,1988	Federal	The program established the legislation related to the national policy on environment, with special references to Amazon Region.
1989	Law No. 7.735 22.02.89	Federal	The Federal Agency for Environmental Control-SEMA(Secretaria Especial do Meio Ambiente) was extinguished and the IBAMA (Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis) was created with broader objectives. IBAMA was also part of Ministry of Interior.

YEAR	LEGISLATION	STATE OR FEDERAL LEVEL	MAIN SUBJECTS
1989	Decree No. 97.507 13.02.89	Federal	The mercury and cyanide utilization was limited in the gold mining activities.
	Law No. 7.797 10.07.89	Federal	The National Fund of Environment was created.
	Law No. 7.804 18.07.89	Federal	Some modifications were introduced into Law No. 6938.
	Decree No. 98.161	Federal	The criteria for the administration of National Fund of Environment were established.
	State Constitution	State	A special chapter on Environment was introduced - Chapter VIII - Articles 258 to 279. On the Article 258, the requirements for Environmental Impact Assessment were enforced. On the Articles 265 and 266, Baia de Guanabara was defined as an area of permanent preservation and as an area of relevant ecological interest. On the other hand, on the Article 274, it was defined that sewage discharge on the coast had to be preceded of primary treatment.
1990	15.03.90	Federal	The first president elected by direct vote, Fernando Collor de Mello was inaugurated. The " Plano Collor" was announced with strong economic measures.
	Law No. 8.028 12.04.90	Federal	The Environment Secretariat - SEMA (Secretaria do Meio Ambiente) was instituded as a direct assistance for the President. The Law 6.398 was amended: SEMA - Central Organism CONAMA - Consulting and Deliberative Organism IBAMA - Executive Organism The Ministry of Interior was extinguished and IBAMA passed to be under SEMA supervision.
	Law No. 1.700 29.08.90	State	Measures for environmental protection of Guanabara Bay were established, based on Articles 265 and 266 of State Constitution.

YEAR	LEGISLATION	STATE OR FEDERAL LEVEL	MAIN SUBJECTS
1991	NT-213 Standards and Criteria for Toxicity Control in Industrial Effluents 18.10.90		The aquatic toxicity approach was introduced into the industrial effluent pollution control.
	JN-214 Technical Basis of NT-213 18.10.90	State	The criteria used on the establishement of standards were justified.
1991	Decree 22.01.91	Federal	The Project on Recuperation of Environmental Quality in Rio de Janeiro -"Projeto Ambiente Rio"was instituded.
	Decree No. 16.520 20.03.90	State	The State Secretariat of Environment - SEMAM (Secretaria Estadual de Meio Ambiente) was changed to State Secretariat of Environment and Special Projects - SEMAMPE (Secretaria Estadual de Meio Ambiente e Projetos Especiais).
	Decree No. 78	Federal	The new structure of IBAMA was approved.
	DZ-205-R5 Instructions for Organic Load Control from Industries 05.10.91	State	The BOD requirements became more restrictive and COD requirements were introduced.
1992	June 1992		The UNCED - United Nations Conference on Environment and Development took place in Rio de Janeiro - Brasil.
	September 1992	Federal	The House of Representatives declared the impeachment of president Fernando Collor de Mello, that was substituted by Itamar Franco, the president in office.
	Temporary Measure October 1992	Federal	The Ministry of Environment was created.

5.1.2 Law for Marine Pollution

There is a MARPOL-73 as an international agreement relating to the prevention of marine pollution and maritime disaster. This agreement consists of the following items:

Annex 1: Prevention of oil pollution
Annex 2: Providing with an international prevention certification for marine pollution
Annex 3: Inspection of the cargo
Annex 4: Treatment of sewerage discharged from the vessel
Annex 5: Disposal of garbage from the vessel

The Brazilian government has signed the Annex 1 to Annex 3 of this agreement,but has not yet signed the Annex 4 and Annex 5.

In connection with the above, Decree No.83.540 of the prevention for oil pollution was established in 1979.

5.2 Water Quality Standards

5.2.1 Environmental Quality Standards

FEEMA has initially adopted the approach of establishing the water quality standards based on the definition of present and future benefit uses of water resources and the establishment of water quality criteria for each use.

Basing on the concepts, FEEMA had developed instructions for the classification of water resources according to their uses and technical norms with water quality criteria for each use.

Main instructions and norms established in the late 1970's are as follows;

DZ-101 : Instruction for Benefit Uses of Water Resources
DZ-105 : Instruction for Water Classification of Guanabara Bay
DZ-106 : Instruction for Classification of Guanabara Bay Rivers
DZ-302 : Definition and General Concepts of Water Benefit Uses
NT-305 : Water Quality Criteria for Public Supply with Slow Sand Filtration and Disinfection
JN-306 : Technical Basis of NT-305
NT-307 : Water Quality Criteria for Public Supply with Conventional treatment
JN-308 : Technical Basis of NT-307
NT-309 : Water Quality Criteria for Aesthetic Use
JN-310 : Technical Basis of NT-309
NT-311 : Water Quality Criteria for Salt WaterRecreation (Primary Contact)
JN-312 : Technical Basis of NT-311
NT-313 : Water Quality Criteria for Salt Water Recreative (Secondary Contact)
JN-314 : Technical Basis of NT-313

NT-315 : Water Quality Criteria for Fresh Water Recreation (Primary Contact)

JN-316 : Technical Basis of NT-315

NT-317 : Water Quality Criteria for Fresh Water Recreation (Secondary Contact)

JN-318 : Technical Basis of NT-317

NT-319 : Water Quality Criteria for Protection of Marine Aquatic Life

JN-320 : Technical Basis of NT-319

NT-321 : Water Quality Criteria for Salt Water Propagation of Species used as Human Food

JN-322 : Technical Basis of NT-321

NT-323 : Water Quality Criteria for Protection of FreshWater Aquatic Life

JN-324 : Technical Basis of NT-323

NT-325 : Water Quality Criteria for Fresh Water Propagation of Species used as Human Food

JN-326 : Technical Basis of NT-325

NT-327 : Water Quality Criteria for Irrigation of Vegetables consumed in Raw Form and Fruits consumed with Peel

JN-328 : Technical Basis of NT-327

NT-329 : Water Quality Criteria for Irrigation of Other Crops

JN-330 : Technical Basis of NT-329

NT-331 : Water Quality Criteria for Animal Growing

JN-332 : Technical Basis of NT-331

NT-333 : Water Quality Criteria for Industrial Supply including Power Generation

JN-334 : Technical Basis of NT-333

NT-335 : Water Quality Criteria for Navigation

JN-336 : Technical Basis of NT-335

On the other hand, SEMA (federal environment secretariat) through the Norm No.13 (Jan.15, 1976) classified the fresh water into four (4) classes according their main uses and established standards and conditions for each class.

All the Brazilian states except Rio de Janeiro state adopted SEMA's standards. The approach adopted by FEEMA was more flexible than SEMA's one. Besides the fact, FEEMA showed clearly which use was more restrictive in relation to each parameter comparing with SEMA's approach.

The Norm No.13 was reviewed after several technical discussions under the participation of SEMA and Brazilian states. At that time, the number of classes was increased, including salt and brackish waters, and standards and conditions for each class were reviewed. The results were established as the CONAMA Resolution No.20 (Table 5.2-1 and Table 5.2-2) on June 18,1986.

The resolution has classified the waters into nine (9) classes, five (5) for fresh waters, two (2) for salt waters and two (2) for brackish waters. It also established standards and conditions attended in each class, including conventional parameters and toxic substances such as heavy metals and organic micropollutants.

These standards were based on international criteria and standards as well as on Brazilian experiences.

Table 5.2-1 Water Quality Standards for each Class of Water Area (CONAMA No.20)

Fresh Waters

Class	Item / Purpose of Water Use	Standard Values					
		pH	BOD	TDS	DO	No. of Coliform Groups	Turbidity
Special	-Public water supply without previous or with simple desinfection -Natural balance protection of aquatic life	-	-	-	-	Zero for Total Coliforms	-
Class 1	-Public water supply after simplified treatment -Aquatic life protection -Primary contact recreation -Irrigation of green vegetables eaten in raw form and fruits consumed with peel -Natural or/and intensive growing of species for human feeding	6.0 | 9.0	3 mg/l or less	500 mg/l or less	6 mg/l or more	(Recreation) not good when 80% of samples 1000MPN/100ml or less F.C. or 5000MPN/100ml or less T.C. (Irrigation) zero coliform (Other Uses) 80% of samples 200MPN/100ml or less F.C. or 1000MPN/100ml or less T.C.	40 NTU

(Note) F.C. : Fecal Coliforms
T.C. : Total Coliforms

(continued)

Class	Item / Purpose of Water Use	Standard Values					
		pH	BOD	TDS	DO	No. of Coliform Groups	Turbidity
Class 2	-Public water supply after conventional treatment -Aquatic life protection -Primary contact recreation -Irrigation of green vegetables and fruit trees -Natural or/and intensive growing of species for human feeding	6.0 | 9.0	5 mg/l or less	500 mg/l or less	5 mg/l or more	[Recreation] equal to Class 1 [Other Uses] 80% of samples 1000MPN/100ml or less F.C. or 5000MPN/100ml or less T.C.	100 NTU
Class 3	-Public water supply after conventional treatment -Irrigation of several culture -Animal growing	6.0 | 9.0	10mg/l or less	500 mg/l or less	4 mg/l or more	80% of samples 4000MPN/100ml or less F.C. or 20000MPN/100ml or less T.C.	100 NTU
Class 4	-Navigation -Aesthetic -Other uses	6.0 | 9.0	-	-	2 mg/l or more	-	-

Salt Waters

Class	Item / Purpose of Water Use	Standard Values: pH	BOD	DO	No. of Coliform Groups
Class 5	-Primary contact recreation -Aquatic life protection -Natural or/and intensive growing of species for human feeding	6.5 | 8.5 ΔpH ≦ 2	5 mg/l or less	6 mg/l or more	[Recreation] equal to Class 1 [Growing of Species for Human Feeding] mean ≦ 14 MPN/100ml F.C. and 10% of samples ≦ 43 MPN/100ml F.C. [Other Uses] 80% of samples : 1000 MPN/100ml or less F.C.
Class 6	-Commercial navigation -Aesthetic -Secondary contact recreation	6.5 | 8.5 ΔpH ≦ 2	10 mg/l or less	4 mg/l or more	80% of samples : 4000 MPN/100ml or less F.C. or 20000 MPN/100ml or less T.C.

Blackish Waters

Class	Item / Purpose of Water Use	Standard Values			
		pH	BOD	DO	No. of Coliform Groups
Class 7	-Primary contact recreation -Aquatic life protection -Natural or/and intensive growing of species for human feeding	6.5 | 8.5	5 mg/l or less	5 mg/l or more	[Recreation] equal to Class 1 [Growing of Species for Human Feeding] mean ≦ 14 MPN/100ml F.C. and 10% of samples ≦ 43 MPN/100ml F.C. [Other Uses] 80% of samples : 1000 MPN/100ml or less F.C. or 5000 MPN/100ml or less T.C.
Class 8	-Commercial navigation -Aesthetic -Secondary contact recreation	5.0 | 9.0	-	3 mg/l or more	20% of samples : 4000 MPN/100ml or less F.C. or 20000 MPN/100ml or less T.C.

Table 5.2-2 Environmental Quality Standars for Water Pollution (CONAMA No. 20)

ITEM	STANDARDS VALUES			
	Class I and Class 2	Class 3	Class 5	Class 7
Aluminium	0,1 mg/l Al	0,1 mg/l Al	1,5 mg/l Al	-
Ammonia (as un-ionized)	0,02mg/l NH_3	-	0,4mg/l NH_3*	0,4m g/l NH_3*
Arsenic	0,05 mg/l As	0,05 mg/l As	0,05 mg/l As	0,05 mg/l As
Barium	1,0 mg/l Ba	1,0 mg/l Ba	1,0 mg/l Ba	
Beryllium	0,1 mg/l Be	0,1 mg/l Be	1,5 mg/l Be	
Bonon	0,75 mg/l B	0,75 mg/l B	5,0 mg/l B	
Benzene	0,01 mg/l	0,01 mg/l	-	
Benzo(a)pyrene	0,01 ug/l	0,01 ug/l	-	
Cadmium	0,001 mg/l Cd	0,01 mg/l Cd	0,005 mg/l Cd	0,005 mg/l Cd
Cyanides	0,01 mg/l CN	0,2 mg/l CN	0,005 mg/l CN	0,005 mg/l CN
Lead	0,03 mg/l Pb	0,05 mg/l Pb	0,01 mg/l Pb	0,01 mg/l Pb
Chloride	250 mg/l Cl	250 mg/l Cl	-	
Residual Chlorine	0,01 mg/l Cl	-	0,01 mg/l Cl	
Cobalt	0,2 mg/l Co	0,2 mg/l Co	-	
Copper	0,02 mg/l Cu	0,5 mg/l Cu	0,05 mg/l Cu	0,05 mg/l Cu
Trivalent Chromium	0,5 mg/l Cr	0,5 mg/l Cr	-	
Hexavalent Chromium	0,05 mg/l Cr	0,05 mg/l Cr	0,05 mg/l Cr	0,05 mg/l Cr
1.1 dichloroethane	0,3 ug/l	0,3 ug/l	-	
1.2 dichloroethane	0,01 mg/l	0,01 mg/l	-	
Tin	2,0 mg/l Sn	2,0 mg/l Sn	2,0 mg/l Sn	
Phenols	0,001mg/l C_6H_5OH	0,3mg/l C_6H_5OH	0,001mg/l C_6H_5OH	0,001mg/l C_6H_5OH
Soluble Iron	0,3 mg/l Fe	5,0 mg/l Fe	0,3 mg/l Fe	
Fluorides	1,4 mg/l F	1,4 mg/l F	1,4 mg/l F	1,4 mg/l F
Total phosphate	0,025 mg/l P	0,025 mg/l P		
Lithium	2,5 mg/l Li	2,5 mg/l Li		
Manganese	0,01 ug/l Mn	0,5 mg/l Mn	0,1 mg/l Mn	
Mercury	0,2 ug/l Hg	0,002mg/l Hg	0,1 ug/l Hg	0,1 ug/l Hg
Nickel	0,025mg/l Ni	0,025mg/l Ni	0,1 mg/l Ni	0,1 mg/l Ni
Nitrate	10 mg/l N	10 mg/l N	10 mg/l N	
Nitrite	1,0mg/l N	1,0mg/l N	1,0mg/l N	
*possible errors				
Ammonia Nitrogen		1,0mg/l N		
Silver	0,01 mg/l Ag	0,05mg/l Ag	0,005mg/l Ag	
Pentachlorophenol	0,01 mg/l	0,01 mg/l		
Selenium	0,01mg/l Se	0,01mg/l Se	0,01 mg/l Se	
Total dissolved solids	500 mg/l	500 mg/l	-	
Detergents	0,05mg/l LAS	0,5 mg/l LAS		
Sulfites	250 mg/l SO_4	250 mg/l SO_4		

ITEM	STANDARDS VALUES			
	Class I and Class 2	Class 3	Class 5	Class 7
Sulfides (as un - dissociated H_2S)	0,002 mg/l S	0,3 mg/l S	0,007 mg/l S	0,002 mg/l S
Thallium	-	-	0,1 mg/l Tl	
Tetracloroethylene	0,01 mg/l	0,01 mg/l		
Trichloroethylene	0,03 mg/l	0,03 mg/l		
Carbon tetrachloride	0,003 mg/l	0,003 mg/l		
2.4.6 trichlorophenol	0,01 mg/l	0,01 mg/l		
Total Uranium	0,02 mg/l U	0,02 mg/l U	0,5 mg/l U	
Vanadium	0,1 mg/l V	0,1 mg/l V		
Zinc	0,18 mg/l Zn	5,0 mg/l Zn	0,17 mg/l Zn	0,17 mg/l Zn
Aldrin	0,01 ug/l	0,03 ug/l	0,003 ug/l	0,003 ug/l
Chlordane	0,04 ug/l	0,3 ug/l	0,004 ug/l	0,004 ug/l
DDT	0,002 ug/l	1,0 ug/l	0,001 ug/l	0,001 ug/l
Dieldrin	0,005 ug/l	0,03 ug/l	0,003 ug/l	0,003 ug/l
Endrin	0,004 ug/l	0,2 ug/l	0,004 ug/l	0,004 ug/l
Endosulfan	0,056 ug/l	150 ug/l	0,034 ug/l	0,034 ug/l
Heptachlor epoxi	0,01 ug/l	0,1 ug/l	0,001 ug/l	0,001 ug/l
Heptachlor	0,01 ug/l	0,1 ug/l	0,001 ug/l	0,001 ug/l
Lindane	0,02 ug/l	3,0 ug/l	0,004 ug/l	0,004 ug/l
Methoxychlor	0,005 ug/l	30 ug/l	0,03 ug/l	0,03 ug/l
Dodecachlor+nonachlor	0,001 ug/l	0,001 ug/l	0,001 ug/l	0,001 ug/l
PCB's	0,001 ug/l	0,001 ug/l		
Toxaphene	0,01 ug/l	5,0 ug/l	0,005 ug/l	0,005 ug/l
Dimeton	0,1 ug/l	14 ug/l	0,1 ug/l	0,1 ug/l
Guthion	0,005 ug/l	0,005 ug/l	0,01 ug/l	0,01 ug/l
Malathion	0,1 ug/l	100 ug/l	0,1 ug/l	0,1 ug/l
Parathion	0,04 ug/l	35 ug/l		0,04 ug/l
Carbaryl	0,02 ug/l	70 ug/l		
Organophosphate compounds and total carbamates in terms of parathion	10 ug/l	100 ug/l	10 ug/l	10 ug/l
2,4-D	4,0 ug/l	20 ug/l	10 ug/l	10 ug/l
2.4.5 TP	10,0 ug/l	10 ug/l	10 ug/l	10 ug/l
2.4.5 T	2,0 ug/l	2,0 ug/l	10 ug/l	10 ug/l

5.2.2 Effluent Standards

The CONAMA Resolution No.20 also established the minimum conditions for the direct and indirect effluent discharge into water resources (Table 5.2-3), emphasizing that effluent discharge could not provoke in the water resources characteristics different from its classification.

In Rio de Janeiro State, the state general standards were elaborated in 1978 through NT-202. The minimum requirements for discharge and permissive maximun concentration for toxic substances were established, considering more aggressive substances and the ones that do not degrade on the environment. These standards were established based on the legislations of several countries, such as Denmark, Italy, Switzerland and Japan. Later on, they were reviewed and new parameters were added while more restrictions were introduced to the existing one.

The standards for industrial typologies should be established based on studies and experiences related to each industrial branches in Brazil and other countries. FEEMA has started these program, developing the Instruction for Metal Finishing Effluents.

The initial idea for the effluent standards was to use the general standards established in NT-202-R-10 : Effluent Standards and Criteria (Dec.4, 1986) until defining the standards for all the typologies. However, FEEMA decided to postpone this program, waiting for more effective results in the industrial effluent control.

After that, FEEMA/CECA adopted the minimum requirements approach for industrial effluents based on existent technology levels for different industrial typologies and processes. These minimum requirements were supposed to be adopted, independent of the assimilation capacity of water resources. However, additional measures can be required in

order to reach the water quality standards. The general aspects of industrial control were presented in DZ-209 : Instruction for Industrial Wastewater Control (June 25, 1987).

Considering the case of toxic effluents with a complex mixture of chemical substances that can not be isolated or identified as a confident result, FEEMA/CECA elaborated a technical norm NT-213 (Oct.18, 1990) that was established as criteria and standards for industrial wastewater toxicity control. The NT-213 was standards for the total toxicity of the effluents that work as a substitute variable in the effluent control.

According to this norm, initially the effluent should follow a minimum value of fish acute toxicity. Additionally it could be required minimum value of acute toxicity for other organisms, such as bacterias and algae.

Besides that, the quality of water resources could not be effected by toxic substance discharge. Therefore, it was proposed that the relationship between the toxicty of the effluent discharge and the effluent concentration in the river after discharge had to be greater than the level of doubt involved, that introduced as safety factor. Also, it should be considered the worst conditions of the maximum effluent flow and minimum river flow at the downstream of the discharge.

For the wastewater organic load control, the controlled utilization of the environment assimilative capacity was adopted in no saturated areas by FEEMA/CECA during their first ten years to keep always a good reserve for the future, as a safety factor.

In the saturated areas, the best available technology for the organic load control was required for new industries and for existing industries when possible. These details

were described on the first version of NT-202.

The approach of wastewater minimum requirements established by FEEMA/CECA in 1987 was used on the development of the instruction for organic load control from industries (DZ-205-R-3). According this instruction, the industries responsible for 90% of the total organic load of a specific basin or sub-basin should remove 90% of their BOD discharged load. The rest of the industries responsible for 10% of the total organic load would be required to remove coase and settleable solids that corresponded to the basic level of the control technology.

This instruction was reviewed in 1991 (DZ-205-R-5) and became more restrictive in terms of requirements of BOD removal. It was also introduced requirements in terms of COD. For BOD, it was established that industries with organic load greater than 100 kg/day would be required to remove 90% of the discharged BOD. For the other industries, the basic level of the technical control would be required, that means 70% of BOD removal and setteable solids less than 0.5 ml/l. Standards in terms of COD for several topologies were also established.

It was been elaborated in FEEMA, a special instruction for the organic load control from no-industrial sources and the requirements will be established as function of the load of BOD discharged.

Another important aspect to the organic load control is the article No.274 of the State Constitution that the discharge of sewage on public or private systems should be proceeded with primary treatment.

Table 5.2-3 Effluent Standards (CONAMA No.20)

Parameter	Standards Values	Parameter	Standards Values
pH	5 - 9	Fluorides : F	10 mg/l
Temperature	40 ℃	Soluble	
Setteable Solids	1 ml/l (1 hour in Inhoff Cone)	Manganese : Mn	1.0 mg/l
		Mercury : Hg	0.01 mg/l
Mineral Oils	20 mg/l	Nickel : Ni	2.0 mg/l
Vegetable Oils	50 mg/l	Silver : Ag	0.1 mg/l
or Animal Fats		Selenium : Se	0.05 mg/l
Ammonia : N	5.0 mg/l	Sulfides : S	1.0 mg/l
Total Arsenic:As	0.5 mg/l	Sulfites : SO_3	1.0 mg/l
Barium : Ba	5.0 mg/l	Zinc : Zn	5.0 mg/l
Boron : B	5.0 mg/l	Organophosphate	1.0 mg/l
Cadmium : Cd	0.2 mg/l	Compounds and	in tems of
Cyanides : CN	0.2 mg/l	Total Carbamates	paration
Lead : Pb	0.5 mg/l	Carbon Sulfide	1.0 mg/l
Copper : Cu	1.0 mg/l	Trichloroethylene	1.0 mg/l
Hexavalent		Chloroform	1.0 mg/l
Chromium : Cr	0.5 mg/l	Carbon	
Trivalent		Tetrachloride	1.0 mg/l
Chromium : Cr	2.0 mg/l	Dichloroethylene	1.0 mg/l
Tin : Sn	4.0 mg/l	Other Organophos-	
Phenols : C_6H_5OH	0.5 mg/l	phate Compounds	0.05 mg/l
Soluble Iron: Fe	15 mg/l	(Pesticides, Solvents)	

5.2.3 Beneficial Uses of Water Resources

(1) River

The beneficial uses of the water resources in the Guanabara Bay basin were established in DZ-106 : Instruction for Classification of Guanabara Bay Rivers (1978).

This deliberation defines the following beneficial uses of water resources (see Table 5.2-4) ;

1. Public Water Supply

    (1) With or without desinfection
    (2) With slow sand filtration and desinfection
    (3) With conventional treatment
    (4) With special treatment

2. Recreation

    (1) Primary contact
    (2) Second contact

3. Aesthetic

4. Aquatic life Protection

    (1) Natural Aquatic Life
    (2) Species for Human Feeding

5. Farming Activities

    (1) Irrigation of Green Vegetables
    (2) Irrigation of Other Crops
    (3) Animal Growing

6. Industrial Supply

7. Navigation

8. Waste Dilution

In the DZ-106, the beneficial uses are described for total 91 rivers in the Guanabara bay basin. For example, the beneficial uses of the Canal do Mangue are "Aesthetic " and "Waste Dilution" as shown in Table 5.2-4.

Seeing this table in detail, all the rivers are specified as the use of Aesthetic and the most of the rivers are specified as the use of "Natural Aquatic Life of Aquatic Life Reservation" (65 rivers) and "Irrigation of Other Cultures of Farming Activities" (37 rivers).

The uses other than the above are as follows:

1. Public Water Supply

With or without desinfection: 6 rivers
- Rio Trapicheiro (the upper reaches to Saboia Lima)
- Rio do Ouro
- Rio da Cachoeirinha
- Rio Roncador/Santo Aleixo (the upper reaches)
- Rio do Pico (the upper reaches)
- Rio Macacu (the upper reaches to Corrego Macuqui)

With conventional treatment: 2 rivers
- Canal do Imunana
- Rio Macacu (the upper reaches to Corrego Macuqui)

2. Recreation

Secondary contact: 1 river
- Rio Macacu (the upper reachers to Corrego Macuqui)

3. Farming Activities

Animal growing: 1 river
- Rio Macacu (the upper reaches to Corrego Macuqui)

4. Industrial Supply: 5 rivers
   Rio Maracana
   Rio das Tintas
   Rio Iguacu
   Canal Mato Grosso
   Rio Macacu (the upper reaches to Corrego Macuqui)

5. Navigation: 1 river
   Rio Macacu (the upper reaches to Corrego Macuqui)

Table 5.2-4 Benefic Uses of Water (Rivers)
(DZ - 106; May 1, 1997)

BENEFIC USES OF WATER			GUANABARA BAY BASIN	CANAL DO MANGUE	RIO COMPRIDO	...
PUBLIC WATER SUPPLY		With special treatment				
		With conventional treatment				
		With slow sand filtration and desinfection				
		With or without desinfection				
RECREATION		Secondary Contact				
		Primary Contact				
		Aesthetic		X	X	
AQUATIC LIFE PRESERVATION		Species for Human Feeding				
		Natural Aquatic Life				
FARMING ACTIVITIES		Animal Growing				
		Irrigation of other cultures				
		Irrigation of green vegetables				
		Waste Dilution		X	X	
		Navigation				
		Industrial Supply				

(2) Sea Area

The beneficial uses of the Guanabara bay waters were established in DZ-105: Instruction for Guanabara Bay Water Classification (1980).

This deliberation defines the following benefit uses of waters (see Table 5.2-5);

1. Recreation
   (1) Primary contact
   (2) Secondary contact

2. Aesthetic

3. Aquatic life Preservation
   (1) Natural Aquatic Life
   (2) Species for Human Feeding

4. Industrial Supply

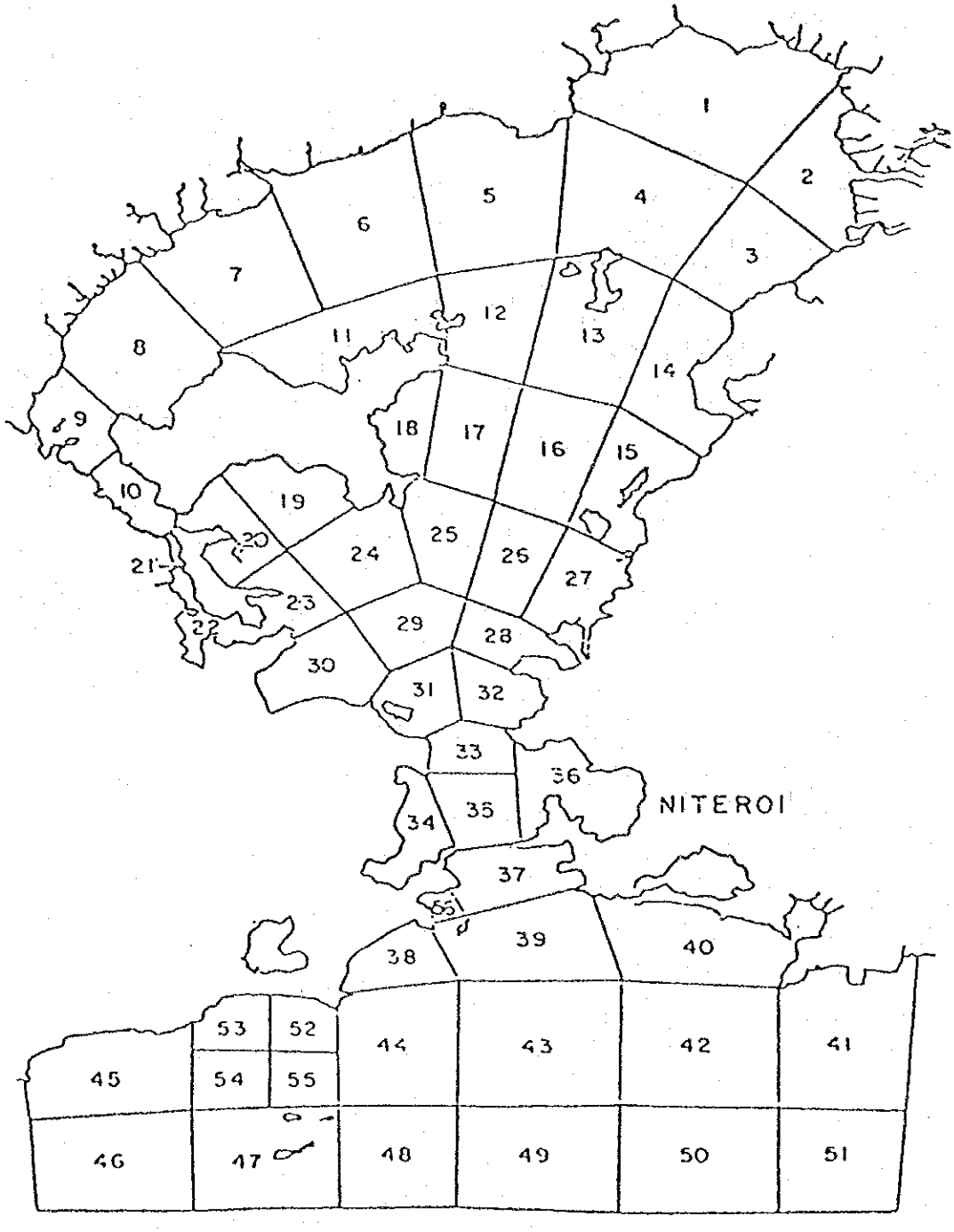
5. Navigation

6. Waste Dilution

In the DZ-105, the beneficial uses of the Guanabara bay waters are specified as shown in Table 5.2-5 and Fig.5.2-1 using the Segments of the Mathematical Model Grid in 1976.

Table 5.2-5 Classification of Guanabara Bay Waters
(DZ - 105; Aug. 8, 1980)

GUANABARA BAY (SEGMENTS FROM MATHEMATICAL MODEL GRID)	BENEFICIAL USES							
	RECREATION		Aesthetic	AQUATIC LIFE PRESERVATION		Industrial Supply	Navigation	Waste Dilu tion
	Primary Contact	Secondary Contact		Natural Aquatic Life	Species for Human Feeding			
Segments 1, 2, 3, 6, 7, 9, 14, 15, 24, 28, 31, 32, 33, 42, 43, 44, 54, 55, 46, 47, 48, 49, 50, 51.		X	X	X	X	X	X	X
Segments 4,12, 16, 17, 25, 26, 29, 35.		X	X	X	X		X	X
Segments 5, 8, 11,18, 19, 20, 36	X	X	X	X	X	X	X	X
Segment 10	X	X	X			X	X	X
Segments 13, 34, 37, 56, 38, 39, 40, 41, 45, 52, 53	X	X	X	X	X		X	X
Segments 21, 22			X				X	X
Segments 23, 27, 30			X			X	X	X



GUANABARA BAY - Mathematical Model
Division in Segments

Fig. 5.2-1 Water Area Division of Guanabara Bay
(Segments from Mathematical Model Grid)

5.2.4 Water Quality Classification

(1) River

Regarding the water quality classification in the rivers of the Guanabara bay basin, the rivers are classified as shown in Fig.5.2-2 using "Fresh Waters of the Environmental Quality Standards for Water Pollution" (Table 5.2-1) and "Benefit Uses of Waters of each River" (Table 5.2-4)

For example, we use the standard of Class 4 for the Mangue Channel (Canal do Mangue), because its benefit uses are only Aesthetic and Waste Dilution. On the same way, the Iguacu River (Rio Iguacu) is considered to be Class 2, because its benefit uses include Aquatic Life Protection.

As a result, the rivers near the mouth of the bay belong to Class 4 and the other rivers belong to Class 2.

(2) Sea Area

As same as the rivers, the water quality classification in the Guanabara bay is classified as shown in Fig.5.2-3 using "Salt Waters of the Environmental Quality Standards for Water Pollution" (Table 5.2-1) and "Beneficial Uses of the Guanabara Bay Waters" (Table 5.2-5 and Fig.5.2-1).

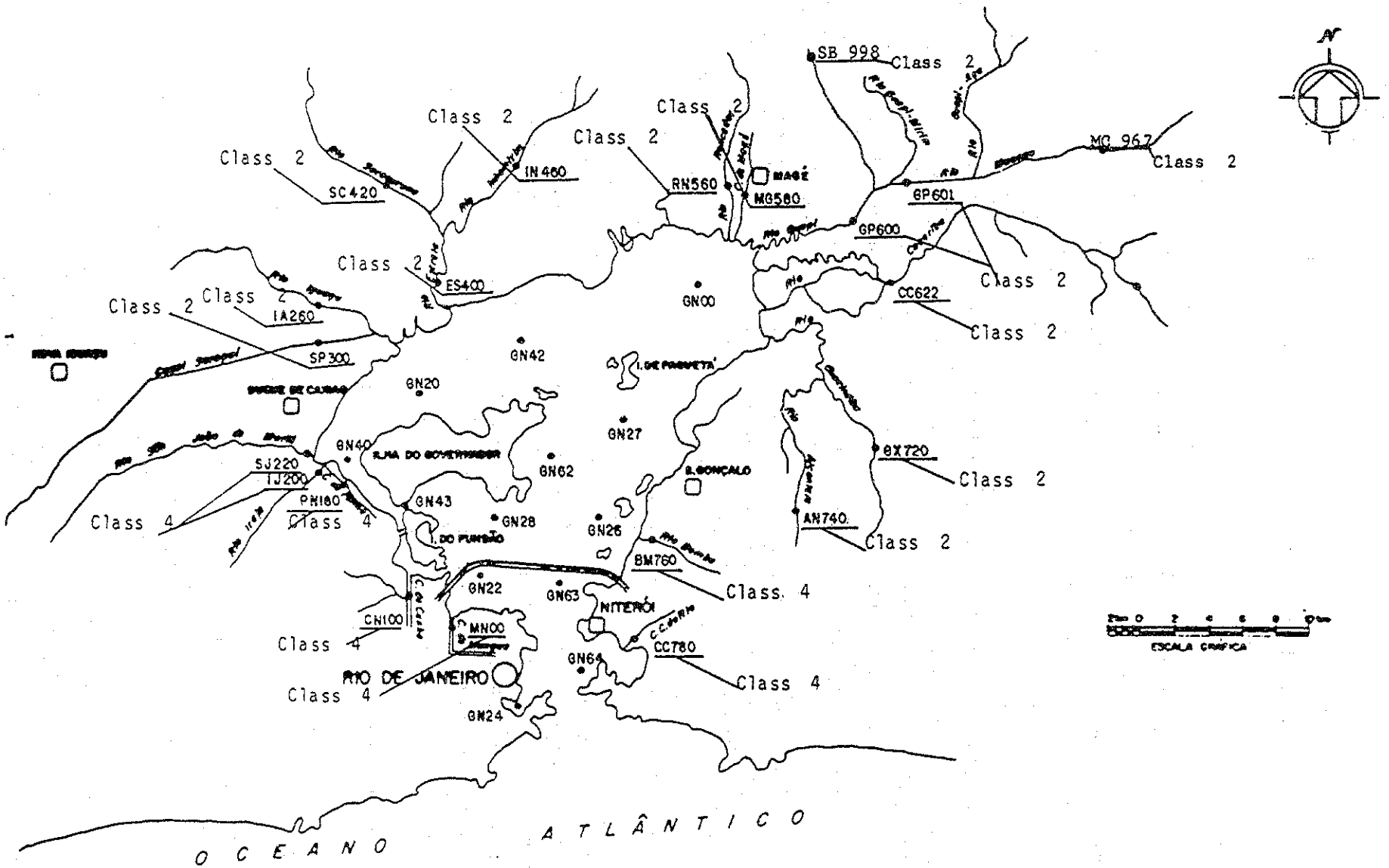
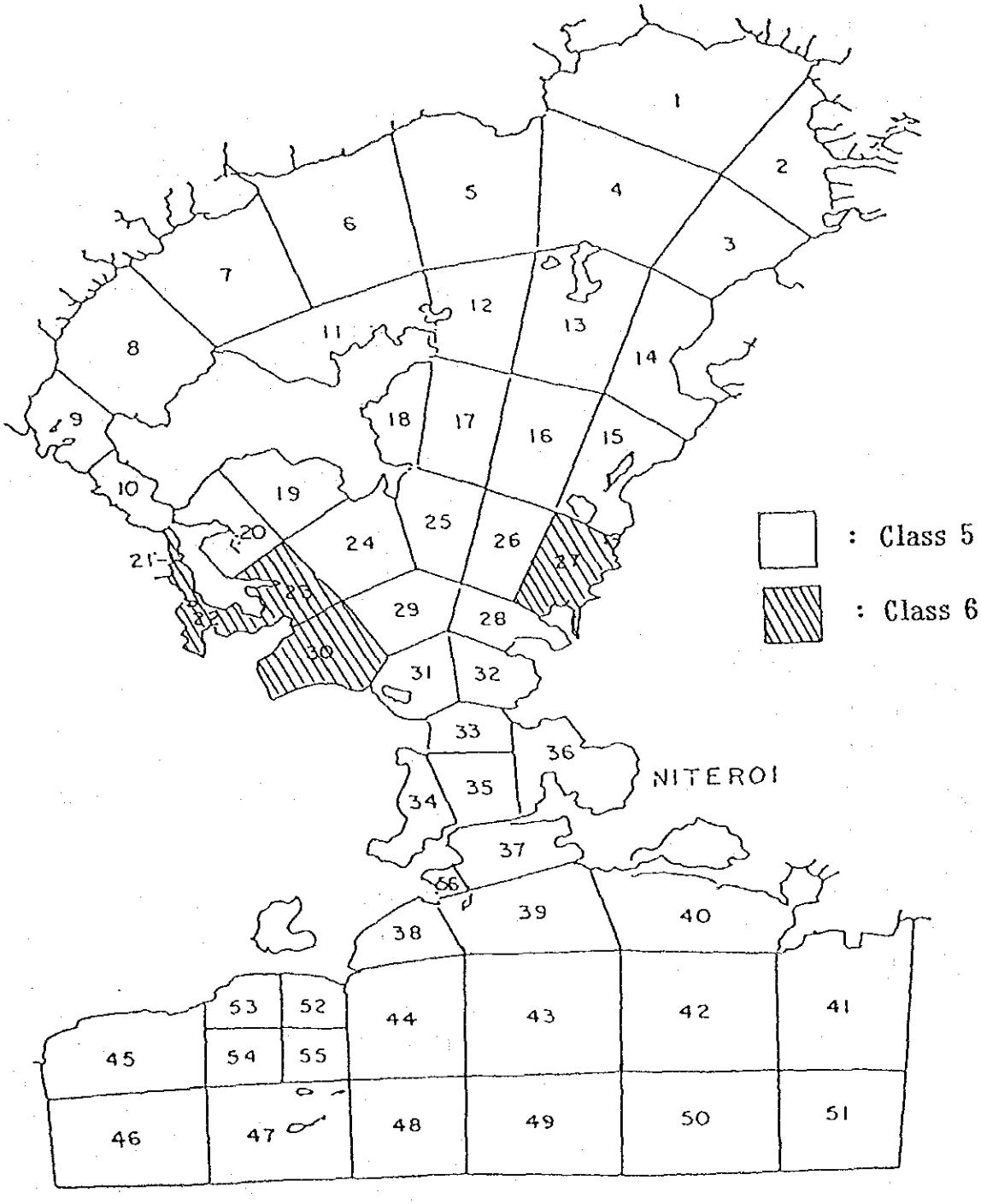


Fig. 5.2-2 Water Quality Classification of Rivers in Guanabara Bay Basin



GUANABARA BAY - Mathematical Model
Division in Segments

Fig. 5.2-3 Water Quality Classification of the Guanabara Bay

5.3 Administrative Organization

5.3.1 Federal Level

Administrative organizations on the federal level concerning the environmental pollution control are shown in Fig.5.3-1 and their main activities are shown in Table 5.3-1.

In these organizations, SEMA has a full responsibility for the national policy on environment and CONAMA establishes norms/resolutions as mentioned before.

On the other hand, IBAMA has the functions to assist SEMA in the coordination and execution of the Natural Policy on Environment as well as conserve and control over natural resources such as APA (Environmental Protection Area) to which all mangrove areas belong.

5.3.2 State Level

Administrative organizations in Rio de Janeiro state concerning the environmental pollution control are shown in Fig.5.3-2 and their main activities are shown in Table 5.3-2.

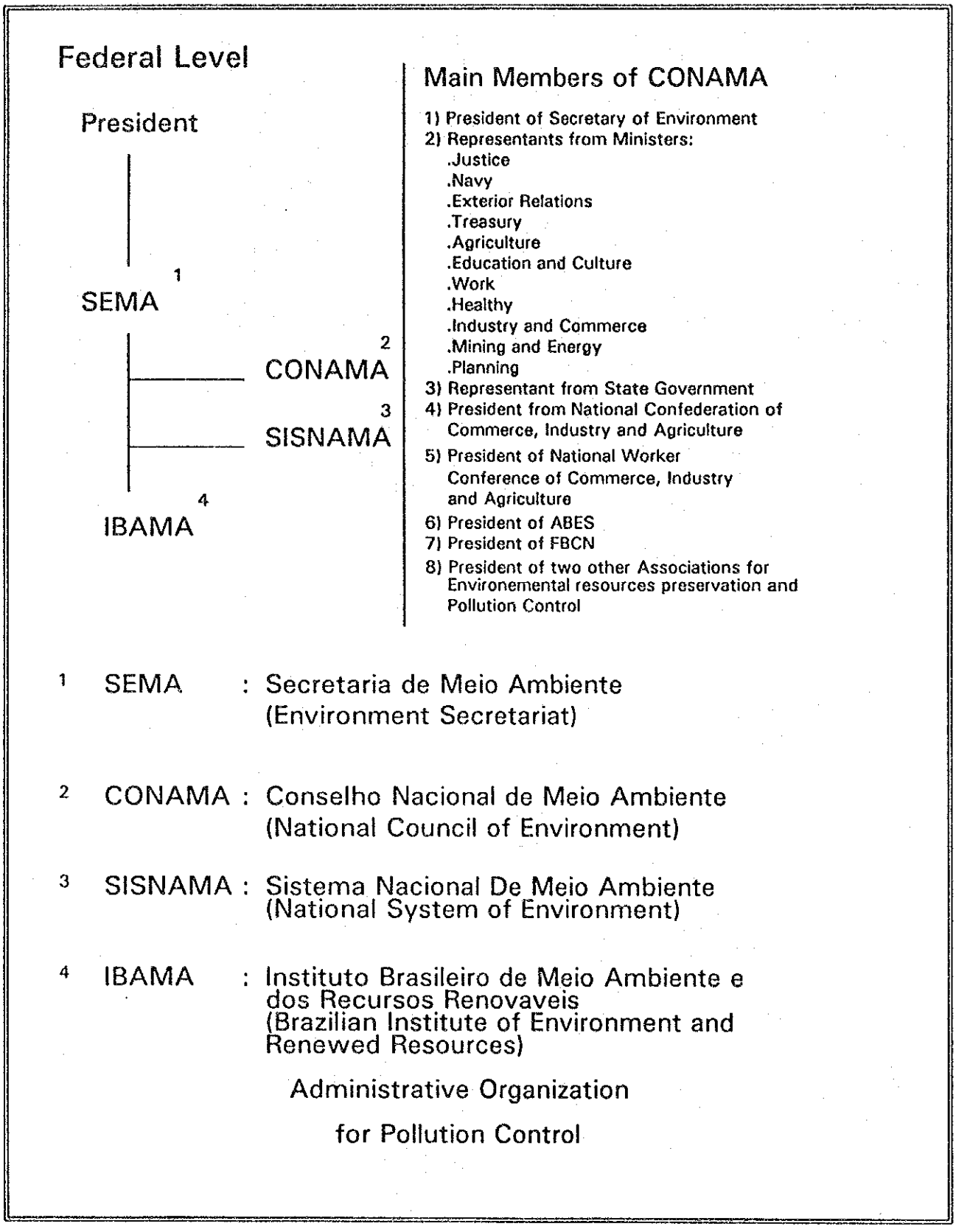
In these organizations, GEDEG, SEMANPE, CECA and FEEMA are mentioned as important organizations for the recuperation of the ecosystem in the Guanabara bay.

Especially, CECA (State Commission for Environmental Control) composed of the representatives of the organizations concerning the environmental pollution control has the responsibility for the establishment of norms/resolutions for the water quality standards in the Auanabara bay.

5.3.3 Municipality Level

Administrative organizations in Rio de Janeiro municipality concerning the environments are shown in Fig.5.3-3.

Fig. 5.3-1 Administrative Organization for Pollution Control
(Federal Level)



1 SEMA : Secretaria de Meio Ambiente
(Environment Secretariat)

2 CONAMA : Conselho Nacional de Meio Ambiente
(National Council of Environment)

3 SISNAMA : Sistema Nacional De Meio Ambiente
(National System of Environment)

4 IBAMA : Instituto Brasileiro de Meio Ambiente e dos Recursos Renovaveis
(Brazilian Institute of Environment and Renewed Resources)

Administrative Organization

for Pollution Control

Table 5.3-1

ACTIVITIES OF MAIN ORGANIZATIONS
(FEDERAL LEVEL)

1. SEMA

. Main functions:

- To plan, coordinate, supervise and control the activities related to the National Policy of Environment Preservation and Conservation of renewaste natural resources

. It is composed by:

- National Council of Environment (CONAMA)
- Coordination and Planning Department for the Policy of Environment
- Technical-Scientific and Cooperation Department
- Committee for National Fund of Environment

2. CONAMA

. Main functions:

- To establish norms and criteria for licensing of effective or potential polluting activities
- To determine, when judge necessary, study of alternatives and possible environmental consequences from public and private projects. Also, to request to federal, state and municipal agencies, as well as, to private organisms, the necessary information for appreciation of environmental impact assessments, related to works or activities of significant environmental degradation, specially in areas considered to be national patrimony.
- To decide, as last administrative chance, about penalties imposed by IBAMA, under previous deposit.
- To determine, under IBAMA representation, the loss or restriction to fiscal benefits given by Public Power, and the loss or suspension of loans from official establishments.
- To establish rational norms and standards for pollution control from automotive vehicles aircraft and ships, leaning the competent Ministry.

- To establish norms, criteria and standards related to control and maintenance of environmental quality, that aims the rational use of environmental resources, specially water resources.

3. SISNAMA

Sisnama is composed by the agencies from Union, States, Federal District and municipalities, as well as, by the foundations instituted by Public Power, responsible for protection and improvement of environmental quality.
It has as structure:

I. Superior Organism
The Government Council, that has the function of assisting the President of the Federative Republic of Brazil in the formulation of National Policy and governmental instructions for the environment and environmental resources.

II. Consultive and Deliberative Organism
The National Council of Environment - CONAMA, that has the function of assisting, studying and proposing to Government Council instructions of governmental policies for the environment and natural resources. Also, it has the function of deliberating norms and standards compatible to a balanced ecological environment and essential to a healthy life quality.

III. Central Organism
The Environment Secretariat of Republic Presidency, that has the function of planning, coordinating, supervising and controlling, as a federal organism, the national policy and governmental instruction for the environment.

IV. Executive Organisms The IBAMA, that has the function of executing and making execute the policy on environment, as well as, the preservation, conservation, conservation, rational use, inspection and control of natural resources.

V. Setorials Organisms

Organisms or agencies from direct and indirect federal administration, as well as, the foundations instituted by Public Power, whose activities are related to environmental quality protection resource use.

VI. Sectional Organisms

State organisms responsible for executing programs, projects and the control and inspection of activities capable of provoke environmental degradation.

VII. Local Organisms

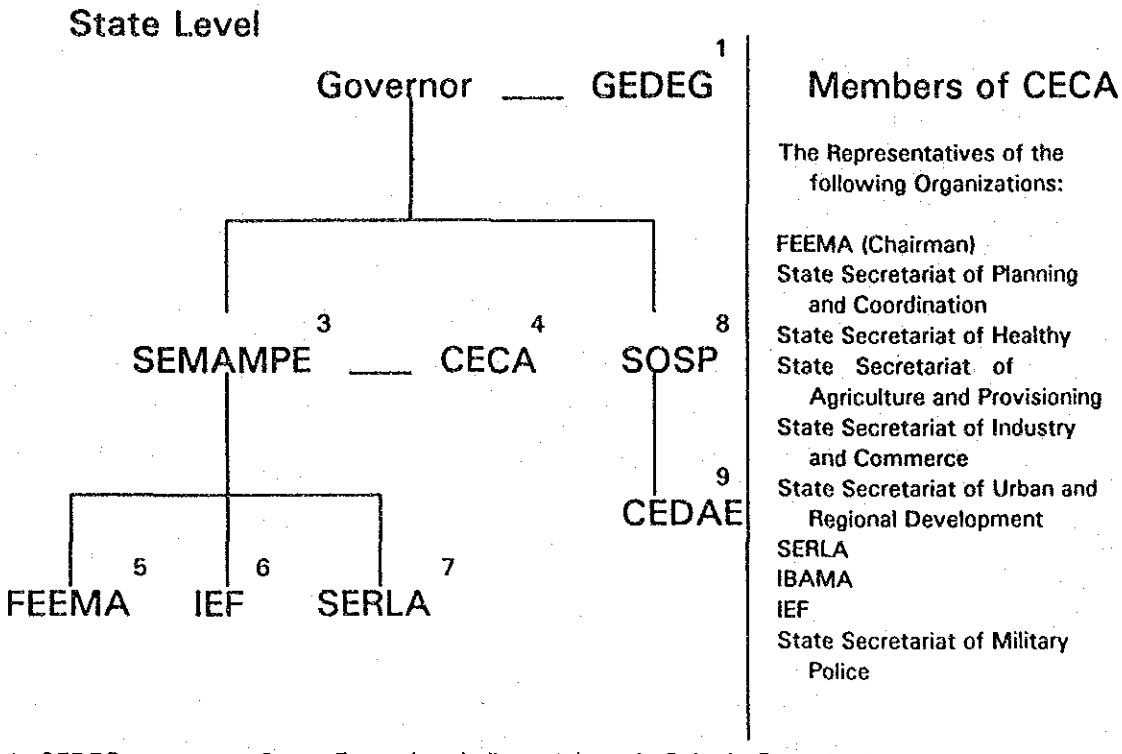
Municipal organisms responsible for the control and inspection of activities capable of provoke environmental degradation, in the respective area of its jurisdiction.

4. IBAMA

IBAMA is linked to SEMA and has as functions:

- To assist SEMA in the coordination and execution of the Natural Policy on Environment, as well as, in the preservation, conservation, rational use, inspection and control of natural resources.

Fig. 5.3-2 Administrative Organization for Pollution Control
(State Level)



1. GEDEG : Grupo Executivo de Despoluicao da Baia de Guanabara
(Executive Group for Depollution of Guanabara Bay)

3. SEMAMPE : Secretaria Estadual de Meio Ambiente e Projetos Especiais
(State Secretariat of Environment and Special Projects)

4. CECA : Comissao Estadual de Controle Ambiental
(State Commision for Environment Control)

5. FEEMA : Fundacao Estadual de Engenharia do Meio Ambiente
(State Foundation for Control Environmental)

6. IEF : Fundacao Instituto Estadual de Florestas
(State Institute for Forest Preservation)

7. SERLA : *Superintendencia Estadual de Rios e Lagoas*
(State Foundations for Rivers and Lagoons)

8. SOSP : Secretaria de Obras e Servicos
(Secretariat of Public Works)

9. CEDAE : Companhia Estadual de Aguas e Esgotos
(State Company of Water and Sewages)

Table 5.3-2

ACTIVITIES OF MAIN ORGANIZATIONS

(STATE LEVEL)

1. GEDEG

- To coordinate and follow the special projects related to the improvements of the inhabitant life quality and environmental conditions of Guanabara Bay basin.
- To assist the Rio de Janeiro State and Rio de Janeiro Municipality, together with financing agencies during the resources taking phase, as well as, during the implementation phase of projects.

3. SEMAMPE

Functions:

- To promote, supervise, coordinate and execute programs, projects and official activities related to environment
- To exert the power of environmental policy, through licensing and control of potential polluting activities, as well as, through the application of penalties when the legislation is not followed.
- To establish environmental norms and standards for the State of Rio de Janeiro.
- To cooperate with federal and municipal authorities, as well as, with authorities from other states in order to execute measures related to pollution control and natural resources preservation.
- To implant and administrate the units of nature consevation, instituted by the State.
- To execute drainage works in order to recuperate the fluvial and lake basins in relation to flood control, erosion and regularization of fluvial regime.
- To manage the state water resources

4. CECA

Functions:

- To approve and propose to the Secretariat of Environment the necessary measures for pollution control and environmental protection, recommended by FEEMA.
- To exert the police power related to pollution control and environmental protection
- To give permission to the operation of potential pollution activities

5. FEEMA

Functions:

- The research, the environmental control, the establishment of norms and standards, the personnel training and service attendance for rational utilization of the environment.
- To give technical support to CECA
- To suggest to CECA, the necessary measures for pollution control and environmental protection.
- To exert, in name of CECA, the attendance fiscalization of norms about environmental protection in Rio de Janeiro State, including federal norms, under agreement.

6. IEF

Main Objectives:

- To attend the necessity of flora and fauna conservation
- To promote and foment the reflorestation
- To execute the forest policy, promoting the compabilization of the socio-economic development with the environmental conservation in Rio de Janeiro State.

7. SERLA

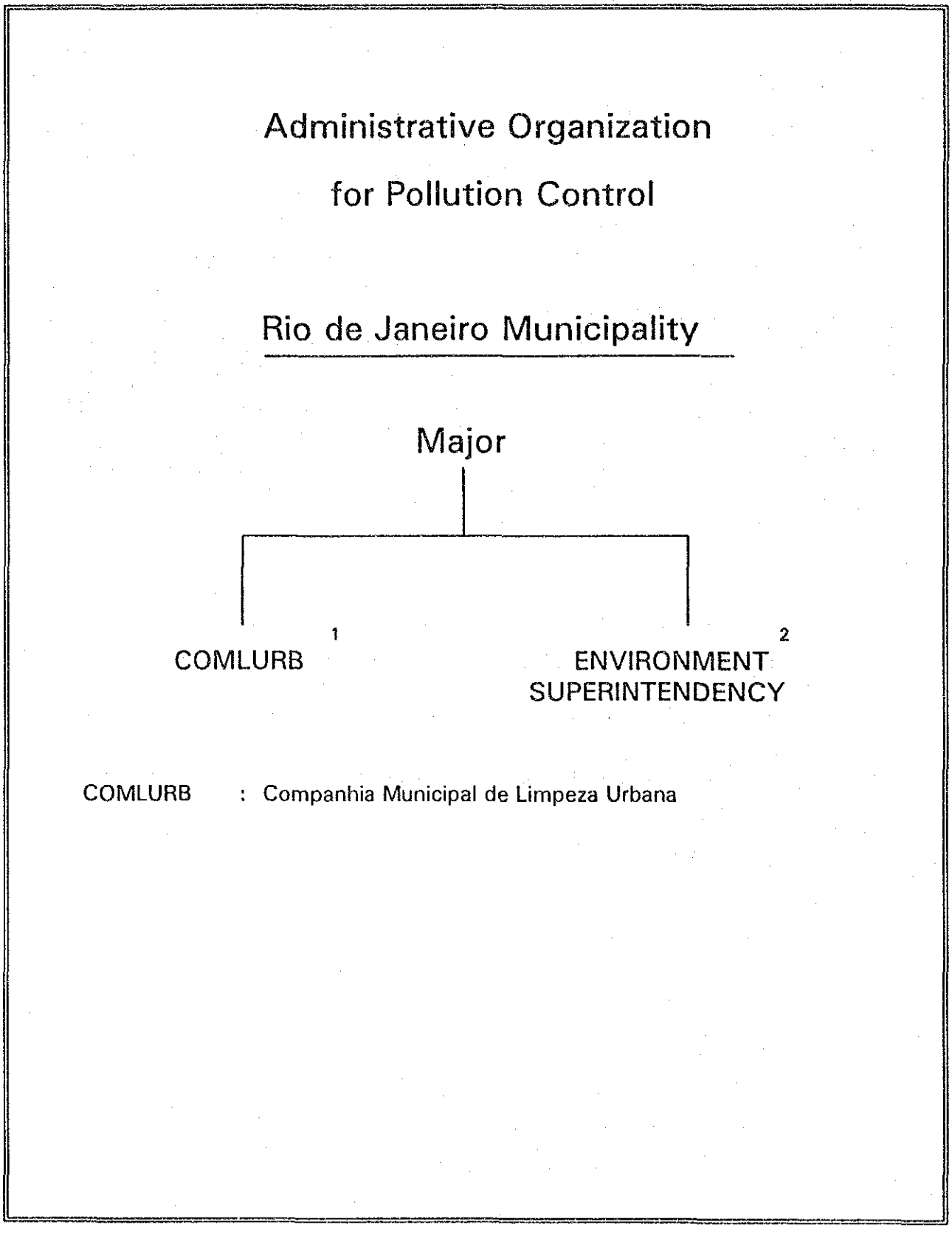
Main objectives:

- Recuperation of river basins and lakes, through public works for control of flood and erosion, and regulation of fluvial regime in rivers, channels and estuaries.
- Execution of macrodrainage, microdrainage and underground drainage works for the recuperation of densely urban areas.
- Inspection related to marginal areas of water bodies under state jurisdiction for:
  - . protection of lagoons and natural water bodies against interference of rural and urban processes
  - . control of erosion and solid transport in rivers, lagoons, estuaries and coastal areas
  - . Conservation of rivers, channels, lakes and lagoons and their estuaries

8. SOSP

- To formulate policy and execute programs, projects public works and activities in the area of urban, regional and micro regional development.
- To support the Municipalities in the area related to urban management.
- To operate and inspect the public service of water supply and sewage collection.
- To project and execute works in public buildings under state responsibility.
- To assist the municipalities in the programation and execution of urban infrastructure works.

Fig. 5.3-3 Administrative Organization for Pollution Control
(Municipality)



5.4 Non-Governmental Organization

(1) Activities of NGO

Some Non-Governmental Organizations (NGO) are acting in a viewpoint of the environmental conservation in Rio de Janeiro. In these NGOs, "Baia Viva" has keen interesting in the environments related to the Guanabara bay as shown in its name Baia Viva (Alive Bay) and it will be said that only this Baia Viva is positively playing an active part in the environments of the Guanabara bay.

(2) Baia Viva

The organization which acted to protect the mangrove in the Guanabara bay in 1970's was the past of Baia Viva and its name changed to the present name in 1990.

Baia Viva takes aim at the preservation of Guanabara bay so that the citizen can utilize as valuable places.

One of the responsible persons of Baia Viva said that the organization composes of more than sixty (60) groups, total members of which are about 100,000 persons including 6,000 fishermen.

(3) Environmental Education

In a viewpoint of the environmental education, the group called "El Mundo Del Fango (World of Mud)" is acting in a quiet way but steadily not only to educate the values of the mud flat for children but also to do clean operations in the mud flat.

5.5 Software-Type Measures for Water Quality Conservation

5.5.1 Components of Software-Type Measures

It is necessary to keep a balance among economic activities, preservation of nature and living condition of residents to maintain the environment in its assimilative capacity. This is the reason why an adequate administrative intervention is required to preserve the environment, including water quality.

Table 5.5-1 shows various forms of the administrative intervention as the components of the social system. These components are rather important than the techniques for the improvement of river or ocean water quality. Importance of each component, however is different by country due to the history, disposition and the living custom as well as the political, social and economic conditions of the nation.

In the following sections, Construction(1), Merits and demerits(2), Application example in Japan, Europe and USA(3), Existing circumstances and the controversial points in the Study area(4) concerning each system are described.

Table 5.5.1Components of Software-Type Measures Related to the Water Quality Improvement

(1) Administrative System
- A. Water quality standard as an administrative target
- B. Administrative organization to practice the environmental policy
- C. Role of a research institute attached to the administrative agency

(2) Legislative System
- A. Regulation of land use
  - A-1 Restricted land use system
  - A-2 Taxation system on land profit
  - A-3 Land expropriation system of land
- B. Regulation on effluents from individual pollution source
  - B-1 Regulation on effluent concentration
  - B-2 Regulation on total pollutant load

(3) Agreement and Approval System
- A. Environmental impact assessment system
- B. Agreement system between the local government and the owner of firm
- C. Permission and approval system by the authorities concerned

(4) Economic System
- A. Demand control type water charge system
- B. Effluent charge system
- C. Product-charge system
- D. Marketable certificate of right to pollute
- E. Subsidy system
- F. Treasuary investments and loan system
- G. Tax reduction system

(5) Financial System
- A. Financing from taxes
- B. Financing from the income of government works
- C. Fund raising system through the polluter's
- D. Fund raising system through the beneficiaries
- E. Credit financing system (International monetary agency, Bilateral assistance)

(6) Resident Participation System

(7) Education System

5.5.2 Administrative System

A. Water Quality Standard as an Administrative Target

(1) Water quality standard is established as an administrative target for the environmental improvement of the public water area according to its use. consequently, the beneficial use of the water area should be primarily examined prior to discussions on water quality which can be tolerated for beneficial use should.

(4) Guanabara Bay is divided into thirty-six(36) segments based on the mathematical model in 1977, and the beneficial use of each segment is decided based on the "Environmental Quality Standards for Water Pollution" established by CONAMA. As for the major rivers flowing into the Bay, their beneficial uses and water quality standards are also established.

Table 5.2-1 shows the water quality standard established by CONAMA for the fresh water, salt water and brackish water areas. The standard for the salt water area should be applied to the Guanabara Bay.

The water area classification in the Guanabara Bay basin is shown in Fig.5.2-2 for the rivers and in Fig.5.2-3 for the bay.

B. Administrative Organization to Practice the Environmental Policy

(1) It is well known that environmental improvement projects, especially the water quality improvement project, are linked to many administrative organizations, whose cooperation is necessary to attain the purpose of the project.

(4) With respect to the recuperation of the ecosystem in the Guanabara Bay, the following are the administrative organizations in the Rio de Janeiro State:

GEDEG	:	Executive Group for Depollution of the Guanabara Bay
SEMAMPE:		State Secretariat of Environment and Special Project
CECA	:	State Commission for Environmental Control
FEEMA	:	State Foundation for Environmental Engineering
IEF	:	State Foundation for Forest Preservation
SERLA	:	State Foundation for Rivers and Lagoons
SOSP	:	Secretariat of Public Works
CEDAE	:	State Company of Water and Sewages

Under the present stage, measures are being taken as regard to how to activate these organizations and how to render them economically responsible and competent in the preservation and control of the water quality in the Bay.

5.5.3 Legislative System

The establishment of legislative regulation on effluent pollutants is the most direct measure to conserve the environment, and its effect appears at once if its enforcement is strong. But as a prerequisite, it is necessary to establish the individuality of the legislature, the executive and the judicature bodies and the authority to correct the mistakes of the executive. The regulative force may be weakened, or an unfair regulation may not be challenged when the respective independence of the three powers is just a facade for a strong executive power, especially a central government power.

A. Regulation on Land Use

(1) Environmental problem are closely related to land use. Private possession of land is usually guaranteed in the capitalist countries, and the freedom of land use is generally included in the ownership of land. But an adequate administrative intervention is necessary to restrict the use of the land when it badly effects a wide peripheral environment.

A.1 Restricted Land Use System

(1) This system limits the use of land to prevent undesirable use in view of the preservation of the environment. The regulations intensity is decided in proportion to the importance of the land under the City Planning Law and so on. However, it is meaningless if these laws have no provisions for environmental preservation. In some countries, the right to purchase land is recognized to protect private ownership, and other countries also recognized along with this right a compensation system such as tax reduction.

(3) More than ten states in the U.S.A. restrict development of the retardation area to protect residents from flood, and an indemnity for the land owner is not approved. In Massachusetts and Wisconsin states, tidelands and marshlands are designated as preservation areas and changes are prohibited without permission from the Bureau of Natural Resources, though the right to purchase land is recognized to protect private ownership.

In Sweden, utilization of private land is limited to protects the rights of the people concerning the use of beaches. In France, building, except in urbanized districts, is legally prohibited in the 100m wide zones adjacent to the high tide lines in the area.

In Japan, regulations concerning the utilization of tidelands or marshlands have not yet been established except Nature Conservation Law and Natural Parks Law. Further, continuous reclamations and development of these kinds of land were conducted by private companies or public agencies. Consequently, the establishment of the right to enter the beaches is requested by the people. Though utilization of the private land in the riverbed is strongly restricted by the River Act, there are no regulations of the development of retarding basin.

A-2 Taxation System on Land Profit

(1) In this system, the appraised value of land is kept low to enable the owners to use their lands as farmland or forests, uses favorable to environmental conservation works. On the other hand, the appraised value of lands irrelevant to environmental preservation works rated high.

As the system does not completely restrict the form of land use, land owners can buy lands as long as they pay the taxes.

A-3 Land Expropriation System

(1) This system covers the purchase of land for public use with government funds. In some countries, land owners are given rights to confirm the public entity's intended use of the land prior to selling it at the current price, when there is a desire to sell it for the counter value (Forward purchase right, Prior negotiation right).

(3) Further, some countries employ a system giving the public entity the right to lease the land to the former owner after purchasing, provided that the latter will not change the use of the land. For example, the government of Canada leased a purchased land for green belt use to the former owner under the condition above mentioned with a five-year renewable contract.

The national trust system established in U.K. was conceived to maintain a good environmental condition as it can exercise control the land from public funds.

B. Regulations on Effluents from Individual Pollution Sources

(1) This system refers to regulations imposed on effluent discharging actions directly causing water pollution. Further, it also refers to the balancing of the private and public properties, as well as setting limitations to the right to profit.

B-1 Regulation on Effluent Concentration

(1) This system imposes regulations on the concentration of pollutants discharged from pollution sources. There is a fear that the aquatic environment would not be improved if the waste water is diluted to an extent that complies with the effluent standard.

(3) In Japan, local government can establish more strict effluent standard than nationwide uniform standard when it is presumed that the preservation of the water quality of a certain water area will be difficult.

(4) In Rio de Janeiro State, the CONAMA resolution shown in Table 14.2-2 keeps the direct and indirect effluent discharge condition into the water resources in a minimum. This resolution emphasizes the incapability of the effluent water to provoke change in the classification of the water to provoke change in the classification of the water resource characteristics, to offset the lack of quantitative regulations.

B-2 Regulation on Total Pollutant Load

(1) This system limits the total effluent load of a certain area within the environment's assimilative capacity. Each factory in the regulated area is authorized to discharge a certain amount of effluent load.

(2) It is difficult to appropriately decide the amount of effluent standard allowed for each factory. After the allotment ratio of effluent load is set, the technical development of the production system with a small quantity of effluent load ceases to become economical to the private companies. Consequently, these private companies will not have a strong desire to develop pollution control techniques.

5.5.4 Agreement and Approval System

A. Environmental Impact Assessment System

(1) This system is conceived to implement an appropriate countermeasure prior to the implementation of a large scale development which can possibly influence the peripheral environment, by studying and estimating the type, the extent and the degree of impact and publicizing the results. the actual way of assessment differs widely depending on the social intention and the political system of the nation.

(3) In Japan, though the Law of Environmental Impact Assessment(E.I.A.) has not yet been established, Implementation Scheme for E.I.A. has been applied to a large scale development under the administrative leadership. But, the assessment results were often criticized because of lacking objectivity and insufficiency of information disclosing.

B. Agreement System between the Local Government and the Owner of a Firm

(1) This is the original system conceived in Japan. An anti-pollution countermeasure is agreed upon during a conference between the firm, as the pollution source, and the local government. The result of the conference is formulated in a written agreement. In the 1960's, air pollution and water quality deterioration has inten-

sified in Japan, and the local government was often hard pressed between radical movements of citizens suffering severe pollution and the central government, which cannot cope with the situation quickly.

This is the reason why the above mentioned system came out. There are still doubts, however, whether this system has legal binding power or not. Recently, this system is getting attention from the cities in the world suffering from various types of pollution.

(2) This agreement remains collusive between the enterprising agency and the local government or will be an indulgence for the latter when the local government does not understand the resident's.

The success of this agreement would depend on the assistance of a sufficient number of local government specialists on pollution control and strong support of the residents.

(3) The Tokyo Metropolitan Government and Tokyo Electric Power Supply Co., Ltd. agreed upon the establishment of pollution control. The agreement entails the reduction of the sulfur dioxide emitted from the latter to fifty percent of the 1967 level until 1974, the required use of low-sulfur heavy oil, granting of approval by the latter to the former to enter and conduct inspection and monitoring.

C. Permission and Approval System by the Authorities Concerned

(1) This system controls industrial activities by giving administrative agencies the power to grant permission, authorization, to conduct examination, formulate legislations, etc...

(2) Though the primary object of this system is to establish uniformity in economic activities, protect national rights, and secure national safety, it is easy to induce the protection offered by the vested rights. Further, the administrative organization tends to grow larger because many people are necessary in the screening or inspection works.

(3) In Japan, each governmental agency is vested with the authority to grant permission and approval on various enterprising activities and they can be very effective in realizing the policy when administrative guidance is also applied. The administrative guidance is not legally established but is strongly enforced in Japan.

5.5.5 Economic System

This system prevents discharge of pollutants by formulating economic incentives. One type of this system follows the Polluter Pays Principle (the so-called PPP), while another type contradicts PPP, despite the economic incentives.

A. Demand Control Type Water Charge System

(1) Good water quality is indispensable to domestic life and industrial activities. But more efforts should be stressed on saving water. From this point of view, water tariffs based on increasing block rates are preferable.

(2) As saving water effects the reduction of effluent load and amount of waste water to be treated, it is supported in view of water quality preservation.

B. Effluent Charge System

(1) This is the system in which the polluter pays the social cost generated by the environmental pollution. Though the effluent charge should be decided in proportion to the social cost, it is actually decided by the load amount of effluent, the production amount or the profit, because the social cost is difficult to calculate.

(2) This system agrees with the Polluter Pays Principle. Reduction effect of effluent load is large because the effluent charge is lessened when the effluent load is reduced. Further, enterprises buckle down to the development of the pollution control technique. The optimal allocation of resources will result from this system due to the banishing of industries or industrial categories which induces high pollution preventing costs. Further, the government is able to obtain the funds for the countermeasures.

It is difficult to accurately ascertain the optimum charge.

The most important matter in introducing this system is to distinguish the groups and stages bearing the charge to effectively attain environmental improvement.

(3) In Germany, a taxation system for waste water was introduced in 1976. According to this law, the dischargers of waste water directly flowing into the public waters have to pay charges in proportion to their amount of discharge and toxicity level. This is the first system in the world utilizing economic incentives for environmental improvement, and it affected many countries.

Tax for water pollution in France is levied upon the polluters in proportion to the amount and the quality of discharged waste water. A part of the revenues is used to subsidize private companies in their purchase of the pollution control facilities.

In Japan, a special surcharge is collected from the enterprises whose waste water is discharged into the sewerage according to the volume and the quality of discharge.

C. Product-charge System

(1) This is the system imposing tax on manufactures in proportion to the sales of goods such as synthetic detergents, fertilizers, agricultural chemicals, and so on, as a means to repress consumption of these products as they are harmful to the aquatic environment. This system is applicable when alternative goods are available.

(2) Comprehensive Environmental Response, Compensation and Liability Act (so-called Superfund Act) established in 1980 in the U.S.A. is a taxation system which levies a tax on the production and import of chemical and petrochemical goods which largely affect the environment. The fund, accumulated from this tax system are used to prevent stock-type pollution.

D. Marketable Certificate of Right to Pollute

(1) In this system, the right to pollute, a kind of property right, is established and a certain number of this certificate is issued by the government. Factories are obliged to purchase this certificate in proportion to the amount of pollutants they discharge. The certificates are bought and sold in the market by polluters, environmental preservation groups or other people after they are issued by the government. Consequently, the most adequate pollution level has been attained under market principle.

(2) This system has secured a source of revenue for the countermeasures. But, the environmental assimilating capacity should be estimated to endorse the propriety of supply of the certificate published by the government.

E. Subsidy System

(1) This is the system in which investment for equipment or technological development projects to prevent discharge of pollutants is subsidized partially or totally with the public funds.

(2) This system has a short-term effect with regard to the reduction of effluent load since the enterprise requires more subsidy. Further, this system will be welcomed by small-to-medium sized enterprises with little fund for the installation of pollution control facilities.

This system, however, not only excludes the root cause of pollution but also opposes the Polluter Pays Principle. Further, it is feared that this system breeds the hotbed of graft or political corruption.

Increase in pollution sources, however, is possible in the long-run, because the introduction of this system will mobilize some enterprises. Since subsidy was granted in view of the present technical level and industrial structure, the enterprises will be apt to neglect efforts toward technological development for pollution control, and the curtailment of products costs based on the amount of the subsidy.

F. Treasury Investments and Loan System

(1) This is the system in which the fund collected by the national financial agencies is used for low-interest and long-term loans as a private company investment to promote pollution prevention or environmental improvement.

(3) In Japan, saving is encouraged from way back, and a large sum of private money is deposited as postal savings used by the governmental agency. This postal savings and the social security fund are applied to the treasury investment with the scale reaching about half of the general account. Recently, these funds are used to cover the moving cost of the pollution generation enterprises or the installation cost of the pollution control facilities.

G. Tax Reduction System

(1) This is the system in which the cost invested for pollution prevention by a private company or person is recognized as an object for tax deduction.

(2) In Japan, the special depreciation system which admits the shortening of the repayment period is applied to the pollution control facilities. Local taxes and fixed property taxes are also reduced.

5.5.6 Financial System

A. Financing from Taxes

B. Financing from the Income of Government Works

C. Fund Raising System through Polluter's

(1) OECD presented the Polluter Pays Principle as one of the principles applicable to the sharing of cost for pollution prevention and control, to promote the rational use of scarce environmental resources, and to avoid the distortion of international trade and investment. Fund raising from the polluter follows this principle.

(2) This system means the internalization of the exterior cost and results the optimum allocation of the resources, and is fair from the view point of economics as well as morality.

D. Fund Raising System through the Beneficiaries

E. Credit Financing System (International Monetary Agency, Bilateral Assistance)

5.5.7 Resident Participation System

The environmental right of residents is sometimes damaged severely when public work is only implemented by the government. Community welfare has priority over personal rights in some countries. When a resident movement against public work is strong, the project cannot be promoted smoothly and the public agency also suffers serious damages. Consequently, it is recognized that a consensus between the resident and the public agency should be reached through the participation of the former in the implementation stage of the policy.

Public participation in the implementation stage of the policy has positive meanings in the sense that the intentions of many people are reflected in the project, and problems which could have been overlooked without community participation become obvious.

The residents can publicly participate in various ways: (1) Declaration of opinion in the council at the planning phase of the project, (2) demand for the disclosure of information to the public, (3) Presentation of written opinions, (4) Participation in explanation meetings or public hearing, (5) Participation in the inhabitants' poll and so on. Stability of the democratic system, national character and other factors should be considered when these measures are institutionalized.

Further, it would be meaningless if residents cannot participate in the above form while an alternative or revised plan can be presented or a plan can be stopped by the administrative side.

5.6 Existing Circumstances and Issues of Software-Type Measures

5.6.1 Adiminstrative Organization

It is emphasized that the water quality improvement project is linked to many administrative organizations, whose cooperation is indispensable to attain the purpose of the project.

With respect to the recuperation of the ecosystem in the Guanabara Bay, it will be said that such administrative organizations of Rio de Janeiro State as GEDEG (Executive Group for Depollution of the Guanabara Bay), SEMAMPE (State Secretariat of Environment and Special Project) and three organizations belonging to SEMAMPE, that is FEEMA, SERLA and IEF, have an important role.

Adding the above, CECA (State Commission for Environmental Control) which is a commission umder SEMAMPE has a responsibility and a strong power for the preservation and control of the water quality in the Bay. In view of water, sewage and garbage, CEDAE (State Company of Water and Sewages) and COMLURB (Municipal Company of Urban Cleaning) also assume responsibility of the water quality in the Bay, though CEDAE and COMLURB do not belong to SEMAMPE.

The most important thing for the recuperation of the ecosystem in the Guanabara Bay is to activate these organizations. On this point, the strong leadership of SEMAMPE is desired cooperating with GEDEG, SEMAMPE should lead FEEMA, SERLA and IEF belonging to itself at least and render them economically responsible and competent. As these organizations have many engineers of ability, it is not difficult to activate these organizations, if SEMAMPE would render sufficient responsibility and competence backed by finances.

The main functions of CECA are to approve and propose the necessary measures for pollution control and environmental protection to the State Secretariat of Environment under the recommendation by FEEMA, to exert the police power related to pollution control and environmental protection and to give permission to the operation of potential polluting activities. From these functions, CECA plays an important role for the preservation and control of the water quality in the Bay. Though CECA is seemed to have a regular meeting, it is desired that this commission acts more energetically and exerts the power to the pollution control and environmental protection more strongly.

It is a regulation that the fine collected from offenders to the pollution and environmental protection is laid up in FECAM (Special Fund for Environmental Control) and this fund is used for projects for the pollution control and environmental protection by three organizations of FEEMA, SERLA and IEF. This system looks so interesting and excellent that it shall be continued and work well.

As a result, existing administrative organizations of the Rio de Janeiro State relating to the preservation and control of the water quality look sufficient as organization itself. If there should be a point to be indicated, it might be said that the government of the Rio de Janeiro State carries forward an environmental policy more strongly backed by finances.

5.6.2 Regulation on Water Quality Standard, Effluent Standard and Land Use

(1) Water Quality Standards

In the Guanabara Bay, a water area classification is divided into thirty six (36) segments based on the mathematical model of FEEMA in 1977, and the beneficial use of each segment is decided by CONAMA. The water quality standard in the Bay are also decided as Class 5 and Class 6 (salt waters) by CONAMA.

This water area classification and water quality standard in the bay are decided based on the beneficial uses of the water area and the coastal area at that time.

Basically, this has not different views of things from ours. The existing water area classification and water quality standards, however, shall be restudied into details taking into account of the present beneficial uses of the area and results of this study including the result of the numerical simulation.

(2) Effluent Standards

Effluent standards in Brazil are decided by CONAMA in terms of many parameters for the effluent discharge into the water resources. These standard values are decided as the concentration of pollutants, for example less than 0.01 mg/l for mercury (Hg). This system has a fear that the aquatic environment would not be improved if the waste waters are diluted to an extent that complies with the effluent standards.

Thereafter, FEEMA made a "Guideline for Organic Amount Control in Industrial Liquid Effluents (DZ-205; Aug. 07 th, 1991)" as effluent standards for each type of industries, which is more strict than the existing effluent standards (see Appendix 1).

Recently, FEEMA proposed a new guideline TCPHA "Taxation for Control of Water and Air Pollution" to the commission for the preservation of environment. This proposal aims at the total pollutant load system and is said to be the latest intention (see Appendix 2).

(3) Land Use

Environmental problems are closely related to land uses. Therefore, an adequate administrative intervention is necessary to restrict the use of the land when it badly effects a wide peripheral environment.

In Brazil, the urban planning area is controlled by municipalities and the agricultural area is controlled by the federal government. The state government, FEEMA in the case of Rio de Janeiro State, however, can intervene in projects in an urban planning area through the regulation of EIA (Environmental Impact Assessment) when the projects give bad effects to the peripheral environments.

The concept of a permanent protection area "APP (Area de Proteção Permanente)" is used in Brazil for the precious area in view of environments (Law N°. 6902, CONAMA N°. 011). The APP can be appointed by each of municipalities, states and federal government. If circumstances require, the owner of the land appointed as APP can be exempted from taxation and the government expropriates it in some cases.

This APP does not be appointed as a clear area, but the area in general terms like a mangrove area. The mangrove area around Rio Guapimirim is appointed as APP in the Guanabara Bay.

CODIN (Companhia Distrito Industriais) practises the removal of factories in the center of city to suburbs in view of environments. For example, the Santa Cruz municipality removed factories to the area where the municipality purchased lands, and the municipality controls strictly the factories which did not comply with the recommendation.

At present, FEEMA carries forward a scheme for the management of the coastal area of the Rio de Janeiro State together with municipalities. This scheme is a macro-zoning of the coastal area which is divided into four areas of the south-west part, the east part, the north part of the state and the Guanabara Bay basin. In these areas, the zoning works for the east part have already completed and the works for the Guanabara Bay basin will be started on this year. The main land use categories of this macro-zoning are as follows;

1. Environmental Protection Zone
2. Floral Zone
3. Federal Protection Zone
4. Urban Zone
5. Development Zone on Urban Planning
6. Recreation Zone
7. Industrial Zone
8. Agricultural Zone
9. Port and Harbor Zone

(4) Environment Impact Assessment System

Environment impact assessment (EIA) system is conceived to implement and appropriate counter-measures prior to the implementation of a large scale development which can possibly influence the peripheral environments.

In Brazil, EIA is stipulated in the resolution CONAMA N°. 001 (Jan. 23rd, 1986) and FEEMA has a responsibility for the evaluation of the report "RIMA (Relatorio de Impacto Ambiental)". A public hearing on RIMA must be held at the final stage under the newspaper advertisement on the main three newspapers.

5.6.3 Economic System and Financial System

(1) Economic System

Two kind of economic systems will be considered to prevent the discharge of water pollutants. One of them is a system by formulating economic incentives and the other is a system following the pollutor-pays principle (PPP).

The latter system is accepted by the regulations on the concentration of pollutants discharged from pollution sources in Brazil. This system looks not going well in practice because of the lack in the sufficient system bear ing the effective charges to attain the environmental improvement.

Recently, FEEMA intends to introduce a new effluent charge system (so-called TCPHA) by the load amount of pollutants for each category of industries as mentioned above.

The former system, economic incentive systems such as subsidy system and tax reduction system, is not familiar in Brazil.

(2) Financial System

There are some roots to furnish a loan to industrial companies with cheap interests such as through Banco Nacional de Desenvolvimento Social and Agence Financeiro de Bassin.

As a loan to funds relating the environments, however, is examined rigorously by a bank, it was very difficult to get a loan for installation of environmental equipment in this decade.

A fund raising system through the beneficiaries is not familiar in Brazil.

5.6.4 Resident Participation System

It is important to recognize that a consensus between the resident and the public agency should be reached through the participation of the former in the implementation stage of the policy.

The participation of the resident in Brazil is seen in various ways such as participation in a public hearing on RIMA, declaration of opinion and/or presentation of written opinion at the planning phase of the project and demand of information to the public.

These resident participations are mainly done by the resident associations, environmental groups (so-called NGO) and men of learning and experience.

5.6.5 Education System

An environmental education plays an important role in the improvement of the environment.

In Rio de Janeiro State, two organizations of "Educação Ambiental" of Secretaria de Educação and "SEMAMPE" carry on an environmental education. The former practises the education to the students of statal secondary school (stage 05 to stage 08) and this education is practised systematically.

SEMAMPE including FEEMA, SERLA and IEF practises the education to the students of primary school (stage 01 to stage 04) through the environmental section of municipalities. To put it concretely, these organizations back to establish an environmental section in municipality and train the teachers of the primary school. They also carry on preparing materials necessary for the education.

Regarding the environmental education for the recuperation of the ecosystem of the Guanabara Bay, FEEMA intends to educate the following persons together with GEDEG through the IDB project;

1. Students of the primary and secondary schools
2. Officers of municipalities
3. Resident associations including NGOs
4. Churches and Clubs such as Rotary and Lions
5. Owners of enterprises
6. Workers

As a methodology, FEEM plans to use various kind of tools which are most suitable to the area and/or person such as a meeting system and an audiovisual system. They also plan to put the universities, NGOs and other organizations like IBAM, Roda Viva, ISER and Rio Cine to practical use.

CHAPTER 6

RESIDENT AWARENESS

6.1 Methodology Questionnaire Survey

The questionnaire survey was performed to know the opinions of the persons, who live or work in the Guanabara bay basin, for the existing environmental problems and the future figures of the bay and rivers.

As shown in appendix 1, the questionnaire is composed of thirty six (36) items. Eighteen (18) of them were the inquiries for the personal data of the answerers such as personal informations and socioeconomic informations, and the other eighteen (18) items were the inquiries for the water quality in the Guanabara bay and of the rivers flowing into Guanabara bay.

On the performance of the questionnaire survey, the attention was paid to the following things;

(1) Impartial to specified areas
(2) Impartial to specified job, age, sex and scholarship
(3) Impartial to specified group

To bo concrete, the questionnaire survey was carried out through residence associations, fishermen's associations, environmental groups and yacht clubs etc.

Actual distribution and collection works of the questionnaires were carried out by FEEMA.

6.2 Results of Questionnaire Survey

6.2.1 Recovery Percentage of Questionnaire

Thirteen (13) areas shown in Fig. 6.2-1 became the object of this survey and the recovery percentage are shown in Table 6.2-1. this shows that the high recovery percentage (52% recovery) was obtained.

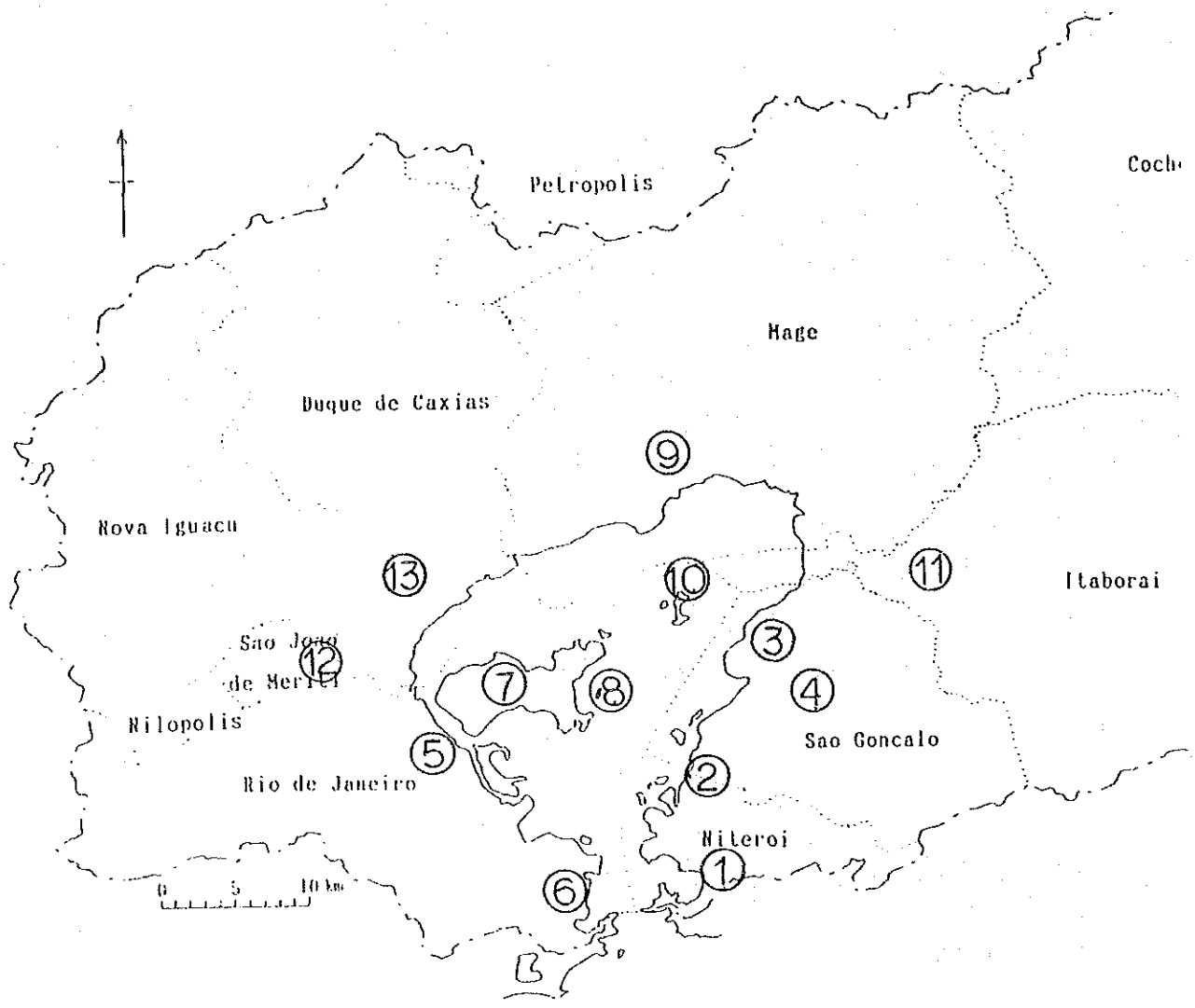


Fig. 6.2-1 Area Code No. of Questionnaire Survey

Table 6.2-1 Recovery Percentage of Questionnaire

Area Code No.	Name of Area	No. of Distribution	No. of Recovery	Recovery Percentage
1	Jurujuba Residence association	230	137	59.6 %
2	Niteroi & Sao Goncalo Fishermen's association	150	101	67.3 %
3	Porto Pedreira & Residence association	100	76	76.0 %
4	Favela do Pica-Pau	100	59	59.0 %
5	Ramos & Praia de Ramos Residence association	200		
6	Flamengo Residence association	100	87	87.0 %
7	Jardim Guanabara Yacht club	200	29	14.5 %
8	Ilha D'Agua Petrobras terminal	100	24	24.0 %
9	Camara Mun., Mage Ecological group	200	107	53.5 %
10	Ilha do Paqueta Ecological group	100	58	58.0 %
11	Manilha, Itaborai Residence association	110	51	46.4 %
12	Sao Joao de Meriti Residence association	110		
TOTAL		1,700 1,390	729	52.4 %

6.2.2 Results of Questionnaire

The results of the questionnaire survey are shown in Table 6.2-2 and Fig. 6.2-2 for each question.

Table 6.2-2

Answers to the Questionnaire

A. Personal Informations

1. Age			%
○	no answer	: 2	(0.3)
①	10 - 19	: 128	(17.5)
②	20 - 29	: 139	(19.1)
③	30 - 39	: 186	(25.5)
④	40 - 49	: 142	(19.5)
⑤	more than 50	: 132	(18.1)
2. Sex			
○	no answer	: 8	(1.1)
①	male	: 477	(65.4)
②	female	: 244	(33.5)
3. Scholarship			
○	no answer	: 10	(1.4)
①	primary	: 367	(50.3)
②	secondary	: 219	(30.3)
③	superior	: 133	(18.3)
4. Residence (Municipality)			
		729	(100.0%)

B. Socio-Economical Informations

1. Family's Income			%
○	no answer	: 27	(3.7)
①	less than 2 min. salaries	: 311	(42.7)
②	between 2 and 5 min. salaries	: 212	(29.1)
③	between 5 and 10 min. salaries	: 90	(12.3)
④	more than 10 min. salaries	: 89	(12.2)
2. Job			
○	no answer	: 24	(3.3)
①	fisherman	: 186	(25.5)
②	farmer	: 4	(0.5)
③	factory worker	: 48	(6.6)
④	maid	: 31	(4.2)

⑤ washing woman	:	8	(1.1)
⑥ casual labourer	:	34	(4.7)
⑦ private company worker	:	83	(11.4)
⑧ public worker	:	118	(16.2)
⑨ others	:	193	(26.5)

3. Are you employed now ?

○ no answer	:	32	(4.8)
① yes	:	449	(66.9)
② no	:	190	(28.3)
		729	(100.0%)

C. Residence Conditions

1. Type of Residence

			%
○ no answer	:	16	(2.2)
① masonry house	:	428	(58.7)
② apartment	:	141	(19.3)
③ wooden house	:	78	(10.7)
④ others	:	66	(9.1)

2. Own or Rental House ?

○ no answer	:	22	(3.0)
① own house	:	583	(80.0)
② rental house	:	124	(17.0)

3. Number of Rooms

○ no answer	:	17	(2.3)
① 1 room	:	24	(3.3)
② 2 rooms	:	133	(18.2)
③ 3 rooms	:	174	(23.9)
④ more than 3 rooms	:	381	(52.3)

4. Do you have a yard ?

○ no answer	:	3	(0.4)
① yes	:	506	(69.4)
② no	:	220	(30.2)

5. Number of Inhabitants

○ no answer	:	107	(14.7)
① 1 person	:	17	(2.3)
② 2 persons	:	73	(10.0)
③ 3 persons	:	125	(17.1)
④ 4 persons	:	148	(20.3)

⑤ 5 persons	:	112	(15.4)
⑥ 6 persons	:	84	(11.5)
⑦ 7 persons	:	24	(3.3)
⑧ 8 persons	:	19	(2.6)
⑨ 9 persons	:	4	(0.6)
⑩ more than 10 persons	:	16	(2.2)

6. Water Supply

○ no answer	:	11	(1.5)
① CEDAE services	:	414	(56.8)
② pipe cars	:	39	(5.3)
③ well water	:	228	(31.3)
④ collective pipe	:	37	(5.1)

7. Do you have a toilet ?

○ no answer	:	3	(0.4)
① yes	:	709	(97.3)
② no	:	17	(2.3)

8. Sanitary Drainage

○ no answer	:	5	(0.7)
① drainage system	:	363	(49.8)
② concrete cesspit	:	178	(24.4)
③ walloon	:	114	(15.6)
④ direct into river	:	69	(9.5)

9. Garbage Collection

○ no answer	:	10	(1.4)
① no sevice	:	136	(18.6)
② once a week	:	147	(20.2)
③ twice a week	:	204	(28.0)
④ three times a week	:	232	(31.8)
		729	(100.0%)

10. Where do you throw domestic garbages away ?
(to persons who don't have garbage services)

① empty terrain near residence	:	69	(50.7)
② near walloon	:	24	(17.7)
③ river	:	16	(11.8)
④ some area along Guanabara bay	:	4	(2.9)
⑤ other places	:	23	(16.9)
		136	(100.0%)

D. Questions related to the Water Quality in the Guanabara Bay

1. What do you think about the water quality in the Guanabara bay ?

			%
○	no answer	: 7	(1.0)
①	very clean	: 7	(1.0)
②	clean	: 6	(0.8)
③	dirty	: 254	(34.8)
④	very dirty	: 429	(58.8)
⑤	no idea	: 26	(3.6)

2. If you think that the water in the Guanabara bay is dirty , what would you like to be done ?

○	no answer	: 14	(1.9)
①	I wish the water could be cleaned up as soon as possible.	: 481	(66.0)
②	I wish the water could be cleaned, if it is possible.	: 172	(23.6)
③	It should be as it is.	: 34	(4.6)
④	There is no way.	: 18	(2.5)
⑤	no idea	: 10	(1.4)

3. What degree do you want to be cleaned ?
(to persons who wish to be cleaned)

○	no answer	: 175	(24.0)
①	to be able to swim	: 106	(14.5)
②	fishs and shells can survive	: 329	(45.1)
③	to be able to enjoy marine sports	: 54	(7.4)
④	no smell and no floating garbages	: 31	(4.3)
⑤	no idea	: 34	(4.7)
		729	(100.0%)

4. What do you think are the reasons for the dirtiness of water in the bay ?

○ no answer	:	7	(1.0)	
[Strongest Reason]				
① disposal waters from drainage system frow into the bay	:		337	(46.7)
② disposal waters from factories frow into the bay	:		185	(25.6)
③ throwing the garbages in the rivers and bay	:		89	(12.3)
④ existence of accumulated mud in the bottom of the bay	:		17	(2.4)
⑤ throwing the garbages and oil from ships	:		63	(8.7)
⑥ others	:		14	(1.9)
⑦ no idea	:		17	(2.4)
		729	(100.0%)	722 (100.0%)
[Second Reason]				
① disposal waters from drainage system frow into the bay	:		68	(13.5)
② disposal waters from factories frow into the bay	:		235	(46.6)
③ throwing the garbages in the rivers and bay	:		104	(20.6)
④ existence of accumulated mud in the bottom of the bay	:		10	(2.0)
⑤ throwing the garbages and oil from ships	:		81	(16.1)
⑥ others	:		6	(1.2)
			504	(100.0%)
[Third Reason]				
① disposal waters from drainage system frow into the bay	:		37	(9.0)
② disposal waters from factories frow into the bay	:		55	(13.4)
③ throwing the garbages in the rivers and bay	:		172	(41.7)
④ existence of accumulated mud in the bottom of the bay	:		26	(6.3)

⑤ throwing the garbages and oil from ships	:	112	(27.2)
⑥ others	:	10	(2.4)
		412	(100.0%)

5. How do you think to control the disposal water from residendes & offices ?

○ no answer	:	10	(1.4)
① it should be controlled rigorously	:	488	(66.9)
② it should be controlled within economical permission	:	189	(25.9)
③ as it is	:	27	(3.7)
④ others	:	5	(0.7)
⑤ no idea	:	10	(1.4)

6. How do you think to control the disposal water from factories ?

○ no answer	:	9	(1.2)
① it should be controlled rigorously	:	551	(75.6)
② it should be controlled within not disturbing economic activity	:	140	(19.2)
③ as it is	:	16	(2.2)
④ others	:	1	(0.1)
⑤ no idea	:	12	(1.7)

7. Which part of the bay do you think is most polluted area ?

○ no answer	:	12	(1.6)
① area A (inner western area)	:	199	(27.3)
② area B (inner eastern area)	:	91	(12.5)
③ area C (central eastern area)	:	190	(26.1)
④ area D (central area)	:	45	(6.2)
⑤ area E (bay mouth area)	:	85	(11.6)
⑥ no idea	:	107	(14.7)
		729	(100.0%)

E. Questions about the rivers flowing into the Guanabara Bay

8. What do you think about the water quality of the rivers ?

			%
○	no answer	: 38	(5.2)
①	very clean	: 2	(0.3)
②	clean	: 10	(1.4)
③	dirty	: 285	(39.1)
④	very dirty	: 350	(48.0)
⑤	no idea	: 44	(6.0)

9. Which river is so ? (in relation to the above question)

○	no answer	: 86	(11.8)
①	the majority of rivers	: 394	(54.1)
②	the river near my house	: 71	(9.7)
③	the river which I see on the way to the office	: 12	(1.6)
④	others	: 14	(1.9)
⑤	no idea	: 152	(20.9)

10. In what season do you observe that the water of rivers becomes dirty ?

○	no answer	: 25	(3.4)
①	Dec. to Feb. (summer, rainy season)	: 300	(41.2)
②	Mar. to May (dry season)	: 71	(9.7)
③	June to Aug. (winter, dry season)	: 71	(9.7)
④	Sep. to Nov. (rainy season)	: 71	(9.7)
⑤	others	: 60	(8.3)
⑥	no idea	: 131	(18.0)

11. In what time do you observe that the water of rivers becomes dirty ?

○	no answer	: 38	(5.2)
①	in the morning (6:00 - 9:00)	: 137	(18.8)
②	during the daytime (11:00 - 15:00)	: 165	(22.7)
③	in the evening (16:00 - 17:00)	: 124	(17.0)
④	in the night	: 19	(2.6)
⑤	others	: 65	(8.9)
⑥	no idea	: 181	(24.8)
		729	(100.0%)

12. What do you think are the reasons for the dirtiness of water in rivers ?

		%		%
○ no answer	:	26	(3.6)	
[Strongest Reason]				
① disposal waters from drainage system frow into the rivers	:		348	(49.5)
② disposal waters from factories frow into the rivers	:		199	(28.3)
③ throwing the garbages in the rivers	:		82	(11.7)
④ reclamation and occupation of the riverbed	:		39	(5.5)
⑤ existence of accumulated mud in the bottom of the rivers	:		9	(1.3)
⑥ others	:		9	(1.3)
⑦ no idea	:		17	(2.4)
		729	703	(100.0%)
[Second Reason]				
① disposal waters from drainage system frow into the rivers	:		109	(21.7)
② disposal waters from factories frow into the rivers	:		212	(42.1)
③ throwing the garbages in the rivers	:		131	(26.0)
④ reclamation and occupation of the riverbed	:		30	(6.0)
⑤ existence of accumulated mud in the bottom of the rivers	:		15	(3.0)
⑥ others	:		6	(1.2)
			503	(100.0%)
[Third Reason]				
① disposal waters from drainage system frow into the rivers	:		32	(7.9)
② disposal waters from factories frow into the rivers	:		50	(12.3)
③ throwing the garbages in the rivers	:		205	(50.3)

④ reclamation and occupation of the riverbed	:	72	(17.7)
⑤ existence of accumulated mud in the bottom of the rivers	:	42	(10.3)
⑥ others	:	6	(1.5)
		407	(100.0%)

13. What river do you think is the dirtiest river ?

			%
○ no answer	:	20	(2.7)
⑪ no idea	:	200	(27.4)
		729	(100.0%)

		%			%
(01) Canal do Mangue	: 204	(21.9)	(19) Inhomerim	: 2	(0.2)
(02) Canal do Cunha	: 41	(4.4)	(20) Fariatimbo	: 10	(1.2)
(03) Rio Iraja	: 62	(6.7)	(21) Jequia	: 1	(0.1)
(04) Rio Sao Joao de Meriti	: 109	(11.7)	(22) Pavuna	: 1	(0.1)
(05) Rio Sarapui	: 100	(10.7)	(23) Maracana	: 4	(0.4)
(06) Canal do Mage	: 96	(10.3)	(24) Rio Acari	: 1	(0.1)
(07) Rio Guapimirim	: 34	(3.7)	(25) Carioca	: 4	(0.4)
(08) Rio Alcantara	: 123	(13.2)	(26) Imbarie	: 1	(0.1)
(09) Canal Canto do Rio	: 102	(10.9)	(27) Barao do Iriri	: 1	(0.1)
(10) Rio Iguacu	: 3	(0.3)	(28) Boassu	: 1	(0.1)
(11) Rio Estrela	: 6	(0.6)	(29) Pomba	: 1	(0.1)
(12) Jurujuba	: 3	(0.3)	(30) Macacu	: 1	(0.1)
(13) Rio Paraiba	: 1	(0.1)	(31) Aldeia	: 1	(0.1)
(14) Ilha da Conceicao	: 2	(0.2)	(32) Guaxindiba	: 4	(0.4)
(15) Surui	: 6	(0.6)			
(16) Tiete	: 2	(0.2)			
(17) Neves	: 4	(0.4)			
(18) Bomba	: 2	(0.2)			

Total : 933 (100.0%)

F. General Questions about the Guanabara Bay

14. Which relationship do you have with the Guanabara bay in your daily life ?

			%		
○	no answer	:	28	(3.8)	
①	fishing in the bay as a family invome	:		154	(15.7)
②	fishing in the bay sometimes	:		88	(9.0)
③	not fishing in the bay	:		41	(4.2)
④	playng with a pleasure-boat or using a ferry-boat	:		194	(19.7)
⑤	always walking along the beaches	:		155	(15.8)
⑥	my family plays in the beaches	:		195	(19.8)
⑦	using the bay as a disposal site	:		13	(1.3)
⑧	looking over the bay from a certain distance	:		72	(7.3)
⑨	no special relationship with the bay	:		46	(4.7)
⑩	others	:		25	(2.5)
			729	(100.0%)	983 (100.0%)

15. Do you have any strong memories to the bay in former days ?

○	no answer	:	76	(10.4)	
①	I swam and played in the water	:	251	(34.5)	(25 years ago)
②	I caught crabs and shrimps	:	92	(12.6)	(20 years ago)
③	I played marine sports in the bay	:	14	(1.9)	(15 years ago)
④	I fished always	:	24	(3.3)	(10 years ago)
⑤	others	:	14	(1.9)	
⑥	no special memory	:	258	(35.4)	
			729	(100.0%)	

16. How do you think that the Guanabara bay should be in the future ?

○	no answer	:	19	(2.6)	
①	being able to swim and enjoy the beaches	:		363	(30.5)
②	being able to catch crabs and shrimps, and to fish	:		369	(31.0)
③	being able to play marine sports	:		176	(14.8)

④	no way to recuperate the bay	:	41	(3.4)
⑤	giving the priority to the industrialization	:	8	(0.7)
⑥	making housing areas and parks by reclamations	:	9	(0.8)
⑦	as it is	:	4	(0.3)
⑧	intensifing the recuperation	:	208	(17.3)
⑨	others	:	2	(0.2)
⑩	no idea	:	12	(1.0)
			729 (100.0%)	1192 (100.0%)

17. What is your opinion to the mangrove areas ?

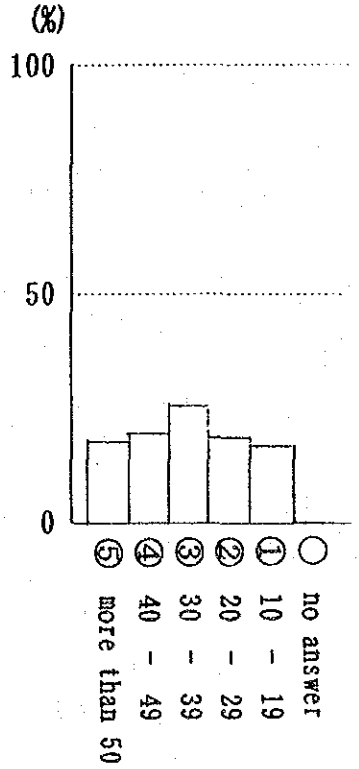
			%	
○	no answer	:	39 (5.5)	
①	It is important to breed fishes, crabs, shrimps and others	:		477 (49.6)
②	It is important to protect birds	:		282 (29.3)
③	no importance and no utilities	:		61 (6.3)
④	creating a mud with bad smell and a terrible aspect	:		66 (6.9)
⑤	construct houses and factories on the mangrove area	:		23 (2.4)
⑥	others	:		45 (4.7)
⑦	no idea	:		8 (0.8)
			729 (100.0%)	962 (100.0%)

18. Do you have any opinion about the pollution control in the Guanabara bay ?

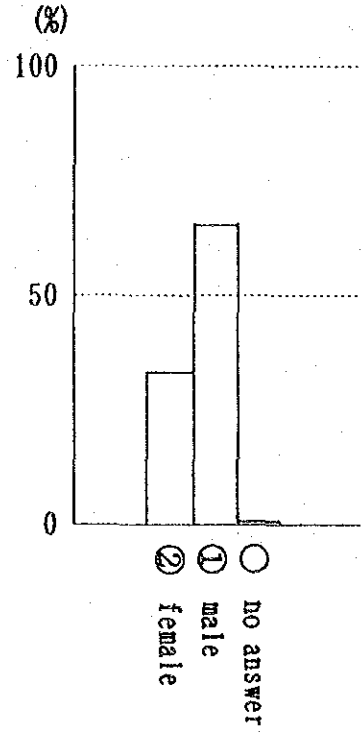
We got total 276 opinions. [see attached table]
(37.9 %)

A. Personal Information

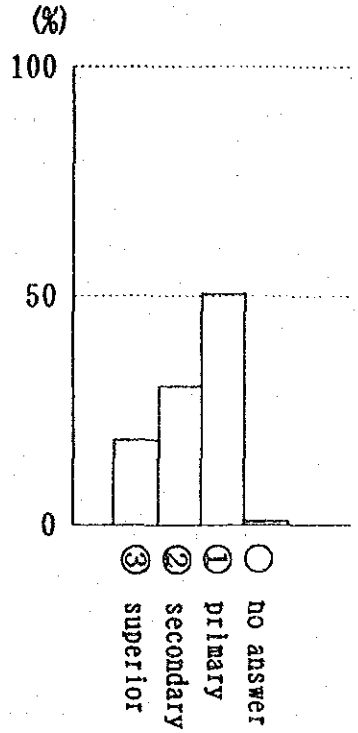
1. Age



2. Sex

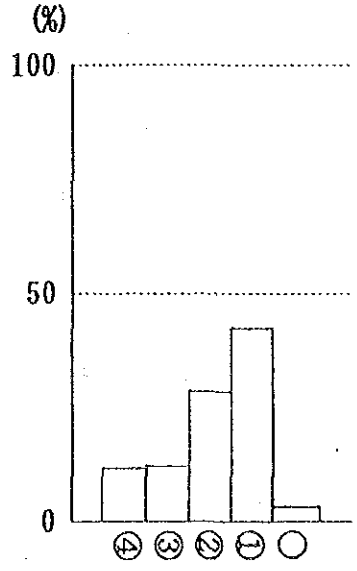


3. Scholarship



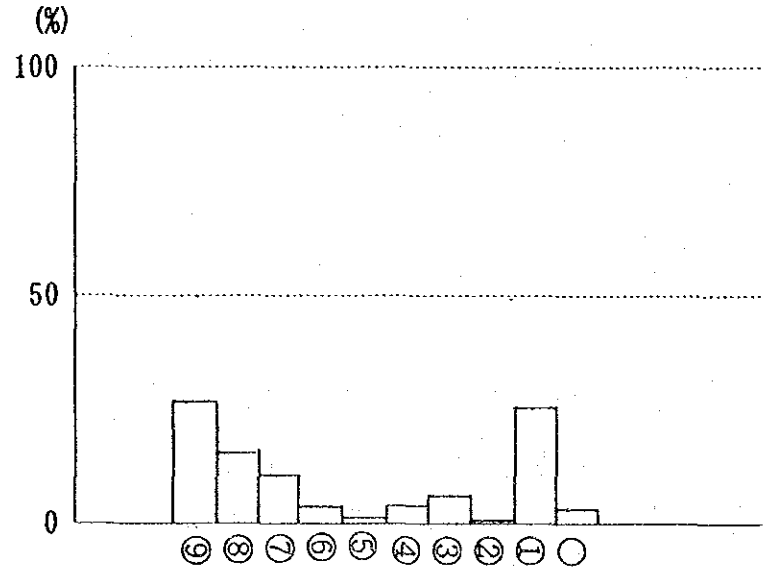
B. Socio-Economic Information

1. Family's Income



○ no answer
① less than 2 min. salaries
② between 2 and 5 min. salaries
③ between 5 and 10 min. salaries
④ more than 10 min. salaries

2. Job

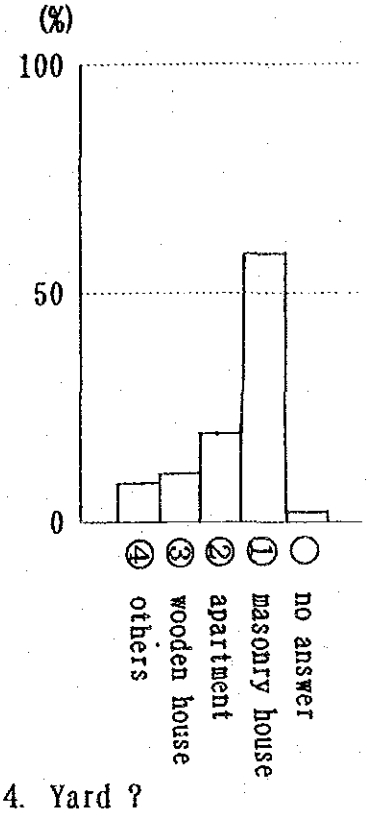


○ no answer
① fisherman
② farmer
③ factory worker
④ maid
⑤ washing woman
⑥ casual labourer
⑦ private company worker
⑧ public worker
⑨ others

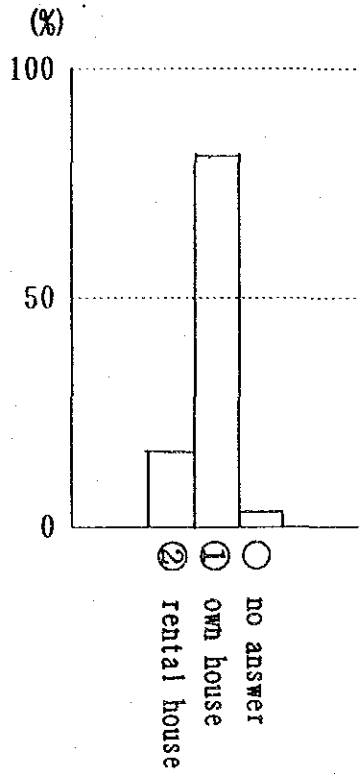
Fig. 6.2-2 Results of Questionnaire Survey

C. Residence Condition

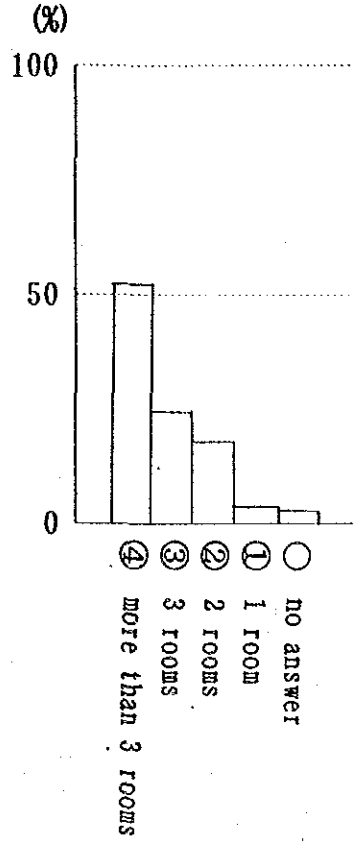
1. Type of Residence



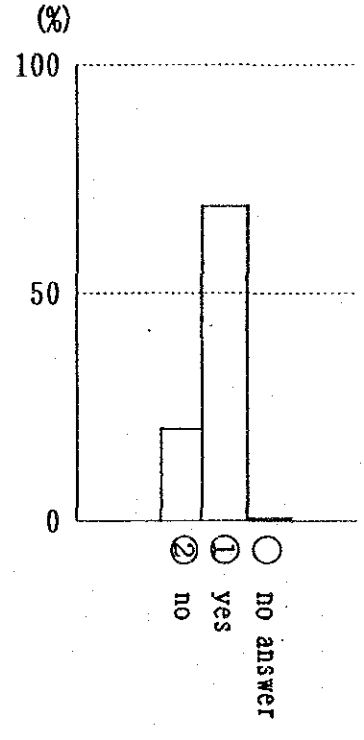
2. Own/Rental House



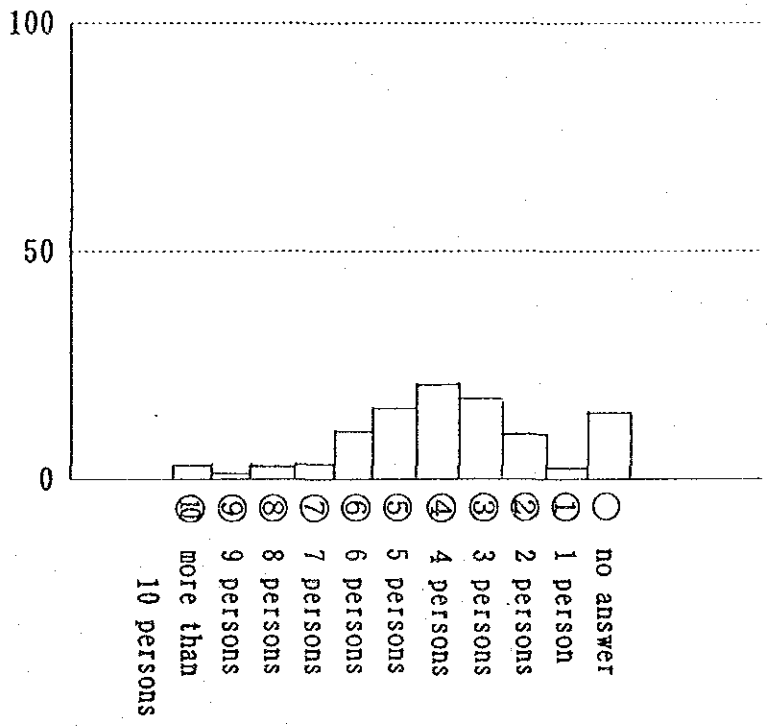
3. Number of Rooms



4. Yard ?

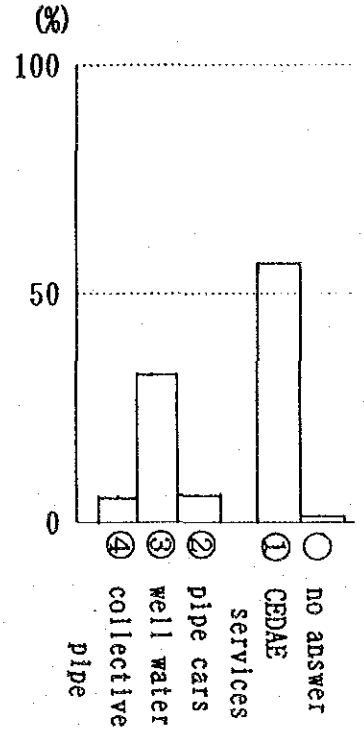


5. Number of Inhabitants

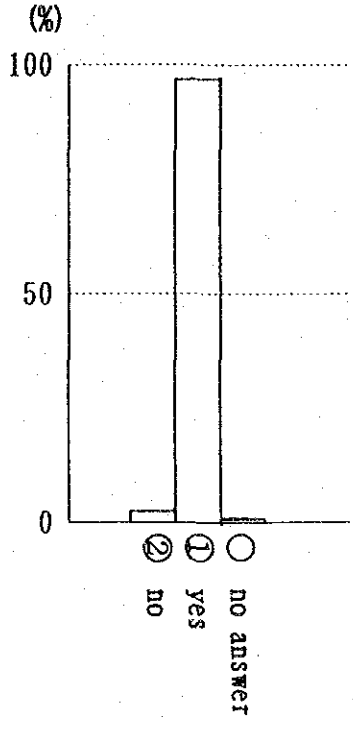


Results of Questionnaire Survey

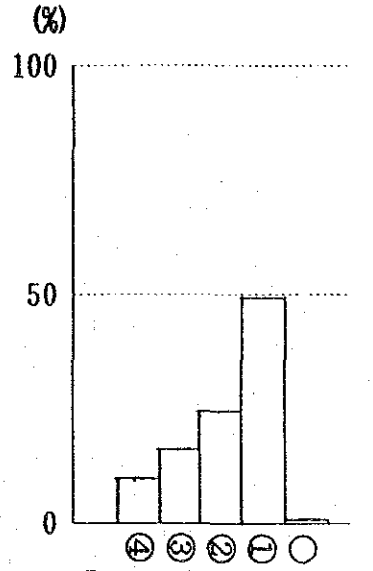
6. Water Supply



7. Toilet ?

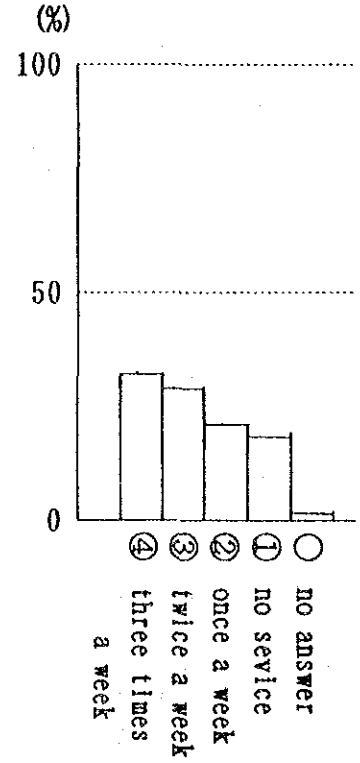


8. Sanitary Drainage

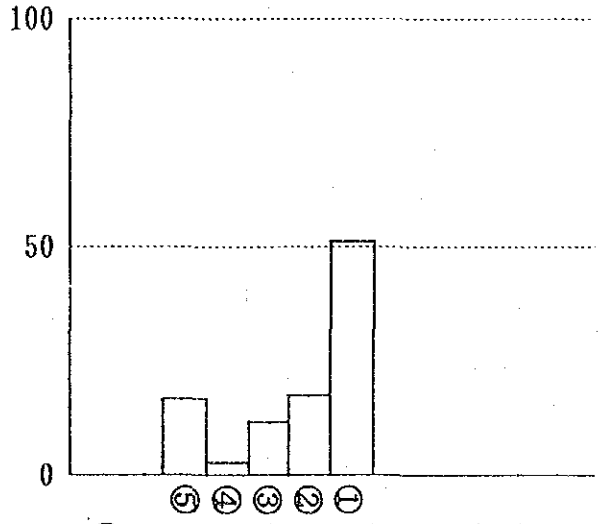


○ no answer
① drainage system
② concrete cesspit
③ walloon
④ direct into river

9. Garbage Collection



10. Where do you throw domestic garbages away ?
(to persons who don't have garbage services)

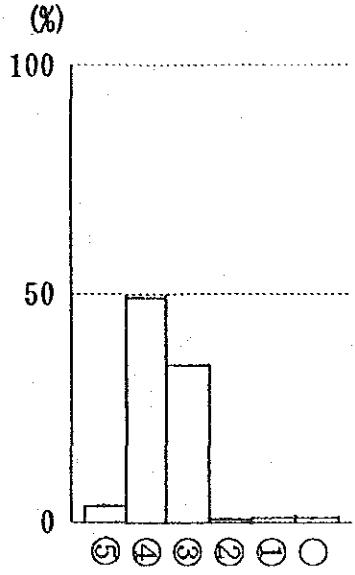


① empty terrain near residence
② near walloon
③ river
④ some area along Guanabara bay
⑤ other places

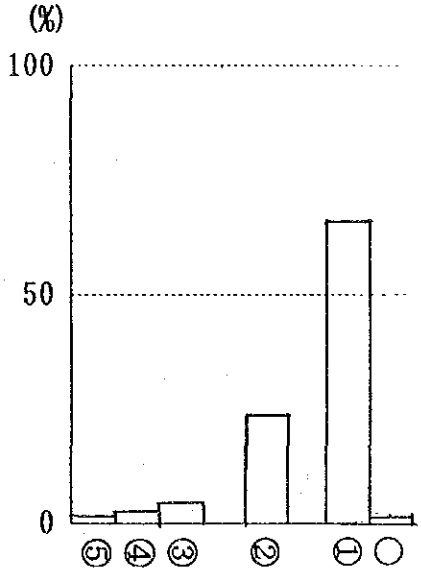
Results of Questionnaire Survey

D. Water Quality in the Guanabara Bay

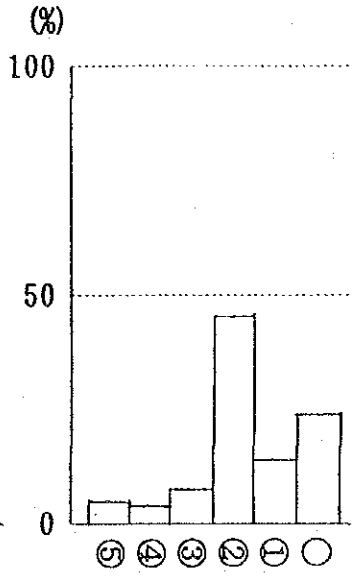
1. What do you think about the water quality in the Guanabara bay ?



2. If you think that the water in the Guanabara bay is dirty, what would you like to be done ?

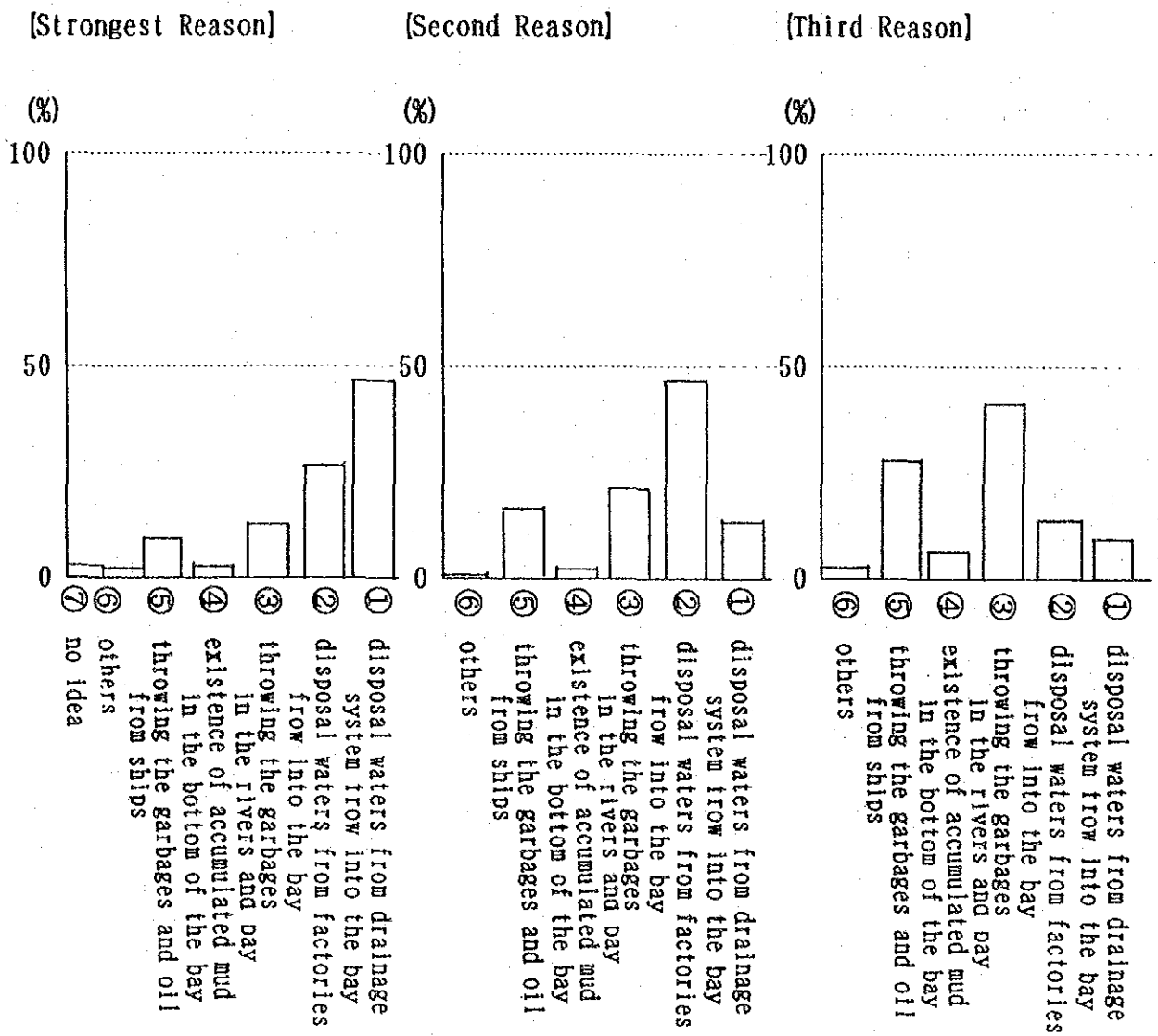


3. What degree do you want to be cleaned ?



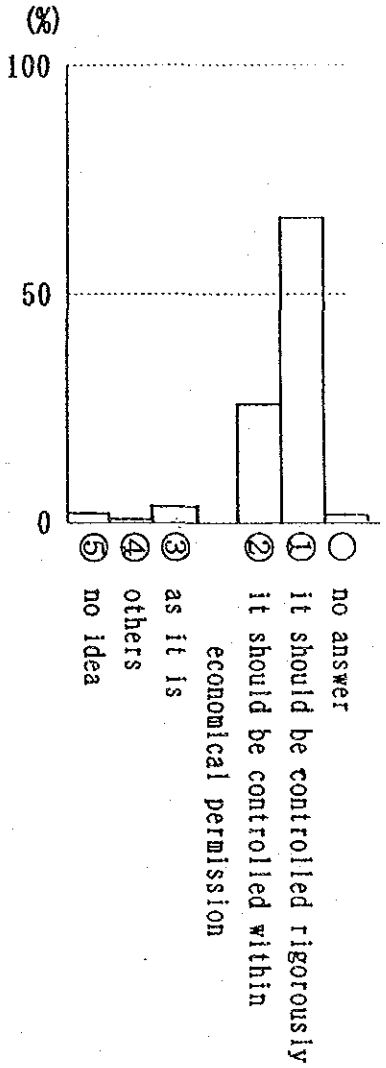
Results of Questionnaire Survey

4. What do you think are the reasons for the dirtiness of the water in the bay ?

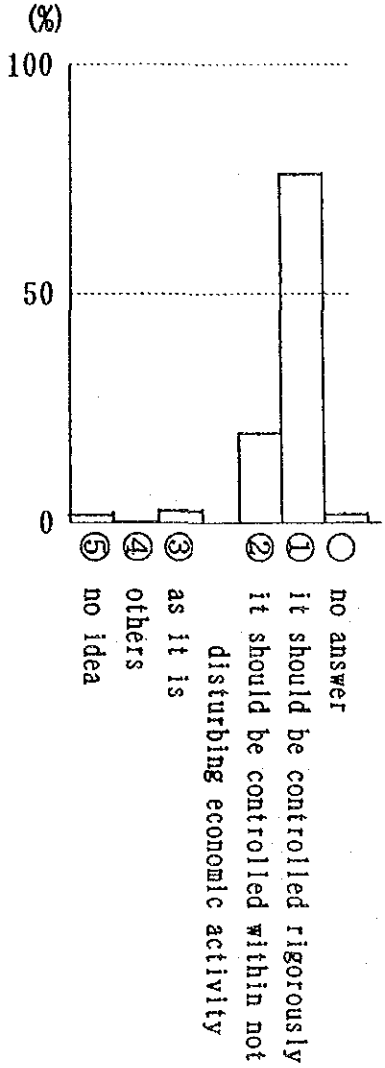


Results of Questionnaire Survey

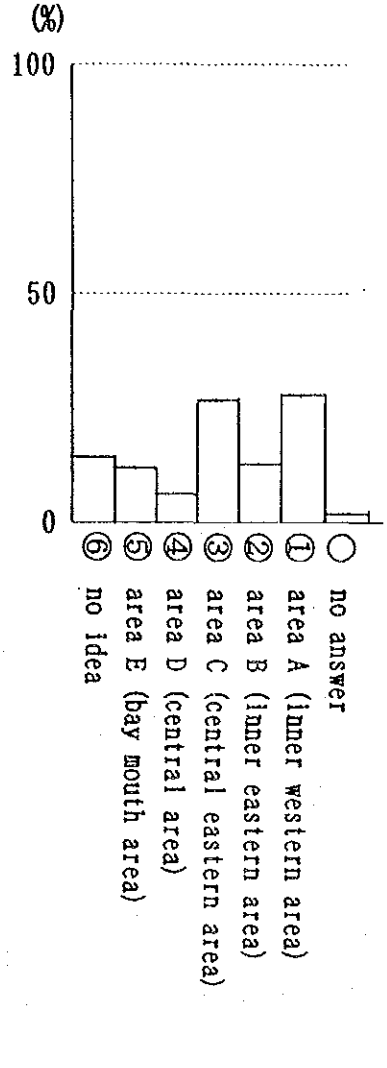
5. How do you think to control the disposal water from residences and offices ?



6. How do you think to control the disposal water from factories ?



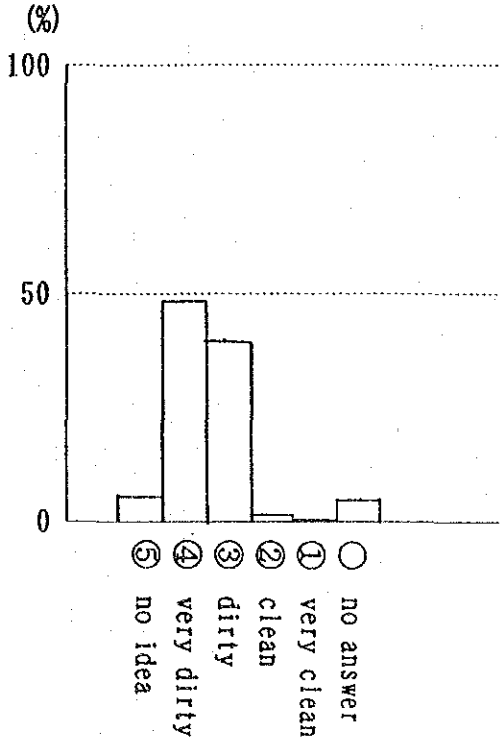
7. Which part of the bay do you think is most polluted area ?



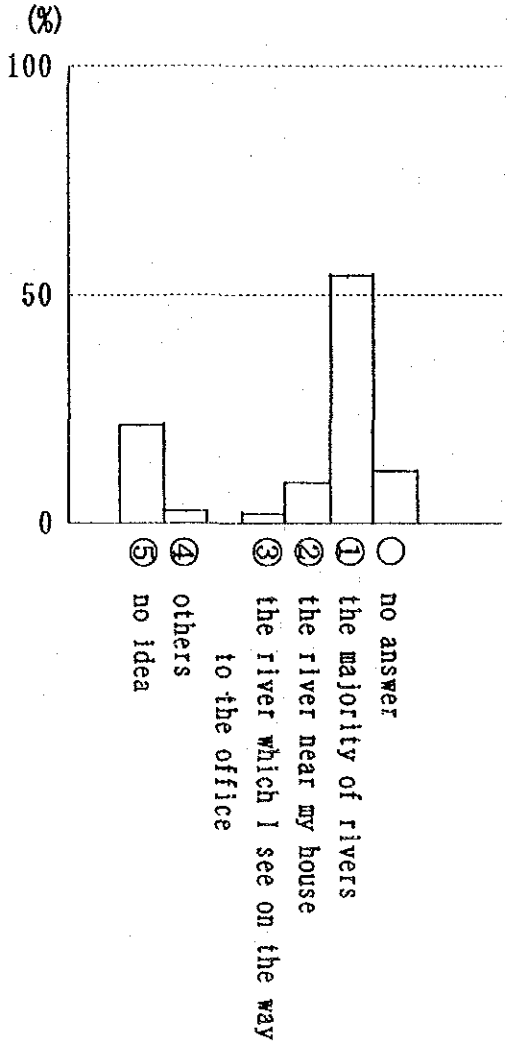
Results of Questionnaire Survey

E. Water Quality in the rivers flowing into Guanabara Bay

8. What do you think about the water quality of the rivers ?

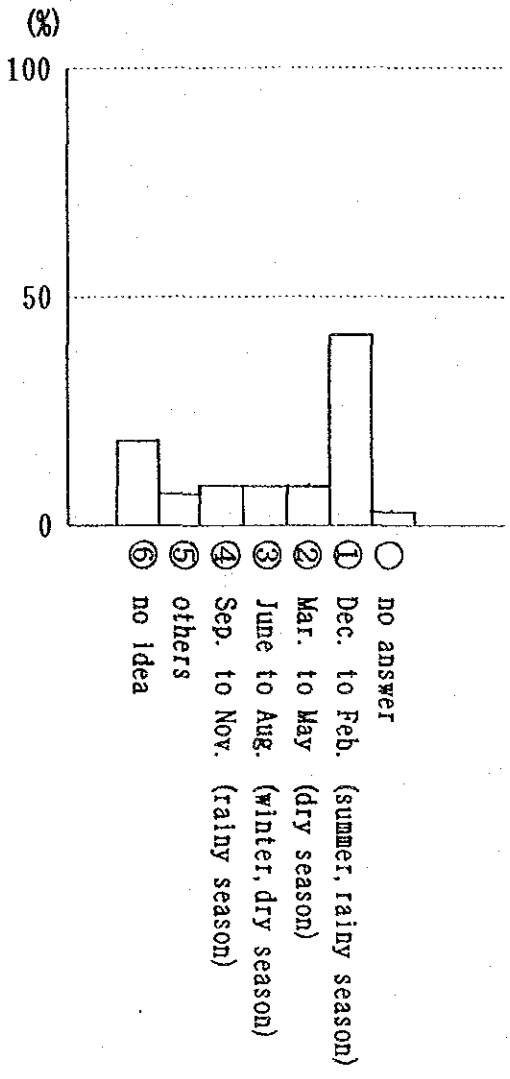


9. Which river is so ? (In relation to Q. 8)

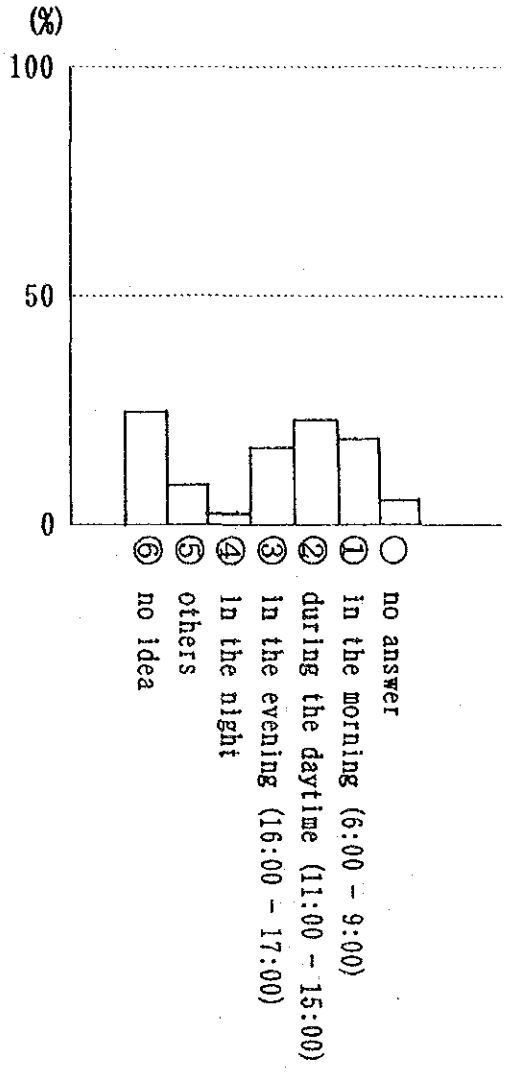


Results of Questionnaire Survey

10. In what season do you observe that the water quality of the rivers becomes dirty ?

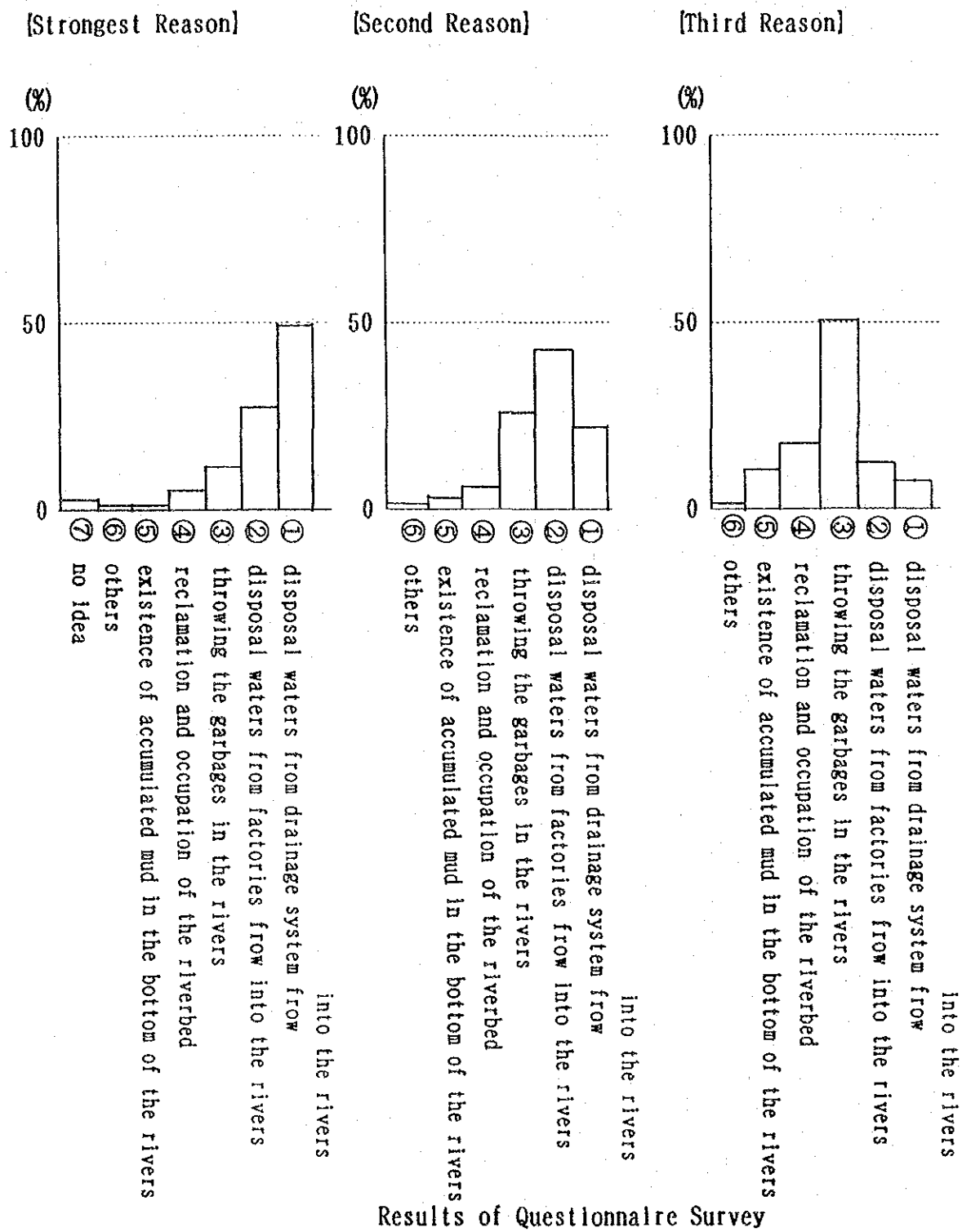


11. In what time do you observe that the water quality of the rivers becomes dirty ?



Results of Questionnaire Survey

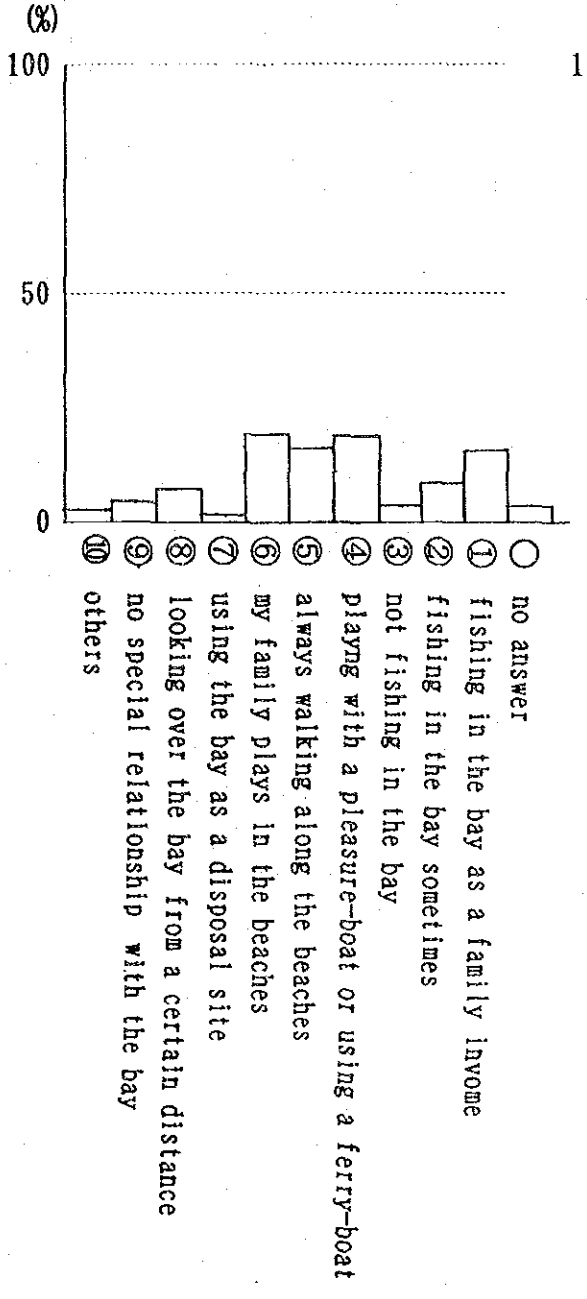
12. What do you think are the reasons for the dirtiness of the water in rivers ?



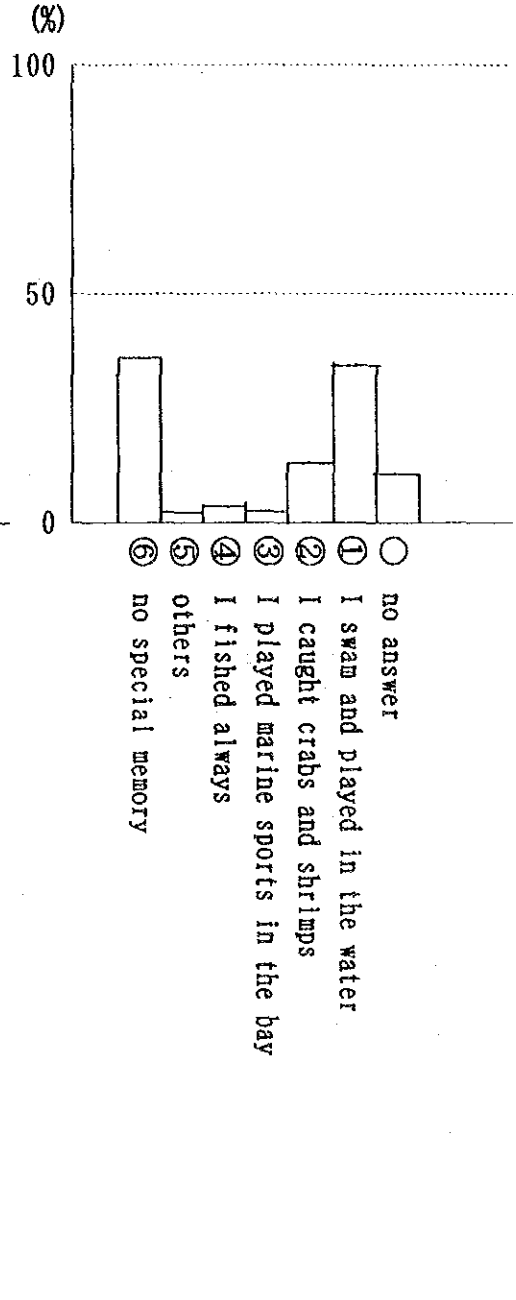
Results of Questionnaire Survey

F. General Questions about the Guanabara Bay

14. Which relationship do you have with the Guanabara bay in your daily life ?

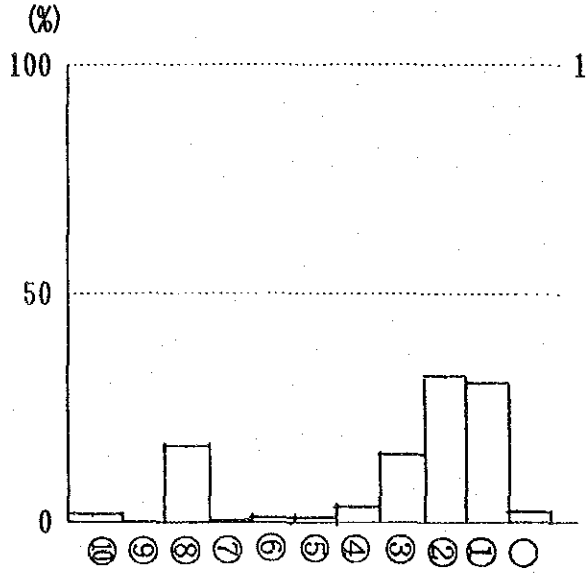


15. Do you have any strong memories to the bay in former days ?



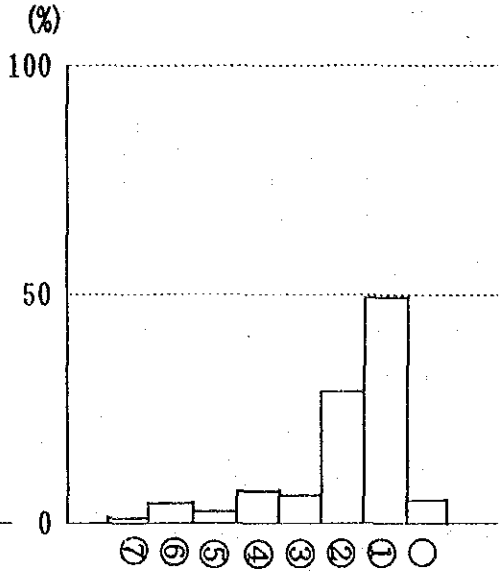
Results of Questionnaire Survey

16. How do you think that the Guanabara bay should be in the future ?



○ no answer
① being able to swim and enjoy the beaches
② being able to catch crabs and shrimps, and to fish
③ being able to play marine sports
④ no way to recuperate the bay
⑤ giving the priority to the industrialization
⑥ making housing areas and parks by reclamations
⑦ as it is
⑧ intensifing the recuperation
⑨ others
⑩ no idea

17. What is your opinion to the mangrove areas ?



○ no answer
① It is important to breed fishes, crabs, shrimps and others
② It is important to protect birds
③ no importance and no utilities
④ creating a mud with bad smell and a terrible aspect
⑤ construct houses and factories on the mangrove area
⑥ others
⑦ no idea

Results of Questionnaire Survey

6.2.3 Suggestions for Depollution of the Guanabara Bay

Through the questionnaire survey, we obtained many previous suggestions/opinions for the depollution of the Guanabara Bay.

The suggestions attained to the total 276, and they are summarized as shown in Table 6.2-3.

Table 6.2-3 Suggestions for the Depollution of the Guanabara Bay (Total: 276)

1. Rigid regulations should be enforced for factories ships and persons. Offenders should be punished with a fine. (53 persons)
2. Efficient projects should be started immediately including this project. (49 persons)
3. Treatment sewerage system should be constructed without delay. (49 persons)
4. Efficient counter-measures should be taken by organizations concerned. (26 persons)
5. Dredging and cleaning of rivers should be practised as well as removal of sinking ships. (24 persons)
6. Environmental education and campaigns should be practised to citizens together with tourist agents. (24 persons)
7. Urban planning should be carried out such as no factories along the bay, removal of slums and no reclamations. (19 persons)
8. Don't throw away rubbishes to rivers and the bay, and reuse them. (13 persons)
9. More dumping disposal sites should be constructed. (06 persons)
10. Other Oppinions. (13 persons)

. Recuperation of mangrove
. Keep watch on APA
. Taxation to factories and ships
. Clean operations
. Strengthening IBAMA's authority
. Prohibiting the use of trawlnets
. Ask for foreign country's assistance
. Obtain cooperation from universities to this project.

6.3 Basic Conditions and Typical Opinions of Resident

A questionnaire survey was performed to know the opinions of persons living or working in the Guanabara Bay basin regarding existing environmental problems and their wishes for the future image of the bay and rivers through the associations of residents, fishermen, environmental groups and yacht club, etc...

Main results of the survey are shown in Fig. 6.2-3 to Fig. 6.2-6, presented in circular graphs with percentages.

The basic conditions of the residences indicate that the water supply by CEDAE services is 57 % and well water occupies 31 % of water supply. The remaining 10 % are supplied through pipe cars and collective pipes. With regard to sewerage, 50 % use the drainage system. It is noticeable that persons who throw garbage directly into the rivers occupy 10 %. On the other hand, about 20 % have no services for garbage collection and 20 % admit to discharge garbage into rivers and some places of the bay.

In respect to the water quality of the bay, the majority think that it is dirty and should be cleaned as soon as possible to a degree which would enable fishes and shells to survive. They say that the biggest reason for the dirtiness of the water is the water discharged from drainage system followed by those discharged from factories and garbage thrown into rivers and the bay. They also say that these discharges should be controlled rigorously.

The same things are said on the water quality of and the reason for the dirtiness on rivers. They think that rivers such as the canal do Mangue, Rio Alcantara, Rio Sao Joao de Meriti, Canal Canto do Rio, Rio Sarapui, Canal de Mage, Rio Iraja, Canal do Cunha and Rio Guapimirim are especially dirty.

As for the relationship of the residents with Guanabara Bay, it was clearly observed that most residents conduct fishing and use the beaches for recreation. They also think

that the existing mangroves are important for breeding fishes, crabs, shrimps, etc., and for the protection of the birds.

As for questions regarding the former condition of the bay, most of the persons replied in average that they used to swim in the bay until about 25 years ago, caught crabs and shrimps until 20 years ago and played marine sports until 15 years ago. Conclusively, the water in the bay has largely deteriorated within the past 20 or 30 years.

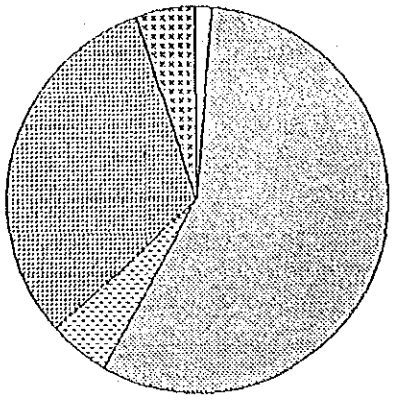
Finally, the following opinions were obtained as typical suggestions for the depollution of the Guanabara Bay:

(1) Rigid regulations should be enforced on factories, ships and persons who made the bay dirty. Violators should be fined.

(2) Effective projects should be started immediately.

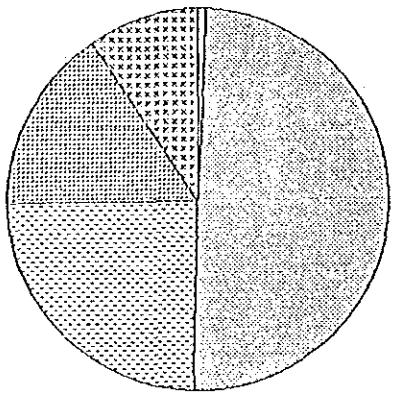
(3) A treatment sewerage should be constructed without delay.

A. Residence Condition



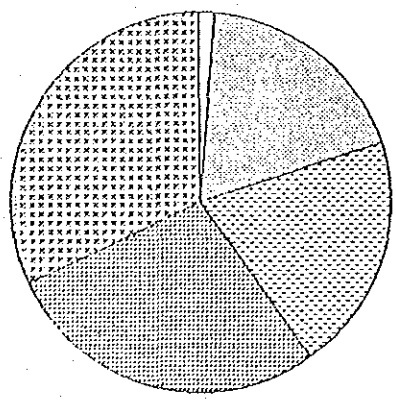
1.5% : no answer
56.8% : CEDAE service
5.3% : pipe car
31.3% : well water
5.1% : collective pipe

Water Supply



0.7% : no answer
49.8% : drainage system
24.4% : concrete cesspit
15.6% : wallon
9.5% : direct into river

Sanitary Drainage

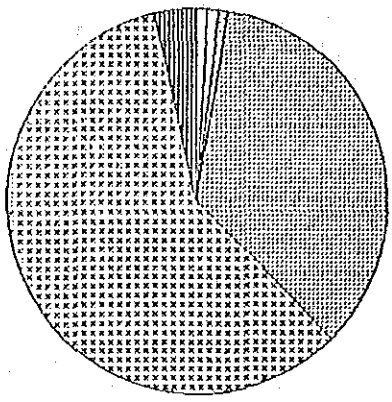


1.4% : no answer
18.7% : no service
20.2% : once a week
28.0% : twice a week
31.8% : three times a week

Garbage Collection

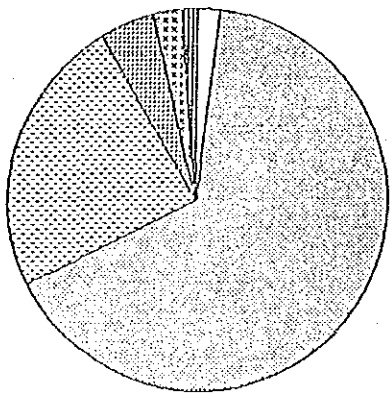
Fig. 6.2-3 Residence Condition of the Answeres for the Questionnaire Survey

B. Water Quality in the Bay



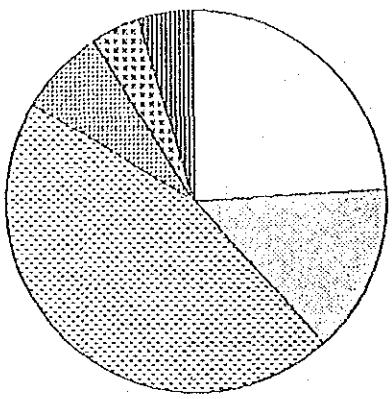
1.0% : no answer
1.0% : very clean
0.8% : clean
34.8% : dirty
58.8% : very dirty
3.6% : no idea

What do you think about the water quality in the Guanabara Bay ?



1.9% : no answer
66.0% : to be cleaned soon
23.6% : to be cleaned if possible
4.7% : to be as it is
2.5% : there is no way
1.4% : no idea

If you think that the water quality in the Guanabara Bay is dirty, what would you like to be done ?

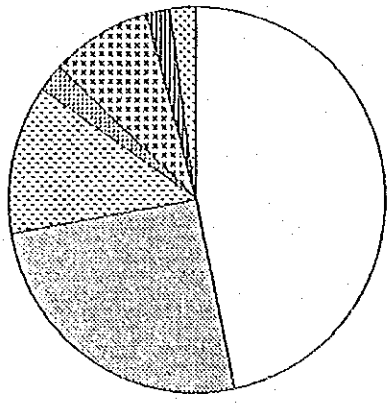


24.0% : no answer
14.5% : to be able to swim
45.1% : fish & shell can survive
7.4% : to enjoy marine sports
4.3% : no smell/floating garbages
4.7% : no idea

What degree do you want to be cleaned ?
(to persons who wish to be cleaned)

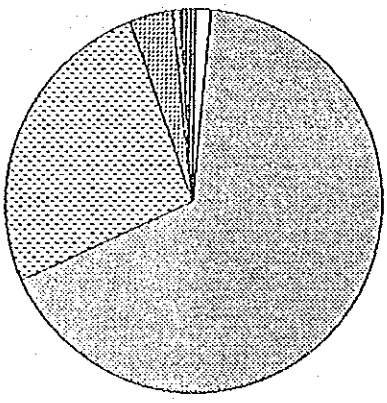
Fig. 6.2-4 Oppinions on the Water Quality in the Bay

C. Reason of Dirtiness & Control of Disposal Water



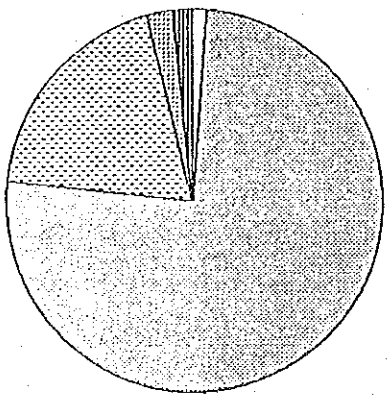
46.7% : disposal waters (drainage)
25.6% : disposal waters (factory)
12.3% : throwing garbages
2.4% : accumulated mud
8.7% : garbages/oil from ships
1.9% : others
2.4% : no idea

What do you think are the reasons for the dirtiness of water in the bay ?



1.4% : no answer
66.9% : to be controlled rigorously
25.9% : to be controlled
3.7% : to be as it is
0.7% : others
1.4% : no idea

How do you think to control the disposal water from residences and offices ?

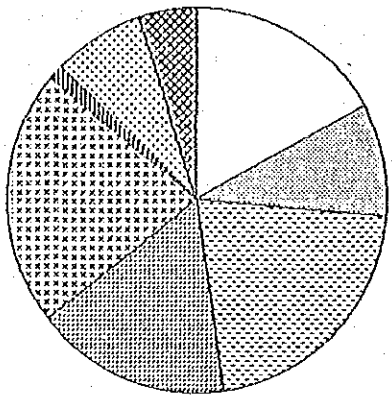


1.2% : no answer
75.6% : to be controlled rigorously
19.2% : to be controlled
2.2% : to be as it is
0.1% : others
1.6% : no idea

How do you think to control the disposal water from factories ?

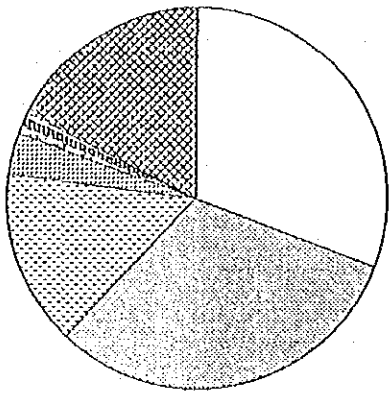
Fig. 6.2-5 Oppinions on the Reason of Dirtiness and Control of Disposal Water

D. General Question about the Bay



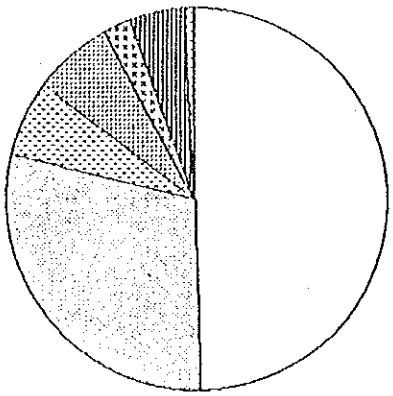
16.8% : fishing as professional
9.6% : fishing sometimes
21.2% : using ferry boat etc.
16.9% : waking along beaches
21.3% : playing in beaches
1.4% : using as disposal site
7.9% : looking over
5.0% : no special relation

Which relation do you have with the bay in your daily life ?



30.8% : to swim & enjoy beaches
31.3% : to fish
14.9% : to play marine sports
3.5% : no way to recuperate
0.7% : priority to industry
0.8% : reclamation for houses
0.3% : as it is
17.7% : intensifying recuperation

How do you think that the bay should be in the future ?



49.6% : important as breeding
29.3% : important for birds
6.3% : no important/utility
6.9% : bad smell mud
2.4% : use as housing area etc.
4.7% : others
0.8% : no idea

What is your opinion to the mangrove areas ?

Fig. 6.2-6 Oppinions to the General Question about the Bay

APPENDIX

APPENDIX 1

FAVELA POPULATION AND AREA

Appendix 1

Favela population and area by the basin in the study area of Rio de Janeiro municipality

Area Code	Number of Favelas	1980		1991		
		Pop.	House	Pop.	House	Area(ha)
17-6RJ	21	8,148	1,835	33,343	7,547	77.93
19-1RJ	67	104,880	23,699	157,201	34,540	379.69
19-2RJ	36	13,554	3,062	27,469	5,749	80.52
20RJ	44	139,216	31,775	164,116	37,797	303.00
21RJ	104	154,806	35,440	205,864	45,964	444.97
22RJ	8	15,276	3,694	19,567	4,533	25.16
23RJ	48	88,359	20,128	113,093	24,583	285.04
24RJ	19	16,111	3,725	27,592	6,296	37.37
25RJ	22	30,578	6,750	51,304	12,074	104.06
26RJ	0					
27RJ	0					
Total	369 Favelas	570,928	130,108	799,549	179,083	1,737.74

* Pop. ; Population House ; Number of houses

* Total favela of Rio de Janeiro Municipality by IPLANRIO

Total number of favelas	;	about 600
Total favela population	;	1,045,721
Total number of houses	;	233,997
Total favela area	;	2,433.6ha

17－6RJ

Code	Name of Favela	1980		1991		
		POP.	DOM.	POP.	DOM.	Area(ha)
201	RUA DO CONGO 147	-	-	300	60	2.74
263	BAIRRO NOVA ALIANCA	2,219	516	3,246	755	12.88
266	BOQUEIRAO	175	40	175	40	1.72
267	CAMINHO DO LUCIO	1,173	276	3,999	941	10.56
276	TIBAGI	874	200	1,154	264	3.89
278	VILA CATIRI	2,726	593	2,726	591	8.05
280	VILL PROGRESSO	481	110	553	110	1.99
379	FALANGE	500	100	15,877	3,536	4.20
380	MORRO DO SOSSEGO	-	-	553	110	3.20
382	SAIBREIRA	-	-	750	150	3.50
383	TANCREDO NEVES	-	-	110	22	1.05
392	TRAV SANTA CATARINA	-	-	600	120	2.51
420	TIQUIA	-	-	300	60	0.92
422	A.M.DO DOCINHO	-	-	150	20	0.49
424	BECO DA USINA	-	-	220	58	0.06
450	ESTRADA DA SAUDADE	-	-	400	80	0.86
505	VILA PIQUIROBI	-	-	480	120	0.91
507	BAIRRO SANTO ANDRE	-	-	-	-	10.37
519	VILA MORETI	-	-	1,200	400	7.21
542	ESTRADA SARGENTO MIGUEL FILHO 164	-	-	400	80	0.58
543	RUA SANTOS AMOS	-	-	150	30	0.24
Total	21 Favelas	8,148	1,835	33,343	7,547	77.93